INDUSTRIAL LEADERSHIP:

A HISTORICAL ANALYSIS OF MERCHANT SHIPPING

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Abstract of a Thesis submitted in fulfillment of the requirements of the Degree of Doctor of Philosophy

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This thesis set out to explore the forces that determine the rise and fall of industrial leadership. It attempted to do this by applying an industry life cycle model to the shipping industry. The industrial life cycle was posited on the basis of existing literature, particularly the growth of knowledge, evolutionary and institutional literature, which lend themselves to patterns of industrial growth and entrapment. On this basis, this thesis set out to examine whether industrial leadership can be explained by a four-staged process of imitation, catch up, advance and entrapment. However, this thesis has exposed something more complicated. Processes of imitation, catch up advance and entrapment were shown to be at work in the shipping industry, but they were tempered by the effects of military and political forces that may not be exogenous, and the trend from regionalism to globalisation. The original model did not encompass early indigenous developments that are not based on imitation that do not immediately lead to a position of advanced leadership. In this light, a better description of the first stage would be capability building.

Key Words: Evolutionary Economics, Economic History, Shipping, Maritime Industries, Institutional Economics.

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Chapter 1

Introduction

> In order simply to maintain itself intact... an empire must be continually improving its technology at a pace sufficient to counter balance the improvements made by its neighbours (Elvin 1973:18).

When Marco Polo visited China at the end of the thirteenth century, he was visiting the richest nation in the world. Its very productive agriculture was irrigated by a sophisticated system of canals that also served as arteries for trade and stimulation of industry. Paper money was in use, while in the north, iron production reached levels not equaled in Europe for another four hundred years. China could have been described as the world's leader technologically, industrially and in terms of quality of life. However, China's day in the sun eventually came to an end. Its decline relative to the West was such that, by the middle of the twentieth century, it had become one of the world's poorest countries on a per capita basis. As we enter the 21st century, the East is once again on the rise, giving birth to the age old economic questions regarding what it is that causes the wealth and poverty of nations.

If any nation, company or sporting group wishes to remain at the top of any comparative ranking, it must either have an advantage that others can not better or imitate, or it must be capable of generating improvements at a faster rate than those with which it is compared. The ability of any economic unit to attract resources and surpass the achievement of its competitors depends on its ability to improve its process, product and organisational technologies at a faster rate than its competitors. Continuous innovation has been the hall mark of industrial leadership.

History is punctuated with periods of rapid innovation in which a nation has been able to establish positions of industrial leadership. China during the late T'ang(618-907AD) and Sung (960-1279AD) dynasty achieved such a rate of innovation and improvement as did the Dutch in the late sixteenth-early seventeenth century. Britain's period of leadership was also born from a period of innovation. As Mc Closky(1981:118) states 'contrary to much thinking on the matter, innovation was widespread. The industrial revolution was not the Age of Railways or even of Steam entirely; it was an age of improvements'. Plumb (1982:332) goes as far as saying 'improvement' was the most over-used word of the eighteenth century in the United Kingdom, followed closer by 'new method' and 'latest fashion'. In the late twentieth century, it was the Japanese who made 'kaizen' (continuous improvement) a corporate philosophy, which propelled them into global leadership.

Ironically, these nations began their periods of innovation by imitating nations, which previously had a superior record of innovation. For example, in the early seventeenth century, as European nations were beginning to carve out their maritime empires, Francis Bacon claimed that the three greatest inventions that the world had

known were the compass, printing and gunpowder. These inventions, which allowed Europe to rise to global supremacy, were all created in China. This is not an isolated phenomenon. At the end of the nineteenth century, the United States imitated technologies that had been developed in Europe and took them to a higher level. In the second half of the twentieth century, many American inventions fell in to the master hands of the Japanese who were criticised as only being capable of imitating. They soon shook off this criticism.

It appears that the process of innovation and supremacy is preceded by a process of imitation. This opens several questions. Why did the compass have to travel to Europe before its potential was more fully developed? Why weren't the Chinese the first to circumnavigate the world? Why was it, that at the beginning of the twentieth century, Americans proved more resourceful in developing European inventions than the peoples who invented them? These questions shed light on one last process that appears to be at work here, namely, the relative stagnation or failure of the old leader to develop innovations at a rate necessary to maintain its position of pre-eminence.

From a preliminary view, it appears that industrial leadership can be seen as a process of imitation, innovation, supremacy and decline. If there is such a process at work, economists require a closer understanding of the forces involved in order to understand industrial development and competition.

In explaining the reason why Chinese innovations developed further in Europe, Jones et al. (1993:22) stated 'The key difference between China and the West was not really technological - it was in social organisation, which in Europe extended the use of advanced methods and pursued their further development'. Freeman(1992:171) made a similar observation when referring to the United Kingdoms' loss of industrial leadership:

> British scientists and inventors from Faraday to Swann made an outstanding contribution to the development of electricity. The really important point of Britain's' loss of technological leadership in the 1880s and 1890s was not that Britain ceased to make scientific discoveries or radical inventions, but that British institutions proved incapable of diffusing these innovations, of scaling them up and of using them in a wide variety of applications...

Clearly, the domestic environment is not neutral. Porter (1990) recognised this in his landmark *Competitive Advantage of Nations* in which he recognised that "Competitive advantage is created and sustained through a highly localised process. Differences in national economic structures, values, cultures, institutes and histories contribute profoundly to competitive success" (1990:19). What is less clear is why one environment can produce a high level of innovation in one period and low levels of innovation in another.

This dissertation seeks to answer the question what determines the rise and fall of industrial powers? The literature on industrial evolution reveals processes that lend themselves to an industrial life cycle so, on the

basis of that literature, I propose that industry follows a life cycle. This is not a rigid, mechanistic cycle. It is one that accepts variation and the unpredictability of events such as wars and other chance events.

The proposed model states that the changing face of global industrial leadership is an on-going process of imitation, catch-up, advance and entrapment. The process is driven by institutional and technological dynamics that affect not just producers but the entire environment in which producers operate. The model is strongly influenced by Porter (1990) who emphasises the importance of the environment in determining competitive advantage and Perez (1983) who emphasises the rigidity the techno-economic environment in which a firm operates.

To help identification of the key issues, this thesis focuses on one industry, shipping. This is a new area of research for, although many books and articles have been written about the industry, no one has taken a long term view of shipping from the stand-point of economic literature, particularly evolutionary and institutional literature. There are several reasons why shipping has been chosen. Firstly, it is a very old industry. Consequently, considerable historical data are available providing a chance to review the industry over a long time horizon. Secondly, shipping's international nature provides a chance to give possibly the best indication of international commercial leadership compared with other industries. Finally, shipping is a highly illuminating industry as its derived demand aspect gives an indication of underlying commercial activity.

Over the period in review, the shipping industry has thrown up a diversity of growth patterns and changes of leadership. During the earliest period of examination (12th to 16th centuries), the Chinese were clearly the most advanced shipping nation, as they were in many industries at the time. The fifteenth century gave birth to a new path of development when growing political stability and the rise of Malacca created an environment conducive to maritime expansion in the Indian Ocean. It was the nation of Gujarat which rode this wave to its greatest possibilities, gaining a position of pre-eminence which it held for three centuries. At the end of the fifteenth century, the Spanish and Portuguese opened up new economic paths when they opened new routes in the Atlantic, Pacific and routes inter-linking the oceans. Quickly establishing first mover advantages, the Iberians maintained pre-eminence on these routes for over a century. In the seventeenth century, the Dutch mastered the necessary skills to knock them off their perch and achieved a mastery based on industrial and institutional innovations. In the eighteenth century, the British acquired the mantle of leading shipping nation which it cemented with innovations in iron, coal, and steam. Britain held this position until the 1960s, at which point the time frame of this thesis ends.

By understanding the historical forces at work, this thesis attempts to explore to what extent a life cycle of imitation, advance and decline can explain the varying fortunes of these nations. In covering such a long

time period, it seeks to reveal the underlying dynamics of industrial competitiveness while at the same time recognising the changing nature of global commerce.

Chapter 2

The Literature on Shipping, Dynamic Competition and Entrapment

2.1 Literature on International Merchant Shipping

The key advantage that the shipping industry lends to such a long-term analysis is the availability of information on the industry over such a long period. There are a number of books dealing with the industry's long history. For example, Fayle's (1933) *A Short history of the World's Shipping* details the industry from antiquity to the twentieth century. However, it is now dated and suffers from a eurocentric focus. More recent is the excellent series published by Conway Maritime Press and edited by R.Gardiner. This series examines the industry from the earliest ships through to the container revolution. Although technical in focus, it does include chapters on economic issues and refers to environmental factors that shaped the development of technology. Perhaps its only weakness is its eurocentricity, although it does address eastern traditions in a minimal form.

The definitive work on Chinese shipping technology is Joseph Needham's (1971) *Science and Civilisation in China* Vol.4 Part.III. More recently, Gang Deng (1995, 1997 and 1999) has released a number of works on economic and institutional aspects of Chinese shipping. On Gujarat and Indian, a number of authors have written on different aspects of the trade, in particular, M.N. Pearson's (1976) *Merchants and Rulers in Gujarat*, S.Arasaratnam's (1994) *Maritime India in the Seventeenth Century.* K. Chaudhuri's (1985) *Trade and Civilisation in the Indian Ocean* and Kenneth McPherson's (1993) *The Indian Ocean: A history of People and the Sea* give excellent summaries.

On early European shipping and trade, R. Unger (1978, 1980) has produced two definitive books with a technical aspect while C.R Boxer (1965, 1969, 1985) has produced a number of definitive works on the Dutch and Portuguese maritime accomplishments with a broader social-economic approach. These can be augmented by works from a large range of authors dealing with technical, commercial and institutional aspects of their trade. It is in this period that two of the texts in the series edited by R.Gardiner stand out, in particular *Cogs, Caravels and Galleons* (1994) and the *Heyday of Sail* (1995).

There is a wealth of material available on British shipping. Standing out are Ralph Davis's *The Rise of English Shipping in the Seventeenth and Eighteenth Century* (1967) which presents an industry of growing capabilities while Sturmey's (1962) *British Shipping and World Competition* presents the same industry in decline. Ronald Hope's *A New History of British Shipping* (1990) provides an excellent examination of the industry.

Two books stand out on American Shipping and both by the same author. Rene de la Pedraja's *The Rise and Decline of US Merchant Shipping in the Twentieth Century* (1992) *and A historical Dictionary of the US Merchant Marine and Shipping Industry* have no peers, although Bauer(1988 and 1979), Safford (1979 and 1985) and Whitehurst (1983) also make invaluable contributions. Kilmarx's (1979), *America's Maritime Legacy* contains contributions from a number of authors and must also be considered a 'must read'. Contributions on American and British shipping also appear in T.Yui's and K.Nakagawa's (1985) *Business History of Shipping: Strategy and Structure*, a vital book on the rise of Japanese shipping. As its name suggests Chida and Davie's (1990) *The Japanese Shipping and Shipbuilding Industries: A history of their modern growth* is a key source while more general books such as Hirschmeier and Yui's *The Development of Japanese business 1600-1980* also deal with rise of firms like Mitsui and give a good account of environmental forces operating at the time. For an account of the all-pervasive government policies, refer to Miwa's (1985) *Maritime Policy in Japan: 1868-1937.*

A number of journals have occasionally produced articles of interest, particularly on British shipping. These can be easily found in the *Journal of Transport History*, *International Journal of Maritime History Marriner's Mirror* and *Transport History.* Articles on American shipping are to be found in *American Neptune.* The occasional article appears in more general historical journals such as *Moyen Orient et Ocean Indien*, *Journal of the Economic and Social History of the Orient*, but these are generally historical and lack economic analysis. Articles in these journals are most useful in defining the economic and social environment in which the industry operated. The occasional article in the *Journal of Economic History,* such as Harley.C.Knick's (1988), Ocean Freight Rates and Productivety 1740-1930, is stronger in economic analysis but, they are a rarity. Clearly, this list is not exhaustive and a more comprehensive list appears in the bibliography.

This thesis departs from these works in one very clear way in that it attempts to apply modern economic theory in analyzing shifting positions of industrial leadership. In particular, there has been no attempt to apply institutional theory to the industry. In the next section, we examine the economic literature relating to industrial leadership.

2.2 Competitive Advantage and Life Cycles

> With regard to the amount of prosperity and business activity in them, cities and towns differ in accordance with the different size of their civilisation ..... what is obtained through the co-operation of a group of human beings satisfies the need of a number many times greater than themselves. For instance, no one, by himself, can obtain the share of the wheat he needs for food. But when six or ten persons, including a smith and a carpenter to make the tools, and others who are in charge of the oxen, the ploughing of the soil, the harvesting of the ripe grain, and all other agricultural activities, undertake to obtain their food and work toward the

> purpose either separately or collectively and thus obtain through their labour a certain amount of food, that amount will be food for a number of people many times their own. (Ibn Khaldun, *The Muqaddimah*, ed Franz Rosenthal, Princeton, 1967, II 271-2)

The paragraph above was written by a fourteenth century Islamic poet and political economist, Ibn Khaldun. He introduced the concepts of specialisation and division of labour four centuries before Adam Smith raised them in Europe. Standing out is the idea that productivity improvements based on specialisation are determined by the size of the market (or civilisation). To this, Ibn Khaldun added it was the 'conditions and customs of luxury' that laid the basis of trade. The rich import from those with a surplus and therefore those with a surplus build up wealth. It is no coincidence that Ibn Khaldun made these observations four centuries before Adam Smith. Islamic market activity was far more active and far more prosperous than anything in Europe at the time. Adam Smith's observations only came in Europe, when he could observe the same phenomenon on a significant scale in his own environment.

Further east, Chinese literature on international trade was borne out of the political debate over whether China should trade with foreign nations that they perceived as barbarians. Pin-tsun Chang (1989), who examines the official literature on the subject, notes that most of the economic debate related to arguments for and against trade, not the causes of competitive advantage. However, standing out is the concept of 'mutual benefits' expounded by progressive officials such as T'ang Shu and Chang Han who advocated freeing trade in the mid-sixteenth century. The concept of mutual benefits recognises that different regions had different goods in different levels of abundance. Trade was based on the simple idea of 'exchanging what you have for what you do not have'. Countries should also trade if there were cost differentials between the two nations. Absolute cost advantages were touched on by Lan Ting Yuan (1680-1733) who noted that ships and rice could be produced much more cheaply in South East Asia than in China. By contrast, China was a low cost producer of many manufactured goods. Many of these manufactures were relatively worthless in China but regarded as valuable overseas. Officials of Ming and Ching China were well aware of the importance of demand elasticities. The greater the level and more elastic the foreign demand, the more favourable were the terms of trade to the home country.

In the West, it was not until the eighteenth century that Adam Smith enunciated the concept of absolute advantage in which a nation exports if it is the world's low cost producer. David Ricardo introduced to Europe the notion of comparative advantage where a nation might forgo its low cost advantage in one industry if it is more competitive in producing other goods. John Stuart Mill expanded on this to introduce the concept of reciprocal demand which recognised that terms of trade are determined by levels and elasticities of demand in various countries.

While China eventually adopted Socialist models, the concept of comparative advantage became the bedrock of Western classical thought on international trade. The dominant version was embodied in Heckscher and Ohlin's model and is based on differences in factor endowments of land, labour, natural resources and capital. It was assumed that nations all have equivalent technologies but different endowments. Posner (1961) challenged the idea that nations have similar technologies and production functions. His model was based on the idea that trade is generated by differences in the rate and nature of innovation between nations. Comparative advantage in industries where factor endowments are similar (such as machine tools) is determined by the rate of technical change in an industry which is a result of differences in investment.

Vernon (1966) continued this emphasis on innovation. Vernon introduced a life cycle to international trade recognising that when a product became standardised, its centre of production was likely to shift to a nation with lower costs. Driving Vernon's model were two environmental forces, domestic demand and prices of labour. Innovation was most likely to come in a wealthy nation where the level of demand could support innovations while at the same time, expensive labour would put pressure on the development of innovations that reduced costs. Porter (1990) continued this emphasis on environmental forces and questioned the relevance of models based on factor endowments. The old models may have been relevant in previous centuries but, they could not accurately describe modern industries with higher levels of technology, multinationals, and economies of scale. The old notion of comparative advantage needed to be replaced by 'competitive advantage' which recognised that standardisation was not a once-and-for-all event as posited by Vernon. Innovation was continuous and an industry's ability to derive competitive advantage was a function of interactive features in the home environment.

2.3 Evolution and Economics

Much of the current theory on economic evolution draws on Marshall's life cycle theory of the firm (for example Porter (1990), Nelson and Winter (1982), Downie (1958). Marshall's theory was centred on the 'representative firm', a firm whose features were considered normal for the industry. Any one firm was a tree in an industrial forest and like all living organisms, they went through a cycle of birth, growth and death. Marshall(1890:377) noted 'that in almost every trade there is a constant rise and fall of large businesses'. Behind this cycle, lay the abilities of the businessmen themselves. A businessman with energy and ability gains a footing in a trade and his enterprising zeal causes the business to grow. Growth brings with it economies of specialisation. Every 'improved process is quickly adopted and made the basis of further improvements' (ibid). Success breeds success until death or loss of faculties causes the business reins to eventually fall into the hands of less capable businessmen, after which decline sets in. This biological-evolutionary description appeared in Marshall's *Principles of Economics* in which he also outlined his description of market activity. Unfortunately, economic thought seized upon his mechanical analogy of the market and over-looked the evolutionary development of the firm. In neo-classical

economics, the firm became a black box assembler of factors of production according to their marginal productivity, in response to equilibrium prices. Economists lacked understanding of variation and evolution of those organisations that were responsible for much economic activity.

Marshall recognised the importance of the environment as a contributor to competitive strength through the external economies of 'Marshallian' districts. However, he did not see the environment as a determining factor in the rise and fall of particular firms or industries. For Marshall, this was driven by the energy and ability of the entrepreneur. Marshall's theory of the 'clogs to clogs' family may have been overly influenced by exposure to his his immediate commercial environment in Britain which, even as he was writing, was falling behind its rivals in the USA and Germany. The clogs to clogs firm lost its descriptive relevance when family firms gave way to large corporations controlled by managers. This change was not lost on Schumpeter. In the *Theory of Economic Development*, Schumpeter (1934) praised the industry structure of small firms that characterised Europe at the end of the nineteenth century. With relative ease of entry, these structures generated innovation as new entrepreneurs arrived with new ideas and continuously disrupted the old ways of production. However, in 1942, Schumpeter's position changed with the publication of *Capitalism, Socialism and Democracy* in which he recognised the superiority of US firms in the first half of the twentieth century. With their large scale R&D laboratories, engineers, technicians, production and distribution faciltities, these corporations could generate innovation far in advance of the old structure.

Schumpeter recognised that economic systems evolved and the nature of the economic system was important in generating technological advance. For Schumpeter, capitalist systems generated technological evolution because firms would advance technology to compete with their rivals. A process of creative destruction revolutionised 'the economic structure from within, incessantly destroying the old one, incessantly creating a new one'(1942:83). With innovation, new firms rose to prominence, dethroning old leaders who operated with older techniques. As innovative as his work was for the time, Schumpeter lacked access to the more detailed business histories and historical perspectives available to a later generation of writers, such as Chandler and Landes. Consequently, he failed to anticipate some of the relationships between strategy, management and innovation.

Drawing on both Marshall and Schumpeter, Downie (1958:28) believed the most fundamental characteristic of a capitalist economy is growth and change, not equilibrium. Downie put forward a model in which two mechanisms determined whether a firm succeeds. The transfer mechanism (TM) is a selection process by which firms invest profit in increased capacity, consequently a firm grows at a rate proportional to its rate of profit. The firms with the greatest efficiency, or what is now called total factor productivity, earn the highest profits and increase their market share at the expense of others. Propensity to invest is determined by the rate of market growth and growth in the economy. Downie's theory also includes an adaptive mechanism.

A firm facing death can respond by innovating. The innovation mechanism (IM) occurs when a firm that finds its market share slipping so improves its efficiency by investing some of its funds on innovations. The population of firms that exist at any time, and the success of any given firm, is a consequence of processes of selection and mutation (or adaptation), and contains a high degree of variation.

Penrose (1959) opened up the 'black box' firm of neo-classical economics and revealed that firms can vary in their make up. Firms have different endowments, in particular human resources. The efficiency of human resources improves over time as personnel become more knowledgeable and more adept in their positions (see Robertson and Langlois 1994:365). In the course of its operations a firm will choose to use its resources in a way that most closely fits the types of knowledge and scope of operations that they have evolved from their earlier experience. Penrose's thinking anticipated Richardson (1972) who introduced the term 'capabilities' to refer to the skills, experience and knowledge that a firm possesses.

In putting cumulative change at the centre of economic progress, writers such as Penrose and Downie attack the existence of a stable equilibrium as posited by the classical economists. For the evolutionists, the economy is in a constant rate of change. For Penrose, this is a consequence of continuous adaptation to the environment which itself is changing as other firms and institutions also adjust to the changes around them. In such a state of change, a position of static equilibrium cannot exist. However, while Penrose disregarded equilibrium she did not offer a theory of industries and markets in which the firm operated (Nightingale 1996:22).

The evolutionary nature of capitalism was put centre place by Nelson and Winter (1982), who offered an evolutionary theory of economic growth. Their analysis shows strong similarities to Downie in the development of biological conceptions of economics, although Downie does not appear in their sources (Nightingale 1997:149). In contrast to Downie whose focus is on the firm, Nelson and Winter's focus is on changing best practice techniques. Consequently, the emphasis is not on firms but the techniques with which they operate. According to this theory, all firms carry out procedures and use technologies that determine their success or failure. They labelled these behaviours 'routines'. They include standard operating procedures, investment behaviour and, the process of finding better ways of doing things. The company with the most effective routines will become more profitable, and its success will indicate to other companies that they should adopt those behaviours. Hence, the most profitable routines will be broadly accepted and tend to become predominant over time. The profitability of routines will depend on the characteristics of the environment (which in turn will be shaped by the routines of existing firms). Under this model, it is the need to cope with a varied environment that leads to flexible and mutating behaviours as firms adopt new processes and routines. Consequently, routines change over time in an evolution of commercial technology. Nelson and Winter place firms at the centre of their analysis of economic change.

This has left some room open to explore the influence of the environment in shaping the decisions and prosperity of firms.

Metcalfe (1984) recognised that any population of producers is based on a technological regime which they use to produce their output. Commercial competitive struggle is not so much a competition between firms but a competition between technological regimes. Metcalfe drew on Downie's model and introduced Population Ecology theory in which population of firms have difficulty adapting to change due to institutional inertia, rules and vested interests. With restricted ability to adapt, populations of firms can die and be replaced by firms more suited to the changing environment. The knowledge base and capacity of a firm is largely shaped by its past history and previous technological commitments. This restricts firms to a limited set of design configurations. Because of varying previous commitments, firms have different capacities to innovate and improve productivity, and consequently firms vary in their profit levels. A firm's survival and prosperity depends upon the possibilities of the technological regime on which they have invested. It also depends upon externalities of adoption; the extent to which the environment is wedded to that regime.

2.4 Industry Formation and Entrepreneurship

Three classes of entreprenerial activity can be identified as arbitrage, speculation and innovation (Harper and Earl 1996:309). The entrepreneurial-type we would most expect to give birth to a new regime is the innovative or Schumpeterian entrepreneur, although this is not neccesarily always the case. The Schumpeterian entrepreneur innovates through the introduction of new goods, new production methods, opening of new markets, conquest of new source of materials and/or the creation of a new type of industrial organisation (Schumpeter 1934). The entrepreneur is motivated by a dream, creative instincts and a will to conquer. Schumpeter's analysis down plays the role of prices because prices are not yet available for these markets.

By contrast, Hayek and Kirzner place prices at the forefront of the explanation of the role played by entrepreneurs (see Casson 1982:367-373). Hayek (1949) ties entrepreneurship to the assumption of market equilibrium. It is a world of continuous discovery, new technologies and new awareness of individual wants at particular time and places. These discoveries are localised so that different people have different information. Through the market, these discoveries are acted on and entrepreneurs co-ordinate their decisions in a movement towards a state of equilibrium. For Kirzner (1973), alertness to disequilibrium is the distinguishing characteristic of the entrepreneur. This alertness is reflected in their buying, selling and pricing plans. However, Kirzner and his fellow Austrians provide no description on how resources are developed, a key aspect of entrepreneurial innovation. His is a market-based description that ignores organisational and technical determinants of innovation.

Kirzner also lacks an explanation for the superior alertness and foresight of the entrepreneur. Knight (1921) linked entrepreneurship with confidence in one's own judgement coupled with a low aversion to risk. Since then psychological literature led by McClelland (1967) has sought to identify personality traits consistent with entrepreneurship. Such a focus runs in danger of down-playing the importance of environmental factors which give rise to entrepreneurial behaviour.

Leibenstein's (1978) concept of X-efficiency has also been applied to entrepreneurship. In this theory, a number of factors cause the economy to operate inside the production possibility frontier. These include psychological costs that cause agents not to exhibit full rationality and incomplete contracts which allow discretionary employee effort. Effort is required to break old habits and psychological inertia. Entrepreneurship is a creative response to this situation. By mediating in the market place (in particular management skills and capital markets) the entrepreneur improves information flows and fills gaps in the economy where holes exist.

A key problem faced by an entrepreneur considering entering a market is anticipating the response of other players (Richardson 1960). If a large number of players enter the field, profits will be low. On the other hand, if few players enter, profits will be high. Consequently, information problems on other agents behaviour create risk. Firms must also ensure they have sufficient supply of their own imputs. Richardson (1972) notes that firms can guarantee supplies through a number of strategies including forward purchasing orders, vertical integration, taking partial ownership of potential suppliers and developing close relations with suppliers.

For Casson (1982:25-8), opportunities for entrepreneurship are provided by the availability of new information, through discoveries and updates. Consequently, there will be a greater market for entrepreneurs in times of change. However, there is a level of uncertainty, otherwise everybody would act. The entrepreneur is someone that has better or more relevant information than others. This is a rejection of the neo-classical concept where everyone has access to the same information. Constraints on entrepreneurship are derived from the existing theory on the way the world works. The entrepreneur makes judgements different from the norm.

There is a big difference between the entrepreneur who moves an economy closer to equilibrium and one who makes new paths for an economic development through the introduction of new products and processes. In effect this latter entrepreneur introduces greater uncertainty and takes the market further away from the old equilibrium. To some extent, George Shackle's (1988) portrayal of an entrepreneur, as someone endowed with creative imaginations, bridged this divide. Shackle's entrepreneur takes existing notions and puts them together in new ways

Porter (1990) moves away from the individual to the environment as the determinant of innovation. He (1990:174) gives a biological analogy in stressing the role of the environment in the development of competitive industries. It is the environment that gives birth to diversity and new methods of competing, and Porter saw a number of environmental factors that contribute to the growth of a new industry. Sometimes industries grow purely from chance; however, in practice, any one of three factors can give birth to an industry. These include an endowment of factors of production such as iron ore giving birth to the Swedish steel industry, or university research and training giving birth to more advanced industries. Industries can also grow from related and supporting industries. For example, the Italian ski boot industry grew out of the manufacture of climbing and hiking boots. Finally, local demand conditions can provide a stimulus for the formulation of new industries. Porter's environmental focus can be married with both Hayek who emphasised localised differences and the Shackle-type entrepreneur who puts ideas together in new ways.

2.5 Securing Competitive Advantage

Abernathy and Utterback (1975) describe a pattern of industrial evolution upon the arrival of a new technology. When a major new technology arrives and creates a new industry, customers are unfamiliar with the technology so demand is small. Producers are still grasping the potential of the technology and a number of variants will exist in what is a rather experimental stage. However, as the quality of the products improves and the market grows, the number of firms will increase. Eventually, a dominant design emerges, specialised production processes are developed, and as firms get bigger, the economies of scale and capital they build up provide them with competitive strength which acts as a barrier to entry to any potential new entrants into the industry. This clearly suggests that there are advantages to being an early (if not first) mover. Other advantages of being a first mover include the ability to define the market in terms of product characteristics and exploit customer rigidity (see Davis and Devinney 1997:77). It also allows a firm to develop a reputation and build up assets gradually over time. First movers also have an opportunity to gain experience, learn by doing, and build up of economies of scale and scope; these last three all leading to reduced costs which make it difficult for new entrants to enter the industry at a later date. However, first movers or pioneers face one big problem - they are investing in unsteady technologies and this opens up the high possibility of failure. In an historical analysis, Golder and Tellis (1992) showed that pioneers failed 47% of the time. Consequently, they state that being first is less important than holding and capturing the position of leader during a period of early market growth.

A key factor in reaping the benefits of innovation is appropriability; to what extent can a firm appropriate the returns of their innovation. If an innovation can be easily replicated, a firm faces the danger of bearing all the costs of development which other companies can then exploit without having to bear the development costs. Kay (1995:100-1) notes that innovation can be protected through patents and secrecy, and also via strategic responses in which the innovation is combined with a distinctive capability such as

reputation, organisational architecture, or strategic assets (including economies of scale, experience curves and other entry barriers). In many industries, competitive advantage can be maintained due to the difficulty new players have in acquiring technologies. In 1967, Polanyi noted that some tacit knowledge can only be acquired by experience and can not be easily be transferred (see North 1990:74). This acts as an obvious barrier to late movers attempting to catch up in an industry at a later stage. A nation that gains experience with a technology early in its life will have greater opportunity to transmit tacit knowledge to its workers. A nation acquiring the technology late is at a disadvantage.

Vernon's(1966) International Product Life Cycle model was based on the assumption that imitation was likely to occur once a product technology had developed to the point of standardisation where, it was easily imitated. Producers transfer their operations to low wage nations who become the new centres of production. However, Perez and Soete (1988:459) note that a follower nation faces huge catch up costs. They face higher investment costs than the first mover who built up assets gradually. They must acquire experience and the science and technical knowledge to run the necessary productive equipment. These costs place a high threshold on anyone wanting to enter the industry. Consequently, they suggest the window of opportunity for entering the industry should be grasped in the early stages of major transition. During phases of transition, everyone is learning so old and new producers are at the same level and the threshold costs are lower.

First mover advantages can also extend into the environment that an industry builds around it. Hirschman (1958:99&119) notes that the founding of a new industry stimulates economic activity in a number of areas, including experimentation with technologies and searching for industrial supplies. This demand for supplies creates opportunities for satellite firms to grow in their wake. At the same time, the leading firm will attempt to promote the use of their product among customers. We can recognise these forward and backward linkages as the development of industrial clusters which Porter(1990) stated were key contributants to a nation's economic success. Clusters reduce transaction costs and create collective assets in the form of information, specialised institutions and reputation. These assist innovation and speed productivity growth. Porter's theory builds on Marshall's (1890) description of industrial districts where external economies of scale could be gained outside of the firm due to the pool of labour and other infrastructural resources that could be shared among the resident businesses.

While accepting the importance of first mover advantages, Porter (1990:163) suggests that more significant is the need to be the first to create a national 'diamond' that sustains competitive advantage. This 'diamond' is a diagram portraying forces such as sophisticated buyers, a large number of competing industries, factor endowments (including knowledge resources and infrastructure) and clusters as mentioned above. The factors that make up the diamond are mutually dependent and reinforcing. The state of these factors has an effect on the dynamic nature of an economy and on its constituent industries. For example, in the same way

that demand can affect the quality of supply, the inverse can happen, the result being that users and producers serve to raise each other's standards. If a producer has competent firms in related and supporting industries, mutually reinforcing industrial advancement can occur. Suppliers help firms obtain new methods of production, providing a greater opportunity to apply new technology and buyers in turn, are in a position to influence the suppliers technical advances. Through exchange of research and development and joint problem solving, the rate of innovation is accelerated, and costs can be spread throughout the industry. Having a number of companies in compatible industries, increases the nation's total industry knowledge. It can also lead to economies of scale in infrastructure and, there can be a flow on effect whenever one part of the industry has success. A high degree of co-ordination benefits all. A nation gains competitive advantage when it has established a unique diamond. The components take time to establish however, this time factor also affects would-be competitors thinking of imitation.

It is important to note that these industrial characteristics do not just appear. They are the consequence of history and commercial evolution. Similarly, the sources of competitive advantage at the level of the firm are products of its past history. The foundations of corporate success identified by John Kay (1995) include reputation, experience and other strategic assets. Competitive strengths clearly go beyond any initial endowment. They are 'the outcome of processes of innovation, learning, imitation and diffusion' (Dosi 1988b:234). As Porter (1991:163) notes, the 'process of gaining national advantage is one where history matters and where cause and effect become increasingly difficult to separate'.

2.6 Advance and Improvement

When an economy adopts a technological invention it has a momentum which will stimulate further invention. As Carter (1963:687) states, this

> ...may be done by creating new demands: for instance, an improved design of motor car engine, giving rise to higher speeds, stimulates the invention of improved designs of brakes. Or the stimulation may occur because the primary invention alters the relative scarcity of factors of production.... The most interesting possibility is that the primary invention may create new opportunities for the interaction of ideas between different types of technology -- it may turn out to be the missing element which makes a practical possibility of something which was previously only a theoretical dream.

A new technology creates pressures and compulsions that propel innovative activity in particular directions. For example, Rosenberg (1969:5) noted that the invention of Kay's flying shuttle led to the need to speed up spinning operations. Once this was achieved, it revealed a shortage of weaving capacity which eventually led to the invention of Cartwright's power loom. It is an illustration of technological innovation creating imbalance which propels innovation in certain directions. This non-neutrality of the direction of technological advance is supported by Nelson and Winter (1982), who state the solutions we create to

technical problems are determined by our knowledge, investment and routines built up over time. A new technology is developed along a path that reflects these endowments. Nelson and Winter call these paths 'natural trajectories', a reflection that advance follows advance in a way that appears almost inevitable given the technical endowment. Dosi (1982) uses the term "technological trajectory" to define this path-like nature of advancement. The technological paradigm defines for the scientist and the industrialist what is technologically possible, shaping the way they perceive, approach and resolve technological problems. They determine what technological directions to pursue or not to pursue.

As technology advances along a path or trajectory, greater knowledge is gained on the potential of the technology. New opportunities are revealed, pushing development further along the path in a cumulative effect. As a country progresses along a trajectory, it gains greater tacit knowledge of the technology and, is in a better position to exploit the cumulative nature of technological development (Dosi1988b:393). Success breeds success and a technological gap is opened up between it and other countries. With a well established paradigm, advancement becomes endogenous along the trajectory.

Porter (1990) saw environmental features as the chief factor in determining the rate of innovation in the economy. The interplay of the nation's factor conditions, demand conditions, related and supporting industries, firm strategy, structure and rivalry. This emphasis on the environment is supported by studies of 'National Systems of Innovation'. The first explicit use of the concept 'National Systems of Innovation' came from Christopher Freeman who, in his 1987 book, identified that Japan's success was strongly determined by its organisation of sub-systems and interaction between those sub-systems in a manner that was specific to that country. The organisation of R&D, firms and government organisation such as MITI, played a key role in generating innovation.

Lundvall (1992:12) defines National Systems of Innovation as 'all parts and aspects of the economic structure and the institutional set up affecting learning as well as searching and exploring'. The concept of NSI recognises that technology is not easily transferable and is country specific (Archibugi and Michi 1995). It is rooted in skills, capabilities and knowledge that has been built up over time; a factor of prime importance given Polanyi's (1967) identification that much knowledge is tacit and can not be easily acquired. National differences in the adoption and development of technologies are the result of a nation's peculiar ideologies, cultures, historical experience and language. These forces create the inter-firm relationships and other factor environments that determine the level of innovation in a country. While there is much similarity between Porter and those studying NSI, Porter presents the national system as an environment for a particular industry involved in international competition whereas those studying NSI focus on the environment in its own right. To that extent, this thesis will take a line more akin to Porter's in that the domestic environment is presented in relation to the shipping industry. Both Porter and those studying NSI stress the role of historical forces.

A key feature of many authors is the central role of competition in forcing firms to take innovative actions and deliver technological change. However, other factors might deliver an innovative response. Dosi (1988a:227) provides a list of other factors that can influence technological innovation. This includes technological bottlenecks and scarcities of critical inputs; or, conversely an abundance of particular inputs (eg energy, raw materials, etc). He also identified changes in the rates of growth of demand, changes in relative price levels (especially the price of machines relative to the price of labour) and patterns of industrial conflict which affect the supply of labour.

For Schumpeter (1942), perfect competition was not the sole harbinger of advance. Small firms in perfectly competitive markets might not be so well placed to advance technology as their larger counterparts with a larger resource base for development. Consequently, technological advance could also occur under socialist planned economies where improvement would occur by decree. In fact he recognised that monopoly rights promoted innovation as they increased the certainty that an innovation might be worth financing and pay a return. Hence patents, copyrights and grants of exclusive rights are a necessary condition for progress. By contrast, Klein (1977:17) disputes the advantages of larger companies. In analysis of some fifty major inventions, he found none came from a large company. Large companies might provide resources for R&D but not the incentives. Through specialisation and constraints on internal interactions, large companies seek static efficiencies via exploitation of existing technological choices. They make choices on the existing production possibility frontier using existing inputs but, do not push the frontier out. For Klein, the main reason a company enters 'slow history' is not the diminishing returns of technology (ibid:58) but the fact that an industry over time becomes more structured and less adaptable to uncertainty in the environment. For 'fast history' a high level of competition with ease of entry into the industry was the best prescription for technological advance (or dynamic efficiency). This seems to be supported by Abernathy and Utterback (1988) who note that once a company has established high sunk costs in an industry, it is not likely to introduce radical innovation that lays those sunk costs redundant. The company will create a formalised structure to exploit the model which has become standardised and improvements will tend to be only incremental improvements in process technology. Consequently, major product change often comes from outside the industry.

Klein's theory is highly compatible with Burn's and Stalkers's (1961) characterisation of organisations as mechanistic or organic. Klein saw large firms as becoming mechanistic. However, his views are not so compatible with Chandler (1962) and Contingency Theory. They are consistent in that large static firms can only advance through acquisition, a fact Chandler's research seems to bear out. However, while Chandler sees organisational competition as a process of survival of the fittest, Klein notes that sometimes large inefficient firms can succeed on the basis of their ability to influence their environment through advertising, lobbying, political influence and exploitation of tax loopholes. Clearly, this last argument lends itself well

with the thoughts of Institutional Theory which stresses the importance of legitimisation in the institutional environment, and Resource Dependency Theory which stresses the importance of managing relationships in order to secure access to resources.

Chandler's work did not concern itself with innovation per se, with the exception of organisational innovation which was a function of strategy. However, Lazonick (1991), who built on Chandler's work, did link the processes identified by Chandler to innovation. Lazonick recognised that innovation was not born from technology alone. It involves an interaction between machines and people, and an incentive to innovate. In contrast to the competition stressed by Porter, it is co-operation that induces innovation. He identified that vertical specialisation in the production chain can create a barrier to innovation that co-operation can overcome. Large firms with their advantages in resource and knowledge utilisation are more likely to generate innovation. However, given the uncertain nature of change, Langlois and Robertson (1995) do not believe that internalising change is always the best option. In times of high uncertainty and changing resource needs, flexible relationships with outsiders may more effectively generate innovation. The Chandlerian-type firm appears only when the rate of innovation has slowed. For Langlois and Robertson, the most effective organisational form for generating innovation and growth depends upon the problems confronted, the stage in the product life cycle, the availability of information and many other factors. It is a theory in which organisational moulds are made and broken over time.

2.7 Organisations, Institutions and Production Technology

Once a significant innovation is adopted, the economy will build up institutional relationships that help to maximise it. These will include educational institutions and literature to diffuse knowledge of the technology, transportation, government services, and producers. A follower nation seeking to catch up by adapting the same technologies faces the problem that diffusion and advancement of a technology requires these institutional and environmental features that the leading nation has built up over time. As Dalum, Johnson and Lundvall(1992:311) note laggards are sometimes slow to catch up because 'product or process technologies do not automatically fit into new institutional set up'.

Success in exploiting a production technology is likely to depend on the co-ordinated actions of many individuals. This raises the problems of how to ensure that each individual performs his or her required task. Economic organisations must co-ordinate the activities of a large number of individuals towards the common goal while maintaining motivation. Over-riding this is the importance of aligning objectives between agent and principal. Therefore, organisational structures must address these issues of limited information and incentives.

The incentives that institutions embody provide a number of benefits that enhance the performance of an economy. Firstly, they provide stability. Institutions provide mechanisms to ensure that the activities of the

members do not stray too far from that required to maximise potential. As North(1990:25) states they provide information and discipline waywardness by regulating patterns of human interaction. By providing a degree of certainty in human interaction, institutions allow economic agents to perform their tasks in confidence. Johnson (1992:26) notes that through their ability to mediate conflicts and provide incentive systems, the stability they provide can actually assist implement necessary change. Incentives can take a number of forms. Rules, norms, and values all provide the incentive structure of an economy, telling members how to direct their economic activity. They also reflect what is considered rational behaviour. Vanberg (1988:248) notes that for recurring problems of choice, rules provide standard solutions which improve the quality of outcomes, reduce costs and mistakes. Consequently, despite the short term imposition, they provide a greater pay off overtime.

Institutions provide knowledge on production and economic conditions. They create and co-ordinate the use of knowledge and information for the individual decision maker (Boland 1979, Johnson 1992). They also provide social knowledge which may be needed for interaction with other individual decision makers'. The importance that institutions play in handling information is very important in dictating economic activity given the limitations of human cognitive activity. Decision makers information about the world is full of omissions and distortions and is only an approximation of the real environment (Simon 1959:96). Information is heavily filtered through the perception process. Through the handling of information, institutions can strongly shape the schemas and belief systems in which decision makers base their decisions.

In identifying the role that rules, incentives and values play in directing business and productive behaviour, the work of Lakatos must be mentioned (see Harper and Earl 1996:314). The Lakatosian approach suggests firms behave in different ways because they are characterised by different hard core assumptions and operational heuristics. Like scientists, businesses follow a program which consists of a hard core that is rigid, and a periphery which contains those aspects of the program that can be changed or sub-contracted. Hence, a business programme is capable of flexibility but within constraints. It is based on a particular way of viewing the world. The resulting heuristics provide the rules of thumb and define what can and cannot be done. Earl (1987:25-7) gives some insight into how such management philosophies are created. They may result from personally designed experiments of trial and error, or they may be derived through social learning of pre-existing doctrines. Such philosophies can occur at the firm and individual level and may exhibit a co-evolutionary aspect in which corporations can shape the view of individuals while individuals can contribute to corporate philosophy.

If organisations are infused with values as ends in themselves Selznick (1957) states they have become institutionalised. With institutionalisation, a unique organisational character emerges which is crystallised by the forces of custom and precedent. Organisation values and norms shape the actions of their members

while newcomers to the organisation undergo a process of socialisation in which the values are internalised, shaping their subsequent judgement and commitment.

Where beliefs are widely held, they become encapsulated as culture. Camerer and Vepsalainen (1988) see a firm's culture as a mechanism for governing rational behaviour by firms. Written contracts can not sufficiently cover all behaviour because of the cost of making them complete. Unwritten 'cultural contracts' fill the void. They state that a 'companies early history often determines its culture for a long time because precedent is a powerful focal principle' (ibid:124). Stories and anecdotes serve to help install the rules of culture. Due to its tacit nature, culture is difficult to change which can become a large problem for an organisation if an environmental shift renders a culture inappropriate for the changing circumstances.

2.8 Change and Rigidity

An important feature of innovation is the rate at which it occurs. Klein (1977) believed that progress occurred at different rates but clung to the notion of equilibrium. In plotting performance over time, Klein produced an S shape curve which illustrated periods of 'slow history' and 'fast history'. This decline of innovation is related to a decline in competition and producers taking a more structured and predictable approach to business where they seek incremental not discontinuous change. Mokyr (1990) notes that economic history reveals long periods of stagnation and very slow gradual change punctuated by leaps in technology like the industrial revolution. By contrast, Schoenberger (1997) speaks of a quickening of change over time, a compression of time and space.

Gersick (1991) explored the evolutionary work from a number of scientific disciplines and noted that periods of relatively stable equilibrium are punctuated by revolutions, a finding not dissimilar to Mokyr (although cautions this is not the only way change occurs (ibid:33)). These revolutions require a dismantling of the old structures and a breaking of the old inertia. Therefore the system goes through a period of instability before pieces of the old system and new pieces assemble into a new system with a new set of rules. Gersick notes that these revolutions (punctuated paradigms) are most likely to occur in systems that have confining deep structures, the depth of the previous structure being resistant to gradualism. A more flexible system will adopt innovation more gradually and without friction. This view lends itself to Potts (2000) who examines the role of connections in an economic system. Potts applies complexity theory to economic systems with the conclusion that a system that becomes too ordered with large numbers of connections, loses its ability to change and yet retain coherence and stability. The economy becomes over-connected and agents in that system become bound to an old structure unable to make change.

Perhaps the pace of change is less important than the extent to which the innovations are compatible with the existing set up. Langlois and Robertson (1995:116) state that if an innovation is compatible with existing capabilities, a leader will probably retain leadership. On the other hand, an entirely new innovation

will be appropriated by those firms that already have access to the most relevant capabilities, which need not be the existing leader.

Freeman and Perez (1988) created a taxonomy of innovations that varied from incremental innovations which can readily be adopted by an existing industry through to technological revolutions. It is these last ones which pose the greatest threat to established producers. It is associated with a cluster of interrelated innovations that leads to a new style of technology and management (techno-economic paradigms) which clearly has similarities with the notion of regimes that Metcalfe raised the following year. A new techno-economic style raises productivity to a level that is clearly superior to what was 'normal' with the previous technological style. Perez (1983) uses the term 'technological style' (or mode of development) to describe a kind of 'ideal type' of productive organisation or best technological 'common sense' which develops given the dynamics of the time (ibid:361). The arrival of a new style of management and technology requires accompanying changes in the socio-infrastructure of the economy in areas such as education and politics. However, when a new mode of development is first introduced, the surrounding social, educational and market infrastructure is one which has developed in response to the needs of the previous style of production. Until there is a change in the broader social and institutional spheres, the new technology can not be fully exploited. The economy enters a period of experimentation and reassessment in the face of tradition, established ideas, vested interests and other inertial forces which actively oppose the required transformations(ibid:365). The result is a social-institutional crisis which needs to be resolved before the economy can reap the benefits of this new technology and enter a new wave of growth. Eventually, the complimentary innovations in the social and institutional spheres are made and the crisis is resolved. Educational, political and other systems are adapted to the rising technological needs, and the economy enters a new period of growth.

While economies making the transformation from the old mode of development to the new undergo crisis, newcomers can sometimes make social and institutional innovations with more ease than leaders trapped by their own success, whose institutions Freeman and Perez (1988:64) describe as 'arthritic'. This suggests that industrial productivity, and hence leadership, can be to some degree accounted for by the broader institutional environment.

2.9 The Chains of Entrapment

The literature discussed so far portrays an industry as being far more than the sum of the firms that make it up. It also conflicts with a view of firms that make changes to their production function on the basis of changing prices. An industry's success is based on external economies, rules, cultures, supporting institutions, etc. In contrast to a neo-classical view of free flowing technologies and market adjustment, this section will discuss psychological, technological and institutional barriers to change and also the costs of change itself. Some barriers have already been alluded to in the previous discussion so will not be repeated.

2.9.1 Psychological Barriers to Adjustment Herbert Simon and James March (1958) are credited with introducing cognitive science to the study of Industrial Organisation. They criticised the classical economic model where decision makers choose from fixed and known alternatives, each of which has a known consequence. In reality, there are limits to human cognitive ability. Decision maker's information about the real world is full of omissions and distortions, so the decision maker's model is only an approximation of the real world. It encompasses only a fraction of the relevant characteristics of the real environment and information is heavily filtered through the filtering process. People tend to be receptive to information that is consistent with previously held beliefs while contrary information tends to be down-played.

Coupled with this idea of a limited model is the idea of 'schemas'. These are beliefs and propositions based on our personal experience. A piece of information which is at odds with our belief system (eg: that the way we do business is no longer good enough) can encounter a great deal of psychological resistance before it is accepted. Cognitive dissonance can result when information appears to contradict our previously held belief systems. In such a situation, Festinger (1957:3) noted that humans will seek to reduce that dissonance and/or avoid situations and information which would increase the dissonance. Such options could lead to decision makers seeking social corroboration of their views and selecting with who they mix or, they emphasise negative aspects of information that conflicts with their own views (Elster 1983). Decision makers may go to some lengths to avoid recognise irrecoverable sunk costs and actually escalate their commitment to projects that information now shows to be unwise. Escalation of commitment literature dates from Staw (1976) who found that subjects who invested in an under-performing R&D project invested more in an attempt to turn things around. The escalation was a consequence of their perceived responsibility for the original decision.

Barriers to change also include motivational effects. Levinson (1978) describes the pain of loss, the uncertainty and fear of failure as barriers to changing existing life structures. Lost opportunities, losing power struggles, and failure all serve to dampen motivation for change. Levinson also suggests fear of losing control of the situation under the new regime. People with expertise based on the last technology will no longer be perceived as experts (Earl 1984). They may use their remaining expert status to resist innovation and therefore protect their status and power base.

The notion of schemas can be seen in Thomas Kuhn's (1963) notion of paradigms. Kuhn noticed that innovative momentum is not without order. Outside of divine intervention and chance happenings, innovators can only solve problems within their intellectual and educational constraints. Scientific education plays a key role. It inculcates the scientific community with a deep commitment to a particular way of viewing the world and practising science in it. That education determines how discoveries are

interpreted and, results in an emphasis on finding scientific discoveries which support what is already known. In effect, the existing scientific paradigm determines how science advances and, is so strong that findings not fitting the existing paradigm can be discarded. Occasionally, findings inconsistent with the paradigm once accepted, serve to create a new paradigm. However, commitment to the old paradigm is so strong that scientists can not merely give up their old way of viewing the world. There is a resistance to new modes of thinking.

Kuhn's approach was applied to business by Earl (1984:102-3) who saw changes in corporate strategy mirroring Kuhn's scientific revolutions. When a strategy fails it requires transition to a new strategy but myopic vision (with the old) can throw a company on the corporate rocks. Lorsch (1986) had a similar line of thinking and suggested culture was an invisible barrier to change because it (i) produces a strategic myopia which distorts incoming signals and (ii) even if this myopia could be overcome, management's response is still guided by the old belief system. When persistent problems finally led to a recognised need for a change in beliefs, there is frequently a period 'of what psychiatrists label denial. They choose to ignore the possibility that key beliefs could and should be modified'. This is followed by a period of confusion, development of new strategic visions, and experimentation. Sometimes the new strategic vision does not work as they go through a process of forming new beliefs

Cultures became a popular area of attention in the 1980's, a consequence of Japanese industrial success, but its origins can be found in the work of Selznick (1957) mentioned earlier. Schoenberger (1997) recognised that cultures can be vulnerable to changes in the competitive environment (although with no refernce to Selznick). For Schoenberger, an industrial climate is borne from the temporal-spatio rhythms and practices at work and the environment, competitive practices, traditions, processes of valuation, etc. As a competitive environment undergoes dramatic change with time-space compression, the old capacities are thrown into question leading to a 'cultural crisis of the firm'. The ability of a firm to respond to these environmental changes is restricted by bureaucratic resistance, economics of information and uncertainty, problems of capital-labour relations and regional obsolescence. Firms will not be totally resistant to change but the underlying cultural processes play a vital role determining patterns of change and resistance.

Schoenberger (1997:11) recognised that cultural values occur at various levels including industry and internal production sites. However, Schoenberger's focus is on the culture of the firm as this is where strategy is made and the firm is more accessible to analyse. The effect of the broader culture on the functioning of an industry has not yet received much attention in the literature and my thesis will hopefully contribute to closing this gap.

Culture is particularly compelling in that the institutions and information flows in an economic system mutually reinforce each other to accept that the cultural values are correct. Learning in the culture is itself

an accumulation of past learning and this affects the interpretation of new knowledge and its relevance. Colleges employ staff who have graduated within the broader educational system and seek to advance existing knowledge on the basis of what they know. Leading schools develop with particular ways of thinking which recruit staff with similar philosophies. Similarly, top management in industry, who have graduated with such a philosophy, recruit staff who can operate within their company's culture and method of operations and consequently, employ staff with some degree of compatibility. Educational institutions turn out graduates to meet the demand in a self-buttressing interaction of supply an demand. Chambers of commerce, newspapers and other literature reinforce the information flows. The system is not immune to innovation but there is an economic and social pressure to conform to the values of society and industry.

2.9.2 Technological Paradigms, Path Dependency and Lock-In Throughout an economy's historical development investments are made in technologies and institutions. These investments and linkages cannot be broken easily and effect the later development of the economy (Perez 1983:365). These past investments can determine the progress of industrial leadership.

Inertia is also a consequence of the persistence of practices or routines (Nelson and Winter 1982). In the course of a firm's development, it will acquire skills and experience necessary to function profitably. These routines have not been acquired with ease. Nor can they be discarded with ease. Consequently, routines have a rigidity that makes change hard to implement. A nation with large technological/productive investments may find it very hard to switch from one technological trajectory to another requiring different skills and experience. One may have to start almost from the beginning. The result can be 'firm specific trajectories' in that firms will 'search in zones that enable them to use and build on their existing technological base' therefore future achievement is constrained by the past (Dosi 1988b:224). With a consequence, firms and industries suffer from 'lock-in'.

The notion of being 'locked-in' to a specific technology was illustrated by David (1985) who noted that industries can be locked-in to a given technology despite the existence of better alternatives. Economies of scale and technical interrelatedness meant that an industry would benefit from the adoption of a single standard. This leads to 'lock-in' for a change in the standard has repercussions for other parts of the industry. Once a technology becomes locked in, it is very hard to reverse because the industrial system in itself is not planned or under the control of any designer. Arthur (1988) explains that for an individual firm 'lock-in' can be attractive because of (i) learning by using (ii) Network externalities ie: advantages in all using (iii). Scale economies in production (iv) informational increasing returns ie: better understood (v) technological interrelatedness. Technical rigidity can also be influenced by local factor prices. Given the feasibility of technology is dependent on factor prices, these can have an impact on the diffusion of a best practice technology (Salter 1966).

Salter (1966:64) noted that when an industrial plant is built, it normally embodies the leading technology at the time. Consequently, any industry will comprise a number of plants embodying a number of technologies reflecting the rate of investment when they were built. These plants are embedded in a technology that it is indivisible. They can not flexibly be re-moulded as classical economics would suggest. New technologies can only be embodied when fresh capital is created. This clearly inhibits the possibility of piecemeal change and makes change expensive.

These authors recognise that any individual producer's production technology is part of a larger economic system. It can not make technological decisions in ignorance of its environment and institutionalised relationships which may be born in economic advantages. For a country, specialisation along a specific technological trajectory and paradigm can lead to a trade off between allocative efficiency and Schumpeterian efficiency (Dosi 1988b:398;403). A country may have trouble choosing between (i) increasing efficiencies and continue to progress down a technological trajectory with which it has a lead or (ii) change to a new mode of development with which it possesses no lead but has greater long term potential. The greater the lead a nation has, the less likely it is to change. In effect, technological leadership in old technological pathways may be a hindrance to quick adoption of new ones.

2.9.3 Institutional Entrapment Earlier we noted that institutionalisation can assist the diffusion of a new technology. However, by definition institutionalism also involves a creeping conservatism and an inertial quality. As mechanisms are put in place to stop waywardness, they direct people's behaviour in ways that may be difficult to change when external circumstances change or a new paradigm comes along. This creeping conservatism can best be understood by examining the problems an organisation faces as it grows. Greiner (1972) notes that as an organisation becomes older and grows in size it evolves through crises that must be solved if the organisation is to survive. An organisation initially characterised by its technically or entrepreneurially driven founder and an informal structure finds with size it incurs crises of planning, co-ordinating and controlling. The introduction of a more formal hierarchical structure and work standards solves these problems but creates problems of excessive centralisation. Increased delegation and a more decentralised organisation structure will solve these problems but leads to a loss of control. The use of more formal systems solves this problem but leads to a 'red-tape crisis'. Eventually, the firm that reaches an evolutionary phase which emphasises strong personal collaboration, greater spontaneity in management action and increased use of teams and education.

Greiner's model shows that growth requires some measures of control for an organisation to maximise its potential. Gjerding (1992) states that innovation design in organisations must overcome two conflicting requirements (i) diversity (ii) formalisation and centralisation. While diversity increases flexibility and innovation, rules are intended to secure conformity. Rules constrict waywardness that undermines the efficiency of the economic system but, at the same time, restrict the flexibility of behaviour. They result in

behaviour that is more predictable and more reliably administered (Heiner 1983:343). Effectively, rules maximise current production technology (static efficiency) but sacrifice the opportunity to develop new productive technologies. Values can also act as a barrier to the adoption of innovation (Bush 1987).

Institutionalisation can also affect market relationships. In this light, it is important to note that the market involves a series of institutionalised relationships and is far from being a neutral environment (Pagano 1991:420). Organised markets involve relationships that go beyond mere exchanges of price and volume. They involve flows of qualitative information and an on-going learning process about each others capabilities and requirements. Over time, trust and investment in information channels build up, exchange of information becomes more efficient and routinised with common codes and channels of information (Lundvall 1988:356-7). While this increased efficiency reduces transaction costs, they create an inertia resistant to change and severing these connections will involve some cost.

Markets have another in-built resistance to change in that their decentralised and dispersed nature can make it difficult to co-ordinate a change that affects the whole system - systematic innovation. As a producing nation experiences market growth it will be in a position for producers to increasingly specialise and further increase its productivity. However, this specialisation occurs within a given technology. As the routines that workers perform become more specialised they become less flexible (Langlois and Robertson 1995:23). It may be possible to overcome barriers to systematic change by internalising production within large firms. It can, for example, overcome powerful resistance to innovation by suppliers who must serve others, may have asset specificity and, may not share the innovators vision. On the other hand, large organisations may resist innovations that have the effect of destroying the value of investments already in place.

Growth has a further negative consequence for flexibility in that decision making tasks become separated from productive tasks. In effect, decision makers become more isolated from core technologies and perhaps the market. Acquiring accurate information becomes more difficult. This has particular importance if the decision makers are also responsible for enforcing "control" of industrial activity. Greiner's model (above) suggests economic growth results in changes in the skill requirements of leaders with the early technological-entrepreneurial leaders being replaced over time by more administrative skills. In the modern context, Galbraith (1967) noted how the creative entrepreneurial role had been replaced by a managerial role being performed by a techno-structure. It reflects an increased distancing of decision makers from core economic activities. The rise of a specialist professional management class noted by Hayes and Abernathy (1988) could also be interpreted as a consequence of growth which invariably creates a barrier to effective change as decision makers become more distanced from core activities.

The ability of institutions to direct our thinking along a particular paradigm or direction is reinforced by the role they play in learning. Johnson (1992) notes institutions affect learning by defining communication flows and interaction inside and between firms. They also provide the educational and communication infrastructure, the incentive system, social norms, etc, which shape the learning process. Change is dependent on the information received and the processing of that information (North 1990:8). The institutional structure filtering the information therefore sets the preconditions for certain types of change. Consequently, institutional change is rather incremental and slow because of the inherent inertia. Dramatic changes in knowledge that depart from previously held learning paths can find the institutionalised directed learning and inertia a barrier to the adoption of major change. The ability to influence the learning process can result in a situation where institutions continue to teach new members of a society that an institution is required long after the need for it has gone (Boland 1979:323). By referring to the importance of the earlier need or problem for which the institution was created, they continue to justify their existence, with consequent social rigidities.

Stake-holders can be particularly powerful barriers to change. Olson (1982:44) states that, over time, a stable society will build up a number of distributional coalitions - organisations that are 'overwhelmingly oriented to struggles over the distribution of income and wealth than to the production of additional output'. Their effect is to reduce efficiency and aggregate income and contribute divisiveness to the nation's political life. The incentive structure, of which the distributional coalition are a part, encourages its members to keep organisations alive even after its original purpose has disappeared. This they can do with the advantage of an established organisation. This gives them an advantage over groups which might not have the incentive or, have too large a number to effectively organise. These coalitions are particularly damaging in their ability to influence what the people in that society find 'customary and fitting'. The role of distributional coalitions is particularly relevant given the recent theories of organisational economics that see firms as a set of stakeholders who come together through a nexus of related contracts. All stakeholders require a minimum pay-off in order to secure co-operation.

Porter(1990) identifies that 'Nations will succeed in industries where their goals and motivations are in line with the sources of comparative advantage'. An intrinsic beauty of the 'invisible hand' is the congruity between individual goals and economic growth, but I suggest that this congruity is limited by circumstances. An example of this are capital markets in which, during growth stages, investors' pursuit of short term returns can be combined with long term industrial growth as the broader economic environment provided the opportunity to do so. However, during decline, short-term returns can only be obtained by sacrificing long term investment and growth. (Perhaps if a firm is privately owned or has significant resources, it can reduce its reliance on self seeking agents with conflicting goals).

Congruity between institutions and industrial growth can also occur between institutions that have no direct economic incentive, most obviously, military institutions. For example, in Portugal and Spain economic goals coincided with military goals providing a two-engined motor for growth. In the twentieth century, US growth enjoyed a beneficial congruity when the US department of defence helped explore computer, semi-conductor and aircraft technology, developing new industries and embedding US companies with capabilities and experience in routines in those industries. However, as the technology developed, there were fewer spill-overs, and the industrial and military institutions began to conflict as they competed for resources - growth and decline driven by a chance congruity.

2.9.4 Cost of Change A further difficulty in implementing large scale organisational and technological change is the costs associated with that change. Penrose (1959) claimed the costs of change place limits on the rate at which change can occur. The "Penrose effect" occurs when managers have to employ and induct new staff with the consequence that managers are detracted from performing their day to day tasks with the danger that they lose touch of operations.

The costs in shifting to a new production technology include retraining or hiring workers for different skills and routines, obtaining different capital endowments and production facilities. These costs can act as a barrier to change. As figure 2.1 shows, as a technology develops, a producer gains more experience with that technology and costs decrease. An established producer(A) would be far down this cost curve. If a new technology arrives, it will be initially be more expensive (at B). If the technology has potential, new entrants in the industry would be wise to adopt it but, the old leader must take into account the costs of change. They may finally change when superiority of technology is evident but at this stage, the new firms have advanced further down the curve (to C). Even with the benefits of the now available public knowledge concerning the technology, the old leader must enter the new technology further back along the cost curve (ie; they are now the followers).

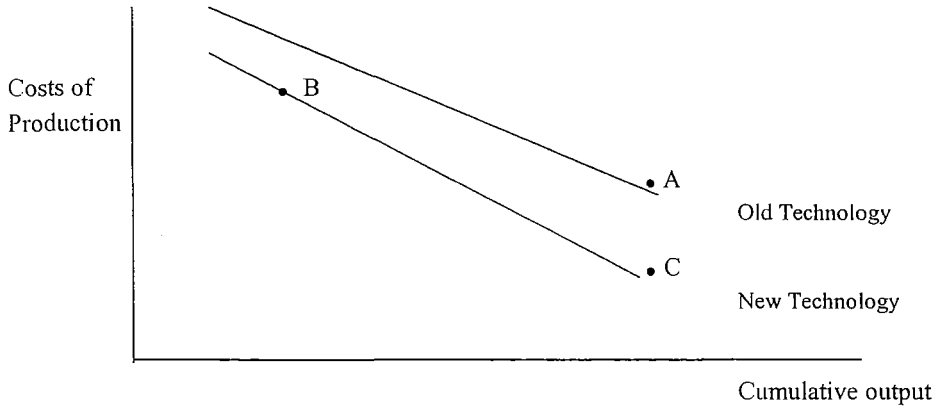


Figure2.1. The effect of innovation on the relative cost structure of firms (adapted from Langlois and Robertson 1995)

Consequently, Langlois and Robertson (1995;112) hypothesise that:

> a firm that is adept at employing an existing technology will be less likely to adopt a new technology that is incompatible with its current capabilities than will a firm that is less adept at using the existing technology, even if the new technology offers the prospect of long-run increases in profits for both firms.

Given that, the superiority of the new technology is not always evident on its introduction, an established firm is not likely to incur the costs of change until the potential of the technology is evident. This gives competing producers the chance to gain experience and perhaps an early lead with the technology. Once the potential of the technology has been displayed, an established producer may find it can still compete by reducing slack in its own operations (Hirschman 1970). The existence of slack allows decision makers to carry on going down existing pathways in a changing environment (Earl 1984 sections 1.7 and 11.2).

Another cost of change to consider are the psychological effects of decline in a competitive environment. Kets de Vries and Miller (1988:96) note that stress in a failing organisation can cause a leader to become depressed. A depressed or paranoid manager can in turn have a negative effect on the performance of organisation with destructive cultures developing.

Table 2.1 **Barriers to Change**

Psychological	Cognitive Dissonance Bounded rationality Satisficing Schema/paradigms/cultures Motivation-Loss
Technological	Routine persistance Lock-in Embedded Technology Path Dependency
Institutional	Rules/Values/heuristics Institutionalised Relationships Isolated Decision Makers Specialisation Institutionalised learning Stakeholders.
Costs of Change	New Capital, retraining, etc Time required for implementing change Psychological stress

2.10 Summary

In table 2.2, the various barriers to productive flexibility are summarised. They stand in sharp contrast to the economic world described by classical economics of perfect knowledge and instantaneous adjustments to changes in the environment. There is no inertia from previous technological investments, values and institutional constraints and, technology was seen as a free flowing public good. But, reality would appear not to support this position. Changes in the environment, and in particular recent technological innovations in process technology, can lead to massive displacements in industries such as automobiles (Robertson and Langlois 1994:361). Clearly, management and organisational performance goes beyond a flexible production function.

The true picture is one in which history matters. There are 'economies of time' which include (i) the timing of industry entry (ii) the subtlety between first mover advantages versus the costs of being a pioneer or late follower, but most importantly (iii) the legacy that historical investments have on shaping future industrial activity. The question this thesis asks is can these forces of advance and entrapment be built into a model that explains the nature of industrial development, particularly given the long life of many industries?

Porter(1980) had earlier examined industrial evolution within a framework of the product life cycle. However, while recognising that industrial phases include introduction, growth, maturity and decline, he rejected the idea that one model or pattern of evolution could be used as a predictor of industry evolution, preferring instead to examine the underlying forces and relationships. Apart from Porter, there has been limited effort at applying a life cycle to industry. Lambkin and Day (1989) believe this is because industries embrace several classes of non-competitive products each with its own pattern of evolution. Population ecology theory applies a life cycle at the level of organisation populations, with clear implications for industry. In the model posited by Hannan and Freeman (1977), it is the environment that selects the organisational form that fits the available resource space. At some point environmental change exceeds the organisational rate of change leading to death. There are a number of problems with this model (see Donaldson 1995). In particular it fails to explain environmental change, it sees population density as the driver of births and deaths, and leaves no room for managerial action. It stands in sharp contrast to contingency theory which provides organisations with the ability to adapt their structure in response to changes in contingency factors such as strategy, size and technology.

Given the previous reluctance to apply a life cycle at the industry level, I face the danger of walking where angels fear to tread. However, the history reveals that many industries have gone through phases of birth and growth, and those industries that no longer exist have obviously died. On the other hand, those industries that still exist have not died. The whole notion of commercial 'Life Cycles' is not without controversy. The product life cycle has been subject to frequent criticism. For example, Tellis and

Crawford (1981) criticise its sequential nature and orderly bell-curve shaped progress. Their alternative was a Product Evolutionary Cycle with phases that are non-sequential and allow for periods of stabilisation, differentiation and divergence. Nevertheless, I suggest there is still room for a flexible application of a life cycle. Any organism goes through processes of behavioural adaptation, disease, growth, resource loss (famine or drought) and reproduction. Identification of phases such as birth, growth, and death does not preclude the existence of variation.

Chapter 3

A Model of an International Industry Life Cycle

3.1 **Description of the Model** This model attempts to answer the question what determines the rise and fall of industrial powers? The literature on industrial evolution reveals processes that lend themselves to an industrial life cycle. On the basis of that literature, I propose the following life cycle. This is not a rigid, mechanistic cycle. It is one that accepts variation and the unpredictability of events such as wars and other chance events. As stated in the previous chapter, identification of phases such as birth, growth, and death does not preclude the existence of variation.

The model states that the changing face of global industrial leadership is an on-going process of imitation, catch-up, advance and entrapment. The process is driven by institutional and technological dynamics that affect, not just producers but, the entire environment (or system of innovation) in which producers operate. The model is strongly influenced by Porter (1990) who emphasises the importance of the environment in determining competitive advantage and Perez (1983) who emphasises the rigidity the techno-economic environment in which a firm operates. This thesis posits that these dynamics can be built into a four stage industry life cycle:

Stage 1. Imitation - In the first stage, the people in a nation (or influential members of it) come to the awareness that another nation has obtained greater wealth through better production and commercial technologies. That awareness may come about through a demonstration effect, external threats or the on-going process of communication and interaction. Consequently, we would expect diffusion of best practices (and stage 1 of the cycle) to be influenced by proximity and ease of interaction. Such a proposition is consistent with Downie's innovation mechanism in which firms seek to innovate (including imitation) when faced with possible decline. However, even with awareness of a new pathway to growth, a decision maker might still decide not to imitate. For example, Earl (1984:76) identifies four strategies that decision makers can use when an existing way of doing things begins to perform poorly. They include (1) continue with the existing programme but make ad hoc adjustments and sinking further resources in an attempt to preserve the existing system (2) narrow the scope of existing programmes (3) attempt to use existing programmes in unfamiliar territory (4) seek a new programme.

A number of barriers to adoption could occur if the country has belief systems with which the new economic pathway is not compatible. Religious and military values and institutions can present barriers, as can psychological barriers such as the persistence of schemas and cognitive dissonance. Conflict over change will occur between those who benefit from the change and those who suffer and in many cases, the result will be determined by circumstances, for example, an external threat that hastens the need for change.

Once people in the nation become aware that it is in their best interests to adopt the new techniques, those members of society with access to the necessary resources and skills, and incentive to change, attempt to adopt those production and organisation technologies. There are clear advantages in adopting an existing technology as opposed to developing an indigenous one. Firstly, adoption saves on development costs. The imitator can adopt the new techniques without going through the long process of trial and error that the originator had to incur. Secondly, the adopted technology has already been proven to work so can provide an improvement in the conditions of the imitator. This can provide a level of confidence in the change process as long as the technology is consistent with the existing infrastructural system and environment.

The ease of imitation will be affected by the sophistication of the technology or processes involved. Obviously, more simple processes are easily imitated. In some cases we might find that first attempts with the new technology are hampered by inexperience and the small scale of production so, they frequently require some level of government assistance or protection. The nation may also benefit from protection provided by wars that upset the imports of superior competing products. This allows the young nation to imitate the production technologies of the early leader and adopt the necessary productive requirements to their local markets. Initial production in the imitating country will be on a small scale and consequently, the process of imitation is more often than not driven by front-line workers and engineers who are having to perform a number of tasks.

The imitation process faces the inevitable problem of how to graft new processes on to an existing system while the old system still generates an element of inertia. The new technologies may continue to encounter resistance as they impact on old values and old methods of production. Some workers or power groups may find their prestige and incomes are sacrificed with the new production methods. Imitation may also be restricted by a lack of resources, trained staff, or supporting industries. Attempts to overcome these problems may lead to innovative solutions that lead to greater competitiveness. Consequently, continuous improvement during this stage may include both imitated and indigenous advances.

Stage 2. Catch Up - In stage two, the nation successfully acquires the skills, experience, capital and other supporting industries to compete internationally. The rate of catch up is determined by a number of factors. Abramovitz (1986:388), who recognised that a number of countries caught up to the United States after World War 2 in a 'convergence' of productivity levels, noted that the pace at which catch-up occurs 'depends on factors limiting the diffusion of knowledge, the rate of structural change, the accumulation of capital, and the expansion of demand'. Drawing on Salter (1966), we would expect the rate of catch-up to be hindered where productive investments embody an older technology that can not merely be remodelled to adapt the new technologies. But clearly, this depends on the nature of the technology involved existing capital.

The rate of catch-up will be affected by the speed at which that nation acquires the new capabilities and this involves a process of learning of new knowledge and techniques. Much knowledge might be able to be required through formal education institutions depending on the sophistication of those institutions and the nature of the knowledge. However, it is most likely that a great deal of tacit knowledge will need to be required in its journey down the experience curve.

Successful imitation requires some degree of technology capabilities, factor endowment and institutional similarity to the current leader. This includes educational institutions, government policies, organisational structures, etc. The new industries will require institutional support that the country might not be able to provide. In these instances, the imitation effort may fail or not reach a high level of efficiency.

The rate of catch up is also determined by the pace of technological advance in the industry. If the industry is not generating a great deal of technological advance, it is far easier for an imitating nation to catch up. The slow rate of improvement and innovation results in a period of stability in which followers can easily catch up by mere imitation. The leader suffers from its failure to improve continuously, and therefore maintain the gap. Part of the problem may lie in the fact that it is on the technological frontier of an increasingly exhausted trajectories and, its R&D functions need to peddle twice as fast just to maintain the lead.

Stage 3. Technological Advance - Throughout the process of catch-up, the imitating nation borrowed ideas and processes that it needed to develop its own industry. However, some of these ideas and institutions may need to be modified to suit local conditions. The requirement for modification may give birth to a number of innovations that enhance competitiveness. For example, there may be something in the local environment that is new and adds stimulus to continuous improvement, or alternatively, the imitating country may have to develop a substitute to accommodate for weaknesses in its infrastructure/factor endowment. Innovations may result from a need to overcome specific bottlenecks of the old technologies, in particular, the dramatic change in availability of a key factor (or factors) of production (eg: iron, coal, steel and electricity). On the other hand, the imitator may take up a technological advance developed in the old leader but not actually applied in that country due to socio-institutional resistance (an example being transistors or Deming's work on Quality Control - developed in the US but not applied until introduced in Japan). This may result in a new productive style more efficient than that preceding it. The source of the innovation is not so important as the country's ability to adopt and diffuse it. This will be affected by the state of the nation's endowments in finance, production, education, science and marketing; those factors identified in the National System of Innovation (Lundvall 1992).

Some innovations can be so broad in their effect that they are adopted by a large number of industries and create a new techno-economic paradigms. The new paradigm may be more effective for its greater ability to solve the control-flexibility debate, resulting in institutions with a greater capacity to generate continuous improvement. Given the reduced geographic limitations on competition as the 'world is getting smaller', the increased intensity of competition suggests a paradigm is likely to be replaced by one that can generate continuous improvement at a faster pace.

The new development path provides opportunities for entrepreneurs to become rich and build up new centres of production. It creates a new techno-economic system with an underlying rationality that allows it to exploit the new production technology. It will be fed by educational institutions that provide skilled workers and trade associations that maintain standards and diffuse knowledge. Supporting industries will be spun off creating clusters that reduce transaction costs and enhance the flow of information within and between companies. The nation may also develop a reputation for excellence in the area. In effect, the nation has developed the sources of competitive advantage identified by Porter (1991:340).

Once adopted, an innovation can have a cumulative effect, it can lead to a clustering of investment, and that such investment can increase the rate of progress in an industry, leading in turn to an eventual further clustering of innovations (Posner 1961). The developing industry will require supplies and this would help development of other related industries. Over time, the nation builds up a cluster of related industries which complement the competitiveness of each other through information flows and external economies of scale.

Stage 4. Entrapment - In stage three, a new imitator adopts an innovation which enables it to improve its competitiveness and tackle the old leader who is in now in a similar situation to that the imitator found itself in stage one ie: it must consider whether to adopt a foreign innovation. When the innovation first arrives, it may only be marginally superior to existing techniques. Until the superiority of the new technology is threatening, it is economically logical for the old leader to pursue existing methods in which it has invested in routines, capabilities, and specific assets. But even with recognition of superiority, a raft of psychological, technological and institutional barriers can inhibit successful change.

Potts (2000) view that economies become over-connected and agents in that system become bound to an old structure unable to make change can be wedded with Earl's (1986) view that economic agents become strongly attached to old decision making pathways because of the perceived negative implications from doing otherwise. Information-processing limitations can cause agents to resist significant shifts that threaten their core beliefs of how they see their world. Consequently, a combination of cognitive and systemic forces act to reduce the flexibility of economic systems.

While Potts focuses on how systems are put together, another approach would be to stress what the economic systems are made of. The effect of an innovation on industrial leadership depends on the extent to which a technological innovation departs from the past. A country whose existing capabilities are compatible with the requirements of the new paradigm could easily make the transition. If an innovation, is highly compatible with existing capabilities, the incumbents could possibly retain leadership. However, if the innovation is entirely new then the benefits of the innovation will be appropriated by those 'firms that already has access to the most important relevant capabilities. These may be either entirely new firms or incumbent firms in related fields' (Langlois and Robertson 1995:117). Conflict over change will occur between those who benefit from the change and those who suffer and once again, the may be determined by circumstances

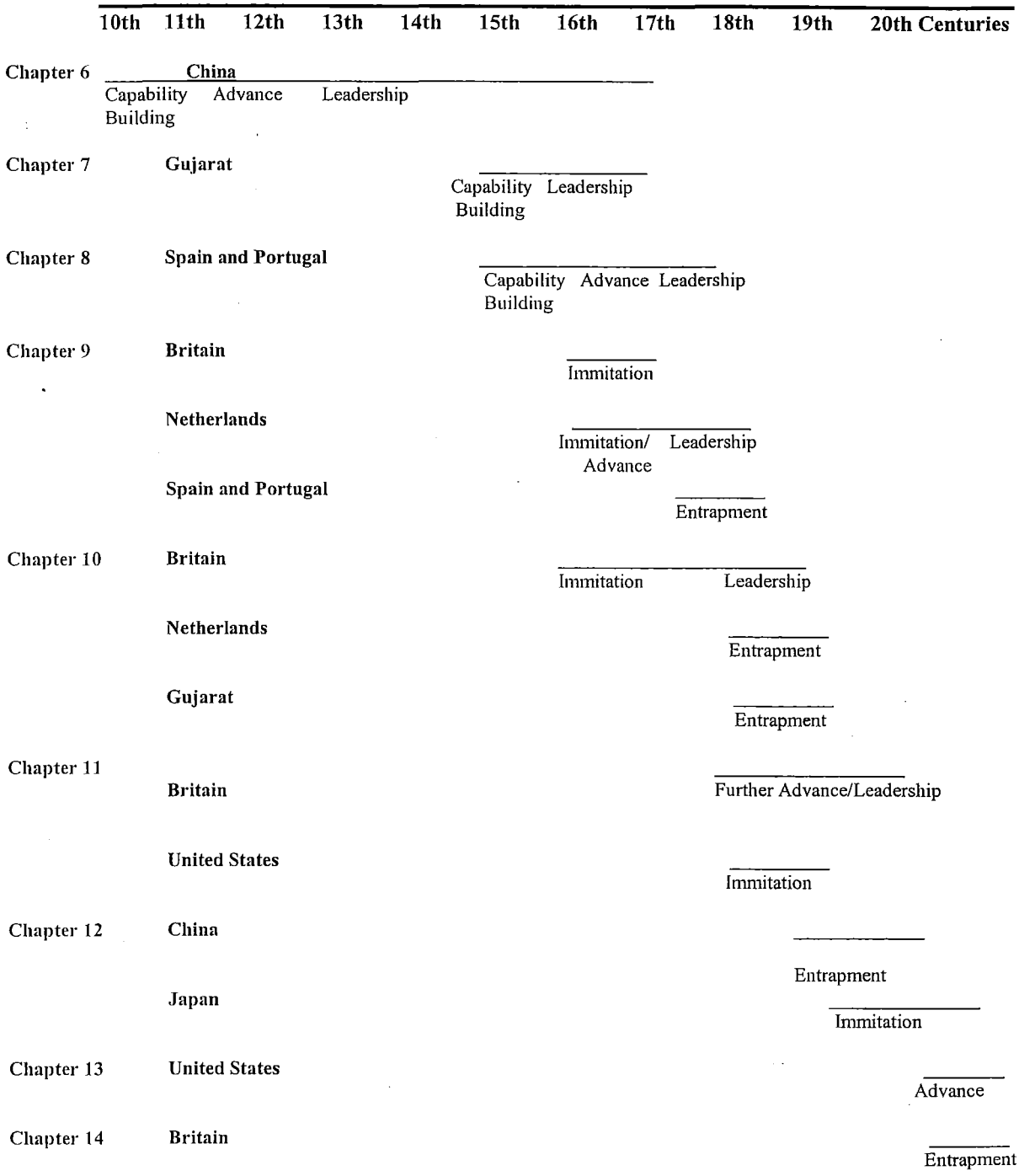
With a significant shift, the biggest losers are likely to be those countries with the deepest commitment to the old structure. They will incur the most internal resistance to change (Gersick 1991). The success that the old leader has had with the old techno-economic paradigm are the anchors that may stop it sailing with the new. It has large scale investments in the old technologies. This includes training institutions, capital investments, relationships and methods of doing business. Most importantly, the whole value system and rationality of the economic system is associated with its old production base (Schoenberger (1997), Freeman and Perez (1988)). When a techno-economic shift occurs, the rules change.

The old leader loses markets and is left with surplus production capacity and reduced earnings. This reduces the incentive and ability to invest in new technologies, making it harder to push the technological frontier forward and keep up with the new rivals. Its producers may ask its government to provide protection from the imports now coming in. Protection might serve to give the leader a breathing space which allows the necessary adjustment. On the other hand, if the nation is too deeply entrapped by its past, its glory days will have passed it by.

In the mean time, the imitator is now armed with capital, skills and a greater inertia for continuous improvement. The nation eventually takes a strong lead creating a new economy based on the new technologies. As the new leader, it grows large, institutes controls necessary to exploit the new technology, and institutionalises values associated with that success. The system will be able to accommodate change and will have nothing to fear until a major shift in production technologies erode the source of the nation's competitive advantage, and the system begins again.

Table 3.1

Chronological Map of Thesis



Chapter 4

Methodology and Criticism

This thesis seeks to determine to what extent the entrapment-based model outlined in chapter 3 can explain the historical shifts of the locus of industrial leadership. To achieve this, the historical literature on each epoch is examined with regard to the fortunes of the shipping industry in each nation. Primary and secondary sources will be studied. In each case, the historical literature is contrasted with the model to see if a fit can be achieved without recourse to ad hoc modifications.

There are several problems with such an approach. The first is the time frame and the different economic circumstances under which each epoch operates. The time frame is so long it poses the question 'do different economic systems have similar underlying forces?' and 'how reliably can twentieth century theories be applied to the longer time frame?' There is nothing new in applying models over long time frames. For years, economists have clung to the supply-demand model of market behaviour. But it is persistence that has been attacked and modified. For example, Galbraith (1967) noted that in the United States, a market of entrepreneurs has been replaced by an economy of large organisations and technocrats. Lazonick (1991) goes as far as saying the market economy is a myth. Porter (1990) observed that changed business practices have reduced the accuracy of the old model, and this throws open the question to what extent any model could be applied across a time frame spanning many centuries when practices and environments have dramatically changed. There is growing recognition of the dangers in applying a model over a long time frame in which methods of resource allocation change.

The view of industry taken in this thesis is strongly institutionalist in nature and stands in sharp contrast to the neo-classical industry of free-flowing technologies and firms who adjust their production functions in responce to innnovations and changing market conditions. Neo-classical theory does not conceive markets institutional terms, seeing it as an institutional-free 'state of nature' (Hodgson 1993:58). For example, Williamson (1975:20) writes 'in the beginning there were markets'. This view appeals to the Principle of the Uniformity of Nature, which states a principle or generalisation that has held in the past will continue to do so (Pheby 1988:8). However, anyone with even the basic knowledge of economic history will be aware that 'in the beginning' markets played a minimal role in resource allocation. Markets are a form of economic co-ordination that has evolved over time. A number of writers, including Hodgson (1988) and Dosi (1988b), have argued that the market is not a natural but a social institution governed by its own set of rules that restrict some behaviours and legitimise others.

Classical theory can be criticized for an over-commitment to the market model as an explanation of economic activity throughout time. However, any model which seeks to appeal to the Principle of the Uniformity of Nature is in danger of being exposed to the same criticism. Models are descriptions of activity in a given context and there are difficulties in anticipating future contexts. The model I propose is a dynamic model that incorporates change (in contrast to the static equilibrium model). In fact, it is change that the model seeks to explain. However, even if my model provides a more accurate description of the past, it leads to an important consideration; the predictive value of the model. Even if the hypothesis is upheld, does this necessarily give it predictive power? Future economic activities will occur in contexts very different to those in the past and present. With this in mind, my model will hopefully reveal forces that are capable of having greater or declining strength in the future but, it does not attempt to state that countervailing forces will or will not appear or the strength of those forces will wane because of circumstances.

Economic evolution was a process stressed by Veblen (1934:8), who saw the key question as 'not how things stabilize themselves in a "static state", but how they endlessly grow and change'. Veblen saw the evolution of social structures as a process of natural selection of institutions. This institutional view has been taken further by a number of authors including Rosenberg and Birdzell (1986:115) who noted that innovations in business institutions (eg: banking and insurance) in Western Europe contributed strongly to economic growth. Alfred Chandler (1977) emphasised the importance of a number of managerial innovations while Langlois and Robertson (1995) examined a number of organisation forms and structures by which capabilities are organised, from decentralised markets to integrated companies. In chapter two, we discussed the importance of institutions in providing economic incentives and information. Clearly, any model on economic performance must address the evolution of institutional forms.

An historical approach to research has much to offer evolutionary and institutional economics. It is an approach that is best represented by Alfred Chandler (1984:3) who explicitly suggests generating theory from historical research:

> The historian has at least two exacting and exciting challenges. One is that of relating specific human events and actions to the ever-changing broader economic, social, political and cultural environment. A second is the development of generalisations and concepts which, although derived from events and actions that occur at a specific time and place, are applicable to other times and places, and are, therefore, valuable as guideposts for or as tools of analysis by other historians as well as economists, sociologists, anthropologists and other scholars.

The approach of generating relevant theory through the study of history was pioneered by Karl Marx who, in *Capital,* examined the relationship between organisation and technology, or what he called the 'relations

and forces of production' (see Lazonick 1991:267-71). However, Marx's model and predictions led to the misplaced anticipation of class-conflict between capitalists and workers. Fortunately, since Marx's day, there has been much progress in the sheer depth of historical information available and methodology.

A problem I face in covering such a long time period is in dealing with data. While some data can be interpreted as fact, for example the date of an invention, other evidence is more problematic (Robertson 1996:132). Some data can only be interpreted in the context from which it has arisen. In the period covered by this thesis, there have been numerous changing contexts in which shipping and business activity occurs and at any given time, a number of contexts might co-exist. To overcome this problem, it is important to reveal as much information as possible. However, history offers a wealth of information. It is not linear or orderly and sometimes there is too much information. With this comes the problem of identifying causal links for events and processes that can be quite complex and multi-faceted. James Burke (1968) illustrated these problems in *Connections* in which he reveals that an invention is not merely the product of an inventor but is part of a causal chain of what can be seemingly unrelated events. It is an approach to history that moves beyond heroes, themes and periods and shares some common ground with the approach taken in this thesis. In this light, we no longer see entrepreneurs and decision makers as 'great men', but as products of an inherited legacy, a viewpoint that has much in common with Dosi's (1982) and Nelson's and Winter's (1982) work on trajectories.

In dealing with these problems, I have been aided by the fact that much of the historical data has already been interpreted. Most of my research is based on secondary sources in which the weeding has already occurred. This means that I might inherit the weaknesses of those who have gone before me, but cross referencing can help over-come this problem as can reference to original sources where they are available. For example, it is common to cross-reference the records of the Dutch and English East India Companies, especially given the scarcity of Indian records on Indian Ocean trade. However, the sheer mass of original sources and, in some cases, language problems places restrictions on the extent to which this can be done within the confines of a study of this length. Fortunately, there is a broad variety of information on shipping that has only become available relatively recently. In fact, it could be said that ten years ago, it would not be possible to conduct this thesis. Fortunately, writers such as Gang Deng (1995, 1997, 1999) and Yoneo Ishii (1998) offer interpretation and translations of work previously unavailable to the English speaker and have made this thesis possible.

One problem in interpreting information (i) over such a long period and (ii) on an international scale is the possibility that contexts are blurred, which make the interpretation of evidence biased. Robertson (1996:137) has identified these weaknesses in Chandler's *Scale and Scope* (1990), which explores only three nations over a far shorter time period. It is important to capture the environmental factors that underpin development. For that reason, I go beyond the actual industry and include the environmental

features that have shaped development in the industry. This is consistent with Porter (1990) who highlights the importance of the national environment in determining competitive advantage. Although Chandler recognised that the large organisations on which he focused were not suitable for all industries, by making such a focus his study is biased towards a population of large firms operating in mature industries. It ignores firms at different stages of development. So not to encounter the same problem, I have endeavoured to start my histories, not only at the birth of the industry in each country, but also of the key factors that have shaped the industry. Nevertheless, my selection is biased to those countries that at one stage became industry leaders. A more comprehensive study would provide greater detail on the 'also rans'. While I do note the positions of competitors I do face problems of (i) limited information on the small players in the early years and (ii) limited time and space constraints of the thesis which already covers seven nations over six hundred years.

This leads to the question of where do you draw the line? Comprehensive histories should contain everything relevant but, as Pearson notes can we write a history of Akbar without considering his predecessors and legacy? Pearson (1987) states that 'everyone slices up the real world, which is monistic, to suit themselves, so there is no methodological reason why we should not also?' At some point we have to draw a line and this comes down to judgement that the important issues of relevance have been included. Robertson (1996:146) gives a good guide when he suggests that good business history 'must attempt to cover a story in its complexity. This entails admitting contradictions in the evidence and placing the material in its context.'

While my model is put forward as an attempt to find amore accurate explanation of industrial forces over time, it runs the risk of imposing meaning, order and patterns on historical activity. The patterns I am imposing are designed in the late twentieth century. In recognizing an evolution of improving productive technique, my judgment is based on modern values. Given that the current epoch has cultural values of a commercial society very different to those of earlier societies, each history includes an outline of the dominant institutions in each country that shape the value system of the time.

One weakness, I overtly tried to avoid was too rigorously applying explanations bound by economic viewpoint where it might limit the revelation of more accurate explanations. This has been done before and I wished to avoid falling in the same trap. For example, in exploring maritime history and international trade, Douglas North has faithfully applied the concept of transaction costs to a degree that blurred accuracy. In 1968, North claimed that in the two centuries after 1650, productivity in British shipping rose significantly due to the decline in piracy and improvements in economic organisation. However, as French (1995:28-9) notes this understates the role of technology and many technological improvements were made during this period which advanced productivity. These include the movement to larger ships which reduced the man/ton ratio, breaking up of sail units which allowed greater flexibility, and the adoption of

the wheel for steering and the fore and aft sail. By 1991, North acknowledged the role of technology but, repeated the old emphasis stating 'what distinguished Western Europe from other places in the world where persistent growth failed to occur, was that they evolved a set of adaptive efficient institutions that persistently tended to lower the costs of transacting, producing and transporting in a way that produced a continuous evolution of productivity increases' (ibid:35). Although no one disagrees with this, it ignores many other forces that at times were more important. However as Brady (1991) notes only certain types of property rights led to economic development. In many cases, economic development occurred at the expense of peasantry. The Western European states came to favour merchant property rights over other forms of property rights. While the transaction cost view offers a valuable perspective, in the East, European businessmen operated without the same property rights and acted as plunderers, slavers and extortioners on their road to enrichment (ibid:160).

For this reason, my first priority was to examine the historical data and find the reasons that historians ascribe for events. The opportunity to explore such a long history and explore so much evidence relatively free of economic bias seemed too good to waste. I use the term "relatively free" to indicate my sources are historical not economic. They have been written with the eye of the historian not the economist and this should reduce their exposure to economic dogma. Although this should not be taken too far. Historians also have their own interpretative dogmas. We only need think of the post-independence literature of the 1970's, which frequently blamed colonisation for national economic, political and social problems. Even many of the original historical sources were full of intention that contaminated historical records. We need only think of Prince Henry's chronicles and the attempts to justify actions such as slavery. The other problem with this statement is my own interpretative leanings. I am obviously not totally free of bias.

While trying to avoid the confines of dogma, I opened up many other problems for myself, many of them identified by Finch(1999) in his discussion on grounded theory. First, as much as I try to cleanse myself, I am not free of personal bias nor the effects of previous training. This can affect my selection and interpretation of data. Second, although I formulated my model after observing trends in historical data, I may have seized upon my ideas earlier than I recognised in myself. Probably the biggest problem with this form of research is the lack of co-ordinating principles needed to deliver neutrality. Traveling through a world history of this scale without guidance of principles is like traveling through an ocean without navigation equipment.

My research method is clearly inductive in its early stages and exposes itself to the criticisms associated with inductive research, in particular the collection of superfluous detail before identifying what data is relevant. In the early stages, several patterns appeared in the data that suggested a cycle of growth of productive capabilities followed by eventual entrapment. On the basis of these preliminary findings, I conducted a review of the literature on industrial development and institutional economics. This theory

provided me with co-ordinating principles but at the possible expense of channeling my vision, although I made a deliberate and conscious effort to try to avoid this trap. From the literature and preliminary historical research, I formulated a model which uses elements from Growth of Knowledge and Evolutionary Economics that provides grounds for expecting entrapment at some point. My next stage was to conduct a more extensive historical review to see how the data fit the expectations derived from the model, thereby adopting a more deductive approach at this latter stage. The demons of bias versus lack of co-ordinating principles and information overload were consistent problems with which I had to contend, but I feel that this approach was perhaps the safest approach.

A major problem with this study stems from the lack of quantitative information over such a long time period consequently, the data will be principally qualitative. There is an obvious lack of quantitative information in the earlier periods and this presents problems in terms of defining leadership. There are no market share figures. Nevertheless, it is possible to determine from historical data which merchant shippers conquered the oceans in terms of miles covered and technology. These will be the gauges of leadership used. In some instances, statistics will be provided. However, for the early years, these can not be accurate and should only be interpreted as indications of shipping activity and interpreted with full awareness of their limitations. Those limitations include the sheer scarcity of records and the limitations of those that do exist. Records reliant on estimations by observers can regularly be found but can only be classed as estimates with all the subjectivity that entails. Where a number of observers have referred to shipping levels, it is possible to make cross-references.

At times governments may have required official recording of shipping activity but, those records are generally limited in the time period and geographic area. Such figures do not include clandestine trade which at times could be plentiful, and are very limited in the amount of information they provide. Ship numbers and routes may be registered but leave out information on size, leaving an obvious problem if we want to compile information on volume of trade. In the last two centuries, national ship registers have become available but, until relatively recently these have been principally a Western concept and still leave a problem whereby ships might be registered in one nation but owned and managed in another.

Where tonnage figures are provided, they are fraught with difficulties due to the different terms used. For example, the terms 'tuns burthen' was a terms initially used in the Bordeaux wine trade in the twelfth century and referred to the number of barrels (or tuns) which a vessel could carry while, the term 'tuns and tunnage' also included the empty spaces between the barrels. The problem is many observers did not differentiate what method they were using. This example also illustrates that differences in interpretation are related to how the cargo is packed (a tun is reckoned to be equivalent to 60 cu.ft or 2,000lb giving figures based on either weight or volume). There can also be confusion when compared with modern definitions of tonnage. Some information is only available in gross tonnage (gt), which does not actually

measure weight at all but, the cubic capacity of the ship (100cu ft = 1 ton). Other information may be in dead weight tonnage (ie: the difference between the weight of the ship when fully laden and empty). The two cannot be directly compared.

Another warning in interpretation relates to one of the reasons I chose shipping. Shipping is a highly illuminating industry as its derived demand aspect gives an indication of underlying commercial activity. However, it does not provide an overall picture of industrial leadership. China, due to its high agricultural productivity, was probably the world's most productive nation on a per capita basis until the end of the eighteenth century, long after it surrendered its lead in shipping. In choosing shipping, I am opening up the possibility that I am presenting an industry with a 'Euro-centric' bias. Maritime activity was one of the first areas in which Europeans gained early pre-eminence. This in no way suggests universal industrial superiority. Vasco de Gama discovered this on his first visit to Calicut. Despite arriving in state of the art European ships, the locals laughed at the European exports he offered, suggesting he offer them gold instead. In fact, the Europeans would be dependent on bullion to pay for imports with Asia up until the industrial revolution. (NB: Some of the products in which Europe had a competitive advantage had no market in Asia, for example woolen products were wasted on peoples living in the tropics, and clocks had no demand in societies not requiring precise time measurements). Industrial supremacy must be handled with care.

Other criticisms refer to the model itself. It is possible that have no relationship to the shifting paradigms exogenous factors could contribute to a nation's industrial decline. These include luck, wars, bad strategic decisions, and values not related to the paradigm. There is also the question of timing. Any decision of technological change is going to involve a debate between those who gain and those who lose. The balance of debate will be affected by circumstances at the time. Therefore exogenous factors can play an important role.

It is important not to be obsessed with the concept of a 'best practice' commercial or productive technology. It is important to note that 'for a technical problem there is often no correct or even best, solution in the long run. In fact there is frequently no terminal state: both problems and solutions are themselves often dynamic' (Frischmuth and Allen 1969). Similarly, in terms of organisational practice and design, Pelikan (1988:376) states 'there is no single-type arrangement - neither markets nor hierarchies - which would be universally optimal for all innovation activities'.

There are other problems with rigidly clinging to the notion of 'technological style' (or best practice) as posited by Perez. If an older technological style continues to improve, it may still be able to compete with the new. It is possible that some producers using the old technological style may be able to survive; for example, the Morgan Motor Company who have maintained a market niche on the basis of these

"traditional" values. In shipping we see the same thing in some regional waterways where traditional forms survive on a combination of cheap labour and labour-intensive technologies. Similarly, not all industries will be suited to any new technological style when they arrive. For example, despite gaining much success from mass production technologies, Lund et al (1977) found that in the United States over 75% of all metal working firms engaged in small batch production. The mass-production style of production, on which American success was so strongly built, was only suitable for manufacturing with large economies of scale.

Finally, we must consider examples where the new technological style opens up the production of new products with no effect on the production of older products. In this case, a nation may remain the industrial leader but lose its position of overall economic pre-eminence. The resulting new consumer expenditure patterns can deflect purchases from the older good and the old leader can go into decline even though it is still the leader in that industry.

Clearly, we can have competing and co-evolving techno-economic styles. This can present problems in terms of definition. For example, what constitutes a techno-economic style? When does one style or paradigm finish and become a new one. This problem of definition can be seen in Todd (1991) who applied the international product life cycle(IPLC) to the ship-building industry. For Todd, the 1970's and 1980's reperesented a period in which ships had reached product maturity with standard technologies, little innovation leading to a consequent change in production location from high to low income countries as suggested by the IPLC. Yet, during this period of so-called stagnation, Japan's century old ship-building industry was producing a large number of innovations including on-board automation, a dramatic transition in size of ships and and many organisational changes in production. Japan' s achievement stood in sharp defiance to the IPLC. The Japanese did not see the 'steel-hull shipped' as having matured as suggested by Todd. This suggests that definition and technological potential is in many ways in the eye of the beholder. In this case, the term maturity and its theoretical basis represents an example where Westerners had theoretically justified what this thesis would see as entrapment. But it brings us back to the problem, why were the Japanese not entrapped by this so-called mature product. Although stopping before the 1970-80's time period, it is on these issues that this thesis (and its institutional and behavioural economic sources) endeavours to throw some light.

The last criticism of this thesis refers to the time frame. In starting with China, I do a disservice to Islamic shipping (see Appendix 1). However, some restriction must be placed on what is by any description, a long time frame. Despite these problems, this research has much to offer. Its wide scope reveals much on commercial and industrial evolution while dramatically reducing Euro-centric bias. I have attempted to think beyond 'The Rise of the Western World' and 'How the West grew rich' to present a more global picture of the rise and decline of industrial fortunes. The shipping industry is observed in a number of environments, time

contexts and cultures while, at the same time, identifying the forces that have acted on evolution, success and decline.

Chapter 5

The Nature of International Merchant Shipping

By definition, international merchant shipping is the transportation of cargoes between nations. The focus of this thesis is oceanic merchant shipping ie: the shipping of goods across oceans. The difference between the two is that sometimes international shipping might not be transoceanic if the two nations are neighbouring. The reason for the approach I have taken is to provide some common level of comparison. For example, a voyage from Amsterdam to Calais would be considered international whereas a voyage along China's coast could be three times as long and still only be considered domestic. Secondly, transoceanic shipping reaches a higher skill and technological level to those trade routes that hug the coast line. Consequently, it illustrates an industry of high productive requirements, many of which are transferable across oceans around the world.

However, the transferability of capabilities should not be overstated. In maritime trade, the quickest route between two points is not a straight line. It involves knowledge of wind and tidal patterns which are regional in nature and acquired tacitly. Ship type must also be wedded to the appropriate conditions. On-shore, knowledge of local trading practices and conditions is also a factor that cannot be instantly applied to regions operating under different practices and conditions. The key tasks associated with transporting goods across the open seas include:

i. **Acquiring marketable cargoes.** In the early days, the activities of a ship-owner and a merchant were joined. A ship-owner was a merchant who invested in ships to transport goods to a distant market. The merchant was involved in arbitrage benefiting from price differentials in geographically separated locations which he could solve through the provision of shipping services. To justify the investment in a ship, the trade must reach a certain size. Alternatively, the ship-owner might be able to lease space on the ship to other merchants. In theory, a fisherman with sailing skills could invest in a larger ship and hire it out to merchants, but this was risky as there was no certainty of cargo. As technology advanced, the relationship between merchant and ship-owner became separated as telegrams, telephones, radio, semaphore and computers could alert ship-owners to the presence of cargoes in various ports. Organisational development also assisted this division as businessmen found other ways of reducing risk, such as pooled resources and insurance. However, the ship-owner merchant structure still exists today with many companies integrating into transportation services.

ii. **Finding and developing markets.** These two tasks include many market making tasks as outlined by Casson (1985:22). This includes establishing contact between buyers and sellers, specifying and communicating details, of the parties involved, negotiating and monitoring performance of agreements, exchanging and transporting goods, payment of the necessary taxes and other institutional requirements, and enforcement of the agreement. When merchant and ship-owning activities are combined, it also involves gaining knowledge on consumer preferences in numerous ports and familiarisation with regional productive conditions, thereby gaining awareness of supply and demand by which intelligent pricing and quality decisions can be made.

iii. **Skills in dealing with foreigners and foreign languages.** International shipping by definition involves conducting business with people from different nations. Where cultural and language differences exist this increases the risk and level of skills required of those involved in transacting. The transacting party may have to be skilled in two commercial cultures in order to acquire information and communicate deals to the satisfaction of both parties without incurring conflict. This goes beyond language to relationship building, awareness of local methods of negotiating, dealing with breach of contract, knowledge of local institutions, etc.

iv. **Raising capital to acquire the ship.** Shipping is a capital intensive industry in which large sums of capital can be tied up for very long periods of time without generating a return. In the early days, voyages might take up to two years before generating a return so the investor had to have sufficient capital free to do without such funds. The importance of raising capital is given added importance in that this in the early days was a very high-risk business. Storms, pirates and other natural and political catastrophes could undermine the best planned ventures.

v. **Ship structure.** The shipper must have access to ship building technology that can create a ship which has the strength to handle a wide range of conditions, sufficient cargo carrying capacity and speed, and provides ease of handling. The structure must also allow it access to a port's infrastructure where it can load and unload without difficulty.

vi. **Sailing skills.** A crew with the ability to handle ships and cargo requirements under a range of conditions.

vii. **Knowledge of routes.** A knowledge of ocean routes between ports reduces the chance of having an accident. Captains must have sufficient knowledge of routes to reduce time spent at sea and the costs of staying afloat (eg: wages and victuals). Fast routes also allows the boat to be used for another voyage and make greater use of the capital invested in the boat.

viii. **Navigation techniques.** Success in any transport industry is obviously enhanced if you do not get lost. In the open ocean with no landmarks in sight, a captain must have the ability to identify the ship's position relative to its destination. This invariably meant a knowledge of wind systems, ocean currents and the position of the stars.

ix. **Defence from predators**, in particular piracy.

x. **Crew and Voyage management.** A number of managerial tasks are required including the co-ordination of seamen's duties on board, meeting loading and unloading time schedules, maintaining discipline, meeting victualling requirements, handling disease outbreaks, etc.

xi. **Co-ordinating activities over long distances**. When a ship and a foreign agent are located thousands of kilometres away from the owner, problems are opened regarding the co-ordination of activity. The nature of this problem varies depending on the level of technology involved. For example, in the earliest days a return trip to the East Indies from Europe would take well over a year. Given the arbitrage nature of shipping, in which information on market conditions are a vital aspect on decision making, the time involved presents a particular problem. Time and distance problems also create information asymmetries and great potential for opportunism by distant agents. Motivating agents and captains to act in the interests of their employers at all times is exceptionally hard to monitor and enforce performance and was very reliant on reputational effects for future hiring. Options to deal with this include integration or open-ended contracts with much discretion left to the captain, and overall performance can be monitored when the ship returns home.

There is a key need to co-ordinate the transportation and market making functions (i and ii above). This could be done through other organisational forms including spot markets, reputation effects, relational contracting and integration. The normal arguments for integration, excluding measurement and control measured above, include asset specificity, in which a company integrates its operations to include a key asset which, if in the hands of an outside contractor, might expose it to 'hold up' or higher costs. In contrast to this Kay (1997) posits 'asset replaceability' in which a firm integrates to incorporate a key asset, which it can not easily replace if another user captures it. Probably more applicable to shipping are the arguments of Casson and Silver. Silver (1984) states that in innovating, an entrepreneur may require the performance of complementary activities in which it has no experience. If others are not prepared to supply that function, the entrepreneur may have to integrate forward and provide this function himself. In other words, if no one else going to incur the large financial risk of a ship that will be exposed to the whims of nature, a merchant will have to integrate into ship-owning if he wants to get his goods overseas. This particularly applies to the development of new routes where ship-owners or other suppliers might not share the innovator's vision. In these instances, the innovator runs into what Langlois and Robertson call "dynamic transaction costs' ie: the

cost of persuading, negotiating, co-ordinating and teaching outside suppliers to provide capabilities that the innovator does not possess. This can be costly if the potential supplier is in a position exploit 'hold up' or information impactedness. Under such circumstances, integration can be a the best option.

Casson's argument relates to modern multi-national enterprises. If we accept that shipping companies exhibit many characteristics of multinational corporations in their trans-national nature, we can see from Casson (1985) an explanation for the integration of the merchant/ship-owning in early trade. For Casson, integration is one way of ensuring a chain of confidence in the supply and quality of product (or in this case shipping services eg: ensuring goods are carried on time and free of damage). Of course, the level of co-ordination depends on the nature of the product. For example, Binswanger and Rosensweig(1986:529) note that if bananas are not put on a cold boat within 24 hours of harvesting, they will ripen too early. Characteristics of bananas require close co-ordination of picking, loading and shipping.

Another aspect of co-ordination that must be considered is that of horizontal integration, the concurrent management of a number of ships or routes. In some instances, this could provide economies of scale in which the company's reputation is spread across a number of ships or economies of scope if different types are used.. Joint production economies might be obtained through the sharing of facilities such as warehouses or skilled management required on specific routes (in which case the firm acts as a store-house of knowledge), and the firm may be able to offer greater customer satisfaction by offering a range of ship types.

Those people who can best provide the skills and capabilities listed above will succeed in the international shipping. Cost reduction in these tasks is often associated with minimising the time in which ship and labour are required to create a unit of production (a voyage) and reduce losses. At the same time these attributes add value to the customer who is hoping for a full and rapid delivery of cargo in good condition. In aiming to provide these services, a number of trade-offs exist. Bulky ships with high carrying capacity sacrifice speed, while over-loading sacrifices safety. Established routes are normally chosen on the basis of speed and safety. In some cases, a captain might be tempted to sacrifice safety for speed. Given that the loss from a mistake is very high in this industry, the tendency is to conservative decision making and this contributes to a strong persistence of heuristics.

If a national environment can add proficiency in these tasks, leadership might not be dispersed throughout the oceans but concentrated in specific regions. As this thesis reveals, regional environments have played a strong part in creating competitive advantage. For example, if a sailor's home environment provides access to capital, cargoes and markets it reduces the costs of completing the first three tasks listed above. If a region has access to good shipbuilding technology and resources, it can gain competitive strength. Consequently, under certain conditions, ship-building and cargo producing industries can be very important

supporting industries in producing competitive success in the shipping industry. Similarly, if warehouse, port facilities and location in the home environment perform an entrepot function, search and co-ordination costs can be reduced favouring the expansion of a shipping industry. A national environment with high levels of scientific and geographic knowledge in areas that help navigation and route development can also assist shippers developing competitive advantage if that knowledge can not be easily acquired by competitors.

The costs incurred while performing these tasks can be classified in four categories; operating costs, voyage costs, capital costs and cargo handling costs (Stopford 1988:100). Operating costs constitute the expenses involved in the day-to-day running of the ship, no matter what route the ship is engaged in. These include crew, stores and maintenance costs. Voyage costs are the variable costs associated with a specific voyage including fuel, port charges and canal dues. Capital costs are associated with how the ship itself has been financed. This includes interest and capital repayments. Finally, cargo-handling costs are expenses associated with loading, stowing and discharging cargo.

Revenue from these activities can come in a number of ways. If the shipper carries his own goods, revenue comes from the eventual sale of those goods. On the other hand, if the ship acts only as a shipping operator carrying the goods of others, a number of revenue earning possibilities exist (ibid:122). These include unit freight rate whereby revenue is a consequence of the freight rate the shipper charges for cartage and the productivity of the ship ie: the number of tons a ship carries in a year. Other common arrangements include time charter in which a shipper can contract the use of a boat including charter for a specific period of time, and bareboat charter where by the charterer not the owner pays the voyage and cargo handling costs and pays a fee.

On the demand side, greatest utility is provided to the customer when a good arrives in the proper place at the proper time in the proper condition. Given that ocean carriers are part of the broader system, co-ordination becomes a key feature of the system to ensure customer value. This is no easy task given the range of environments that a ship might travel through and the distances involved. Associated with this is the importance of time. The common rationale is that the faster the movement of goods is performed, the better the service (Abrahamson 1980:21). Although time-based competition has only recently been stressed in management text books, the shipping industry has always accorded it pride of place.

Additional utility can also be provided by expanding the range of services to include new routes or to accommodate new types of goods. Different cargoes demand different services. For example, a new market for many highly perishable cargoes opened up with the advent of refrigeration. Technology clearly has a role to play in this. Other examples include the development of the compass and steam engine which reduced the reliance on natural conditions and increased the speed and safety of delivery. Advances in

medical technology, such as the elimination of scurvy, can reduce labour losses and costs while advances in cartography, time keeping and many other areas served to reduce costs and increase utility.

Stopford (1988:61) defines the five key influences on demand of shipping to be:
- the world economy (the driver of international trade. It is the resulting level of economic activity that generates trade and the demand for shipping.
- the effect of particular commodity trades using sea transport
- the average haul. Longer routes obviously use more shipping than shorter voyages
- transport costs. Some routes are only viable alternatives if their cost come down to a level that does not increase the price of the cargo out of the market.
- Political events eg: wars can have a huge impact on seaborne trade.

The five key influences on supply identified by Stopford are:
- the size of the world shipping fleet
- shipbuilding output which obviously adds to the fleet size.
- scrapping and losses of ships which clearly reduces fleet size
- fleet performance ie: how well that fleet is used
- operating environment

The movement of sea-borne trade can not be viewed in isolation, and must be viewed as part of a total transportation system (Abrahamson 1980:22). That system includes (i) land-based carriers that carry the goods to the ports (ii) the loading port and its associated facilities (iii) the ocean carriers themselves (iv) foreign ports where the unloading occurs and (v) land carriage in the foreign port. From this, we can see that shipping is an industry reliant on an important infrastructure and a system of related activities. Supporting activities include training facilities, brokerage, insurance and chandlering. Enveloping the transportation system are the various constraints and conditions imposed by the policies and institutions of the countries in which they operate. This includes taxation, subsidies, safety rules, certificates of construction, etc.

Shipping is a service of derived demand. It is derived from the demand for the goods that the ships carry and this in turn is determined by the level of economic activity that produces the goods and the wealth to buy those goods. Because of the direct linkage to trade, the system in which shipping operates is influenced by the forces affecting international trade. This places it in an environment 'determined by complex and numerous sets of relationships that involve both domestic and international economic, technological, social, and political factors influencing world trade in general' (Ibid:23). Clearly, any analysis of the shipping industry must take a broad perspective and include all these environmental forces.

Stopford (1988:61) adds an interesting comment to his description of the market model:

> Although this is an economic model, it is important to remember that shipping is a tightly knit international community, and actions may be influenced by fashion or emotion as by economic logic. For this reason, the market may not always act in the logical way and recent history offers many examples of decisions that are difficult to explain in purely economic or financial terms. In 1973, ship owners ordered far more tankers than could possibly have been required to meet any plausible growth of demand in the oil trade. Slow to learn from experience, exactly the same error was made for bulk carriers in 1982/3.

To some extent, Stopford's comment adds support to the problem that Richardson (1960) noted underlies all markets, and that is the need to make investment decisions in ignorance of competitors' investment decisions and how this could lead to situations of over-supply and disequilibrium. However, in a tightly knit community such as shipping, there is some knowledge of other people's expansionary behaviour. In 1891, Marshall recognised the role business communities can play in keeping prices above equilibrium out of fear of spoiling the market and incurring the resentment of other producers (see Loasby 1978). In the 1970's 'market spoiling" in the shipping industry occurred as the prevailing 'fashion' for investment over-rode economic logic. Stopford's comment also reminds us that economic descriptions bound solely to market models will be inaccurate. Economists need to go beyond price and fully examine the incentives, information and emotions that decision makers are engaged with.

Another important consideration is technology. Changes in technology have impacted on all the key tasks and associated activities. It has at time lead to faster ships and facilities that increase the speed of loading and hence the time a ship is laid up in port. At other times, it could improve the handling and reduce the loss of cargoes. The benefits of advances such as refrigeration, the compass and steam propulsion have already been mentioned. Information advances have also had their impact. For example, the introduction of cable telegrams in the nineteenth century and computers in the twentieth have dramatically reduced co-ordination costs and transaction costs (especially in regard to searching for cargoes). At question is the way in which technology changes affect the status of industry leaders and market share, an issue that will be explored in this thesis.

Economists must also be aware of the importance of past economic activity and the effect it has on the present. For example, in 1987, a select committee was investigating the decline of British shipping. In the course of its proceedings, the managing director of P&O Cruises was asked why Norwegians predominate the Caribbean cruise market. The answer was explicit:

> You have to go back historically. The Norwegians were the ones who opened up cruising in today's terms. They used their expertise in the ferry industry. They used their ferries and they found a niche market in those

days in the Caribbean, they developed their expertise, and it grew from that. They had the foothold there. (Transport Committee, Report and Minutes of Meeting, first report, Session 1987-8, Vol.1, pg 297).

This answer illustrates the importance of historical investment in capabilities. This is an industry in which first mover advantages exist. These include the gaining of experience and expertise, trust and reputation with which they attract custom, and building of infrastructure by which costs are reduced and value is built into services against which late comers have trouble competing.

Clearly, competitiveness in the shipping industry goes beyond price relationships and market forces. A more sophisticated economic model is needed that embodies incentives, information, history and characteristics of the business environment. It is for this reason that a dynamic industry life cycle is posited.

Chapter 6

Chinese Shipping from the Tenth to Sixteenth Centuries

6.1 Evolution of the Chinese Economic System

The formation of any industry is a consequence of the opportunities and constraints in the business environment. To understand Chinese shipping it is necessary to have an understanding of the domestic economy to which it was part.

During the T'ang (618-907AD) and Sung (960-1279) dynasties, the Chinese economic system underwent a transformation that created a healthy environment supportive of shipping entrepreneurs. During this period, China became one of the first nations in the world to abandon the confines of a feudal economy and became one of the earliest and largest market economies in the world at the time, supported by a sophisticated government bureaucracy. It provides an example of Ibn Khaldun's observation that business prosperity is associated with the size of the civilisation to which it is attached. The consequence was a leap in productivity in manufactured goods (and therefore cargoes for ships), an increase in wealth and demand for foreign cargoes, an increase in the availability of capital to finance shipping ventures and an increase in education and technology with applications to shipping.

The reason for the early adoption of a market economy can be attributed to geographic and political reasons. As early as the first dynasty, it was recognised that feudal lords had regional power bases that could destabilise the nation, so a systematic effort was made to get rid of them (Merson 1989:29). Throughout the following centuries, feudal lords disappeared and were replaced by an administrative bureaucracy, the Mandarins. The rationality and value system of Mandarins was intrinsically linked to Confucianism which was adopted as the state doctrine about the same time (Balazs 1964:18).

Confucianism preached virtues of respect, humility, obedience, and submission; values that would help gain compliance from the peasantry to the authority of the scholar-officials. In return, the state had an obligation to provide 'harmonious government'. The emperor only maintained his mandate from heaven while he ruled effectively and fairly. It was through the scholar officials that the resources were managed in order to attain that harmony. They did this by performing key tasks in the economy. To protect against famine and other natural disasters, Mandarins organised and managed public granaries which kept stores of grain in reserve. Another key task was controlling the nation's waterways. Agriculture, which was the foundation stone of the economy, was dependent on the ebbs and flows of the Yellow and Yangtze Rivers. Controlling them was fundamental to maximising the nation's economic potential and, the Mandarins introduced many

innovations in hydraulic engineering with a consequence rise in productivity (Merson 1989:18). Other government activities included preparation of the calendar by which agricultural operations were maintained and maintenance and construction of all public works. They promoted economic exchange through the maintenance of uniform weights, measures and currency; they organised the nation's defence and were responsible for selecting and training their successors. As a consequence of their economic role, the scholar officials gained a position of omnipotence even though they were small in number (Balazs 1964:16).

The roots of the Confucian economy lay in the productivity of agriculture. This could be seen in the status accorded to different professions. Scholar officials were placed at the top of society, followed by farmers and artisans. Merchants, who produced nothing and made money from buying and selling other people's output, were given a low position on the Chinese social ladder.

Despite the low ranking given to merchants, the Confucian paradigm actually contributed to the development of a market economy. Mandarins helped to provide national unity, a factor which combined with geographic features contributed to the development of a national market. The Chinese landscape was relatively open and easy to rule (Kennedy 1988:17). It provided a 'geographic unity' over which the peoples living developed a cultural and economic unity (Elvin 1973:21). The resulting political stability and ease of communication provided by a unified empire would make it easy to conduct domestic trade.

During the T'ang and Sung dynasties, improvements in transport and agricultural production occurred, giving birth to a market based economy. The prime factors increasing output were the improvements in production techniques and equipment that were adopted across the nation. Farmers learned the benefits of preparing their soil with manure, lime and river mud for fertiliser. Tools were improved and new ones developed. New seeds were introduced, the most common being Champa rice from Vietnam in about 1012AD (Elvin 1973:121), which could produce two to three crops per year (Merson 1989:23). The spread of rice cultivation combined with a spread of hydraulic techniques resulted in agriculture productivity significantly higher than we would find in the west. Its output could support a population twice the size of Europe's. Even, as late as the eighteenth century, a Chinese hectare of rice field produced 7,350,000 calories compared to only 1,500,000 for a wheat field in Europe (Braudel 1984:151).

The Government was the key agent in diffusing the new technologies. Officials opened and operated large polders, taught hydraulic techniques and introduced pumping equipment in areas unfamiliar with them. They encouraged farmers to take up the new rice crops and provided tax relief and credit systems for its adoption.

The development of a market economy was also a consequence of (and contributor to) improvements in transport and communications systems (Elvin 1973:131). During this period, the natural barriers that prevented use of natural waterways were overcome by hauling, poling, canals, locks and the development of specialised craft. It now became possible to transport large quantities of goods across the nation. Transportation improvements opened up distant markets to farmers who soon realised they would earn more growing produce for those markets instead of trying to be self sufficient. They now devoted their energies to those crops which grew best given their local climate and soils. As farmers across the nation specialised in crops that made the most of local conditions, there was a quantum leap in productivity. The Chinese peasantry became adaptable, profit-orientated, petty entrepreneurs and, a wide range of new occupations appeared (Ibid:167).

Markets were established as alliances between local clan chiefs and the merchants who maintained the markets and the local government officers who sanctioned them in return for consideration (Shiba 1970:154). A relationship of symbiosis grew between state and commerce. Consequently, in China the commercial rationality was not just the normal merchant thoughts such as getting the right mix of inventory. Commercial success also depended to a large degree on a merchant's bureaucratic connections (Murphey 1970:13), so a merchant would devote significant resources and energy to cultivating such connections.

During the Sung dynasty, a change in government policy accelerated the use of the market. At that time, the country came under threat of invasion so, to increase their economic resources, the government lifted restrictions on market activity. Taxation policies were changed so that the government only took a fixed share of a farmer's output after which the farmer could keep or sell anything else produced (Jones et al. 1993:25). This served as an incentive to raise output and promote market activity.

As the economy grew, the structure of business organisation increased in complexity (Elvin 1973:172). This was a result of increased specialisation and the development of innovations that improved the flow of finance and resources, and protected business-men from abusive opportunistic behaviour. These changes reduced the cost of doing business in the market economy and increased the efficiency of resource allocation in China. These changes include the increased use of credit among merchants and the appearance of specialist brokers and wholesalers as institutions to facilitate commercial exchange. Brokers were a particularly important feature in reducing transaction costs and raising the efficiency of the market. T'ang and Sung law gave only a small amount of commercial protection so, to ensure fairness in business transactions, the government promoted the use of commercial brokers to mediate between buyers and sellers of major items and draw up a deed of sale. For the government, using brokers had the additional advantages in that they could also report transactions and collect tax on their behalf. The collection of brokerage tax was part of an overall trend by the government to move away from taxing agriculture to taxing trade (Jones et al. 1993:25). This, in turn, reflected a change in the way in which government

perceived commerce. A Confucian paradigm co-existed with a market-merchant mentality but, in all cases, the state was in control.

This high degree of co-operation also existed in the iron and salt trades where a State Monopoly existed. The government granted licenses to private merchants to operate the state monopolies on behalf of the government. This organisational structure of 'government supervision-merchant operation' became a long lived feature of the economy. These monopolies became a major source of income for the government (Adshead 1995:117). It reflected the successful partnership being built between merchants and the state.

The Confucian bureaucracy was not always conducive to business expansion. Balzac (1964:17-18) claims the state had a tendency to clamp down immediately on any form of private enterprise, killing initiative and the slightest attempt at innovation. Nor was commerce helped by a secret police atmosphere and the arbitrary character of Chinese justice. However, L.S.Young (referred to in Murphey 1970:17n) states that even in the relatively conservative Ming and Ching dynasties, there was a genuine concern of the State not to ruin or even seriously impede merchant's activities. Nevertheless, merchant incentives and modes of operation were affected by the pervading Mandarins. The merchant class never dared to fight in order to extract the laws and liberties that western merchants obtained. This created a commercial culture in which businessmen preferred to compromise rather than fight, to imitate safe precedents and to invest money safely in preference to risky industrial enterprises. On obtaining wealth, their goal was to finance their children or grandchildren's education so that they became elite scholar officials themselves. In this way, Confucianism defined the goals of businessmen and restricted their perception of innovation.

During the Sung dynasty, government efficiency took a huge leap with the introduction of the Confucian 'eight legged' examinations as a requirement for entering the civil service. Power was no longer granted on the basis of family connections but on merit (Adshead 1995:117). Students were educated and ideologically conditioned on entering the civil service and the Chinese bureaucracy absorbed the most able minds in the country. In the country and prefectural capitals, state sponsored colleges provided students with a Confucian-based education in law, art, poetry, mathematics and engineering. These provided the future elite with a skill base and wisdom with which no other nation in the world compared.

Ironically, a merit-based system lent itself to corruption and an incentive structure that encouraged short-term thinking. On being placed in the bureaucracy, a young official established relations with protectors and, proceeded to solve and enhance his financial position by extracting principal and interest from the people he administered (Balazs 1964:10). In western eyes, this system would be seen as corruption with officials 'milking' and receiving favours from people who sought their official support. Because the system of merit meant the appointee could not hand down his position to his children, he sought to extract what he could while the opportunity existed. The Confucian doctrine, which stressed the importance of family over

outside forces, actually encouraged this racket of protectionism and nepotism. Consequently, milking and short term thinking became a feature of the administrative incentive system.

Despite these weaknesses, by the Sung dynasty, China possessed the largest and most innovative national market that the world had seen. The conflicting values of commercialism versus Confucianism reflect the two strongest institutional forces in China at the time; the national market and the bureaucracy. Within this institutional framework, other valuable institutions arose to increase the efficiency of the economy. Brokers, water transportation, guilds and other merchant networks all appeared as vested interests in a more market orientated economy. The mandarins never lost their suspicion of traders and their practice of buying cheap and selling dear. They often intervened in the affairs of merchants, confiscating property or banning their business. However, while the goals of merchants complemented the goals of the Mandarins the commercialisation of the Chinese economy would continue.

6.2 The Rise of Chinese Shipping

By the standards of the day, the characteristics just described provided a very fertile environment for industry to grow. However, growth in the Chinese economy did not automatically give birth to an international merchant marine. During the T'ang dynasty(618-907AD), Chinese shippers travelled to Korea and Japan but not the southern seas, where trade was in the hands of South East Asian, Persian and Arab ships from the Indian ocean who, at this time, had greater ocean-going capabilities (Elvin 1973:137). We would expect it to be difficult for the Chinese to enter a market where existing players have established first mover advantages such as experience on the ocean routes and established trading relationships, however the foreign competition that existed at the time was not so extensive that it was impossible for new shippers to enter the market. Long distance shipping was full of risks particularly from storms and other unfavourable oceanic conditions, so the volume of shipping was not great. A window of opportunity existed for the Chinese to enter the market if they could gain the necessary capabilities and overcome the chief problem of safety.

Our theory would suggest that a process of imitation would need to occur before the Chinese could compete with these nations. Some level of imitation did occur. The navigation and geographic achievements of the Arabs and Hindus were studied by Chinese scholars who eventually created their own star and sea charts, studies of tides and currents and navigational manuals (Levathe 1994:43, and Lenz 1997:147). Needham (1971:601 & 612) suggests they adopted the canted square sail from the Indonesians, which they then evolved into the more effective balanced-lug sail. However, overall, the amount of imitation was not great and cannot be considered a significant process consistent with our model. The Chinese developed a distinctive maritime capability born out of the local conditions and environment.

The Chinese built on the adopted technologies to make ships that were state of the art. The balanced lug sail proved such an effective solution to the problems of sailing to windward that Needham (1971:598) ranks it as an innovation among the foremost achievements in the use of sea power. As Chu Yu (1119) notes:

> At sea they can use not only a wind from abaft, but winds from onshore and offshore can also be used. It is only a wind (directly) contrary which can not be used (from *Phing-Chou Kho Than* quoted in Needham 1971:462).

The junks themselves were built with iron nails and possessed a strength superior to competitors' boats and, in the oil of the t'ung tree, the Chinese had a superb natural preservative for water-proofing (Elvin 1973:137 and Deng 1997:27). The Chinese introduced watertight bulkheads, buoyancy chambers and bamboo fenders to protect the ship from sinking. Other innovations in navigation included scoops for taking samples of the sea floor and sounding lines for determining the depth. During storms, floating anchors were used to hold the boats steady. Gunpowder, another invention of the Taoists monks, was introduced to shipping to propel small rockets for self defence. A significant advance was in steering where the placement of the rudder at the stern dramatically increased control of the ship. Ships might even have two rudders at their stern, a large rudder for deep water and a small rudder for the shallows. Other practical advances included the use of armour plating and the protection of hulls with sheathing.

In shallow waters, entering harbours or passing along channels, oars would be used to propel the ships but, the main source of power was sail. Europeans at this time used only one mast so Marco Polo (1958:241) was naturally impressed to find ships with up to four masts in Ch'uan-chou. The masts were staggered so that they were not placed directly behind each other, and no sail would shield the other. Chinese sails resembled a Venetian blind or fan. They were comprised of narrow sections of canvas or matting stretched between transverse batons of bamboo. Although less efficient than the Arabian or Western sail, they had the advantage of being easier to control when close-hauled or damaged.

By the 10th and 11th century, Chinese technological advance had given birth to the sea-going junk in which they could now conduct trans-oceanic trade (Dupoizat 1995:205). The most impressive quality was their size. Medium sized merchant junks from Fukien and Liang-Che were over 100 Chinese feet in length, 30 feet high and 25 feet in the beam. They carried a cargo of approximately 120 tons and a crew of sixty (Levathe 1994:43) while their largest ships could carry 5,000 piculs (300 tons) of cargo and 500 to 600 persons (Shiba 1970:7).

By the early thirteenth century, the Chinese had the best ships in the Indian Ocean and had captured the bulk of the sea trade from the Arabs (Levathe 1994:43) and, Ch'uan-chou had become the greatest

mercantile city in East Asia (Medley 1989:170). A pan-Asiatic trade ring developed in which Chinese traded with Koreans, Japanese, Vietnamese, Siamese, South East Asians, Bengalis, Persians and Arabs.

6.3 Sources of Competitive Advantage

The national economic system gave rise to several factors that underpinned this competitive strength. The wealth of the economy provided demand conditions and capital resources that helped the development of shipping services. In this section, we examine other factors in the economic environment that strengthened competitive advantage. These included the nation's superior knowledge resources which led to superior shipping technologies including ships, equipment and navigational ability. Second, were the forms of organisation that made it easier to channel capital into shipping and facilitated the increased specialisation of skills. Third, Chinese shipping drew strength from the supporting industries in the domestic economy. These provided the cargoes with which shippers could confidently seek offshore markets. Finally, supportive government policies which at times financed improvements such as harbours and navigation beacons and, offered incentives for R&D in ship design. In this way the domestic economy provided the competitive strength on which the industry grew.

6.3.1 Specialisation, Experience and Learning Curves As they developed their navigation skills and gained experience of the wind systems, the Chinese greatly reduced the length of time they needed to make their voyages. Whereas a trip to Singapore in Han times took some 150 days(202BC-220AD), by the Song Yuan period(960-1368), a similar trip to Sumatra took only 40 days (Deng 1997:46).

As the industry grew, it enjoyed the economies of specialisation that were occurring in other parts of the economy at the same time (Shiba 1970:18). The following account, although written in 1618 gives an insight into on-board specialisation of duties consistent with our period of inquiry:

> In each junk, command is in the hands of a Junk Master (po-chu). The merchants are all his dependants, like ants who have appointed a leader and move together from one nest to another. In subordinate positions are the Accountant (ts'ia-fu), who is responsible for the financial records, and the General Manager (tsung-kuan), who controls affairs on board and transmits orders on behalf of the Junk Master. There is an Arsenal Comptroller (chih-k'u) in charge of military weapons, Mast Watch Mates (a-pan) in charge of the masts, a first and Second Anchor-man... in charge of anchors, a First and Second Sail-rope Mate... in charge of the sail ropes, and two Helmsmen (t'o-kung) who take charge of the helm in alternation. A Chief Mate (huo-chang) watches over the compass needle, and when the route lies across a wide expanse of ocean, all obey his indications... (Chang Hsieh written in 1618 quoted in Shiba 1970:16)

Specialisation also improved quality and reduced costs for the industry on-shore. Specialist Managerial agents came into being who could be hired by wealthy merchants to conduct their maritime trade under a

contract for carriage. There was a rise in the practice of hiring and chartering ships and crews, and labour hirers arose to provide men to unload sacks. Others provided carriers and porters.

The linchpin of the shipping industry were the brokers who greatly reduced transaction costs while raising the level of efficiency. A number of brokers would be located in every port acting as intermediaries between customers and transporters. They found cargoes for ships leaving port and had warehouse facilities to store goods waiting to be sold. They were extremely valuable to captains of Junks who arriving at a port would not necessarily be familiar with local market conditions and customs formalities. Entrusting the cargo to a broker enabled the captains to set sail after only a short time in port and spend more time in the business of carriage. Brokers were of value to merchants seeking transport as they could not always be fully conversant with the intricacies of shipping or, be aware of the abilities and reputations of captains and crews. Brokers were also responsible for making good any losses suffered by a merchant who hired a ship (Shiba 1970:40) and this would have placed a restraint on opportunism and contributed to the maintainance of high standards. As a consequence of their function, the shipping industry became more efficient and flexible and, a more confident place for investors to place their resources.

6.3.2 Knowledge Resources As the economy grew, more people could take up non-agricultural based jobs and this included the priesthood (Shiba 1970:207). Buddhist and Taoist monks were an active source of innovation with spin-offs for shipping. During the T'ang dynasty, Buddhist monks invented wood-block printing for the purpose of religious propaganda. By the Song dynasty, China achieved the highest rates of literacy in the world and, built up huge libraries of books on astronomy, medicine, mathematics, botany, political and economic theory. Printing became the foundation on which a nation-wide community of scientific discourse arose.

Taoist Monks were another valuable source of knowledge capital. Taoists sought to understand the harmony of the cosmos and included, among their pursuits, the search for immortality. One of their medicinal mixtures (a mixture of sulphur, saltpetre and charcoal) which was originally used to treat skin diseases and as a fumigant against insects, was eventually discovered to have other properties important for the defense of ships, as gunpowder. This could reduce costs associated with piracy.

From geomancy (the art of siting graves and buildings in harmony with supposed occult terrestrial forces) Taoist monks developed the magnetic compass. The introduction of the compass, first mentioned in a nautical context in 1119, solved a major navigational problem and greatly reduced shipping costs (Elvin 1973:138). Astronomical observation was only possible when the skies were clear enough to see the stars. This meant safety and speed could not be assured on cloudy days. The compass revolutionised navigation, making voyages possible in all but the worst weather. Ships could now be more economically utilised, carrying cargoes on cloudy days that previously would have kept them confined to port.

But the most consistent contributor to the technological advance of the industry came from the official education system. Official science was primarily devoted to those areas that would help maintain order in society and hence, concentrated on agricultural development, large scale public works and, the reading of stars to foresee future events. Consequently, the nation developed a strength in astrology, mathematics, physics, and hydraulic engineering (Needham 1963:131-2). Maritime navigation in China had a strong advantage given that astrology was a subject given great attention by the officials, as it led to a deep knowledge base on the positioning of the stars. As early as the Zhou dynasty(1111-255BC), astronomical observation had become a profession with records made (Deng 1997:36). From Han times(202BC-220AD), Chinese histories contained a section entitled *Records of Astronomical Observation* which reported all new important discoveries. Some members of the literati attempted to popularise this knowledge, the best known treatise being Ballad of Stars by Wang Ximing which contained 1,464 stars and their positions (Deng 1997:36). Before long, Chinese astrologers had records showing that a star's height above the horizon varied depending on how far north or south you were taking your record. This meant that they could find their latitude by observing the height of a star above the horizon. Although this research was performed on land, sailors eventually began to use it to find their locations at sea and, by the Tang dynasty a "star measuring ruler" and "handy ruler" had been invented which made astronomical navigation possible.

The polar star became an important feature by which ocean sailors could identify how far north or south they were in relation to their destination, and they could make changes in their route accordingly. However, the stars gave little information on how far east or west a ship had travelled (longitude). The Chinese solution to this problem was to measure the ship's speed (by dropping a piece of wood at the front of the ship and measuring how long it took to reach the stern). Once the speed was known, sailors could consult a specially constructed log (geng) that gave time-distance coordinates from which they could determine how far they had travelled.

With increased knowledge of sea routes and astronomical knowledge, it became possible to create navigation charts. The earliest of these include *A Chart to Overseas Countries* which was presented to the throne in 1003 AD, and the *Comprehensive Charts of Islands on the way to Korea* produced in 1123AD by Xu Jing (Deng 1997:38).

6.3.3 Organisation and Industry Structure Two forms of trade existed between China and its Asian neighbours; trade conducted by private operators and tribute trade conducted by the government. Both these trade forms had to contend with key organisational issues of raising capital, co-ordinating activities over long distances and reducing governance and transaction costs.

Tributary trade, conducted by the state, was an arm of diplomacy in which surrounding nations would send tribute to China. Asian kingdoms, such as Srivijaya played the tribute game as a means of gaining Chinese support and legitimising their regional power. The tribute system provided China with supplies of foreign luxuries while cementing its position of superiority over the subordinate kingdoms. As part of the tribute trade, the Chinese exported products as a kind of gift or reward for paying respect to the Imperial order of China (Lee Chor Lin 1995:175).

The state had many advantages in organising long distance trade given its wide range of resources and techniques of enforcement at its disposal. The state through its well organised bureaucracy and nation-wide resource base could mobilise large amounts of resources and capital into shipping. The absolute nature of control and climate of fear also helped overcome problems of opportunism. However, a level of opportunism would be accepted under the Confucian system. We have already noted that the Confucian system encouraged a level of milking and nepotism. However, only a fool would forget his obligations to his emperor.

To give an idea of quantities of the tribute trade, in 1394 AD, Zenla (Cambodia) sent 60,000 jin of incense to China as tribute (35.8 metric tons) and in 1475, Japanese envoys sent as many as 38,610 swords to China, enough to equip all Ming commanding officers down to the company level (Deng 1997:86).

The bulk of the international trade was in private hands where profit was the prime motive (Deng 1997:87&98). The earliest organisation of shipping was one in which a merchant would arrange transport of goods in his own ships. By Sung times, owners of ships had grown to include members of the imperial household, civil and military officials, Buddhist and Taoist monasteries and temples, owners of manors, powerful families, peasants and fishermen. However, the small family business held the pivotal place in the shipping industry, particularly on inland and coastal routes.

Problems of opportunism were solved by the predominant organisational structure, the extended family firm. The firm was usually headed by a mature male while decision making often involved older generation members of the family. The small decentralised structure gave the firm a flexibility in responding to changes in the marketplace. It also solved problems of control and monitoring of workers. Families embued their members with identity, loyalty and commitment. Consequently, relationships built on family linkages had an underlying trust which served to reduce transaction costs in a society with no laws to enforce employment and contractual obligations. However, a major problem was its growth was limited by the extent of the family. These constraints were important in the industry given the high cost of ships, the high risk and the length of a voyage that tied up capital for long periods of time.

The structure of the family firm should not be solely attributed to economic rationale. To be sure, paternal-biological motives played a role. The Confucian value system also placed a high importance on family and approved of the structure.

With the increase in trade, new forms of organisation came into being which made it easier to raise the capital for larger scale shipping ventures. Frequently, small businesses would form commercial networks with others in the same business. In such cases, each business would retain its independence but operate under the umbrella of these joint concerns to enhance their competitive power and to provide protection against shipwrecks and robbery. While individuals in these groups kept their business separate from others in the network, partnerships also became common in which groups of merchants shared ownership of ships and goods. Many partnerships were for only one voyage and were dissolved after each venture with profits shared. Without the enforcement effects that repeated transactions provide, these partnerships clearly would seem more vulnerable to opportunistic action by either of the partners however, reputational effects were at work. Other partnerships were more permanent however, the scope of activity of these partnerships were clearly limited to the skills and resources that each partner brought. One-venture partnerships enabled capabilities to be combined as necessitated but at the cost of repeated needs to make new transactions.

Acquiring capital was made easier through the rise of commenda and commercial money lending. The commenda is a structure in which a wealthy person or merchant entrusted money or goods to another merchant who makes use of them and shares out the profits at the end. In contrast, commercial money-lending involved lending to entrepreneurs in return for a fixed rate of interest. Hsu Meng-hsin, writing in 1137, suggests that investment in shipping and commerce was commonplace:

> There are numerous commercial transactions at the capital conducted by merchants from every part of the country, and the city is therefore reputed for its wealth and population. Most of those who possess capital engage in stockpiling or storage..., pawnbroking...., or trading in ships. How could they permit their accumulated wealth to lie idle, or buy gold for hoarding at home? (Quoted in Shiba 1970:32).

Pao Hui, writing during the Southern Sung dynasty speaks of the willingness of even relatively poor people to invest in the sea going ventures of others:

> They invest from 10 to 100 strings of cash and regularly make profits of several hundred percent. (Quoted in Shiba 1970:33)

The rise of these activities show increasing instances where the ownership of ships and capital became separated from their management. This further complicates the problem of governance. But underlying many Chinese commercial relationships is the notion of reciprocity, giving in the expectation that sooner or

later you will receive something in return (Hodder 1996). This leads to the development of obligation and trust. When combined with the notion of losing face (reputation), opportunism occurs at great cost. The open nature of these relationships allows great flexibility and openness of information. Relationship contracting of this kind works best when parties realise they are bound to a repeating activity, therefore it is in no one's interest to engage in opportunistic behaviour (Kay 1995:54). Alternatively, with family members left in China, a seaman would think twice before reneging on his obligations. It is a form of 'taking hostages' as in Chinese society, families were held responsible for their members' actions.

With official support, wealthy families in port towns could invest freely in ocean-going ships and cargo. Their success had a demonstration effect on lesser trading families and skilled artisans and, the merchant classes in smaller ports who also began investing in ships for the overseas trade. A geographical spread in investment created a chain of minor ports radiating out of the main port cities which eventually grew into major trading centres in their own right (Gungwu 1990:403). Being some distance from the officials at the main port towns, traders in these satellite ports had even greater freedom to expand their trading activities. Ships would part for foreign ports where merchants frequently established off-shore agencies. As trade grew, small Chinese merchant communities grew in places as distant as Champa, Cambodia, Sumatra and Java.

The placement of agents in foreign ports performed a key economic role that lends much to Pagano's (1991b) suggestion that institutions exist to deal with disequilibirum. When a ship arrives in port, it creates a huge increase in demand for cargoes and pushing up prices. Depending on the timing of the arrival, a ship might arrive in port and find there is insufficient supply to fill the hulls. An organisation that used agents overcame this problem. An agent could buy stock over a longer period of time at lower prices and ensure that the ship on arrival would have a cargo to fully utilise the capital invested in the ship. Similarly, if a ship arrives and unloads a warehouse full of cargo into the market at one time it dramatically decreased the prices for the goods it sold. An agent overcame this problem by storing goods in a warehouse and releasing stock gradually over time, thereby gaining a higher price.

With the use of agents, Chinese merchants were moving from free markets to organised markets, the cost of additional organisation being justified by the higher costs and lower prices it would otherwise have endured. Agents also provided a key role in providing information on market conditions in foreign ports. Communication provided by the agent indicated what types of goods should be brought to the port and what sort of prices they could expect. Given the time involved between shipments, this information could quickly become out of date. However, it was a huge advantage to have what ever information on market conditions was available.

Some shipping fleets could reach substantial size. Shiba (1970:28) records one ship owner had a fleet of 80 ships and clearly had to use a managerial agent or hire ships out. However, most investors preferred not to concentrate their investments but, to disperse their investments in order to overcome "hazards of both a natural and a social kind". This meant not just the risks of storms and wrecks, but antagonistic government officials and a society that still did not fully welcome the seeking of profit. Merchants would endeavour to conceal their investments through the use of others. Land was perennially regarded as the safest place to invest wealth.

6.3.4 Supporting Industries We can probably assume that the initial development of Chinese shipping was a consequence of perceived demand for foreign goods and a search for outlets for domestic manufactures. To that extent, we could see Chinese shipping, at least in part, as a form of forward linkage recognised by Hirschman (1958). Once established, the linkage between the industries acted as the kind of mutually reinforcing cluster of the kind discussed by Porter (1990). The manufacturing industries provided key cargoes while shipping expanded the range of markets for Chinese producers. A flow of information between the two ensured that cargoes were prepared to maximise competitiveness in the foreign market.

Trade was conducted on the basis of barter under which the Chinese gained a strong advantage from the technological superiority of the their goods. Deng (1997:113) notes that the Chinese exports were principally manufactured goods, while imports were dominated by raw materials. Confidence in the products of sale made it easier for Chinese traders to venture off-shore in search of foreign markets, knowing they would receive a ready market for their goods. These included mineral extraction (eg: gold, silver, etc) and products made from those minerals, ceramics, textiles, t'ung oil, bamboo baskets, wooden combs, straw mats, paper, refined sugar, woods and books. These industries had been growing and improving as a consequence of the expanding domestic market.

Silk production had a long history in China and, by the T'ang dynasty, it had become the mainstay of the provincial economies of Zhejiang and Jiangsu (Lin 1995:173). Silk exports reached South East Asia as cargoes in both the tribute and private export trade. However, from the Southern Song dynasty onwards, private traders took a dominant role in this trade, a reflection of the gradual commercialisation resulting from the more market orientated economy (Ibid).

The process of making silk involved the rearing of silk worms, cultivation of mulberry trees, the reeling of silk, dyeing and weaving. By the Song dynasty, the industry enjoyed growing specialisation as dyers and weavers became increasingly separated from those involved in sericulture. Most of the raw silk came from rural areas and sold to middlemen who re-sold it to weavers on the open market. Weaving and dyeing became prominent economic activities in urban areas. Weavers and dyers were among the growing pools of artisans living in cities, working for wages in ateliers. Many of the ateliers were originally retail shops

selling silks woven in nearby villages (Lin 1995:174). This backward integration of the shops would have given them greater control over supplies and allowed them to be more flexible in responding to the needs of customers. By the 15th and 16th centuries, large factories with more than twenty looms were operating in cities such as Hangzhou, Jiaxing and Suzhou. These factories had integrated even further backward, buying silk yarns directly from silk farmers, by-passing the middleman. Lin (1995:174) states 'The result of this vigorous growth in silk production and new marketing power was a tremendous variety of silk products, accelerated by technological innovations and improvements in the looms, as well as dyeing techniques'.

Another industry in which China led the world was ceramics. The Chinese industry was blessed by geographic good fortune which meant that porcelain clays were highly accessible. Initially, ceramic products were made by farming families who would make pots when they were not working in the field. By Song times, market expansion allowed some families to specialise in the creation of ceramics.

Large quantities of Chinese glazed-ware were exported to Southeast Asia as early as the ninth century where they were used for culinary and ritual purposes (Ho Chuimei 1995:118). Initially, these cargoes went in foreign ships until the Chinese developed their own maritime capabilities. Chinese manufacturers learnt to make specific products and shapes specifically for the export market to take account of the ritual and cultural requirements in their target market (Beamish 1995:234).

The rise of export trade stimulated development in the industry and market growth contributed to the industry becoming even more specialised. Different kilns worked for different markets. Inside the kilns, a division of labour had occurred as different workers would design, throw and finish. Eventually the demands on output created by the growing export market put pressure on the industry to obtain a level of industrialisation unheard of in the West, reaping the benefits of economies of scale and specialisation. In the late thirteenth and early fourteenth centuries, family owned craftsmen kilns gave way to industrial complexes controlled by commercial syndicates who controlled the distribution and financed the construction of kilns, ultimately owning the kilns (Medley 1989:171). As demands on individual kilns increased, more and more gave in to the increased security of a well organised industry.

The trend towards industrialisation became more pronounced under the reign of Khubilai Khan who established a 'Porcelain Bureau' which issued regulations on the capacity and production of kilns which were taxed accordingly. The Mongols were keen to encourage the industry for the export revenue that it earned. The government also played an important role in the industry as a sophisticated consumer. Representatives of the imperial court would visit the kilns and select the products they liked. The high standard of demand helped to raise the technical standards of the kilns. In Yuan times, imperial kilns were created to serve the court.

The development of the Sung-Ming ceramics industry is consistent with Abernathy and Utterback's (1975) observations of twentieth century industry in which a productive technology reaches a point which allows economies of scale and specialisation; and the new capital requirements result in an industry of fewer but larger players. With a high division of labour and large scale dragon kilns which could produce as many as 35,000 pieces at a time, the Chinese created the first industry based on mass production. By 1712 when the Jesuit missionary, Pere d'Entrecolles visited the kilns at Ching-te Chen, the city housed 1 million people, and had 3,000 furnaces. The industry had achieved an exceptionally high division of labour:

> One workman does nothing but draw the first colour line beneath the rims of the pieces; another traces flowers, while a third one paints... The men who sketch outlines learn sketching, but not painting; those who paint (that is, apply the colour) study only painting, but not sketching (Pere d'Entrecolle quoted in Sullivan 1973:225).

Pere's description shows strong parallels with Adam Smith's description of a pin factory utilising the benefits of division of labour. However, this might not be a coincidence. Adshead (1995:296) suggests that Adam Smith was actually influenced by these descriptions of Ching-te-Chen when advocating specialisation and division of labour.

The transformation to a mass production industry was made possible by the large demand and advances in the technology of production (Medley 1989:171). As the Chinese moved down the experience curve they built an extensive knowledge of clays, fluxes and glaze chemistry, controllable high temperatures, and experience with large-scale industrial production methods. This experience provided a competitive advantage that was protected through secrecy and the tacit nature of much of the knowledge. These industries meant that Chinese merchants could sail with a hull full of marketable cargoes and be quite confident of making a profit from a sailing voyage. It clearly illustrates that a process of imitation requires the existence of supporting industries that may or may not be going through a process of imitation themselves.

The other vital supporting industry was shipbuilding as it provided the industry's major capital item, the ships. Clearly, the industry was dependent on availability of resources and growth increased production of the materials needed for boat building. This included great quantities of bamboo for sails, nails, lime, silk rags for caulking and oil from T'ung tree nuts (which was used as a wood preservative and caulking material). Resource endowment in these material helped to dictate the location of the industry, as Lu I-hao, writing in the twelfth century, notes:

> In the South, the nature of the wood and the water are suited to each other. For this reason Fukien holds the first place for sea going junks, being followed by Kwangtung and Kwangsi, and then by Wen-chou and

> Mingchou. In the North, the nature of the wood and water are not suited to each other. The sea is bitterly salt and capable of damaging the wood" (quoted in Shiba 1970:6).

6.3.5 Compatibility with Religious and Military Institutions and Consequences for Government Policy The dominant philosophy-paradigm underlying the economic system was Confucianism. This philosophy was embodied by the Mandarins who became the system's most powerful stake holders. Confucianism placed a low value on trade and merchants so government support for trade and shipping was not always forthcoming. Policy changed with the circumstances.

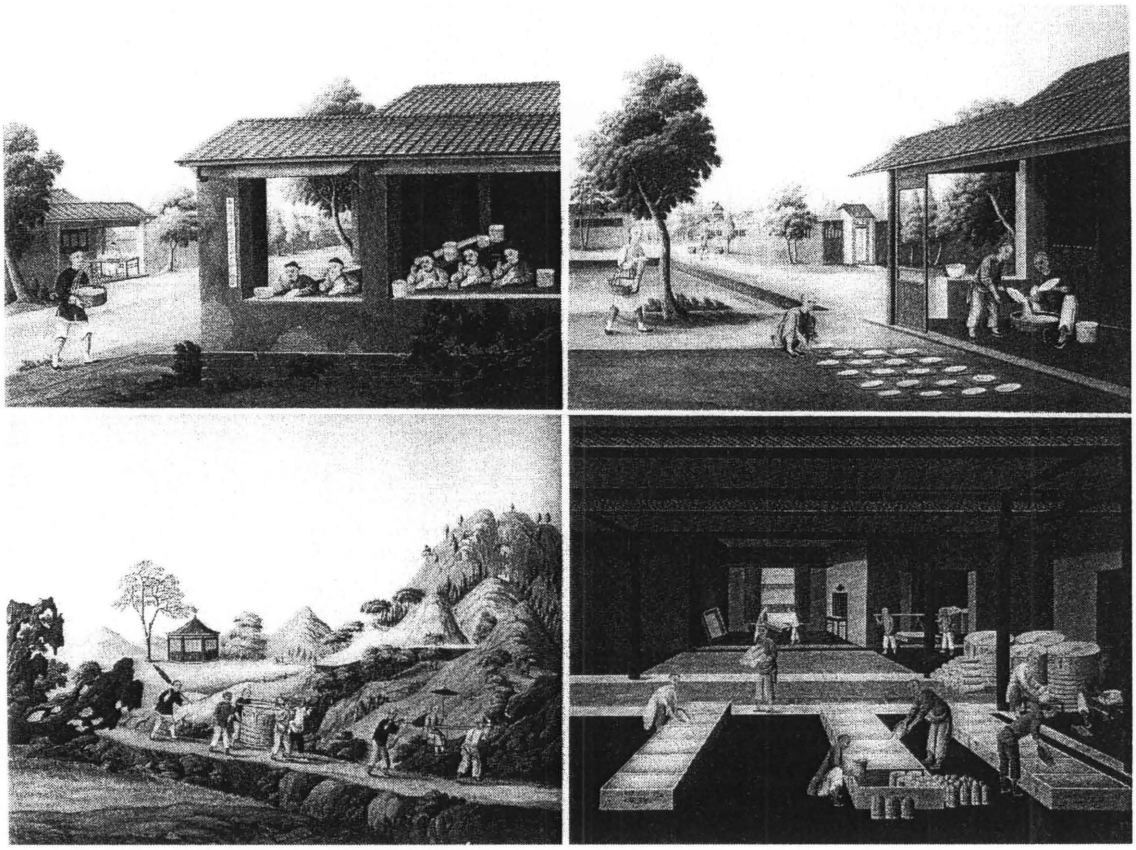
During the Tang dynasty, the state had restricted international trade to one port, Guangzhou, where trade with foreigners could be controlled (Merson 1989:60). However, over time, government policy became more conducive to foreign trade and shipping with commercial and state goals becoming more closely aligned.

During the Southern Sung dynasty, an external military threat created a policy of strong government support for shipping. At that time, the country was under constant attack from Ju-chen invaders in the north, who eventually succeeded in capturing the Song capital of Kaifeng in 1127. The government fled south creating a new capital at Hang-chou, just south of the Yangsi River. The invasion meant that the government now had only half the agricultural land to tax. To compensate for the loss of income, trade was liberalised. A Maritime Trade Commission was established and seven more ports were opened to foreign trade along the Guangdong and Fukien coasts. Revenue from overseas trade jumped from half a million strings of coins at the end of the eleventh century to one million in the early twelfth century and two million by the middle of the twelfth century (Levathe 1994:41) while, the contribution of foreign trade to total government revenues grew from 0.82% in 1098 to 20% in 1131 (Merson 1989:61).

The change of policy did not reflect the existing value system, so a process of legitimisation was required. Given that merchants and the seeking of profit were traditionally seen as lowly occupations in China, there was need for a new attitude towards trade and profit. Emperor Gao Zong(1127-1162) exclaimed:

> Profits from maritime commerce are very great. If properly managed, they can amount to millions (of strings of coins). Is this not better than taxing people? (quoted in Levathe 1994:41)

The policy changed incentives and created a congruence in merchant and government goals. Official rank was given to any merchant whose annual overseas trade exceeded 50,000 strings of cash and, any government official supervising commercial activity greater than one million strings of cash would be promoted one grade. While merchant activities increased imperial coffers, it also allowed merchants to increase their wealth and status beyond that normally allowed in the Confucian society.



Ceramic processes. A key to Chinese success in shipping was the superior technology of the cargoes they carried. These water colour prints illustrate processes in the production of ceramics including painting the unglazed ware, applying the glaze, transport from the factory, and packing in cases for export (The British Museum Book of Chinese Art, plate 156).

The government targeted the shipping industry with a number of forms of assistance. It provided financial assistance to aid the rising competitiveness of the Chinese merchant fleet. Government funds were allocated to improve harbours, widen canals to accommodate ocean going junks, build warehouses for merchants, and construct a costly system of navigation beacons every thirty li (about ten miles) along the coast (Levathe 1994:41).

In contrast to Porter (1990:675) who suggested that direct targeting is not conducive to the development of innovation-driven advantages, the Chinese policy created significant innovations. The key conduit for advances in maritime technology came from government investment in naval technology, with spin-offs for the merchant marine. The navy became a source of research and development with the emperor offering cash-rewards to spur innovation in ship design (Levathe 1994:43). Needham (1971:476) notes that the age was one of continual innovation and inventions included ships steered by paddle wheels invented by the engineer Kao Hsuan, and iron plated armour designed by Chin Shih-Fu.

In 1279, the Sung dynasty was overthrown by the Mongol leader Khubilai Khan who established the Yuan dynasty. Industry and Commerce probably received their biggest state support under Khubilai who being a Mongol, was not influenced by Confucian attitudes to merchants (Rossabi 1994:47-50). Khubilai actively supported merchant communities, placing them on a higher social scale, much to the resentment of the Mandarinsi. The new regime continued with targeted government assistance. A joint venture system was introduced called "Government-Invested Ships" in which the government provided ships to merchants with expertise to undertake maritime trade. Profits from ventures were split in a seven to three ratio (Deng 1995:18). In 1285, the government allocated 100,000 ding, about 19 tons of silver, to build ships for the scheme. Merchants were also given the opportunity to acquire finance at interest rates of three to four percent per month (Deng 1995:18).

The Mandarins, as key stake-holders, were seeing their position devalued. Khubilai utilised the full range of abilities in the empire that stretched from China to the Caspian and promoted skilled foreigners to high positions in the Chinese Civil Service, despite the fact they had not completed the civil-service examinations (Rossabi 1994:450-1). This led to an anti-foreigner mentality among the Confucians who found their status in decline. This would eventually work against the shipping industry.

Of all merchant activity, foreign trade was particularly deserving of suspicion given its off-shore component which was beyond the Mandarins control. Nor did they approve of private merchants profiting at the expense of official trade mission. The years that followed gave birth to policy decisions that reflected the changing power of stake-holders and coalitions at the court and external circumstances which could affect the balance of the debate.

In 1368, the Mongols were overthrown by the Ming dynasty. The new Ming dynasty brought with it traditional Confucian attitudes to trade and a change in policy. The government banned all private trade and overseas travel for Chinese. Foreign maritime trade was restricted to official tributary trade from nations acknowledging Chinese suzerainty. Fortunately, the Confucian trained civil servants were not the only stake-holders at the Chinese court. Much power rested in the hands of eunuchs who were strongly involved in foreign trade. The Mandarins might restrict private trade but the eunuchs were going to increase the scale of tributary trade.

The eunuchs had enough clout to gain support for the great voyages of Cheng Ho, himself a eunuch. In 1405, the Admiral Cheng Ho was sent on the first of seven great maritime expeditions into the Indian Ocean. The Chinese had previously travelled this far on a number of occasions; Marco Polo had returned to Europe taking such a journey on a diplomatic mission for China in 1298. However, the fifteenth century missions reached a new scale of maritime activity.

The voyages of Cheng Ho illustrated that Chinese shipping could move more tonnage more kilometres than any other nation could dream of. For example, the fleet of the fourth voyage (1413-15) consisted of sixty three large vessels and a crew of 22,670 men, while the fifth fleet sailed as far as East Africa (Chang 1989:52). The fleets were composed of trading ships, warships and support vessels. The treasure ships represented a peak in naval engineering and were the biggest vessels afloat. There has been some uncertainty over their size but even conservative estimates of 1,500 tons show they were at least five times the size of the ships used by Vasco de Gama at the end of the century (Needham 1971:509).

The treasure fleets were the most powerful example of the tribute system, encouraging trade and impressing upon other nations that China was the leading cultural and political power. With their powerful armies, these fleets sailed as far away as Ceylon and Zanzibar where, they used their power to force the rulers of these lands to acknowledge the supremacy of the Chinese "Son of Heaven". In Africa, they reached the Swahili towns of Mogadishu and Mombasa. In Jidda and Dhufar, they exchanged their silks and porcelains for aloe, myrrh, and other medicinal drugs.

The prestige of Cheng Ho's voyages shed a lustre on the eunuchs which irritated the Confucian bureaucrats who would have loved to put an end to the voyaging. Having political motives, the voyages were not driven by economic considerations alone. In fact, they were expensive and the benefits they brought from trade did not warrant the vast expenditure on fitting a fleet and financing the army they carried (Lenz 1997:153).

In a battle between opposing stake-holders, external threats could play an important role in determining outcomes. During the first half of the fifteenth century, circumstances changed in a way which strengthened

the conservative forces at the court. An increased threat of invasion by the Mongols meant the government's limited military resources had to be drawn away from the coasts to guard the trouble spots in the north (Levathe 1994:177-9). This included building the Great Wall of China. The nation could no longer afford expensive luxuries like the voyages (Lenz 1997:153). The government was also concerned about attacks on the Chinese coast by Japanese pirates (Chang 1989:54, Meilink-Roelofsz 1962:74). Many Chinese had joined these Japanese and, to prevent this from happening the Chinese government restricted navigation as much as possible.

Economic forces also contributed to a change in policy. Paper money had been used in the tribute trade but, severe inflation reduced the value of the money to one percent of its face value. The Ming dynasty's favourable exchange rate with foreign countries evaporated (due in part to the loss of prestige following the emperor's capture by the Mongols and the hoarding of goods for private trade). Foreign countries were no longer prepared to accept the paper currency and the Ming government was forced to pay more expensive market value for the goods. This undermined the profitability and rationale of tribute trade (Levarthe 1994:177). A factor of equal importance was the desire to prevent precious metals leaving the country. Merchants were exporting these on a large scale (Meilink Roelofsz 1962:74).

As a result of these changing circumstances, the Confucians gained the upper hand and imperial edicts banning overseas trade and travel were issued in 1433, 1449 and 1452. Any merchant caught engaging in foreign trade was defined as a pirate and executed (Merson 1989:77). The contribution of foreign trade to government revenue plummeted from 20% during the Southern Song to 0.77% in the Ming (Merson 1989:75). However, with a reunited China, the government had access to the agricultural production capacity of the whole empire, and trade revenue was less important. In fact sea-trading was seen as a means of avoiding internal levies. Herein lies the big difference between Europe and China. The Ming could afford to withdraw from maritime trade because of the extent of their agricultural revenues.

A ban on foreign trade would have a devastating effect on the economy of Fukien and port of Ch'uan-chou. Given its importance to the livelihoods of so many people, an illegal maritime trade continued to operate on a large scale. The illegal trade had the support of local officials many of whom participated in it. For example, the family of Lin Xiyuan (c1480-1560), a high court judge from Fukien, owned a large commercial fleet with a business network spreading to southeast Asia. Such was the influence of the traders that Zhu Wan, the commanding officer responsible for suppressing shipping was put in jail because of the pressure from the smugglers and their official lobbyists in the imperial court. Zhu had made the mistake of starting a crusade to enforce the anti-maritime legislation. He was dismissed from his position and placed in prison where he eventually committed suicide (Deng 1997:93). Eventually, in 1567 the government repealed the maritime prohibition. Chinese were now free to travel and trade overseas; however, foreigners movement in China were still limited.

Chinese merchants were now free to trade. However, they received no government support, previously a key source of competitive advantage. Nevertheless, Chinese private traders continued to dominate the Pan Asian trade, given a position of superiority from the technologically superior products they carried. However, they took far shorter journeys than that of Cheng Ho. Chinese traders restricted themselves to the China Sea which they were to dominate. In this way, they were the pre-eminent shipping nation in one of the world's two major sea-lanes. The junk trade followed the rhythms of the monsoons in the South China Sea, trading northwards in June or July, Southwards from China in January or February and southward from Japan a little earlier (Ishii 1998:4). Along the way, speculative calls might be made at minor ports in the hope of striking some business. Communities of Chinese traders spread themselves out around the key trading centres in east Asia, forming networks which co-ordinated the flow of goods and information.

After the voyages of Cheng Ho, the Chinese withdrew from the Indian Ocean preferring to meet Indian traders at midway points. We could say that at that point, China lost its status as a global industry leader, choosing to become a regional industry leader. However, we must be careful not to apply modern precepts to the fifteenth century. There was much economic logic in this decision. Firstly, the earlier tribute trade was not driven by pure economic motives but included political and prestige goals. Secondly, the wind conditions of the Indian Ocean were very different from those in the China Sea. Regional specialisation would allow shippers to maximise environmental conditions and concentrate their expertise. Chinese junks were specifically designed for the wind conditions of East Asia and, they could concentrate their navigational skills and energies on the routes and wind systems with which they had the most experience. Experience no doubt lead to faster trips and reduced losses. Finally, shipping is a service that operates as part of a system that is equally reliant on the development of foreign ports. The decision of private shippers to restrict their activities to the China Sea also coincided with the rise of Malacca.

With the rise of Malacca as a transhipment point, Chinese shipping grew, exploiting their competitiveness in East Asian conditions. The establishment of Malacca also contributed to growth in Indian Ocean shipping and a number of shipping nations also enjoyed the benefits of the growing trade but, none more so than Gujarat which we look at in the next section.

6.4 Conclusion:

The growth of Chinese international shipping is not consistent with the analysis in chapter 3. While some imitation certainly did occur, it was not of a level that could be defined as the dominant process in the early stages of the industry. Initial development was shaped by indigenous developments. For example, the strong junk with its bamboo sails and nailed planks were born from local environmental factors such as available resources and sea conditions. The development of Chinese maritime trade was part of a broader process of commercialisation in the economy. The prosperity of this new system had spin-offs in terms of

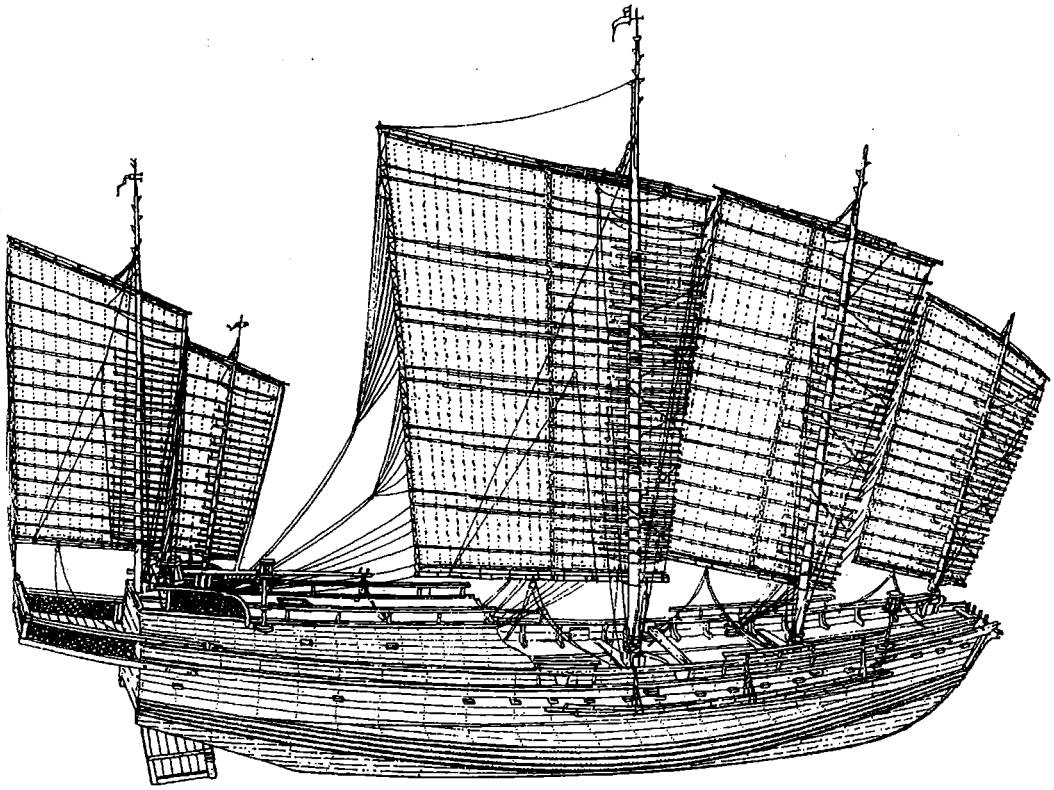
knowledge resources, supporting industries, capital and demand that under-pinned the industry's success. In that way, it is impossible to isolate the success of shipping from the economic system to which it was part.

Although this transition contributed to a rise in the status of the merchant and values that conflicted with the old institution base, conflict was contained by a process of amalgamation. Mandarins learnt that they could benefit by supervising and milking merchant activity. However, this was not a consistent process and government policy ebbed and waned depending on external forces, in particular the threat of invasion or existence of pirates.

While the development of the Chinese shipping industry was a function of opportunities in the environment, the maintenance of that competitive advantage was also a function of the domestic environment, consistent with the writings of Porter (1990). The strength of Chinese shipping relied heavily on factors such as supporting industries, knowledge resources, and domestic demand. To exploit these strengths, a number of heuristics, beliefs and norms were learned that could be considered rational behaviour in that commercial environment (as outlined in table 6.1). At its core was the primacy of the Confucian belief system. It created the world's most prosperous economy, driven by a paradigm that we might describe as Market Confucianism.

Table 6.1 Competitive Strengths and Related Heuristics of Chinese Shipping

Sources of Competitiveness	Paradigm Heuristics
Shipping Industry	
- Organisation, experience and expertise in East Asian trade and waters	- Restrict sailing activities to East Asia and meet Indian Ocean Traders at middle points like Malice. - Manage sailing activities in line with the Trade Winds - Place agents in foreign ports
- Ship Technology (Junks)	- Use high quality locally built ships
- Reputation	- Chinese provide best service for transporting goods in East Asian waters.
Supporting Areas of Economy	
- Technology/Education (knowledge resources)	- Aspire to provide Confucian education for family. - China and the Chinese are at the centre of the universe
- Internal Peace and Government Infrastructure (and support at times)	- Build relationships with officials. - Milking and nepotism are consistent with Confucian values. - Government supervision/ merchant operation is an effective practice for many industries.
- Market of high quality specialised produces of supporting industries/ - High quantity of domestic demand and sophisticated consumers.	- attempt to acquire market power - attempt to anticipate consumer preference and meet through purchases.
Productivity of Agriculture	- Peasants and agriculture are accorded high value (over merchants)



Five mastered Pei-chi-li freighter gives some indication of the build of the much larger treasure ships which traveled as far as Africa at the end of the fourteenth century (from Needham: fig 986).

Chapter 7

Gujarat Shipping and the Indian Ocean

7.1 A Brief Note on the Development of Indian Ocean Trade

In many ways, this thesis creates a false impression by beginning with Sung China as, the first true transoceanic traders were found in the Indian Ocean. The major breakthrough occurred when the regular patterns of the monsoons were understood. Understanding these wind patterns were the key to sailing long distances safely (McPherson 1993:38).

Indian Ocean trade reached new heights with the rise of the Islamic empire in the eighth and ninth centuries. The empire created a vast political and trading entity in which merchants developed their skills in a prosperous environment, which mirrored developments occurring at the same time in T'ang China and, as in China, it was part of a process that included an agricultural revolution. In this instance, the revolution occurred as farmers adopted plants that could grow in the hot summer, such as rice, cotton, sugar cane, egg plants, watermelons and hard wheat and, they introduced a number of innovations in irrigation (Hassan and Hills 1986:206).

The agricultural revolution was accompanied by an increase in market and industrial activity. The Islamic world contributed a number of manufactures to the world of trade. Their improvements in textile production resulted in Damasks from Damascus, Muslims from Mosul, and fustians from Fustat (a Cairo suburb). They also advanced technologies in ceramic and glass production, perfumes, sugar refining and confectionery (Mokyr 1990:41). Such was the sophistication of their commercial infrastructure, it was possible to draw a cheque in Baghdad and cash it in Morocco (Hassan and Hill 1986:18).

It was an era of maritime mastery made popular in the tales of Sinbad the Sailor. The regular patterns of the Monsoons allowed sailors to link regional economies of great diversity, creating a 'merchants paradise'. Surplus spices from the islands of Indonesia could be traded with surplus cotton and textile products from the Indian mainland or the minerals and manufactured products of the Middle East. Arab merchants ventured across the oceans creating Islamic communities in foreign ports made up of permanently based agents and, seamen temporarily sitting out the Monsoons. In this way Muslim merchant communities integrated the region's economies into an Indian Ocean trading world while, at the same time diffusing the Islamic culture.

The great Islamic empire came to and end with the advance of the Mongols and the sack of Baghdad in 1258. The Islamic empire degenerated into a 'collection of squabbling principalities' with devastating effects for production and trade (McPherson 1993:101). As it is at this point of history that I began my

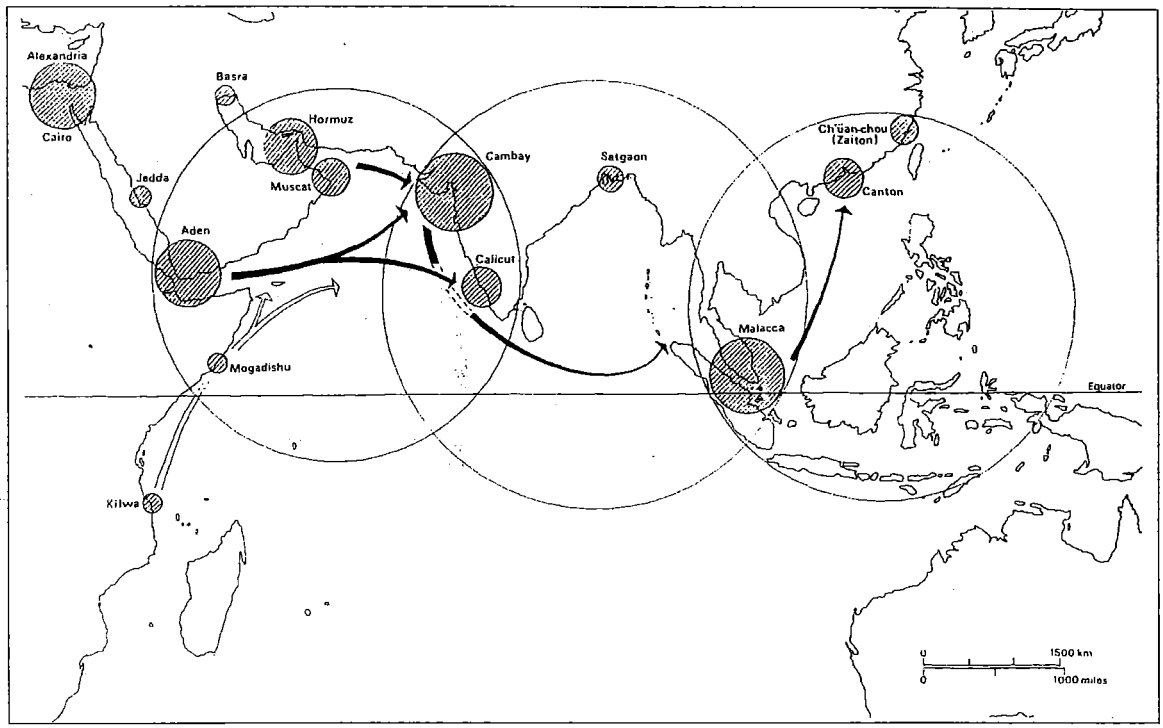
thesis, the contribution of the early Islamic peoples to maritime achievement is dramatically under-represented.

7.2 Gujarat Shipping in the 15th and 16th Centuries

During the fifteenth century, a new wave of economic development appeared in the Indian Ocean based upon the expansion of maritime trade (see McPherson 1993:137-143). There is no doubt that the most important development during this period was the rise of Malacca as an entrepot, where merchants from China, the Indian Ocean and Java could met to exchange their wares (Das Gupta 1994: I, 409). Ships driven by the monsoon winds linked the major civilisations of the region in an expanding and changing network of trade routes and ports. This new economic wave gave birth to a highly developed and flexible merchant capitalist system. The volume and direction of trade was determined by human political and economic activities on land including the rise and fall of states, contraction and expansion of economies, periods of famine and plenty. It gave birth to a merchant capitalist system in which flexible merchants responded to changing conditions through their buying and selling decisions.

Gujarat was the region that dominated this new economic wave. Our model would lead us to expect a process of imitation and advance in the early stages of Gujarat growth; however this is not supported. Gujarat rose on the back of the technologies that had been widely available in the Indian Ocean for centuries which it already possessed. Gujarat's rise is associated with a wider diffusion of technologies it already possessed but, there was no process where new technologies were acquired. Gujaratis clearly had access to Indian Ocean shipping technologies in earlier periods, although perhaps not always as traders. Marco Polo (1958:29) describes them as 'the most arrant corsairs in the world'. Nor did the rise of maritime Gujarat occur as result of advances in technology. There were no significant changes in the major maritime routes, products exchanged, nor the skills used by ship captains in the Indian Ocean (Lewis 1973:241).

Although Muslim observers were certainly impressed by the ships of the Chinese treasure fleet, environmental features limited any imitation process. Sentence (1979: 8-10) goes as far as saying that studies do not indicate any specific Chinese influences on the evolution of Indian Ocean ship designs (though he qualifies the statement by saying further linguistic research of maritime technology is needed). Meilink-Roelofsz (1962: 74-5) suggests that Chinese junks, so suitable for the turbulent storms of the China Sea, were too slow and unwieldy in the lighter winds of the Indian Ocean. Certainly, Indian ships did not reach the size of Chinese ships nor, did they have the same strength. The compass was one obvious item of transfer while the stern post rudder might have been another. The earliest recorded western observation of a stern post rudder was by Marco Polo during his stay at Hormuz. However, we cannot be sure if it was an innovation borrowed from the Chinese or developed independently (Sentence 1979: 9).



The Structure of Emporia trade in the Indian Ocean before 1500. Cambay, the chief port of Gujarat lay in the centre of the Indian Ocean trade. Its trade with Malacca was carried in Gujarat ships while, the trade with Aden was shared with the Arabs (From Chaudhuri - *Trade and Civilisation in the India Ocean*).

The ships used by the Gujaratis and others of the Western Indian Ocean evolved from the Arabo-Indian maritime tradition. This was the broad class of vessels commonly referred to as the dhow. The typical ocean going dhow was a two masted vessel of about 125 tons with triangular lateen sails. Although wooden and iron nails were used in India at the time, dhows were built by stitching planks together with coir. The resulting ships were not as strong as nail-built ships but, it was easy to replace damaged and perished planks with new pieces. Waterproofing was done with a mixture of fish oil, burnt lime and pounded vegetable fibre. The result was a light fast ship well suited to the conditions in the Indian Ocean.

Manguin (1986: 9) notes that the Gujaratis had developed a regional variation on the dhow. They were larger, averaging between 300 and 600 tons and, could go as high as 800 tons. With rounded hulls, as opposed to the V shape normally found on the dhow, they no doubt provided greater carrying capacity. A variation in their construction was the process of 'rabetting', in which a groove is made in one plank so that another plank can easily fit in it, similar to the tongue and groove principle.

The technologies used by Gujarat pilots were also based on an earlier tradition and were no different from those used by others in the region. They used the compass and maritime charts and, by the late fifteenth century, elaborate sailing directions were available for most of the Indian Ocean and Indonesian area. They utilised celestial navigation in which the southern cross or South polar star was used as a point of reference.

Clearly, the history of Gujarat's take off does not support a process of imitation as expected by the hypothesis. The question then becomes what were the sources of Gujarat's competitive strength? As with China, the rise of Gujarat shipping can only be understood in light of the domestic Gujarat economic environment on which many of the industry's competitive strengths were based.

Gujarat's rise to prosperity began at the turn of the fifteenth century, when it gained its independence from the Delhi Sultanate that had ruled northern India to that time. The new government played a role in developing the productive capabilities and knowledge of the region. Gujarat was fortunate to be ruled by Sultans who recognised the importance of encouraging domestic craft production as a key to a flourishing export trade. In particular, we should note Sultan Mahmud Begada (1459-1511) who pursued a policy of developing infant industry. As Muhammad ibn Akbar records:

> Most of elegant handicrafts and ingenious arts now practised in Gujarat were introduced under Mahmud. Clever men from various distant cities were settled there; and people of Gujarat were thus, by Sultan's exertions, instructed in knowledge and practice of the conveniences and elegancies of civilised life. (quoted in Gopal 1975:186).

In this case, we have an imitation process not of shipping technologies but of supporting industries. It should be noted this was a regional imitation process. There is no evidence or reason to suggest craftsmen were brought from as far away as China.

This could be interpreted as government action in creating Porter's diamond. Crafts flourished under an atmosphere of state care and patronage, the result being a lively industrial base. By the beginning of the sixteenth century, the Portuguese traveller Barbosa found a wide array of craftsmen with a wide reputation. This included stone and goldsmiths and craftsmen producing ivory bracelets, handles for swords, chess-pawns and chess boards. In this city, Barbosa claimed "the best workmen in every kind of work are found" (Barbosa 1918:142).

A favourable endowment of natural resources also created a healthy local environment on which a transportation industry could build. Gujarat was blessed with four rivers which irrigated the region enabling it to produce a rich range of agricultural products. On this foundation, the region produced a rich range of agricultural products including indigo, shellac, opium, honey, wax, wheat, barley, millet, rice, sesame oil, meat, butter, soap, raw-hide and manufactured leather goods along with some variety of medicines (Gopal 1975: 188). However, the product by which Gujarat's trade would most be identified was cotton textiles. The river valleys flowing through Gujarat were endowed with a black soil well suited to the requirements of cotton growing (Das Gupta 1979:2), a commodity with strong demand from those that like to be dressed.

As with China, Gujarat shipping provides another example of Hirschman's forward linkages from this industrial base and natural resource endowment. Having marketable export products gave the incentive for merchants to buy ships and look for markets across the ocean. In times without telephone, or telegraph, a good industrial base was a key advantage in the development of a shipping industry. It would have been highly risky for a ship to sail around the oceans in the hope of finding a cargo. Gujarat ships avoided this risk because the cargo was at their doorstep. It meant that a least the very first leg of the trip was cargo carrying and productive. Finally, a shipper could develop closer relations with suppliers which could reduce transaction costs, speed up delivery and improve the reliability of supply.

Nature handed the sultanate one last bounty for the development of its shipping industry, a strategic position in the Indian Ocean. Located midway between Aden and Malacca, Gujarat had a central situation on the major trade routes from which it could serve as the natural gateway to the sea for north west India (Gopal 1975:121). The highly productive Gujarat hinterland and easy communication to the outer regions gave the industry a firm basis on which to grow. As trade expanded, the area served grew to include the Gangetic plains to the north-east and the Indus valley in the north-west (Arasaratnam 1994:13-4). The port and manufacturing town of Cambay was the initial centre of maritime trade. Unfortuantely, silting in the upper

reaches of the river made it dangerous for large ships and resulted in a shift of trade to Surat (Arasaratnam 1994:19). Together, these two ports held an ascendancy over India's overseas trade for about four centuries.

From the ports of Gujarat, the products of northern India were taken across the Indian Ocean. To the East coast of Africa, Cambay ships carried cotton cloths where they were exchanged for gold and ivory. At Hormuz in the Persian Gulf, Indian products were transhipped to Persia and Iraq and overland to Central Asia, West Asia and Europe. In turn, Gujarat ships were loaded with horses, gold, silver, alum, copper, vitriol, pearls and silk which they took back east. At Aden, the chief port in the Red Sea, Gujarati ships were met by merchants from nearby ports such as Jidda, Zeila and Berbera bolstered by traders from as far away as Cairo and the Mediterranean world. Here, Gujarati merchants bought opium, copper, mercury, vermilion, gold (coins and ingots), woollen textiles, rose water and madder (Gopal 1975: 3) which they carried back to the India and the other regions with which they traded. In the east, Gujarat traded with the Maldive Islands, Ceylon (importing elephants and cinnamon), Pegu in Burma, Siam, the Malay peninsula and Indonesian archipelago.

Most important of all the routes was the Gujarat-Malacca trade which was the linchpin of the industry. As Tome Pires (1512-15: ii 270) observed 'The Cambay merchants make Malacca their chief trading centre..... Malacca cannot live without Cambay, nor Cambay without Malacca, if they are to be very rich and prosperous'. The trade in this key oceanic route was handled almost entirely in Gujarati ships (Pearson 1976: 11).

While Gujaratis held the dominant position in Indian Ocean trade, this should not be interpreted as saying they were free of competition. Shipping between Gujarat and Aden was conducted by both Arabs and Gujarati (Meilink-Roelofsz 1962:55). Arabs were particularly active in the trans-shipment of Malabar spices from Calicut, the old centre of Islamic trade. Indians from Coromandel were particularly strong in the Eastern Indian Ocean. The routes that these other nations dominated reflect the localised nature of shipping at the time. Although they were engaged in international shipping, these nations surpassed Gujarat on those routes to which their home region was an end port. Clearly, local knowledge is an advantage in gaining first mover advantages in establishing relations and securing cargoes. Consequently, we should not be too surprised that seamen from Malabar surpassed Gujaratis carrying Malabar pepper from their home base in Malabar. Larger ports like Calicut (the chief port of Malabar) also benefited from economies of scale in that a steady supply of cargo and custom made it more likely that a seamen could fill a ship. This would allow them to dominant cross-trades with smaller ports. However these explanations of performance only go so far, for on any given route we would expect at least two major ports to have equal home advantages, unless the ports have different strategic locations with connections to other routes. This is one advantage both Gujarat and Malacca possessed.

The predominance on the Gujarat-Malacca route raises the question why shippers from Malacca did not enter the trade and eat into Gujarat's market share? At the beginning of the sixteenth century, Malacca had a shipping industry and the Sultan himself owned and chartered ships. However, the bulk of the port's trade was in the hands of foreigners (Meilink-Roelofsz 1962:39 and 51-2). The historic literature is very useful in pin-pointing why Gujarat rose but, it is not so useful in explaining the limited growth of any industry, in this case Malaccan shipping. We can only surmise why an indigenous shipping industry did not develop to a large size. One obvious answer would appear to be the lack of a domestic population from which domestic entrepreneurs would appear. At the time of its establishment, Malacca was nothing more than a fishing village. The port initially grew on the basis of forcing ships to stop there, not by having an indigenous industry. Clearly those ships stopping there were in a position to develop first mover advantages and Pires (1944:45) stresses the role experience played in Gujarat's success.

Another answer to this question might stem from the nature of early shipping at the time. Most ship operators were merchants who bought and operated ships in order to get their produce to market. While the Gujarat shipper had strong relationships and information on his domestic market and production base, the Malacca merchant was very distant from both sources of supply and eventual demand. Without these informational advantages, there was less opportunity for the Kirzner (1973) type entrepreneur to appear and take advantage of price differentials. That is not to say that Malacca was not a hive of information. We can safely assume that every ship brought information on its home base, and exposed this information with every purchase made. However, this information was secondary and left the Malacca merchant highly exposed to the problem of anticipating the appropriate level of supply through the actions of others. It invariably could lead to a Richardson-type problem of over-supply situation. In theory, this information problem could be overcome if Malaccan seamen placed agents in Gujarat and established relationships with suppliers (as Gujarati's did in Malacca). We can only guess that the reason this did not occur to an extent that supplanted the Gujarati's lead, was the difficulty and time involved in establishing these relationships was much harder once the Guajartis had established first mover advantages.

Ships traveled to and from Gujarat whose ports began to earn a reputation as an entrepot for the redistribution of products from all corners of the Indian Ocean. Once Gujarat had established its position as a key entrepot, it also benefited from reputation and expanding economies of scale. Merchants from around the world came to Gujarat as they knew they could obtain reliable supplies and shipping services there. As more merchants went there, the variety of products continued to grow and contributed to the attractiveness of the region as a trading centre. Merchants could hold stock knowing that this region attracted buyers, a reflection of Andrew's (1964) observation that holding stock was not merely a way of satisfying customers but is also a way of generating demand. At the same time, they knew other merchants were doing the same and they could more reliably find stock at Gujarat than from other centres. In the words of Jean Audin, Gujarat had become 'the keystone of the commercial structures of the Indian Ocean' (quoted in Alpers

Reconstruction of an arab

1976:24). So great was the maritime trade of the country that the country's customs revenue alone in the early 1570's was nearly three times the total revenue of the whole Portuguese empire in Asia at its height in 1586-87 (Pearson 1976:109). A Portuguese visitor claimed 'if in any land it can be said that gold and silver flow, it is Cambay' (quoted in Pearson 1976: 108).

7.3 Sources of Competitive Advantage

The competitive strength of the Gujarat economy was initially based on natural resources which gave birth to supporting industries which allowed them to utilise the shipping technology available to them. The reputation it developed as a reliable entrepot contributed to its ability to attract merchants from around the world, while its shippers also developed a reputation and provided the international transportation services on which the entrepot turned.

The Mughal empire became another source of competitive strength. It provides another example of Ibn Khaldun's observation that commercial prosperity is a function of the size of the civilisation. The political stability of the Mughal empire provided access to a larger market and resource base which could now be developed. With that growth came increased opportunities for specialisation and the development of experience. Organisation relations were developed that reduced transaction costs and increased expertise. Gujarat shippers gained much advantage from an environment that provided low cost and high value products to conquer the world. In this section, we examine in depth some of the features that buttressed the competitive advantage of Gujarat's shippers.

7.3.1 Specialisation, Skills and Experience The natural resource endowment, supporting industries and key strategic location of the domestic environment gave local merchants better opportunities to invest in shipping than other regions. With this initial advantage, Gujarat seamen learned by doing the requirements of shipping and navigation in the Indian Ocean. As they moved down the learning curve, this experience gave them another commercial advantage, their navigation skills probably becoming the best in the world. As Pires (1944:45) states 'The Gujaratees were better seamen and did more navigating than the other people of these parts, and so they have larger ships and more men to man them. They have great pilots and do a great deal of navigation'. We can assume that this early experience provided early mover advantages that acted as a barrier to new entrants. A merchant wanting to transport goods safely across the ocean would naturally prefer to use a reputable, experienced operator rather than risk a new entrant or develop his own services.

The profitability of a voyage was strongly dependent on the skills of an experienced mu'allim (or captain) who was in charge of navigation and safety (Chaudhuri 1985: 125). The ocean trade was driven by the winds of the monsoons and the size of profit or loss was strongly dependent on catching the monsoons. A captain with a half full ship might be tempted to wait until he could assemble more cargo. However, if he

missed a change in the winds, the ship could be stuck in port for the year until the winds changed again. The Gujarats developed strong skills in these areas, Pires noting that the quality of their navigators and pilots was a factor in their success in maritime trade (Although Abu'l Fazl Allami thought that the best seamen came from Malabar - referred to in Chaudhuri 1985 124). It speaks for the quality of Gujarat seamanship that when the Portuguese arrived, having just had a revolution in navigation, the Indians were not highly impressed by their navigational equipment (Mathews 1997:28). Indian ships were of equal size and equally manoeuvrable.

The seamanship of the Guajartis was complimented by the high level of commercial skills that existed in the Indian Ocean, although these were not restricted to Gujarat. The level of commercial expertise was of the highest standard that the world at that time could provide. The business talents displayed by the Indian were greatly admired by the Europeans who came in contact with them. Pires (1944:I, 41-2) compared the Hindus with the Italians who were the top Europeans of the day, in their knowledge and the way they handled their merchandise. He praised their bookkeeping and commercial tactics and advised young Portuguese who wish to become clerks to apprentice themselves to the Hindu merchants of Gujarat. The Dutchman Jan van Linschoten claimed that the vanias of Gujarat...

> ...are the subtilist and politiquest Marchauntes of all India.... They are most subtil and expert in casting accounts and writing, so that they do not only surpasse and goe beyond all other Indians and other nations thereabouts, but also the Portingales: and in this respect they have much advantage, for (that) they are very perfect in the trade of merchandise and very ready to deceive men. (Burnell I,60,2523).

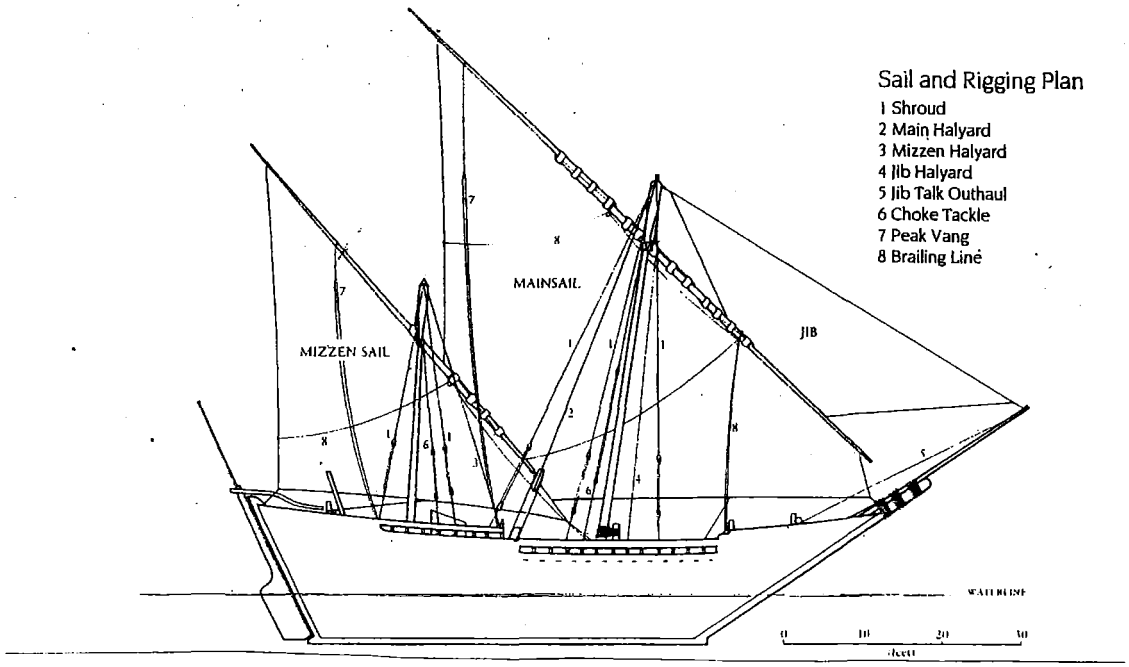
7.3.2 The Mughal Empire Prior to Gujarat's incorporation into the Mughal empire, political factors placed a limit on the nation's growth. A number of wars with bordering nations created a barrier to overland trade (Gopal 1975:122). The constraints continued until 1573 when Gujarat was conquered by the Mughals. Defeat in war was not welcomed by the rulers of Gujarat, but it removed many of the obstacles with trade to the hinterland. There were no longer political barriers or conflicts to limit the movement of merchants trading with Northern India. The new administration heralded a dramatic fall in organised violence which stimulated a rise in commercial activity. An expanding market further increased the level of specialisation with highly skilled individuals operating in a highly competitive environment. Francisco Pelsaert(1972:60), who travelled to India with the Dutch East India Company, noted that 'a job which one man would do in Holland here passes through four men's hands before it is finished'. Such a high level of specialisation must have contributed to the efficiency of output.

Gujarat's location as the gateway to the Mughal empire was a strategic asset that other budding shipping regions could not replicate. It placed Gujarat oceanic transportation in the context of a broader transport and economic system which buffeted the shippers competitive strength. Within the empire, a great flow of

resources was unleashed. This was not just a consequence of peace and stability, for the policies of the Mughal Emperor Akbar further contributed to the regions prosperity. A road-building programme improved transport and communication across the empire. Akbar rationalised the collection of internal customs duty by establishing a rate of 2.5% for goods moving within the empire and, in 1590-1 he abolished a number of duties completely.

The emperor Akbar created a centralised bureaucracy to administer the empire (Richards 1994:58). Below the emperor, four ministries were created with responsibilities for finance and revenue, army and intelligence, judiciary and religious patronage and the royal household. As well as this bureaucracy, another government institution was the system of amirs (nobles) and highly ranking mensabdars that created a warrior-aristocracy class across the nation. Under the mensabdar system, noblemen were assigned their respective personal ranks (zat) and an area of land from which they would collect revenue (jagir). They were expected to use the jagir to maintain a required number of troops (Das Gupta 1994:VI 185-6). Consequently, they performed twin roles of tax collectors and military commanders, contributing greatly to the security of the region. Strict rules issued by the financial ministry determined the methods and levels of taxation, thereby preventing the mensabdars from abusing the system (Richards 1994:67).

As with China, the political stability created by a unified empire accelerated the development of a market economy, a trend aided by government policy. Akbar's decision to accept land tax payments in cash accelerated the move towards a market economy as people engaged in market activity to raise cash (Gopal 1975:124-5). Nobles frequently invested in facilities to develop local markets (Richards 1994:62). The motive was both selfish and public spirited. An emporia helped the local people thereby earning the noble religious merit. It also increased tax revenues while the produce of the emporia could meet the needs of the nobleman's own entourage. Some less scrupulous nobles on occasion ignored imperial regulations and imposed their power on the local markets, buying goods at low prices and onward selling as a monopolist. More entrepreneurial nobles might even use their position to earn a profit and invest in long distance trade, even buying ocean going ships. However, Das Gupta (1994:I 422) notes that a nobleman would be reluctant to 'earn the odium of being a Baniya' (or village trader). If aristocrats did invest in trade (which the royal family itself did) they would normally distance themselves from the activity and hand it to a merchant to manage.



Reconstruction of an Arab trading Vessel of c1000 AD. The principle oceanic vessel of the Indo-Arab trading tradition was the dhow with its two triangular lateen masts. The Gujaratis developed a variation of this vessel with flatter hulls reaching a size of up to 800 tons (from *The Sinbad Voyage* by Tim Severin).

The administration at times helped the development of the textile trade which was the key commodity of trade in the empire. While raising compliance costs, the government conducted activities that increased the confidence of market based transactions and reduced the risks and costs associated with default and non-performance. For example, Naqvi (1968:209-10) notes that cloth once produced appeared to have been collected at a market, where state officers stamped their seals on each piece and collected a duty from the cloth dealers on each transaction. The stamping of goods by state officers acted as a security which prevented the weavers being cheated by the merchants. The merchants were also required to fill in a bond pledging that they would report all business deals. The merchants then either gave the cloth further finishing or retailed the goods as they were to the wholesale dealers through which they would eventually make their way to local dealers, peddlers and foreign merchants.

7.3.3 Complementary with Religious and Military Institutions and Values Incorporation into the Mughal Empire meant that Gujarat was now part of a larger economic system which included a number of competing belief systems and paradigms. The empire's origins were strongly driven in an Islamic crusading spirit but over time, the empire lost its strict Islamic basis and the emperor Akbar began recruiting nobility from a range of social backgrounds. Hindus, Rajpats, Afghans and Arabs were just some of the ethnic groups that provided the empire with dynamism and energy.

As in China, the Mughal military system and incentive base was intrinsically linked with land and land based values. As with all land based empires at the time, the Mughal empire was predominantly agricultural (Moreland 1962:103). It was on agriculture that the Mughal government concentrated its revenue collecting, taking a hefty one-third of gross production. The productive importance of agriculture was highlighted by the fact that status was determined by control over land. Land was the crucial resource, for control over land gave control over men. A wealthy man with status was a man with a large well populated land area under his control and a large contingent of cavalry (Pearson 1976: 90-1). This is reflected in the fact that Gujarat maintained a large army but virtually no navy. Glory was not won at sea as Bahaudar said, 'Wars by sea are merchants' affairs, and of no concern to the prestige of kings' (quoted in Pearson 1976: 91).

The land-based ethos and the vast agricultural territories available to tax meant the state took little interest in sea trade. The government seldom interfered in the affairs of the merchants and this was particularly so for ocean-going commerce. As long as trade operated smoothly and contributed to the states revenues, the Muslim rulers of Gujarat were content to provide merchants with protection but otherwise, leave them alone (Alpers 1976:25). This is reflected in the nation's taxation policies. Sea trade was taxed at only 5% compared to 20% in Lisbon and 30% in Mamluk Egypt (Pearson 1976:86). Customs duties constituted only 6% of Gujarat's income compared to 60% for Portuguese India (Pearson 1976:33).

The development of shipping was also complementary with the nation's religious beliefs, particularly Muslims who dominated merchant shipping at Surat. The Prophet Mohammed had himself been a merchant, so trade (and shipping) were fully complementary with Islamic values. In Islamic Society the occupation of merchant was open to all whereas, other social groups had caste restrictions placed on them at birth (Chaudhuri 1985:211). However, Islamic doctrine was against excessive profiteering and usury and this stopped Muslims entering areas of finance. Consequently, the business of providing loans and other financial services fell to non-Muslims. Hindus were especially active as suppliers of financial and brokering services however, they would not themselves embark on Moslem ships for fear of coming into contact with unclean persons (Meilink-Roelofsz 1962: 63-4). Consequently, maritime commerce exhibited social divisions.

However, at Diu and other ports along the coast, Hindus were involved in shipping; the merchant capitalist paradigm overcoming even religious prescriptions not to cross the sea (Ravichandar 1989:167). While travelling, they would try to their best to avoid offending their faith, for example by eating contaminated food at sea and no doubt, some tried to compensate for any bad karma by living devout lives on shore (Pearson 1981:138). An interesting description showing how religious beliefs modified Indian business operation is provided by Jan van Linschoten who observed Konkan Hindus:

> When they will make a voyage to Sea, they use at least fourteene days before they enter into their ships, to make so great a noyse with sounding of Trumpets, and to beat pots, that it may be heard and seene both by day and night,, the ships being hanged about with flagges, wherewith (they say) they feast their Pagode, that they may have a good Voyage (quoted in Pearson 1981:136)

Religious beliefs also affected commercial practices on shore. Dale (1994:74) notes how the money lending and banking practices of Jains and Hindus were reinforced. by a life-style of commercial devotionalism. 'The tools of their trade, account books, pens and ink, came to symbolise deities in the expansive Hindu/Jain pantheon'. Jains were very pious and would not kill any bird, animal or living being and dedicated a large portion of their wealth towards charity. It has been suggested this is the reason they became merchants and not warriors (Ravichander 1989:168).

7.3.4 Organisation Shipping was an extension of a merchant's task in distributing goods to foreign markets. Consequently, the success of a shipper was tied to his ability in reading consumer preferences in his domestic and foreign market, negotiating favourable prices, maintaining appropriate inventory levels of the possible range of goods, reducing losses and maintaining relationships with distributors. Consequently, efficient institutions and methods of co-ordination were developed to facilitate the flow of goods, and

reduce the costs and dangers of trade. This included solving disputes, avoiding irreputable dealings and overcoming the negative effects of competition.

Although the state generally gave merchants freedom to engage in economic activity without interference, the other side of this coin meant the state gave them little support in this area. The state had no financial or ideological need to build an infrastructure or pass the sorts of legislation, that later supported the merchants in the Netherlands and England (Pearson 1991: 97). Governance and the administration of justice could be arbitrary and personal in its application (see Gokhale 1979). This suggests that political alliances and costs could at times be a legitimate business expense. Arasaratnam (1994: 175) believes the closeness of the relationship between ruler and merchant was dependent on the political and administrative situations in which the merchant operated. In almost all regions, merchants were found to have had access to political power, and they frequently employed vakils and retainers in the courts of emperors and princes to represent them should they have a grievance.

With no strong system of commercial law, disputes were solved through consensus. Dispute resolution and commercial practice was guided by custom and tradition. Under such conditions it made sense to restrict business activity to the same social group (Hindus, Jains, Muslims) which had similar values and a stronger sense of community. This was particularly so for international trade where distance and problems of communication made it difficult to control activities in foreign ports. Solving disputes within social groups reduced costs and saved interference from government officials, thereby retaining a degree of autonomy. Trade guilds (mahajan) were formed similar to those that exited in Europe in the Middle Ages. The guilds (mahajan) looked after all the economic interests of the city, ruled the city traders and organised economic life of the merchants. Their authority included the power to fix prices and productivity, thereby avoiding any unhealthy competition (Ravichandar 1989:170, Alpers 1975:28).

At major foreign ports such as Malacca, the Gujaratis appointed one of their number to be a Shahbander (Alpers 1976:30). The Shahbander would look after the interests of the traders, managing the markets and warehouses, ensuring standards and measurements were observed and adjudicating disputes within the ex-patriot community. He also represented Gujaratis when dealing with the Sultan of Malacca. Alpers (1976:31) suggests a similar organisational arrangement occurred at other major ports where the Gujaratis traded such as Mombas and Malindi.

This organisational structure was not limited to Gujaratis. Three other major merchant communities based at Malacca also had Shahbanders to represent them. However, the Gujarat was the most senior of the four officials, a reflection of their economic importance (Alpers 1975:30). It is hard to imagine that this seniority did not provide Gujaratis with quick redress and rapid response, an efficiency gained from economies of scale. It certainly provided greater protection than those shippers without a Shahbander.

Indian custom provided both freedom and protection and a value system that underpinned individuality. In analysing the commercial structure of the time, one is instantly struck by the importance placed on the individual. Individual freedom was a cherished value of society and state. In contrast to China, maritime India was remarkably open, granting freedom of access to indigenous inhabitants and aliens alike with no attempt to regulate their subjects' coastal movements (Arasaratnam 1994:267). The unwritten law (qanun) of Indian society was that every individual was allowed to work at the post to which he had been born and to the profits of which he was entitled (Das Gupta 1994: I, 421).

The individualistic basis of Indian commerce was reflected in the structure of business. Autonomous self employed individuals decided what they produced, with what materials, on the basis of market forces. This decentralised structure provided flexibility to prevailing conditions. There was little representing the employer-employee relationship of today. The basic business unit was the individual merchant and the family firm, with an occasional trading partner from the same social group. The family business was the predominate structure just as was in China, and for the same economic reasons. Clearly, both the Chinese and Gujarat (and as we will read in chapter 5) merchants adopted similar structures in response to the enduring economic problems of reducing opportunism and ensuring trust and co-ordination. However, these economic reasons should not be stressed to strongly. Clearly, the male heads of these family groups had paternal instincts and a desire to provide for their off-spring.

Merchants would frequently place family members they could trust in foreign ports to act as agents. If their level of business activity was not very high, they would use an agent of the same social group based in that port. The agent would be paid a commission and the merchant would not have to endure the permanent expense of paying wages even when no commercial activity was being employed. Merchants maintained regular correspondence with their off-shore agents, interchanging commercial intelligence on the state of the markets, what products were in demand or in fear of being over-supplied. The organisational structure based on agents was clearly not restricted to Gujaratis. However, the extensive nature of some of the Gujarati networks clearly provided an advantage over periphery nations.

The family firm acted as a store of knowledge and was also the source by which businessmen acquired their commercial skills, as the European traveller Tavernier explained in 1676:

> They accustom their children of an early age to shun slothfulness, and instead of letting them go into the streets, teach them arithmetic which they learn perfectly, using for it neither pens nor counters, but the memory alone, so that in a moment they will do a sum no matter how difficult it may be. They are always with their fathers who instruct them in trade, and do nothing without at the same time explaining it to them. (Travels in India II 43-4, trans. V. Ball, revised by W. Cooke, London 1925 quoted in Habib 1990: 384).

Some of these family firms could reach great size with outlying branches in other towns or countries. Das Gupta (1994: I, 418-9) describes the range of Indian merchants involved in oceanic trade as including 'substantial merchants' who traveled in style with their cargo and establishment of domestics, merchants who traveled as agents of principals who were either managing business at home or traveling elsewhere, and small merchants who provided a ship with the majority of its passengers. Foreign trade was overwhelmingly characterised by small merchants, but each Indian port was dominated by a few wealthy traders.

Investing in ships was not popular among Indian merchants as it tied up a lot of capital in an area of high risk. Consequently, ship owning was a bi-product of a merchant's particular trade and, as mentioned in chapter five, this was most probably due to the complementarities of the two functions. Ship-owning merchants carried their own goods, and those of other merchants, across the sea. Ship-owning had not yet become a separate specialised form of business. As certain trade routes became established we might expect an increase in specialisation however, investing solely in shipping was highly risky. A ship was a very expensive capital item exposed to the vagaries of the sea. Consequently, only those merchants in need of ships to meet their transportation needs made the investment.

To reduce risk, merchants might spread their product range over a number of commodities. Merchant insurance would have helped to reduce the risks of ship-owning but, while cargoes could be insured, no insurance had evolved to insure ships. As with most aspects of Indian business, insurers were mainly small merchants working individually without the financial backing to insure large capital items like ships (Das Gupta 1994: I 418).

In Europe, this problem of risk had been overcome when merchants spread risk by sharing investment in ships. In India, the value system which stressed individuality did not make this possible. Commenda contracts, whereby a stay at home party lends money to a traveling party to utilise in business, were common to Islamic merchants (Chaudhuri 1985: 210). However, the commenda used in Indian maritime trade did not reach the point where the funds of the individual investors were pooled into a common fund with common risks. The spirit of individualism ensured that the investments and cargoes of individuals were kept separate from others (Arasaratnam 1995: I 10).

This was a highly competitive world of small producers. Das Gupta (1994: I, 419) describes it as "a merciless world of almost unrestrained competition which often degenerated into feuding". Competition did not stop the richest merchants from gaining market power. The powerful merchant Abdul Ghafur ruined several small merchants in an attempt to get a monopoly on the Red Sea trade but, with few barriers to entry into the trade, his monopoly could not be sustained. Small merchants could enter the trade with

little investment and there was little that could be done to remove them as a force in Indian trade. (Das Gupta 1994: III, 14)

7.3.5 Infrastructure and Supporting Industries The Gujarat economic system represented a 'merchant capitalist system of the highest order' and was far in advance of areas like East Africa on the edge of the Indian Ocean(Alpers 1975:29). This was an economy increasingly driven by market co-ordination characterised by vertical specialisation, fragmented industries and reliance on external economies.

A very important source of competitive advantage was the level of specialisation that occurred in the economy. As the economy expanded, individuals specialised in particular trades and crafts. As they became more skilful, their costs decreased and their quality rose, giving Gujarat traders a high value low cost advantage.

A ship-owning merchant was just one part of a long chain of highly specialised individuals, a reflection of the economics of specialisation the economy was now enjoying. Autonomous, self-employed merchants and producers performed specialised functions on which others in the chain relied. Ocean-going transportation was part of a chain that linked the markets and producers of the North Indian hinterland with foreign ports. Consequently, a close relationship between ships and the organisation of road transport developed throughout pre-modern Asia linking the main producing areas and the commercial emporiums. From the ports of Gujarat, a series of camels, horses, donkeys, oxen and wheeled vehicles would link the hinterland with the sea.

In the ports, the chief link in the chain were the general brokers who supplied the shipowner-merchants with specific commodities. As in China, the general broker obtained and distributed goods for the merchant-shipper through a network of middle men and sub-brokers in the regions small towns. They reduced risks by testing and weighing products while also providing warehousing facilities. These formed the links with the weavers and cultivators in the hinterland. The brokers greatly reduced the costs of acquiring products and resources as Thevenot (1666) states, they were:

> so expert in their business, that hardly any body can be without them. They give them commissions of all kinds; though it be known that they make their profit of everything, yet Men chuse rather to make use of them, than to do their business themselves; and I found often by experience, that I had what they bought for me much cheaper than what I bought myself or made my servants buy. They are of pleasing humour, for they reject no service, whether honourable or base, and are always readie to satisfie those who employ them. (*Indian Travels of Thevenot and Careri*, Trans. S.N.Sen, New Delhi, 1949 pp77-8, quoted in Habib 1990:391)

The sarrafs (or shroffs) of the mint formed a vital link in the chain. Any importer of bullion had to take his bullion to the mint to get Mughal rupees coined. They would ensure coinage was the correct weight, purity and age. Hindus dominated this function. They were the money merchants of the empire, changing foreign currency into Mughal rupees, buying and selling bills of exchange, supplying marine insurance (for goods not ships) and respondentia loans. They also developed an early form of deposit banking and were an important factor in the efficient flow and utilisation of financial capital.

Even the richest merchants were dependent on the links down the chain and had little control over the processes that brought the product to port. The idea of investing further down the chain would not have been attractive to a merchant given the uncertainty of the markets abroad (Das Gupta (1994: III 13). It would be "folly to make permanent arrangements with weavers".

While the competition between individual suppliers was fierce, a high degree of co-operation and mutual benefit existed between those people a merchant traded and built relationships with. Shipping was a forward linkage of the productive industies and led to the creation of a mutually reinforcing cluster. With high quality cargoes on board, shippers could travel to distant markets confident of a sale. A growing shipping industry was also good for the craftsmen. In return, artisans and craftsmen flocked to the urban areas of Gujarat, attracted by the better transportation facilities and markets (Ravichander 1989:172). Payment in the cities was in cash and immediate, a huge improvement over payment in the villages. In the cities, they organised themselves into craft-guilds which grew out of relations based on ethnic groups.

The key supporting industry which made it possible for Gujarat to dominate Indian Ocean trade was textiles. Pyrard wrote that 'every one from the Cape of Good Hope to China, man and woman, is clothed from head to foot' with cotton stuffs made in Gujarat. Though an exaggeration, this comment reflects the extent of Gujarat cotton cloth exports. Cotton textiles were probably the most important manufactured item in the world at the time (Steensgaard 1990: 123) and India was the greatest producer (Habib 1990: 371). Northern India possessed a natural competitive advantage in that it possessed favourable growing conditions for the plant. Naqvi (1968: 136), who surveyed industry in Northern India of the Mughal era states that 'the cotton textiles industry was universal,..... No city, town, paraganah, casbah or village seems to have been devoid of this industry'.

The process of manufacturing cotton textiles began with the collection of the cotton from the fields after which it is cleaned and spun into yarn. The yarn was then weaved into cloth which is bleached and dyed. The cloth could then be used to produce what ever the market demanded. This included quilts, mattresses, pillows, cotton sheets and bed covers, draperies, cushions, carpets, tents and most important clothing.

With the spread of the market economy during this period came structural adjustments which increased the efficiency of the textile sector. This included an increased market orientation with a consequent rise in specialisation and division of labour among producers. In the rural districts, growers who previously shared their productive activity between their own food and cotton requirements began to concentrate on cash crops. More agricultural peasants gave up the land to become full time weavers and spinners. As the volume of production increased a division of labour became more apparent. Spinners, weavers, bleachers and dyers became specialist professions. An accompanying result of the increased scale of production was the development of a market for the sale and purchase of weaver's tools (Gopal 1975:199-203).

Government policy also contributed to the growth of the industry which they considered of priority given its direct impact on the economy of the region. Mughal emperors introduced measures to assist the industry, including the granting of concessions to cultivators of cotton crops (Naqvi 1968: 137 & 147).

Shipbuilding was another key supporting industriy as it provided the major capital item for shippers. A flourishing shipbuilding industry existed around the gulf of Cambay. Ports at Surat, Goa, Broach, Diu, Nosari, Khambayat and Gandevi were also homes to busy shipbuilding industries. Geography blessed the region with deep rivers for the construction and repair of ships and an abundance of timber in the interior hills which could be transported by river to the place of construction.

What is noticeably absent from this description of the institutional infrastructure is the lack of any body involved in what the National System of Innovation school would define as 'exploring' (Lundvall1992:11). This would go a long way in explaining why Gujarat's success was based on the diffusion of existing technologies not innovation. While China's monks and official scholarship contributed a range of innovations, Gujarat does not illustrate the same process even though its economy could support a number of monks and scholars. In earlier centuries, the Islamic-Hindu world had produced a number of innovations and technological prowess far above Europe, but by the time Gujarat rose to eminence, innovation seems to have stopped. Latourette(1960:555) points to the difference in the nature of their scholarship. While the Chinese were 'this-worldly' and materialistically minded, the great majority of Hindus were engrossed in their struggle to free themselves from physical existence and saw the visible world as an illusion. The effect of this might not be so strong on the day to day life of the average peasant but it certainly affected the most educated members of the Hindu community from which we might expect innovations to come. The Islamic community was not bound by these issues so given that Gujarat contained important centres of Islamic learning we might expect a higher level of innovation. However, Islamic learning seems to have incurred its own process of institutionalisation by this time. Pines (1963:205) examined the stagnation of Arabic science to which Indian Islamic scholarship was intimately connected and noted how debates on Aristotelian physics lost the urgency of their early years and had been transformed of mere topics of

scholarly tradition. It was no longer exciting and innovative and had become a closed world of strictly bookish scholarship.

Table 7.1 Competitive Strengths and Related Heuristics of Gujarat Shipping

Sources of Competitiveness	**Paradigm Heuristics**
Shipping Industry	
- Organisation, expertise and experience in Indian Ocean.	- trade to midpoints like Malacca but do not sail into foreign oceans where capabilities are not so developed. - Manage sailing activities in line with the Monsoon winds - Place agents in foreign ports
- Light ships with few armaments that are fast and cheap to run.	- Trade peacefully
- Reputation	
Supporting Areas of Economy	
- Well developed market of specialised experts	- Don't integrate but rely on market. -Try to anticipate consumer preference and meet with supplies. - Try to obtain market power.
	- Individualism
- Flexible organisational structure of family firms	-Teach what has brought success in the past
- Quality family based education	
- Peaceful empire which allowed trade to grow	Mughal-land linkage
- Productive hinterland	

The competitiveness of Gujarat shipping industry was a function of features of the domestic environment, such as supporting industries, knowledge resources, and domestic demand. To exploit these strengths, a number of heuristics, beliefs and norms were learned that could be considered rational behaviour in Gujarat's commercial environment (as outlined in table 7.1). At its core was the primacy of the peaceful market transactions.

Although this chapter is principally concerned with the rise of Gujarat in the fifteenth and sixteenth centuries, the career of Abdul Ghafur who lived in the seventeenth century, usefully illustrates some of the characteristics of trade at the time (see Das Gupta 1979 and 1994). His success had turned him into the wealthiest merchant in Surat by the end of the seventeenth century. It is believed Abdul Ghafur came to

Surat in the late 1660s from the northern town of Patan where he had been a teacher at a mosque. He was very poor on arrival but his background suggests he was educated and literate, therefore giving him some skills needed to succeed in commerce. He soon made a fortune from trade, most probably on the Red Sea trade. The Red Sea was the destination of many Indian Muslims going on pilgrimage to Mecca and an active trade grew around the shipping that made this route. Experience on the route was of great competitive value as the first ship to the market (and first to return) found a pent up demand and received the highest prices. The earliest ships to return were also the first in transmitting valuable commercial intelligence used at Surat when planning what to order. Ghafur also knew there was some virtue in being the last ship and picking up the late freight. The size of his fleet allowed him to cover an array of strategies.

In the hinterland of Gujarat, Ghafur depended on brokers and sub-brokers who dealt with the headmen of the weavers in long tortuous chains which kept him some distance from the production process. Consequently, he had little interest or control over production and would not be likely to have had any interest in investing downstream, given uncertainty of off-shore markets.

Abdul was inclined to be thrifty. By the middle of the 1680s he was among the richest shipowner-merchants of Surat and by 1700, he was fabulously wealthy. However, his meteoric rise in fortune had not happened without making many enemies on the way. If Abdul saw an advantage, he would make his own rules and crush smaller competitors. He once attempted to obtain a monopoly on the Red Sea run, ruining several small fry in the process but, the market was too open too limit new competitors.

The scale of his operations was without peer. Of the city's fleet of 112 ships, at the end of the seventeenth century, he owned seventeen. The ships would be used on the full range of Asian trade routes from Manila to Mocha. In 1701, he provided eight of the 19 ships which made the Red sea run to Mocha where he owned warehouses and one of the largest mansions in town. His nakhudas (or captains) would stay in the house during their stopover and, sometimes around the year to supervise the sale of merchandise. The nakhudas in command of each venture were either his relatives or important businessmen in the city with whom he had connections. Decision making was centralised around Ghafur himself, with strict instructions given to each nakhuda. With the total tonnage of his fleet at 5,000 dwt, his operations were comparable to the European companies operating in Asia at the time. However, he never received the social and political support that a company like the Dutch East India Company received from its state.

7.4 The Decline of Javanese Shipping

Probably the region to most feel the impact of the formidable Chinese and Gujarati competition was South East Asia which had a strong maritime heritage. Up until the end of the fifteenth century, South East Asia possessed trading fleets of ocean going vessels which sailed chiefly to southern China, Malaku and the Coromandel and, at times sailed as far as the Maldives, Calicut and the Red Sea. Their vessel, the jong,

averaged 350-500 dwt (Manguin 1993:198). These ships were built on the northern Javanese coast, the southern coast of Borneo and Pegu which had access to teak forests.

The jong developed from their earlier high seas tradition but seemed to incur some modification under the influence of the Chinese, an imitation process aided by the Ming's ban on shipping which forced Chinese merchants to make their ships off-shore (Manguin 1986:17). However, this hybrid ship did not have the same range of technical features of their Chinese counterpart which reflected a technological supremacy in ship design and construction (Deng 1999:164).

Although South East Asian trade underwent a considerable boom in the sixteenth century, Javanese shipping did not share in it. Long distance trade changed hands with Gujaratis taking the market in the West, Chinese in the East (Manguin 1993:203). The competitive strength of the Gujaratis and Chinese was too strong and the long distance Asian wide trade of the jong stopped. The Javanese now operated exclusively on regional networks. Gujarat trade from the port of Aceh doubled in the sixteenth century (Manguin 1993:201), while East Asian waters became a Chinese Lake (Deng 1999:1). The great ocean going jong fleets disappeared.

7.5 China and Gujarat Compared

This thesis expected to reveal a process of imitation and advance. Unfortunately, it has not been borne out in these first two studies. In the period under question, the industry was too reliant on local conditions and resources. Consequently, the strong and heavy junk and its bamboo sails plied the seas in the far East while the dhow and its cotton sails enjoyed the lighter conditions of the Indian Ocean.

Nevertheless, some imitation did occur. The Chinese studied Hindu navigational charts, and Kubilai Kahn introduced many foreigners to the Chinese court. Indians used Chinese inventions of paper and the compass, while even the Mughal empire was built on the early adoption of gunpowder.

Organisational structures were very similar, with the family being the basis of all shipping organisations with the exception of the Chinese tribute trade. However, this is more likely to be an independent evolution as entrepreneurs in both countries deal with similar problems.

In the supporting industries, there was more organisational variation. Chinese ceramics evolved into a more concentrated mass production industry while Indian textiles remained fragmented and widely dispersed. Nevertheless, both achieved a high degree of specialisation. The region for the variances in structure possibly relates to the geographic diffusion of the raw materials and also the production technology. With the technologies of the day, it was easier to build a large dragon kiln than mechanised textile machinery.

What this chapter has revealed is the strong similarities between the rise of Chinese and Gujarat shipping. Both provided an environment that was advantageous to shipping entrepreneurs. In particular, political stability and unity gave them access to large markets and productive bases that increased the profitability of ocean going shipping as long as competition did not get too tight. Shippers in both nations were buttressed by supporting industries that exhibited the best of productive technologies of the day and prosperous local demand conditions. These advantages eventually lead them to gain experience and skills that attracted custom from other nations. Clearly, being a gateway to a mighty empire was a strategic asset of value to the industry.

Chapter 8

The Rise of European Shipping

8.1 Evolution of the European Commercial Environment

A feature of the previous two chapters is the importance of the domestic environment in buttressing competitive advantage. It raises the issue that imitation in the domestic environment is just as important as imitation in the industry itself.

In the previous chapter, we discovered that having a domestic base associated with a mighty empire provided advantages for shipping and the development of a market based economy. The Chinese empire was born at the same time as Europe's Roman empire but China retained its unity while Europe fragmented into disjoint economic units. For centuries after the fall of Rome, Europe was the economic runt on the Eurasian continent. Divided by geographical barriers, Europe was a political patchwork of kingdoms and principalities lacking the strength, stability and economic vitality of its eastern neighbours. The governments of Europe were small and uneducated. Market activity was practically non-existent. The dominant institutional form for utilising resources was the feudal manor in which agricultural peasants provided for their own requirements and contributed a share of their labour to the Lord of the Manor who provided them with law and protection in return (North and Thomas 1973:27).

Europe did not provide a favourable environment for the development of a shipping industry. The poor manufacturing base provided few marketable cargoes, a situation not helped by low levels of education. The poverty of the region meant that demand conditions could support little trade while few merchants, if any, had the capital to embark on major oceanic voyages. This environment would need to change before any shipping industry would be viable.

During the Middle Ages, Europe underwent a process of agricultural, commercial and technological change. The process was long and gradual and involved both indigenous developments and imitation of Eastern technology and commercial methods.

As in China and the Islamic nations, Europe evolved from feudal structures towards markets on the back of an agricultural-commercial revolution. There was a steady increase in land reclamation, as drainage, irrigation and land clearance increased the amount of land available for agriculture. Production increases contributed to population growth and provided surpluses which could be taxed or traded. More people could be employed in non-agricultural pursuits with a rise in the number of people involved in government, religion and crafts. Craftsmen who previously provided a handful of luxuries to the rich and a small number of essentials to the peasants could expand their range of activities. The market became a more common

medium for allocating resources, at first through temporary fairs which eventually grew into more permanent market towns.

The expanding market created an environment conducive to the introduction of mechanical labour saving devices (North and Thomas 1973:43). With the introduction of the waterwheel and windmill, Europeans were no longer reliant on human or animal power. Educated Christian monks played a key role in upgrading productivity. For example, the Cisterian order of Monks, created in 1098, promoted a number of new technologies including water-powered grain mills, cloth fulling mills, wine presses, iron forges and furnaces (Gies and Gies 1994:114).

The dominant institution at the time was the Church and Christian values were not totally conducive to a merchant based economy. Christians gave merchants low social status, seeing them as gold-hungry and non-productive (Lopez 1971:60). Usury, the practice of lending money and charging interest, was considered unethical. With different values, Jews filled the vacuum and became successful traders and bankers. Many Jews spread out across the important ports and cities of Europe either to escape persecution or in search of trade. Jews were particularly important in providing a neutral trade link between Catholic Europe and the more advanced countries of the Islamic world, providing a valuable linkage in lands that otherwise might be divided by war or creed (Lopez 1971:62).

The relationship between the Mediaeval church and business was close, complex and uneasy (Hunt and Murray 1999:69). For example, in the twelfth century, the clergy contested the establishment of schools providing a basic merchant education as they felt their monopoly on education threatened. On the other hand, the clergy relied on business for many of their provisions. Like the Hindus, Jains and Muslims in India, religious beliefs affected day-to-day business activity and values of European merchants (Hunt and Murray 1999:69-70). In Italy, a company's books normally opened with a prayer for the success of the business and the health and safety of the personnel. In the north, the Flemish introduced their financial statement "to the Glory of God". Of particular relevance to daily business activity was the concept of the "just price" sanctioned by the church. A price that was just provided an underlying fairness to daily business transactions that recognised utility and demand as well as costs.

Islamic nations were an important source for imitation, a process that greatly improved Europe's productive capabilities and knowledge base. Europeans adopted techniques of linen production from Islamic peoples who also introduced cotton production to Spain. The spinning wheel first arrived in Europe from the East in the 13th century (Ibid:180-5). Venice acquired its famous capabilities in glass making from Syria while sugar production was learnt by the crusaders who brought it back to Europe (Ibid:153&222). Islamic influence was also felt on mining, a subject on which the only publications available until the mid -fifteenth century were Arabic translations (Ibid: 236).

During the twelfth century, the imitation process took a huge leap when the crusades increased interaction with the Islamic world. It opened up a vast pool of technological wealth. This included the rediscovery of ancient Greek classics and more recent Islamic scientific texts which became available to Europeans in increasing numbers. They included Al-Khwarismi's texts on mathematics, medical works of Galen and Hippocrates, and Ptolemy's Geography which strongly influenced European shippers and explorers. Universities were established based on the Islamic style of learning. First was Bologna in about 1100 followed by the University of Paris in about 1150. The Islamic system of 'madrassas' became the model, where the emphasis was on debate and exploring the issue from both sides (in contrast to the memory based examination of China).

The imitative nature of early European commerce can be traced in the language we use today. The word 'cheque' is derived from the Arabic word 'sakk'. The word 'ream' comes from the word 'rismah' meaning bundle of paper (Hissan and Hill 1986:18&192). The word 'fund' comes from the Arabic 'funduq' (Chaudhuri 1991:436) while 'risk' comes from the Arabic 'rizq' (Hunt and Murray 1999:61).

It was in the sea ports of the Mediterranean that the process of imitation and revitalisation was the strongest, in particular, the Italian cities of Venice and Genoa. These towns benefited from the crusades which had introduced Europeans to exotic products from the Middle East and beyond. Galleys from the Italian cities regularly visited Islamic trading ports bringing back products and technologies from the East. The Italians were the first Europeans to introduce the compass and borrowed other innovations such as lateen sails and navigational charts. They most probably adopted the 'commenda' form of business organisation from their Islamic trading partners, a vital ingredient in the rapid growth of European maritime trade (Lopez 1971:76).

The introduction of double entry bookkeeping, probably from the Hindus, helped merchants to keep track of their operations and the activities of their partners and agents. It also gave them a record by which they could learn from the past how to plan for the future. Bills of exchange were in common use and by the late fourteenth century, Italians had derived formulas for marine insurance contracts. With a spread of literacy, the customs associated with business became codified, Italy developing the first written law for enforcement of trade agreements. All these factors reduced the cost of using the market, which became an increasingly effective method of allocating resources (North and Thomas 1973:56).

Through the Italians, Europeans learned the value of maritime trade. With no agricultural base, the Italian cities became dependent on ocean trade. Consequently, the interests of merchants became so important that the state took charge of their protection and merchants became very active in municipal government (Mauro 1990:259). Although these ports were not great by world standards, the wealth they created through maritime trade was envied by other Europeans. It did not go unnoticed that such wealth could finance

strong navies and armies and Europe developed a strong awareness of the economic and strategic value of sea power. As Sir Walter Raleigh would later state, 'Whosoever commands the sea commands trade, whosoever commands the trade of the world commands the riches of the world, and consequently the world itself' (quoted in Mollat du Jourdin 1993:117).

Italian success served as a model for other European states to imitate. Throughout Europe, a symbiotic relationship developed where merchants were free to build their wealth while contributing to the tax base and strength of the state. Governments passed laws to enforce contracts and protect private property, the Italians once again providing the template. The maritime law of Pisa served as the model for Barcelona, then England and the Netherlands (North and Thomas 1973:56). Monopolies might be granted to traders, and letters of introduction given to help the merchants establish themselves in foreign courts. They might be given the status of ambassador for similar reasons.

High level state support was a consequence of Europe's fragmented political landscape. The divided nature of Europe's political map also provided some advantages for technical and commercial advancement. Smaller political units meant rulers had less agricultural land to tax and were more likely to support merchants in an attempt to raise income (Pearson 1991:69). Rulers were closer to merchants and the other people under their rule. This reduced information asymmetries creating a governance system in which rulers were more likely to be in tune with their subjects' needs.

To some extent, the divided landscape provided a political market where the consumer was left with a degree of choice. The existence of many divided kingdoms meant there was no central power to suppress commercial activity or original thought. If a government tried to stop trade as they did in Ming China, the merchants could move to another state. There was always a lord or prince somewhere who would tolerate merchants and if oppression came, the merchants moved on. Europe certainly had its share of incompetent rulers but they could only restrict advance in their limited region. For example, though the Pope did suppress the discoveries of Galileo, Galileo's discoveries could be taken up by Protestant thinkers in Holland, England or Geneva.

Decentralisation also meant one other vital factor - competition. The rivalry for resources so valued by Klein and Porter at the firm level was played out in Europe at the State level and consequently, producing a high level of innovation. The states of Europe were constantly fighting among themselves. Although wars could destroy economies, a competitive arms race needed to be financed. Consequently, despite China and Europe sharing a low view of merchants, European rulers became dependent on their merchants as a source of income. It was in the interests of European states to support their merchants. Before long, political and military competition would become commercial competition.

8.2 European Technological Advance

Many of the eastern technologies imitated by the Europeans underwent further development in their new environment. The introduction of the blast furnace, a Chinese invention, meant that iron could be cast at higher temperatures. Church bells had provided an early demand for the blast furnace technology but it was in conjunction with another Chinese invention, gunpowder, that the political competitive environment of Europe encouraged advancement. Blast furnaces were first used in Europe for casting cannon in 1380. A rising demand from competitive national armies and navies (and later geographic explorers) caused European metal workers to create the smallest, most mobile and accurate artillery pieces in the world.

Greater quantities and qualities of iron had spill-over effects for other industries, including ship building tools and printing. Guttenberg, who had learnt about metallurgy from his father, a goldsmith, adopted the new metallurgical possibilities to another Chinese innovation, printing. He invented the printing press with movable type, which made books cheaper and more available to a wider audience. By 1480, there were over 380 working presses in Europe (Mokyr 1990a:49). Printing greatly expanded the possibilities for recording and distributing ideas and was a vital factor in the European technological revolution. As Mokyr (1990a:65) notes 'a technical literature emerged, written by engineers for engineers, and technical knowledge became increasingly communicable and thus cumulative'.

Europeans developed a respect for machines and the people who made them. The greatest minds concerned themselves with production technology (Mokyr 1990a:64). However, progress was not systematic. There was much duplication and time wasted on alchemy. Yet, by 1500, Europe had achieved a position of technological parity with the rest of the world (Mokyr 1990a:55).

These processes of imitation and advance strengthened the European economic system providing surpluses for trade, education, demand and capital for investment. It provided the conditions on which a domestic shipping industry could grow.

8.3 Early European Shipping technology

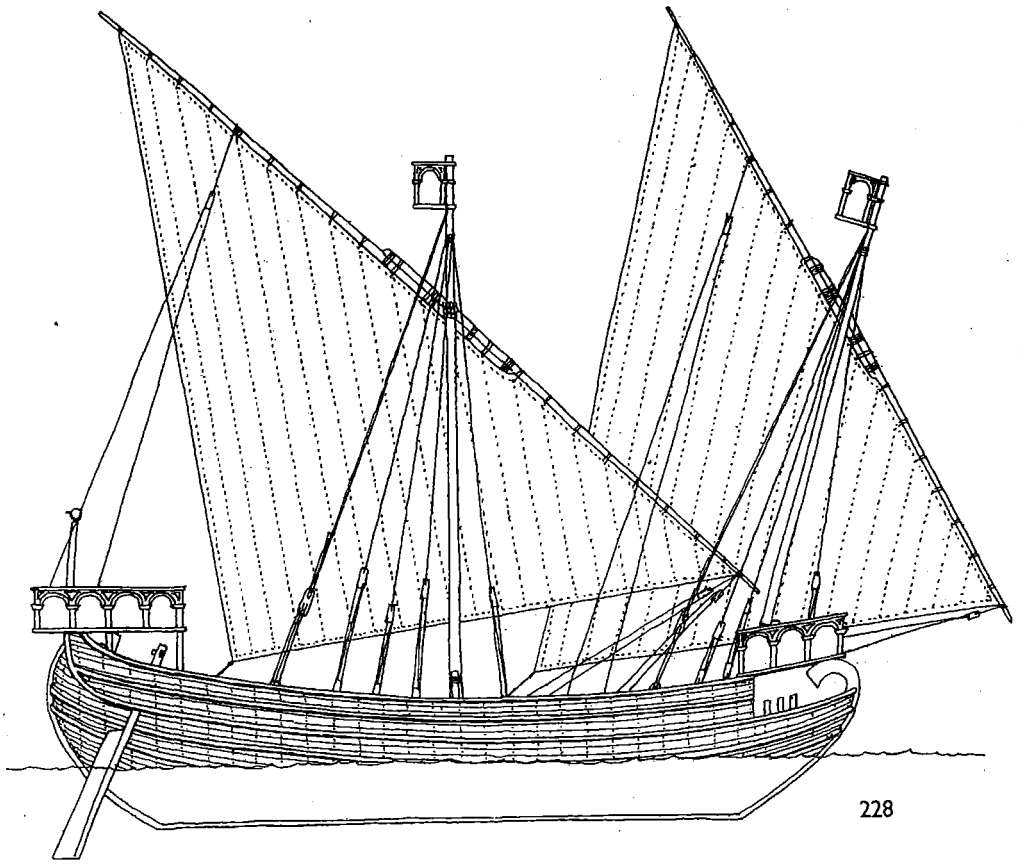
In the early middle ages, as in many other areas of technology, European shippers were well behind the Chinese and Arabs. The high point had been the crossing of the Atlantic by the Vikings but, this was more of an island hopping venture leaping from Europe to Iceland to Greenland before touching the North American coast. Most importantly, it did not lead to an emerging trade or expansion of knowledge. In fact, to many Europeans this success was relegated to myth.

European ships were neither capable of facing severe storms at sea, nor of driving effectively against contrary winds. Limitations in ship strength and navigation technique meant voyages were made by sailing close to the coast, rather than across open seas. Pilots worked on the basis of experience and knowledge of

land marks (Menard 1991:238). However, hugging the coasts brought with it dangers of piracy and the risk of destruction against rocks at the hand of a south-westerly wind. Consequently, mariners spent a great deal of time waiting for favourable winds and, at the first sign of bad weather, would duck into the closest safe harbour. Voyages that could have taken only a few days could often take many months. Long voyages pushed up the cost of transport, forcing up wage bills, victualling costs, and port charges. Variations in voyage length made it difficult to estimate freight costs and respond quickly to market opportunities (Menard 1991: 239). European shipping was a high-cost/low-quality service limited to regional routes.

Our hypothesis leads us to expect a process of imitation to overcome these problems. Certainly, a process of imitation in European shipping is more evident than in the previous two regions. However, it was a very limited process. There are several reasons for this. The ships in the Indian Ocean which could have provided inspiration were too light for the Atlantic winds, although they influenced Mediterranean shipbuilding. The Chinese junk might have served as a better model but the only Europeans that might have seen them were travellers like Marco Polo and while his tales provided information (eg: ships size, use of multiple masts) that was certainly absorbed by the Europeans, distance created a barrier to the rate of imitation. Consequently, with some imitation, European shipping evolved along a path of development that reflected local resources and conditions.

Improved navigation could greatly reduce the cost of transportation and a series of tools and methods were introduced to achieve this end. The Chinese compass, which was a primitive pointer, was introduced and improved by placing the needle on a dry pivot, and a card was placed underneath indicating the wind directions. By the end of the thirteenth century, this improved compass was being used in conjunction with portolan charts (charts with sailing directions). In the north, where there was greater tidal variation, mariners were using tide-tables by the late fourteenth century (Unger 1980:175). These improved navigational methods made sailing safer and more productive. Voyages became more predictable, the number of shipwrecks was reduced and, it now became possible to sail in winter, extending the sailing system. Seamen were still wary of winter storms but, with the new methods, they knew the distance to the nearest safe harbour (Ibid). Sailing in winter meant more voyages could be made per year and earn more form the capital invested in the ship. Safer voyages also lowered insurance premiums. These advances reduced the cost of shipping which further fuelled the expansion of trade.



Mediterranean Merchantman of the thirteenth century with lateen sails

In many ways, development was an environmental selection process as market expansion opened possibilities for experiment by shipbuilders. However, the innovative process was limited by past investments in knowledge of what was technologically possible, a reflection of the path driven development suggested by Dosi (1982) and Nelson and Winter (1982). The slow and gradual process of technical advance reflected the fact that an innovation that failed could result in loss of life at sea. An example of that slowness is the hinged axle rudder, initially introduced in the late twelfth century but not in general use until the middle of the fourteenth century.

The process of environmental selection is evident in that development occurred along several paths depending on the needs and circumstances a ship was intended to solve (Phillips 1994:99). In this way, the environment a ship sailed in shaped the selection of design options. Skippers would, for example, have their own preferred style of rigging. Hulls and rigs did not follow rigid definitions. Such overlap makes it difficult to date the adoption of new technologies as old and new technologies co-existed. A new ship-type did not just arrive. In contrast to Salter's(1966) position that new technology could only be introduced with the creation of fresh capital, some new technologies could be added piecemeal depending on the extent of the change. Clearly, hull shapes could not be changed but adjustments in rigging were made to suit the demands of the route and the desired use of the ship.

For centuries, European shipping had been evolving in two distinct spheres (see Unger 1980 for the definitive work on the development of Medeaval European shipping). In the north, the roughness of the Baltic Sea and North Sea created a demand for a heavier ship, the 'cog' became the dominant vessel. The cog's design was also determined by economic conditions. Falling grain prices associated with the Black Death meant German exporters needed to improve shipping to become competitive. The cog was the solution. Its hull had a rounded shape with a broad flat bottom creating greater carrying capacity. The ship's shallow draught reduced its vulnerability to tidal change. It had one mast setting one square sail making. This made it easy to handle with low labour requirements, labour being expensive after the Black Death. However, the single mast meant it suffered in terms of speed and manoeuvrability. Its high sides were good for defence and positioning archers. A descendent of Viking and Celtic traditions, the cog was clinker built which meant the sides were built up by placing wooden stakes on top of another, slightly over lapping the one below it. There was no internal skeleton.

Southern ships from the Mediterranean area were more exposed to Arab shipping influences and developed very differently. They adopted the lateen sail with which sailors tacking a zig-zag course could make progress against the wind that a square sail could not achieve. In contrast to northern construction, southern ships were built first by constructing a skeleton frame on which planks would be added to the outside. The internal skeleton added greater strength. The planks would not overlap but were placed edge to edge in a process known as 'carvel' construction, saving wood in the Mediterranean area, which had smaller wood

supplies. Southern shipping also differed in the rigging, keel, and the method of supporting the mast. While northern ships needed flatter bottoms so as not to run aground, the Mediterranean Sea experienced less tidal variation so, the keels of the southern ships were curved.

As trade grew between north and southern Europe in the last quarter of the thirteenth century, it opened interaction between shippers from each region and provided an introduction to each other's ship types. Over the next century, the best features of the two shipping traditions were combined and by the closing years of the fourteenth century, the 'Carrack' had evolved. The earliest carracks were two masted, a square mast as per the north, a lateen sail as per the south. Eventually, captains and shipbuilders realised that adding a third mast allowed captains to balance the wind forces on different sails, giving greater control of the ship (Unger 1996:43). With the addition of the third mast in the early fifteenth century, Europe had its first ocean trader capable of long ocean passages.

What became known as the 'full rigged ship' enjoyed improvements that were not restricted to rigging. The ships hulls were carvel-built in the Mediterranean tradition, but contained several northern features, particularly a tall stem, marked sheer, and straight keel. A higher length-to breadth ratio meant the ship could travel faster than the old round ships. From the cog (and before that China), a stern-post rudder was used for steering. The process of imitation and internal evolution resulted in a fast, strong, seaworthy ship that could sail close to the wind, and be more easily manoeuvred than its predecessors (Menard 1991:239-40). With more masts and sails, ships could capture more wind-power so bigger ships could be built with a large cargo-carrying capacity.

Unger refers to full-rigged ships as the 'great invention'. However, this was no technological leap or Gersick-type punctuated equilibrium. As the previous discussion states, this was a slow and gradual process of improvement in which designers responded to environmental opportunity and constraint but, at the same time were limited by previous knowledge. Eventually, a threshold was reached in which they could venture out until the great oceans. However, advance did not stop once this threshold was crossed.

The external environment shaped the development of technological change, in particular demand conditions and factor prices (Unger 1980:277). As trade grew, a more established demand for cargoes allowed shipbuilders the luxury of building larger ships. For example, traders in Genoa, with their high priced cargo, were more able to accommodate the expense of experimentation in ship design and were early movers of the carrack which, by 1500, constituted 90% of Genoa's merchant fleet (Friel 1994:86). There was a constant desire to improve handling capabilities as this reduced manning requirements.

Supply side changes also improved shipping technology. Advances in metallurgy resulted in better quality tools. It was now possible to produce saws that could effectively cut hardwood (Bill 1994:154), while the

introduction of the brace made it possible to bore holes for nails (Unger 1980:226). Stronger ships could be built more quickly. Unger (1980:277) also notes that the government intermittently contributed to technical advance and greater efficiency, although some of the directions that governments took led to extreme waste, particularly when monarchs wanted to build big ships as a sign of prestige. The result was ships of poor manoeuvrability and sea-worthiness that did nothing but sit in port all day.

The last important transformation of European shipping was the placement of artillery on board. The competitive structure of the European state system had resulted in reliable guns that although small had a force equal to monster iron siege guns. Their placement on ships changed naval defence as their ability to cripple or even sink an enemy vessel dispensed with the need for the assailants to board ships (Kennedy 1976:16). This would give Europeans a strong advantage when they ventured in foreign and hostile waters. It reduced the risks of shipping and the costs borne from losses.

8.4 The Rise of Spanish and Portuguese Shipping

By the fifteenth century, Europeans had not mastered trans-oceanic sailing, despite the improvements in maritime capabilities. In this section we examine how these nations acquired the capabilities which propelled them into global leaders in the shipping industry.

The countries of the Iberian peninsula possessed one vital difference from the states of northern Europe. Both nations had previously been occupied by Islamic rulers, an experience that filled these Christian nations with a crusading zeal against Muslims. Initially, Spain and Portugal fought the Muslims on their own territory, but eventually the 'reconquista' mentality evolved into a Christian imperialism that would lead them on to the high seas. The reconquista mentality can be characterised as a militant Christianity, in a society which placed high value on defeating the forces of Islamism. The knights who exhibited valour in such exchanges deserved the high status and the title of 'gentleman' or nobleman'.

Portugal and Spain also benefited from a geographic position which overlooked the Atlantic but backed on to the Mediterranean, a handy position to tap into the commercial and maritime expertise of the nearby Italians (Verlinden 1953). The Genoese were especially valuable in the Iberian imitation process, providing both capital and maritime expertise. From the time of King Dinis (1279-1325), Genoese had dominated officer corps of the Portugal navy (Verlinden 1996:54) and, Portugal's first colonial possession, the Canary Islands (later claimed by Spain), was a discovery of Genoese seamen in the service of the Portuguese government (Ibid:55).

Advance onto oceanic routes was a State-driven research and development project steered by Prince Henry of Portugal. In 1414, the Portuguese Prince fought in the siege of Ceuta in Morocco where he had the opportunity to talk to Muslim merchants about the countries crossed in the inland caravan routes.

Information on the gold supplies in the Upper Niger and Senegal river and looted spices and riches helped confirm the impression that greater wealth could be obtained from trade and shipping. When in 1419, he became governor of Algarve in southern Portugal, he began to put his dream in to action.

Henry's pursuit of gold at the famed Rio D'ora (and Colombus's desire to reach the East) might imply some support of the Austrian notion that these entrpreneurs were attempting to benefit from arbitrage, the implication being that prices of a good are cheaper at its source. However, there is only limited support for this. Henry's motives for exploration were not just the pursuit of gold and were consistent with the incentive structure of the day (Russell 2000:120-8). Henry saw himself as a crusader and his caravels were sent to do as much damage as possible to the Moors along the African coast. His missions were led not by merchants but by squires from his household, while his ships sails were adorned with the cross of the Order of Christ.

At the time, Henry was known to be rash and a poor military planner. Many around him questioned his judgement (Russell 2000:146). If we accept Casson's (1982) statement that an entrepreneur has judgement that differs from the norm, these statements open up the possibility that two characteristics of a succesful entrepreneur might be stupidity and luck, not the generally accepted trait of superior insight. However, after Henry's success, chroniclers and historians would describe him as being astute and full of foresight, the evidence being in his achievements. As a decision making entrepreneur, Henry may have been innovative but, it was innovation within the realms of reconquista paradigm with emphasis on Christian-military values and the defeat of Muslims.

Most of Henry's initial shipping was directed towards colonising the islands off the African coast, the Azores and Madeiras, where sugar plantations were established (Ibid:64). These islands gave the Portuguese experience of the Atlantic wind system and ocean going sailing. From here, Henry sponsored a series of expeditions down the African coast. Developing new routes was fraught with danger so advance was gradual, each voyage going further than the one before it. It was a case of learning by doing and the gradual accumulation of new knowledge. Learning was systemised by the use of logs in which the captain recorded his observations and experiences. These were used in later voyages.

The existing rationality at the time recognised that psychological and physical barriers existed. It was reported that if a ship went past Cape Bojador they would be overcome by a number of possible disasters, for beyond it lay boiling seas in which terrifying monsters lurked and, if the tropical sun didn't burn the sailors black, Satan himself lay awaiting (Russell 1995 XI:11, Boxer 1969:26). The tales of dread were supported by currents and northerly winds that made returning difficult. These tales presented a huge barrier to entry into the African trade and Russell (2000) suggests it may have been invented by Muslims to protect their trade.

In 1434, Prince Henry's sailors passed the Cape without being burnt, boiled or dined on by sub-terrainean monsters. Despite breaching this bind on rationality and market entry, Henry's success was not immediately applauded. He faced all the criticism of an entrepreneur-dreamer spending resources on an untried project, as his chronicler records:

> during the first years, seeing the great number of ships that the Prince fitted out for the purpose at such expense... they gave themselves up to criticising something of which they had little understanding. The longer it took for the enterprise to produce results, the more their criticisms grew. The worst of it was that not only the plebian people but also those of higher rank spoke about the issue in a contemptuous way, believing that no profit would come from so much expense and effort. (Quoted in Russell 2000:110)

The early advance absorbed huge costs with little return so, government patronage was vital for this R&D in oceanic routes to continue. The State was instrumental in overseeing systematic changes needed for the industry to progress. The monopoly the State granted itself brought out many of the advantages for R&D suggested by Schumpeter(1942) in that it reduced the risks of competition and encouraged investment in what would otherwise be a very high risk venture.

Advance was assisted by the high levels of knowledge resources and human capital that Europe had attained after its earlier process of imitation. It opens an interesting example where the technology itself might not have been imitated but other aspects in the commercial environment that have been imitated gave Europeans the capabilities to develop the technology themselves. The voyages down the Atlantic opened up new problems about establishing position at sea. At a time when the rediscovery of classical books on geography had given the study of navigation more importance and respect, Henry brought together leading mathematicians, cartographers and astrologers (McNeill 1976:572). It was a key example of a centralised ruler creating systematic change, bringing together peoples who if left to their own devices might not have come to the same arrangement.

Henry's experts developed the 'altura' system of navigation, in which the latitude of the ship was determined by examining the height of the sun at midday (not the pole star). This was made easier by the use of more reliable instruments (in particular the quadrant) and tables which related the height of the sun to degrees of latitude. By the sixteenth century, published guides and tables for pilots were available. Such changes placed new demands on captains who now had to have a grasp of theory of astronomical observations for finding positions and be able to do some mathematics.(NB: Arab and Chinese pilots of the Indian Ocean knew how to take the position of the sun or stars to derive their own position and had developed a form of quantitative navigation well before the Portuguese.)

The expansion of knowledge was cumulative, another case of the path-like development suggested by Dosi (1982). While new navigation techniques allowed ships to travel further, the resulting discoveries allowed cartographers, the opportunity to make more reliable charts. This in turn gave captains greater confidence to sail out of sight of land. In this way the Portuguese built up capabilities and confidence in long oceanic ventures.

This building of capabilities was clearly indigenous not imitative, although it did have imitative aspects. The initial ships chosen for the exploration were single masted barks and barrinet but both proved inadequate, and by 1440 the caravel became the basis of Iberian exploration. The caravel was initially a small vessel used for fishing and coastal trades (Elbe 1994:91) and probably had Arabic origins (Unger 1980:212). Being light, fast and manoeuvrable it was highly desirable for venturing in unknown waters. With low sides, sharp ends and two lateen sails, it could sail closer to the wind than any other type of European vessel. Although Elbe (1994:92) says there is no evidence that Henry the Navigator improved the caravel, it under went much modification during this period. A third mast was added, and the ship grew from 50 tons to 150-200 tons. A stern post rudder and square rig was added, becoming another variant of the fully rigged ship.

Henry's team was developing capabilities not only in maritime technologies but, they were also contributing to the growth of knowledge in geography which was a leading science of the day much as micro-biology is today. It involved a process of trial and error which was amalgamated with existing knowledge and resulted in a growth of knowledge of routes, winds, currents, coastlines, civilisations and markets. As with modern R&D projects, it involved a high degree of risk and clearly not all voyages were profitable as Henry had to draw on the reserves of the Military orders which he led to fund them.

In 1447, the military nature of the voyages came to an end when they reached black Africa. Here, they encountered poisoned arrows and lances which created a level of discomfort that suggested they resort to more peaceful methods of increasing their wealth (Russell 2000:213). From this point on, the voyages became solely trade missions, initially trading horses for slaves. As they went further down the African coast new markets were opened, in particular, gold and pepper. They provided the earnings and incentive on which further voyages could be based.

Trading in slaves opened up a new economic path inconsistent with the current institutional structure and it called for a process of legitimisation. A new spin was given to the trade, saving souls, as the fifteenth century chronicler Zurara records:

> The only thing that concerned your generous heart was not the thought of the small material gain... Instead of that, you were moved only by your pious intention to seek salvation for those lost souls... That is why, when

> you saw the captives displayed before you, so great was the pleasure the sight of them gave you that you reckoned as nothing the expenses you had to lay out (on this enterprise). (Quoted in Russell 2000:256).

State sponsored research continued after the death of Prince Henry. King John II, who took the Portuguese throne in 1481, financed a number of exploratory voyages and in 1487, Bartolomeu Dias became the first European sea captain to round the Cape of Good Hope. Finally, in 1497 Vasco de Gama, went completely round the Cape into the Indian Ocean and, with the aid of a Gujarati navigator that he picked up in Africa, reached as far as Calicut, India (Verlinden 1996:79). Another Gujarati, Malemo Cana showed De Gama nautical instruments and a chart of the Indian Ocean, and explained the winds and currents that determined navigation in the ocean (Ibid:79). The lesson did not stop the Portuguese from making mistakes on their return trip but provided an introduction to Indian Ocean navigation that trial and error would enhance.

A vital piece of knowledge gained through trial and error was that of the Atlantic wind system. The Portuguese learned that the quickest route between two points was not a straight line down the coast, but to sail far west towards Brazil where they could catch the westward winds that would carry them into the Indian Ocean. Such knowledge was kept secret and provided a huge competitive advantage over would-be competitors.

King John II had also received a proposal from Christopher Columbus to finance a trip to India by travelling west across the Atlantic. After some consideration, he decided not to finance the project and Christopher Columbus, turned to Spain where the advantages of the decentralised political environment once more assisted technological advance. Ferdinand and Isabella were won over on the basis that if they didn't support Columbus, he would go to a foreign power. They did not want to lose the possible benefits to a rival (Philips and Philips 1996:160).

At this point, we become aware of the importance of changes in the supporting economic environment and the earlier imitations from the East which had raised the level of knowledge resources in Europe. Columbus was very much a product of this environment. He came from Genoa, the cradle of European seamanship and had lived in Portugal for some years where he had travelled to the Madeiras and the African Gold Coast. In Portuguese caravels, he had gained knowledge of currents and winds, islands and shorelines that was not available to an earlier generation (Ibid:152). He was also the product of the new age of printing. He had read Marco Polo and had used the wealth of Asia as a selling point in his proposal to the King. He would have known of a work by Silvio Piccolomani (later Pope Pius II) which summarised the rediscovered Ptolemy's geography but rejected the idea that the Indian Ocean was closed off from other seas (Ibid:155). He had also read *Imago Mundi* by Pierr d'Ailly, which suggested a westward voyage from Europe to Asia was possible and it was on this that he based his calculations (by this time, everybody was aware the world

was round). Finally, Columbus's ships embodied the latest European technology (two modified caravels and one carrack).

Columbus was not the only European to venture out into the Atlantic during this time. Fernandez-Armesto (1996:146) notes that between 1452 and 1487, at least eight commissions were issued in Portugal, and at Bristol, English seafarers were searching the Atlantic for the mythical island of Brazil. Luck played a key part in the eventual Spanish success. Spain had already developed the Canary Islands as its first maritime colony, with the financial backing of Genoese merchants. By good fortune, the Canary Islands were close to the prevailing northeast winds. Columbus reached America because, in having a starting point at the Canary Islands, he was closest to the trade winds that could power him across the Atlantic (Fernandez-Armesto 1996:145/6). However, Columbus's R&D venture had failed to find a route to Asia, and the wealth he found in the Indies was not enough to compensate for his failure (Lundahl 1998:102). It would take thirty years before the New World would yield substantial returns (ibid: 118).

Spain did not stop its maritime research with Columbus. Most prominent was the sponsorship of Magellan, an excellent Portuguese navigator who had travelled to the East Indies in his youth and had widely read the geographical theories of the day. He was convinced that the only reason Columbus and Cabot had failed to find a route to the east was because they had yet to discover a way through the Americas (Milton 199:25). Discharged from Portuguese service after being accused of treachery, he travelled to the Spanish court and obtained sponsorship for what was to become the first circum-navigation of the world, with the consequent addition of the Philippines to the Spanish trading empire. Once experience taught the Spanish the nature of the wind system in the Pacific, this led to the development of a new commercial system not imagined by any of the visionaries, the Manila Galleon trading between the Philippines and Americas.

The opening of the routes to Asia and America heralded a commercial revolution which reshaped the world of global commerce and shipping. But the voyages of Columbus did not over night cross a threshold and create a situation of punctuated equilibrium, for it took decades for the potential of South America to be realised. Opening of the Asian trade more readily fits the description of punctuated equilibrium but it was achieved only after a century of R&D down the African coast.

The Spanish and Portuguese had now achieved more than any seafaring nation before them. However, aware of the possibilities of destructive rivalry, Pope Alexander VI had earlier drawn a line which divided the world into Spanish and Portuguese spheres of influence. Unfortunately, sixteenth century maps were very inaccurate and left open potential areas of conflict. Nevertheless, the Treaty of Tordesillas (as it was signed) became the basis of a power-sharing document. The implication for shipping was routes could be divided into a quasi market-share agreement. The agreement gave Spain most of the Americas and took them as far East as the Philippines. Portugal had Brazil and Asia.

8.5 Sources of Iberian Competitive Advantage

With the opening of the trade routes, the Iberian nations had revolutionised commerce, creating a new development path, which for the sixteenth century became their exclusive monopoly. The Spanish and Portuguese completely dominated the Atlantic. The Portuguese were the only traders regularly linking Asia and Europe while Spain's Manila Galleon was the only regular route across the Pacific. Portugal sent about seven ships to India every year in the period 1500-1635, averaging about 600 tons at the end of the century, as well as building ships in the Indies (Phillips 1990:49). In the Atlantic, about 100 Spanish ships with combined tonnage of 9,000 tonnelados (aprox 7,200 tons) traded across the Atlantic each year during the 1520s (Phillips 1990:78). In the latter half of the century, this had grown to 150-200 ships, and as the ships had doubled in size carrying on average 200 tonnelados (aprox 160 tons), to provide a total of 30,000-40,000 tonnelados (aprox 24-32,000 tons). In 1584, the Brazil trade occupied some 40 ships on the Recife and Lisbon route, growing to 130 in 1618 (Boxer 1969:105).

The competitive strength of Iberian shipping rested on supportive government policies, organisations that maximised the dissemination and utilisation of the latest technologies, superior shipping skills and reputation.

8.5.1 Skills, Experience and Reputation Vasco da Gama's first journey to India had been very expensive. This party lost 65% of their tonnage and 63% of their personnel. The pepper they returned home with only amounted to six tons (Duncan 1986:6). However, the Portuguese soon learned from experience and dramatically reduced these costs. By 1500, they had learnt the need to schedule sailings to fit with the monsoons. While da Gama's ships took between 733 and 804 days, the next fleet led by Pedro Alvares Cabral took only between 471 and 505 days.

The Iberians had acquired their knowledge over a century of trial and error. Knowledge of trade routes was vital for success in the industry. A particular advantage was their knowledge of the Atlantic wind systems, the energy source for their trade. On voyage, pilots were required to keep daily logs and make records of the position of the sun, wind and weather patterns, the course they sailed and any noteworthy signs (Zandvliet 1998:17). On return the pilots gave the logbooks to the authorities who would upgrade their charts and sailing instructions. In this way, the government organisation acted as a store-house of knowledge. Before departing, it issued instructions to ships that included the sea route, geographic and technical instructions as well as rules to ensure on-board cleanliness, order and discipline (de Jesus Teodoro Dos Martires Lopes 1997:132). With this knowledge they possessed first mover advantages of which other nations had no knowledge.

Both Spain and Portugal capitalised on the early acquisition of knowledge with the creation of schools for navigation in the early sixteenth century. At Lisbon, the Almazen de Guine e India (Storehouse of Guinea and India) was created, and at Spain a school was attached to the Casa de Contracion in Seville. From the early sixteenth century, Portuguese pilots were required to read and write. Armed with astrolabe, quadrant and the navigation advances developed at Sagres, they crossed the globe. With the added benefit of experience and interaction with locals in the various regions they travelled, Portuguese became navigators par excellence. It is significant that the percent of tonnage lost on the route to Asia declined from da Gama's 63% to a average of 5.4 % in the 1570's (Duncan 1986:23). Such was their reputation, that other European governments did all they could to tempt Portuguese into their service (Magelhaes Godinho 1993:36).

The Portuguese reaped the returns from a large investment in technology with which they developed skills that other European nations could not compete. Their knowledge of wind systems and routes was vastly ahead of any other European nation who might think of challenging them. The Portuguese complemented their position with investments throughout Asia, forts and trading posts. Hence Portuguese success rested on superior skills, infrastructure and reputation. That reputation developed into an aura of supremacy that further protected them from any challenges.

8.5.2 Compatibility with Religious and Military Institutions The prevailing belief system in the Iberian nations was the 'reconquista', a consequence of centuries of fighting Islamic armies. This belief system was embodied in the key institutions at the time; the crown, church and military orders. It was no coincidence that, in the year Columbus sailed, the Moors were defeated in Granada and Jews were expelled from Spain. King Ferdinand in 1481 had stated previously his aim 'to expel from all Spain the enemies of the Catholic faith and dedicate Spain to the service of God' (quoted in Kamen 1983:33).

The adoption of the fully rigged ship was fully congruent with this institutional set up. The great Spanish nobles had owned ships for centuries, providing ships for expeditions against Moors in Granada and the African coast (Pike 1972:31). For the Portuguese 'Trade and religion were two sides of the same coin; to deprive the Arabs of trade profits and to kill them as enemies of Christianity became the passion of the Portuguese for the next several decades' (Sar Desai 1981:84). The reconquista spirit more than made up for a weak capitalist spirit and small industrial base.

Of course, not all entrepreneurs were driven by the same incentives. Bernal Diaz del Castillo, who participated in the conquest of Mexico stated 'We have come here to serve God and also to get rich' (quoted in Lundvahl 1998:108). On the other hand, when a Priest reprimanded Francisco Pizario for maltreatment of Indians and failure to teach them the gospel, he was told 'I have not come here for any such reasons. I have come here to take away their gold' (ibid:107). Christopher Columbus had been driven by

both incentives but, he was very clear on what was most important 'Gold' he said 'is a wonderful thing! Whoever possesses it is a master of all he desires. With gold one can even get souls into paradise' (quoted in Galbraith 1987:35). One clear incentive for all the entrepreneurs across the Iberian peninsula was the desire to become a gentlemen (or hidalgo).

The new economic system provided commercial and bureaucratic entrepreneurs an increased level of social mobility and revolutionised social values (Kamen 1983:104). Migration to the Indies made it possible for artisans to become merchants, upward mobility through geographic change. A good example of this can be seen in the career of Francisco de Esquivel Castaneda (Hoberman 1991:130). Francisco was the son of a guild certified silk-master and trader in Granada. His family circle was composed of silk-weavers, dyers and merchants. He immigrated to New Spain and established himself at Mexico City where he began exporting cochineal and indigo, products used as dyes in the textile industry. He also exported Chinese silk, brought to Mexico on the Manila Galleon, back to Spain. His textile background, his knowledge of dyes and family contacts were obviously an advantage. South American resources allowed him to become more entrepreneurial and embark on a new path of development.

The rise in commercial values was not always welcomed. Cervantes, author of Don Quixote, noted that 'Ya no se estima el valor porquese estima el dinero' (money is prized rather than worth). Nor did the aristocracy approve of rewarding merit ahead of noble blood and proven lineage. Lope de Vega believed that 'states are destroyed through men wishing to change their status' (la perdicion de las republicas causa el querer hacer los hombres de sus estados mudanza - Quoted in Kamen 1983:104-5). As much as status could now be gained through non-military means, the rising nobles were still likely to emphasise the old values of virtue, service to the crown, and the exclusive power of the prince to create nobility (Kamen 1983:106). Nevertheless, trade and Christianity travelled hand in hand. Jesuit missions and the Council of the Inquisition accompanied the trading stations around the world, and while they imposed an added cost, Jesuits did at times play an important diplomatic role in getting preferential treatment from local rulers.

8.5.3 Supportive Government Policies and Organisation The commercial revolution that occurred with the opening of the trade routes simply would not have occurred without government patronage. Private investors shied away from such high-risk projects (Hunt and Murray 1999:219). Columbus had much difficulty getting finance and although his first voyage was financed by a royal official and Genoese backers, the second voyage was very much a royal project. Vasco da Gama had sought private funding including the wealthy Jacob Fugers who turned him down in 1493. However, private backers would lend to the crown who would then bear the risk. Consequently the State played a key role in mobilising finance and the officers on Portuguese ships were not merchants but aristocrats.

Portugal's early African trade had been a monopoly since the time of Prince Henry. The monopoly encouraged the Prince to invest in a risky trade as it increased his chances of obtaining a return. However, the monopoly did create opportunities for private entrepreneurs, including non-Portuguese. Contracting expanded the resource base the crown had access to and reduced the risk for the crown. For example, in 1469 Fernao Gomes was given a five year contract in which he was required to 'discover' a minimum of leagues of coast each year and pay the crown 200 milreis per annum in return for a five-year monopoly to trade in those areas (Pearson 1991:78).

When Prince Henry died, the monopoly reverted to the crown, coming under the control of the Casa da Mina. The Casa consisted of an office and warehouse situated on the ground floor of the royal palace 'by the waterfront of the river Targus, where the king could personally watch the loading and unloading of the ships' (Boxer 1969:30). Once the Asian trade was opened it also became the site of the Casa da India, the controlling mechanism for the crowns trade with Asia. It administered two enterprises; the Carreira da India which served the Cape route to India and, the Estado da India which handled the trade within Asia. Each year, the Casa organised and sent a fleet to India.

In Asia, the King entrusted his capital to a network of factors (or trading posts). Each factor consisted of clerks, a treasurer and a superintendent of weights. Factors were located across the Indian Ocean and were responsible for buying and selling the cargoes on behalf of the crown. The King forbade any individuals other than his representatives or licensees from dealing in pepper, cloves, nutmeg and mace. At a latter date, the monopoly was extended to include cinnamon, pearls and elephants from Ceylon.

When the fleets returned to Lisbon, the spices and other cargoes were stored and registered by the Casa da India, after which, their distribution throughout Europe was handled by private traders (including Jews recently expelled from Portugal).

Once the trade had become established, private investors became interested in investing in the Asian trade and there were fewer advantages in having a state monopoly. However, the crown had become an entrenched stake-holder in the route and jealously guarded its revenue flow, even though its removal might in fact increase income through tax on an increased private trade. But this would require the admission that others could do better.

Despite the Royal monopoly, private traders did become quite significant features of Portuguese trade. Aristocrats, captains, pilots and crew were all awarded some cargo space to transport their own goods. Some conducted their own trade but more often they sold these rights to merchants. For example, the new Christian Duarte Gomes Solis loaded cinnamon and cloves on carreira vessels under the Duke of Braganza's trading concessions (Boyajian 1993:39). Many of these merchants also traded in areas beyond

the reach of the Estado. On these routes, private Portuguese traders competed in extended family groups very similar to the locals.

Consistent with this thesis, the private trade developed into a structure that reduced competition. Initially, a number of official, soldiers and other Portuguese citizens based in Asia invested small sums in these private trades but eventually the bulk of the trade came to the hands of a half dozen Lisbon based families. While the royalty clung to the tried and true cargoes, in particular pepper, these merchants expanded into more diverse products such as diamonds and textiles. The cartel-like structure they developed reduced some of the risks of trade.

Manuel Lobato (1997) illustrates the organisational problems incurred by the Portuguese on the India-Mocambique route. The key task was to secure revenue for the crown and the route was initially operated as a crown monopoly. However principle-agent problems undermined operations; the system being riddled with smuggling conducted by state officers, soldiers, priests and Muslims. Resource shortages then lead to the creation of a contract system. In an effort to reduce royal expenses in providing the "trade ship" (involving several boats), a lease was given to the governor of Mocambique in 1585. However the governor lacked the financial means to fulfil the duties stipulated in the contract and the experimental phase came to an end. In 1593, the Zambesi gold trade was thrown open to free trade. Encouraged by the new freedom, importers brought cheap cloths to the region only to find the hide skin clad residents had low income and limited demand for the clothes. Problems of market transparency meant free trade did not produce the desired results and the amount of gold and ivory exported from Africa to India actually decreased. In 1596, the monopoly system was re-established and hired out to governors for a three year term which could be sold on to another fidalgo (nobleman chosen from a small list) for 70,000 cruzados. This system saw the interests of the fidalgoes triumph over those of the state and privateers, and lead to some abuse. To counter this abuse, judges wielding exceptional powers were appointed to Mocambique. Some judges dismissed local governors and made personal fortunes for themselves. The Portuguese never successfully solved these problems of accumulating and co-ordinating sufficient resources, a consequence of information asymmetries and governance issues when a year's travel separates the business units.

The Portuguese crown's participation in the Asian trade declined from the mid sixteenth century. The King's fortresses, fleets and trading voyages were sold or delegated to prominent fidalgoes. Subrahmanyam and Thomaz (1991:312) suggest this was in response to declining trade resulting from an agrarian crisis in India. The new system certainly did not solve the organisation problems. Voyages were now organised under contract by a Fidalgo who paid the King a fixed sum for organising a voyage between 2 or more ports. However, once again the Captains and Fidalgoes responsible for the various routes increased their share of the income at the expense of the crown. The King could do little to control the corruption as

Lisbon was simply too far away and the administration at Goa found it was more in their interests to take what revenue was available to them while they had the option.

The decline of crown involvement in Asia also reflected a rise in importance of Brazil. In the early sixteenth century, little attention was given to Brazil which did not have the same developed products and markets as the east. However, the route to Brazil was shorter, less dangerous and less dependent on wind patterns, and the sparsely inhabited tribes of Brazil could not offer the levels of resistance of the mighty civilisations of Asia (Phillips 1990:55). The Portuguese colonised their South American possession, establishing an agro-maritime economy with export industries based on the region's rich forest products and coerced Indian labour. In the late sixteenth century, sugar plantations were established becoming the most valuable of Brazil's exports. In the seventeenth century, tobacco was also cultivated.

In contrast to the state-driven Asian empire, the Brazilian empire was characterised by private enterprise. The trade between Portugal and Brazil included many 'small men', merchants and ship-owners running small caravels from a number of ports in Portugal. There were few barriers to entry to this trade and the small ships were fast and flexible. Needing only a small load to fill their ships they could load and return, conducting two round voyages in a year (Boxer 1969:221). Private enterprise was also important in developing the plantations and sugar refineries which furnished the ships with their cargoes. The Brazilian trade furnished the government with a 20% tax on imports and exports.

Spain's South American trade was also conducted by private shippers. The Spanish crown had hoped to impose a monopoly on trade to America similar to the Portuguese monopoly to India. However, it soon found that the colonies needed supplies that government resources alone could not satisfy. The trade was thrown open to private traders from Castile and Hispaniola and the government's role was as a regulating, not a trading body.

Pearson (1991:81) describes the Spanish empire as 'a vast contracting out system'. The Crown contracted out the extraction of minerals and other key activities, taking a one fifth return on all profits. The four-fifths that remained was the incentive to the investor. To the crown, this system meant less risk as it did not need to invest any of the initial capital nor was it in danger of incurring any losses. The openness of the contracts also gave much discretion to the investors to make important decisions when they needed to be made without having to refer back to Spain. Consequently, decision-making could be flexible and quick. The only drawback was that the crown would be giving away four-fifths of its income. However, if we consider the problems of governance that the Portuguese crown was experiencing with its staff in Asia, it is questionable whether this system did lead to greater loss.

Even the conquistadors were organised on a partnership basis in which they would pay a royal fifth. Diego Velasquez and Fernado Cortes established a partnership contract with the object of conquering Mexico, in which each were to furnish half what was necessary and take half of any gains (with the King getting an obligatory fifth) (Sayous 1928:288). Similarly Francisco Pizarro, Diego de Almagro and Fernando Luque formed a company to explore Peru. Luque acted as a stay at home partner, providing the money while the other two conquered an empire (Sayous 1928:289-90). The story of how the conquistadors took control of the South American continent need not be repeated here but is worth noting for the reinforcing effect it had on the reconquista mentality of the Spanish (for further reading *The Conquistadors* by Descola is a recommended source).

To govern the Spanish empire, a council of the Indies was created through which university-trained lawyers governed. It was a change that recognised that maintenance of the empire required different skills from those which constructed it. As (Parry 1966:169) states 'The battle scarred conquistador had been replaced by the official and the lawyer in the administration of the Indies' and, an immense body of secretary officials (escribanos) came into being. Although retaining the old value system, Spain was creating its own Mandarins.

The Casa de Contracion de las Indies (House of Trade) was created in 1503 to regulate and encourage commerce with the new regions. The Casa was a revenue-collecting agent for the crown so checked ships cargoes and collected the appropriate customs duties, especially those carrying precious metals. It registered all cargoes and passengers going to the Indies, activities that not only kept the crown in touch with trade developments but also provided 'clarity and precision in freight contracts between shipowners and merchants' (Haring 1964:59). Although these activities were introduced to protect crown revenues, they had the effect of reducing transaction costs for private shippers, although imposing compliance costs.

The Casa exercised a considerable degree of technical control (Parry 1966:56) ensuring the full benefits of the new technological and navigational knowledge was exploited. It was responsible for fitting out fleets sailing on behalf of the crown and inspected privately owned vessels to ensure their seaworthiness. To ensure safety, it enforced upper and lower limits on ship size and determined the number of armaments for defence, requirements to carry bilge pumps, spare parts and tools, and established strict use of fire on board. The Casa licensed navigators and its technicians kept a systematic record of all discoveries in the Indies which they charted on a standard chart, the 'padron real'. Charts of ships sailing to the Indies were inspected to ensure that they conformed to the most recent knowledge (Parry 1966:57). The Casa appointed a chief pilot under whom a navigation school developed, the first of its kind in Europe. In time a Hydrographic bureau, school of Cosmography and a nautical school were added. As Parry (1966:57) notes, although criticised for their restrictiveness, in the early years of development, the Casa performed essential services for the development of the trade.

Under the Casa, trade was restricted to Seville (later extended to Cadiz). The logic of restricting trade to one port was the greater ease in maintaining control. However, it had the added benefit of providing economies of scale through the facilities based there. Seville could serve all the needs of the trade including the machinery of dockyard services, financial and commercial organisation. Seville had a strong commercial endowment in terms of size, wealth, and availability of commercial experience. The port was safe and had easy communication with the hinterland. These forces combined to make the Seville monopoly both legal and effective (Parry 1966:125)

Initially, merchants preferred to arrange their own transport between Spain and the Americas. After 1526, merchants ships were forbidden to sail alone to America (Harring 1963:304) and a convoy system was introduced. The policy was to protect ships from privateers and pirates as well as assisting to enforce the limited port policy. By the 1540s, the fleet sailed once a year in a convoy to the Caribbean where it would divide into two; one half sailing to New Spain (Mexico), the other to Tierra Firme (Northern South America) and Panama. As time progressed two separate fleets served the two destinations (Phillips 1990:77-8). A guard squadron was provided to accompany the fleet, six to eight galleons for the Tierra firme fleet, two for the fleet to New Spain. The convoy system was not all-inclusive, accounting for about 85% of the trade but its usefulness was such, that when the convoy was eventually abolished in the late eighteenth century, 85-90% of the trade still sailed at the same time and routes which were based on the ideal sailing conditions for the route.

The Casa provided protection to the trading fleets with an Armada paid for by a tax on shippers (the averia). On later occasions, the task of collecting the averia and organisation of convoys was let out by contract to private individuals. In the three hundred years of its existence, only once was a fleet lost to foreign attack.

When merchants started trading to the Americas, they initially sent goods on a speculative basis, to be sold at fairs in the principal ports of America. As merchants established themselves in America on a more long-term basis, connections were formed between the American contact and the house at Seville in which the American contact undertook to sell merchandise sent from Spain and purchase metals or products for the return voyage.

Sayous (1928:283) notes that both the old Italian commenda and societas forms of partnerships were very common in the Spanish-American trade. The heads of houses in Seville could not leave their businesses for any length of time so would send confidential agents with whom they formed company contracts. Such contracts allowed people with capital to expand their range of commercial activities. At the same time, it provided bold entrepreneurs access to capital and participate in entrepreneurial activity otherwise

inaccessible. In the commenda, travelling partner contributed only services but with societas contributed both capital and services.

Although South America was closer than Asia, it still gave birth to problems of information asymmetries. Sayous (1928:296) notes how in the Seville-America trade, European capitalists might offer the travelling partner a quarter of the profits made on 2,000 ducats of goods but providing him with goods to dispose of far in excess of that value. On the other hand, European houses complained of agents not sending in accounts or misbehaviour in the dealing with funds. As in the East, this principal-agent problem was a prime reason for choosing family members as partners and agents and the family was the basis of business organisation.

The firm of Alvaro Jorge, an ex-silk mercer provides a useful example. They were active in the Afro-American slave trade and owned several of their own vessels. They maintained a network of agents in the new world and these normally were staffed by younger family members (sons or nephews). If it was necessary to employ someone from outside the family, someone with similar origins would be sought. Being conversos, this meant other converted Jews. Similarly, many of their business associates were related through marriage (Pike 1972:106-7). This reliance on family trust for commercial control also reflects the limits of the Spanish legal system.

Shipowning could take a number of guises. Great Lords might own a ship outright which they might combine with investments in the wholesale trade of merchandise and slaves (Pike 1972:31-2). However, the typical shipowning structure was of three individuals, two merchants or lower nobles and a ship's master (Pike 1972:31). These lower classes would be involved in a larger range of commercial activity which as well as shipowning, slave and merchandise trading might include extending loans and credit, and New World enterprises such as cattle raising, sugar production and Pearl fishing (Pike 1972:33-4). Small merchants built shipping enterprises which by the mid-century had become large merchant dynasties.

Many of the merchants were 'conversos', Jews who converted to Christianity to escape persecution. An example of the richest Sevillian businessmen was Ruy Diaz de Segura who learnt his business skills as an old clothes dealer (trapero). He owned three ships involved in the carreira de Indias, the caravel *Santa Maria del Cabo*, the *Santa Maria de la Consolacion*, and the *Santa Maria de la Regla* which he owned with his cousin (Pike 1972:50-51).

Increased concentration consistent with the thesis occurred in 1543, when the Sevillian merchants who at that time dominated the trade, succeeded in securing exclusive rights to the trade. This monopoly status occurred, when after repeated petitions, the merchant houses were legally incorporated in a 'Consulado' or merchant guild. For the crown, this involved an increase in efficiency in its commercial jurisdiction. As

trade with the Indies expanded, the number of commercial lawsuits increased and the Casa de Contracion "was choked with business". The new guild took over these legal aspects and simplified and shortened legal proceedings (Haring 1964:44). The merchant houses developed an extensive agency and commission business importing and exporting throughout Europe and the new world. The guild became a rich and powerful distributional coalition 'well able to defend its privileged position by litigation and to pay for them through the loans made it made to an impecunious government' (Parry 1966:125).

8.5.4 Supporting Industries With the exception of shipbuilding, supporting industries based in the home country were never a key ingredient to Iberian success. Ships for the Portuguese-Asian trade were built in the king's arsenal (armazen da India) on Lisbon's wharves. The Armazen by itself was one of the largest commercial enterprises of the day, employing 1500 men (Boyajian 1993:4). The Armazen also contracted with private traders to provide the biscuits, wine and other stores for the voyage. Another armazen was established at Goa to serve the fleets for the return voyage, employing as many men as in Lisbon.

Spanish shipyards were privately operated but occasionally given naval or crown contracts. Shipbuilding was an industry that had received subsidies in both Spain and Portugal for a very long time given the importance of ships to defense (Clayton 1976:239). Merchant ships would be used in time of war. During the sixteenth century, shipbuilders prospered with the expanding Indies trades and protectionist laws that since 1540, barred foreign built vessels to be used in the carrera.

The government was a key factor in providing innovation in shipbuilding. The Spanish government kept a close control of its shipbuilders so that the private ships built would also be suitable for public defensive needs (Phillips 1994:107-8). While the government dictated a number of requirements it was forced to consult shipbuilders about those regulations. The state showed a willingness to experiment (Phillips 1994:108) and shipbuilders had a considerable freedom of action (Clayton 1976:239). It was a period of experimentation with some bizarre results and some great successes, such as the work of Menendez de Aviles and Alvaro de Bazan who developed the 'vesselei', a narrower and faster ship than previously existed in the Spanish fleet (Clayton 1976). In the 1550s strenuous efforts were made to develop the galleon, also under the admiral Alvaro de Bazan (Parry 1966:134). As John Fincham stated 'as the science of naval architecture was formally encouraged more in Spain than elsewhere, the ships were better than those of the northern nations' (quoted in Phillips 1994:107).

The other key supporting industries were those that filled the hulls with cargoes. From Spanish America, cargoes included hides and tallow, sugar, indigo (a blue dye made from vegetables), cochineal (a red dye made from small insects), exotic woods and medicinal plants. However, the most valuable of the exports from the Indies were the gold, silver, pearls and precious stones. An estimated 164,000 kilograms of gold

was exported from the Indies to Spain in the 150 years until 1660 (Hamilton quoted in Phillips 1990:85) providing the Spanish empire with a comparative advantage to complement its shipping.

In the 1540s and 1550s, silver mining leapt in importance with the discovery of the Potosi mine in Upper Peru (present-day Bolivia) and a number of mines in New Spain (Mexico). The industry was aided by the introduction of the mercury amalgamation process which made possible the refining of low grade ores. The mining industry presented yet another example of increasing concentration consistent with the work of Abernathy and Utterbuck (1975). Initially, there were a relatively large number of mines in America however, as the more accessible beds were exploited, the number of owners declined. The remaining mines had high capital costs to cover drainage and excavation. By the 1570s silver mining had become a technologically complex, capital intensive enterprise owned by a small number of Creoles and Spaniards (Hoberman 1991:73). From the mines, a small number of merchants refined the silver, before it made its way to the Royal Mint which supervised the final manufacture and standardised output.

As the resources of the American hinterland were exploited more industries came to have an impact on trade. Sugar cultivation spread in the last decades of the sixteenth century with merchants investing in sugar mills and plantations (Hoberman 1991:95). Cochineal and cocoa were grown by native Indians who possessed the required expertise. Local agents and even priests would act as middle men on the products way to port. Indigo mills appeared while haciendos tapped the agricultural output of the continent.

Brazilwood and other woods were key exports from the Portuguese Atlantic colony, but the most important export was sugar whose importance grew with the spread of plantation production (Phillips 1990:57-8). A labour shortage on Brazil's plantations was solved by importing slaves from its African colonies. Having a source of slaves from its African trading posts also helped it gain the contract (asiento) to supply slaves to the Spanish colonies which it held between 1573-1676.

The complementary demand patterns for these cargoes enabled the Iberians to carve out a global economic system. From Africa slaves would be transported to South America where they worked the mines and plantations. Bullion and other produce from South America would be shipped to Asia and exchanged for goods which would then be shipped to South America and Europe. At the same time bullion, sugar and other produce from South America would be shipped directly across the Atlantic to Europe.

While this new economic system unleashed previous undeveloped resources, this was no free market. Certainly in China and the Indian Ocean, the Iberians had to accept the market price but, the key cargoes of bullion was extracted from mines by using slaves which had been taken from Africa by force. Conquest and force were key features of the Atlantic system (Lundahl 1998:11). At the same time, the main source of

income in Asia was the enforced sale of passes to local shippers. The Iberians gained no competitive strength from the products they personally made apart from ships and mining.

8.5.5 Knowledge Resources It has already been mentioned how the Iberians built up, stored and passed on maritime knowledge but, other areas of knowledge resources are worth noting. The Jesuit order of priests had initially been created in response to the Protestant attacks which exposed many weaknesses of Catholicism. There was a clear need for more qualified priests and a number of higher educational institutions were created, in particular, Jesuit Colleges.

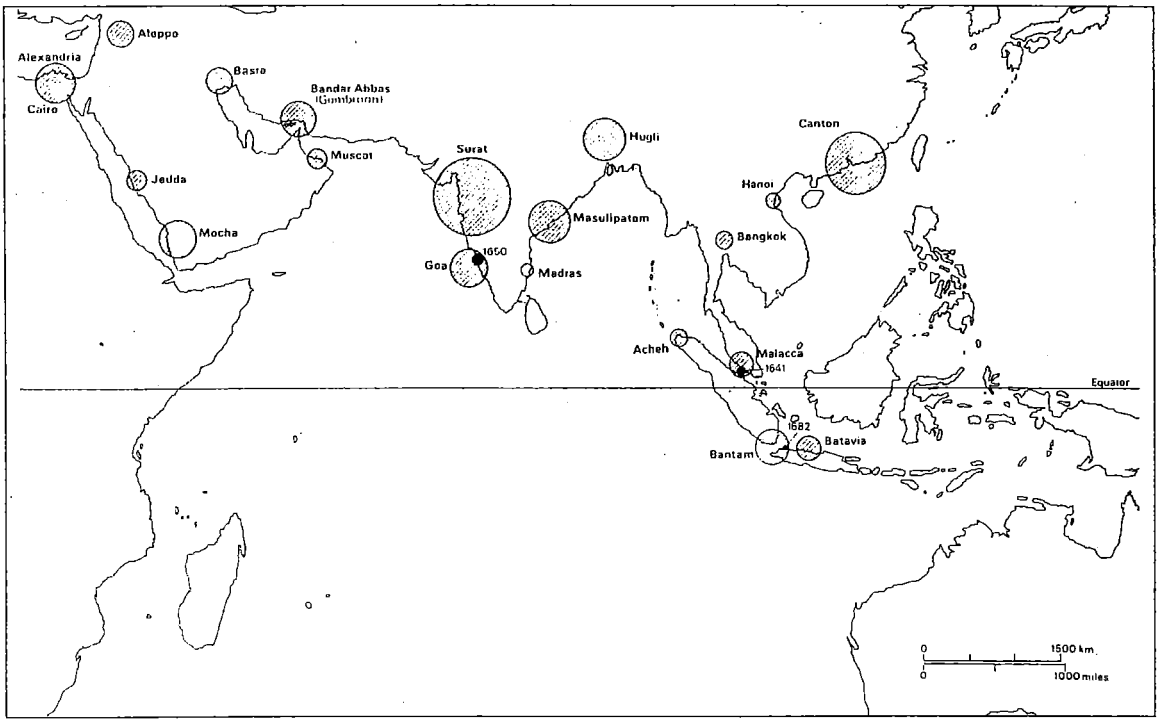
The Jesuit education system was built on the latest knowledge and had obvious benefits for the economy. It led to an increase in the quality of administrators and facilitated scientific advance. It combined with a growing appreciation of the benefits of higher education. Merchants sent their children to the colleges in an attempt to raise their status. At the same time, growing bureaucratic needs of the state increased acceptance of higher education. It resulted in the founding of a number of new universities. While there had been four estudios generales in 1450, twenty were founded in the sixteenth century (Kamen 1983:114).

When combined with the stimulation that the American discovery provided, education improvements propelled Spaniards into the forefront of scientific adventure. They stimulated research into all aspects of natural science including geography, navigation, engineering and medicine (Kamen 1983:192). The first shipbuilding treatise was published at Mexico in 1587. Advances in metallurgy lead to the mercury amalgam program which was introduced in 1556 to the silver mining industry, the most valuable cargo for Iberian ships. This was a period of scientific and technological leadership in Spain

The most extensive trading empire the world had seen was built on a reconquista paradigm. But once established, maritime and organisational efficiencies helped to create an enduring monopoly. From this belief system, heuristics were spawned that supported the use of weaponry, resource development in Latin America and the central role of the crown. These are summarised in table 8.1. For a century, these nations faced no serious competition on the trade routes they had built.

Table 8.1 Competitive Strengths and Related Heuristics of Iberian Shipping

Sources of Competitiveness	Paradigm Heuristics
Shipping industry	
- Use of artillary before ramming and boarding (military strength).	- Use artillery before ramming and boarding.
- Crown support and mobilisation of resources. - Crown organisations act as a store of knowledge and reduce transaction costs.	- Crown as ultimate source of trade revenue and control.
- Ship technology.	- Craftsmen build by experience and rule of eye. - Improve naval technology to compete with foreign navies.
- Skill and Experience.	- A number of rules of thumb, for example sail with the Atlantic wind system.
- Reputation.	
Supporting Areas of Economy	
- Expansionary reconquista Mentality.	- Reconquista paradigm with emphasis on Christian/military. - merchants aspire to status of nobility or clergy. - industry seen as low status with connections to Jews and Muslims
- Natural resources of South America	- Exploit natural wealth of south America



The Structure of Emporia trade in the Indian Ocean after 1600. Due to silting in Cambay's port, Surat became the principle port in Gujarat and, increased its pre-eminence in the Indian Ocean trade despite the arrival of the Portuguese. Mocha replaced Aden as the chief port in the Red Sea while Malacca lost its earlier status (From Chaudhuri - *Trade and Civilisation in the India Ocean*).

8.6 The Portuguese and Spanish arrive in Asia

When the Portuguese first entered the Indian Ocean, they received a welcome from the merchants of Gujarat who saw them as a source of new business. The Portuguese could have traded peacefully in the Indian Ocean obtaining spices for the European market at reasonable rates. However, this was not their goal. The captains and viceroys of the Estado sought to exclude Arabs, Gujartis and Venetians from the spice trade. Their goal was monopoly backed by the force of arms. The result was half a century of violence between Portugal, Gujarat and the other states of the Indian Ocean.

The violence eventually ended with Portugal gaining naval supremacy in the Indian Ocean. The Asians, with their age-old methods of ramming and boarding, were no match for the powerful artillery of the Europeans. However, maintaining such a monopoly was an expensive enterprise. The cost of maintaining a chain of fortifications and large fleets to intercept trade cut deeply into profits. The Indian Ocean was simply too large for a small country like Portugal to control. Time and again, the west had to be supported at expese of the east, or vice versa (Meilink-Roelofsz 1962: 125). Undermining Portuguese operations were resource limitations and the recurring principal-agency problem. As Meilink-Roelofsz (1962:125) states, 'The vast distances ..... made effective control of the governing apparatus impossible, and this led to corruption and insubordination'. The puppet rulers in places such as Hormuz, Cochin and Cannanore 'did not always dance in step to the Portuguese tune' (Pearson 1976:48). Nor did the Portuguese officials themselves, who might accommodate Gujaratis concerns if bribed.

While the monopoly could not be upheld, the Portuguese did achieve some measure of trade control by imposing a system of passes. If Indian ships wanted to sail unmolested by the Portuguese, they would have to buy the passes (cartazes) or face having their ship and cargo seized (Pearson 1976: 40). Under the Portuguese system, the more the Gujaratis traded, the more passes were sold. Consequently, it was in the interests of the Portuguese to encourage Gujarat shipping so, in the second half of the sixteenth century, the Portuguese became more liberal in allowing Indian ships to cross the ocean. To do otherwise would kill the goose that laid the egg.

Gujarati sea trade prospered under the Portuguse system. While the pass system raised the price of shipping and diverted some trade to Portuguese ports, Gujarat traders prefered it to violent resistance which also raised the price and in many cases put an end to trade. Steensgaard (1973) suggests that the benefit of organised violence-protection, such as that offered by Portugal, is that it removed the less organised pirates, in effect introducing predictability to the world of trade. All traders had to make an assessment of protection costs and loss of stock resulting from attack by robbers (or pirates). By making these costs more predictable under the cartaz system, the Portuguese made business more predictable and easier for the trader to determine his costs in advance. Arasaratnam (1994: 45) states that the Portuguese control of sailing and

system of passes actually 'proved advantageous to Gujarati trade which was now able to operate under Portuguese protection'. In the same way that the Mughals provided protection on land for tax, the Portuguese, had in effect gained sovereignty of the sea.

One vital change in Gujarati shipping was a decline in the importance of Malacca. The Portuguese captured Malacca early in the sixteenth century, gaining control of what had been the greatest trading emporium in the world. They had intended to gain control of the trade Malacca had handled. However, the Gujaratis responded by deflecting their trade to a wider area, and ports such as Acheh and Bantam rose in importance. Gujaratis might have to travel a bit further, but they still collected their Chinese and South East Asian cargoes (Pearson 1976:102).

Some Asian shippers suffered at the hands of Portuguese competition, in particular, the Arab shippers who had previously carried spices that reached Europe via Venice. However, the Gujaratis retained their pre-eminence in merchant shipping in the Indian Ocean. While much trade was diverted to the Portuguese centre at Goa, the Gujaratis were not going to go out of business while they produced the cargoes to be shipped. The Portuguese played a secondary role to the Gujaratis in the Indian Ocean who were secure in their competitive strengths based on their cargoes, strategic location and superior exxperience in the Indian ocean.

Nor did the Iberians displace Chinese shipping in the Far East. In fact, they provided a new sense of dynanism to Chinese trade in the East. When the Portuguese arrived in China in the 1540s, the Ming ban on private shipping was still in force. Although trading illegally, they were welcomed by local merchants, and eventually established an authorised merchant colony on the island of Macao.

Luck favoured the Portuguese who benefitted from timing. When the Chinese lifted their trade bans in 1567, they maintained a ban on trade with Japan, a source of pirates. Consequently, the Portuguese became key intermediatries in the China-Japan trade, establishing a permanent colony in Nagasaki in 1571. The Chinese-Japanese trade link became one of the most profitable for the Portuguese.

Spanish activity also contributed to growth in Chinese shipping. At the time of their arrival, the Philipines were an undeveloped chain of islands offering little to the world of trade. The Spanish changed this with the commencement of the 'Manilla Galleons' which brought large amounts of silver to Asia across the Pacific from America. The Spanish wanted to develop Manilla as a trade centre but lacked the resources to do so. The Phillipines were very far from Spain whose resources were being used to develop the South American continent so, the Spanish welcomed Chinese ships, traders and skilled artisans (Gungwu 1990:409). Many Chinese traders went to the Philipines to take advantage of the trade. In many ways, this

attempt to develop markets in the face of resource constraints resembles modern corporate strategic alliances, albeit in a far less structured manner.

Chinese shipping grew rapidly after the lifting of the trade bans. In 1567, 50 Chinese ships were given licenses to conduct foreign trade. Over time, the number of permits increased to 88 in 1589, 110 in 1592 and 137 in 1597 (Reid 1993:15). The Chinese still dominated the far Eastern oceans.

By the end of the sixteenth century, the oceans of the world could be characterised as a series of regional markets dominated by regional shipping leaders. The Chinese dominated the Chinese Sea, the Gujaratis in the Indian Ocean, and the Iberians mastered the Atlantic and the ocean routes linking these areas of activety. It is hard to say which of these nations produced the greatest output given statistics of the time. Historical figures of this age are riddled with inaccuracies and can only be taken as indicative. In terms of value, Gujarat's oceanic trade is by far the greatest. On the basis of customs receipts Micheal Pearson estimates the value of Gujarat sea-borne trade at 40 million cruzados. By comparison, Spanish trade across the Atlantic was valued at 7-10 million cruzados and the Manilla Galleon 3-4 million. At the same time, the Portuguese carreira trade was valued at 5 million cruzados (Boyajian 1993: 42, 65&70).

Unfortunately, we have no values for Chinese trade and no numbers for Gujarat shipping in this period. We do know that 137 ships legally traded from China in 1597 (Reid 1993:15) and this compares to a peak of 200 westbound ships of similar size (aprox 200 tons) visiting the Americas (Parry 1966:240). Therefore, records suggest Spain and Portugal had a greater trans-oceanic fleet in terms of numbers. But in terms of value, Gujarat was by far the greatest oceanic trader. It should be stressed however, that China had a phenomenal coastal trade. So long was the length of China's coast that some voyages considered international by Gujarat (and Europeans) would only be considered domestic in China. Finally, in terms of ocean-miles travelled, the Portuguese and Spaniards were clear leaders.

Despite this relative equality, Europe was producing maritime and related innovations at a faster rate than their eastern neighbours. The combination of changing political, economic and technological forces led to an increased pace of technical advance in European shipping. By contrast, Eastern technology now appeared to be going through what Klein would call "slow history" while Europe was going through "fast history". Klein relates these differences in speeds to changes in the level of competition. High levels of competiton, low barriers to entry and high degress should generate progress and the East scored well on these points but did not generate superior technological advance. The East provided a very competitive commercial environment, particularly in Gujarat. Klein's theory is not supported. In the early days, competition might have helped in the development of the junk and the dhow but, by the end of the fifteenth century, both technologies had stabilised despite the competition. In fact the most innovative period in

shipping technology was the government financed and organised innovation during Sung China, a period more representative of Schumpeter's innovation by decree exploiting the resources of a larger organisation.

In Europe, governments were embarking in much competitive rivalry and were more inclined to invest in testR&D than shippers. Many of the latter technical developments that would occur in Europe would be consequences of spin-offs from naval technology. This would suggest that competition per se is not a sufficient cause of innovation for competitors must have sufficient resources to undertake R&D, a reflection of Schumpeter's (1942) preference for large firms over the highly competitive market of small firms.

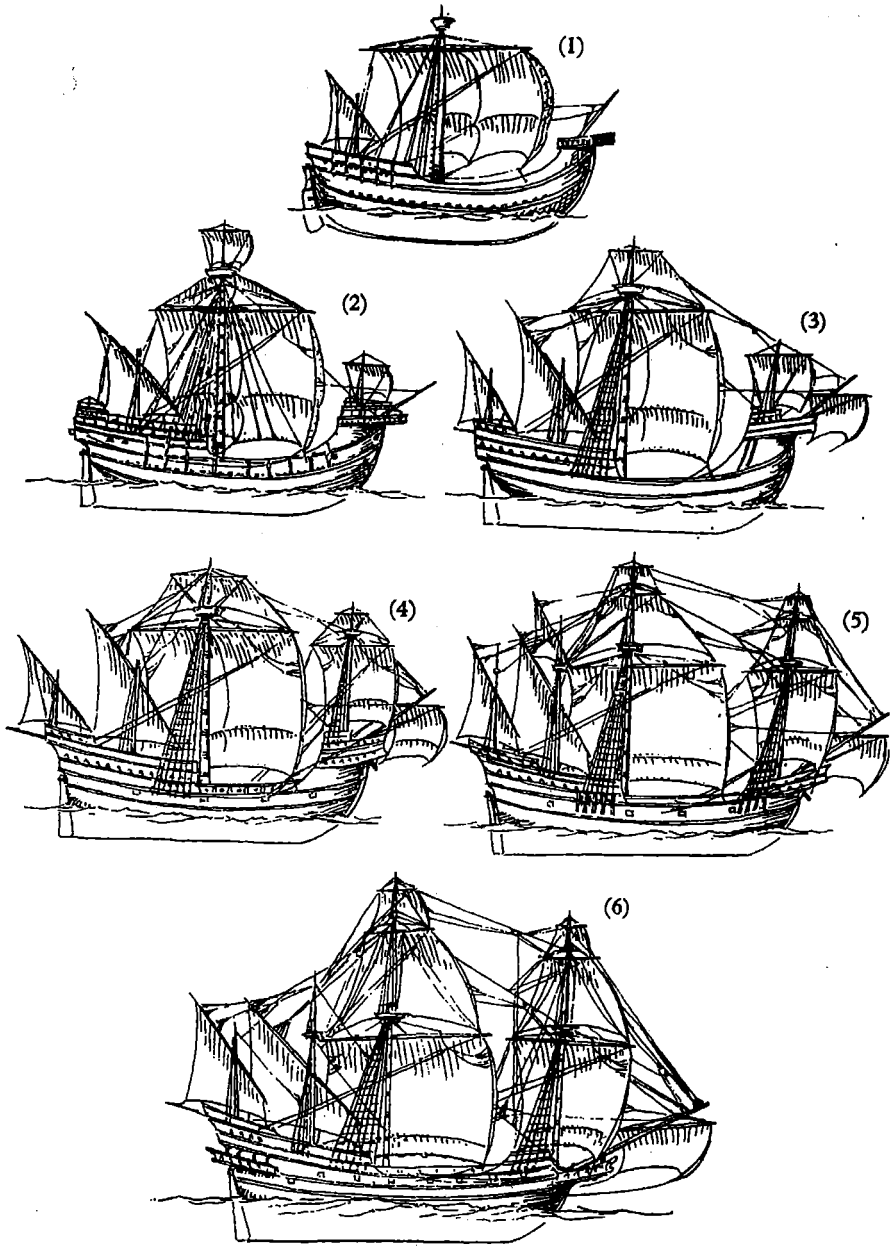
Another possible explanation may be bounded rationality. Experience taught the Chinese and Indians to accept the limitations of the monsoons and trade winds. They did not seem to experiment in sails and rigging as much as Europeans. In the second half of the sixteenth century, Europeans changed from having a few large sails to having many smaller sails, an improvement that was associated with changes in rigging. This gave huge improvements in manoeuvrability. Once started, the process became self-reinforcing as success lead to greater experimentation (Unger 1980:277).

Stagnation in technology can be attributed to risk aversion and the conservative nature of the industry. A risky innovation could result in loss of both life and expensive cargoes. Certainly, the junk and the dhow were faithful workhorses that seem to have reached a technological frontier. For many years, they remained fastest and safest ships in their respective conditions. But this does not preclude the fact that something safer and faster could be built. Merchants seem happy to use the tried and tested; however, I have found no evidence to link this to saisficing. This phenomenon seems best explained by a commercial rationality and heuristics where merchants sought profits not through technical innovation but through commercial strategy; getting the best blend of cargoes for their respective destinations. This is consistent with the economic rationality's of merchant capitalism. Chinese commercial strategy was driven by market-based solutions and the need to have good relationships with Mandarins. In the Indian Ocean, Gujaratis had the most market driven economy of the lot. Their commercial rationality was driven by the need to anticipate and best link the supply of goods with those in demand. By contrast, European traders and shippers seem to be the most open to the possibility that technological changes could advance their profitability.

All merchants had to make political, technical and commercial decisions. However, the merchants in each nation seemed to have differences in the level of emphasis. The Eastern merchant rationality reflected the neo-classical allocative efficiency in which goods were distributed within a given technology. While Europeans still operated with large technological restraints marginal differences were apparent, particularly in sails, rigging and armaments. Marginal differences might not be so important on a daily basis but, over a century, major differences become extrapolated. It would take another century or two before this benefit would become apparent. However, it should be noted that even in Europe, change after the sixteenth

century was hardly revolutionary. As Boscher (1995a:7) states 'if a seaman from Admiral de Ruyter's *De Zeven Provincien* was transfered by a time machine, for instance to Admiral Nelson's Victory he would not need much time to become conversant with the construction, rigging and armament of the latter vessel'. Certainly, in the early sixteenth century, the Europeans gained no advantage in trade from their shipping technology. European maritime technology did not change dramatically between the early seventeenth and early nineteenth centuries. The most significant changes came in politics and related technologies (ibid:8).

It is clear from the above discussion that the market paradigm and rationality of the East were more important than low levels of competition in explaining low rates of innovation. However, probably the most important explanation is the continued success of Eastern shipping. Europeans might be able to handle a broader range of conditions but, in the Indian Ocean and China Sea, they did not threaten the commercial leadership of the Chinese and Gujarati's who had ships specially designed for the international markets in which they partook. If Europeans were catching up with technology, other aspects of the local's operation such as local knowledge gave them a competitive buffer which meant they did not have to consider European technological advances.



Increasing Divisibility of Sail 1430-1600. Europeans son learned that by replacing large sails with more numerous smaller ones, they could create a greater number of sail patterns to exploit various wind conditions. This picture shows ships from (1) 1430 (2) 1450 (3) 1500 (4) 1530 (5) 1560 and (6) 1600. (Source Unger 1980)

Chapter 9

The Rise of Northern European Shipping

9.1 The English Imitation Process

In 1580, Spain annexed Portugal. The Spanish King Philip II now ruled two of the most powerful seafaring nations in the world with a trading network that stretched from China to Peru. This maritime achievement provided impetus for northern European nations to embark on an imitation process. There were two reasons for this. Firstly, Spain's success provided a demonstration effect and secondly Spain posed a significant external threat. The external threat was particularly portent in that the northern nations were Protestant. By contrast, Spain linked military and Catholic values in its reconquista philosophical base, and it had a trading base with which it could finance considerable military and naval action.

Throughout the sixteenth century, England looked upon the strength and wealth of its southern neighbours with a mixture of fear and envy. England was a backward nation. It possessed only one significant industry and only one significant enterprise involved in international trade. That industry was woollen cloth, and that enterprise was the 'Company of the Merchant Adventurers' who exported the cloth to Antwerp (Hope 1990:68).

Although surrounded by sea, Britain had nothing to compare to the fleets of the Spanish and Portuguese. The English had earlier made a number of exploratory voyages at the end of the fifteenth century, in an attempt to find a westward route to Asia and the mythical isle of Brasylle (Ryan 1996:246, Hope 1990:75). Eventually, a voyage lead by the Genoese sea captain John Cabot discovered a 'newe founde launde'. Unfortunately, New Foundland did not have the gold and silver deposits that were so accessible in the south and the only gain from this were the cod fisheries off the New Foundland coast. It illustrates the role of luck in economic development for the nature of sixteenth century economic and maritime development would have been very different if it possessed the same wealth that Spain found in the South.

The weak state of England and the possibility of external attack provided the impetus for a state led imitation process during the sixteenth century. Merchant shipping was a prime target of infant industry protection, not only for the potential wealth it could generate but, with little difference between merchant and naval ships, merchant ships played a key part in warfare. The Tudor monarchs actively encouraged the development of a merchant class and shipping industry. Henry VII introduced protective legislation that reserved certain cargoes for British ships (Hope 1990:61). In an effort to build up a navy, Henry VIII recruited shipwrights from mainland Europe, gaining the latest capabilities in fully-rigged ship technology. He also established Trinity House for the Advancement of Navigation and Training in Pilotage.

The Iberians provided the model for the maritime industries. Books on sailing and navigation were translated, such as *Arte del marear* by the Portuguese Ruy Faliero and *Arte de navegar* by the Spaniard Pedro de Medinas (Cummins 1995:14). To advance navigation technique, Queen Elizabeth established a position of 'chief pilot' in imitation of the chief pilot established at the Spanish Casa (Haring 1963:299).

The poor state of English industry meant that all the country's shipping supplies had to be imported, a huge weakness in time of war, so the infant industry programme was extended to naval supplies French and Italian experts were imported to teach gun founding while the State encouraged research in the use of domestic iron to replace imported bronze.

Outside of state support, two growing industries helped to spread basic seaman skills. Once the potential of the New Foundland fisheries were realised, fishing boats helped to train many seamen in the skills required for ocean going voyaging, while the fish provided the basis of an export trade to Spain and Mediterranean (Davis 1962:4). The domestic coal industry also stimulated maritime progress. Coal, carried south by sea, was responsible for turning many landlubbers into seamen.

A key influence in the advancement of capabilities was Sebastian Cabot son of the Genoese captain who discovered New Foundland. With his Mediterranean connections, Cabot was a key agent of technology transfer and introduced an array of maritime and commercial techniques. He advised the first venture in long distance trading which occurred when a group of businessmen pooled resources in hope of finding a northern route to the riches of the East (Hope 1990:97-8). The venture was entitled 'The Mysterie And Companie Of The Merchant Adventurers For The Discoveries Of Regions, Dominions, Islands And Places Unknown'. Unfortunately, the company's ships did not make it past the Bay of Archangel in Russia. Although they failed to make it to China, the Russian Tsar, Ivan the Terrible, had a soft spot for lowly men such as merchants and granted the Englishmen permission to trade.

About the same time, English trade to North Africa was developed. The Moroccan trade was claimed to have been invented by James Alday, one-time servant of Sebastian Cabot. Together with Henry Ostrich (who married one of Cabot's daughters) and, two naval commanders (Thomas Wyndham and Sir John Luttrell) they established the trade using Jewish intermediaries who arranged the exchange of English cloth, iron mongery and other goods for highly valued Islamic sugar (Hope 1990:93). Thomas Wyndham also led a syndicate that opened up trade to the Guinea coast, using a Portuguese Jew for a pilot. As in the East, these developments in shipping were integrated with the activities of merchants expanding their activety. It reflects the importance of complementary activities leading to integrated activities.

Resource limitations lead to the development of new organisational forms. Shipping to these far distant lands required more capital and sophisticated organisation than that required for a 200 mile trip to Antwerp.

They required more ships, bigger ships and investment in stock levels large enough to cover the long time periods involved. Being new and more distant, these these trades were also much riskier. Not being rich in capital, the joint stock organisation was used in which a number of investors pooled together. This also spread risk among investors. Risk was further reduced when the state gave these companies monopolies in their respected trades, increasing the chance that a profit would be returned.

The monopolies were not popular with the smaller private shipper and interloping was common on the Russian and Baltic trades (Hope 1990:125) When six interlopers tried to break the Russian Company's monopoly in the 1560's, the English government confirmed and extended the Company's power. The company included in its defence a statement that it retained a number of skilled pilots and masters in its employ and paid a man 'learned in cosmography' twenty pounds a year to teach its mariners (Hope 1990:104). The company was investing in a permanent knowledge base of the routes by which they could increase speed, reduce costs and losses and bring new captains into the trade with efficient instructions that a single shipper would otherwise have to learn by himself.

In the meantime, chance political events helped to shape the industry's development. In the last quarter of the century, the Protestants in the Netherlands revolted against their Catholic rulers in Spain. The conflict brought an end to Antwerp's role as a commercial centre and the biggest market for English woollens. With the fall of Antwerp, English merchants were forced to find new markets and establish a new distribution system. This meant longer distance trading. With the success of the Russia Company behind them, a number of new chartered companies were created. The Eastland Company was created in 1579 to seek trade in the Baltic, followed by the Turkey Company (1581) and the Levant Company. These early companies were all export orientated in an attempt to find markets for English woollens (Keay 1991:52), another example of international shipping developing as a forward linkage from domestic manufactures..

Refugees from the war in Flanders aided development of supporting industries, bringing skills which allowed the English to create new woollen products. These 'new draperies' helped English merchants enter markets where there was little demand for the old product (Davis 1967:7). Consequently, the loss of Flanders had been a blessing in disguise, delivering a window of opportunity. With the Dutch preoccupied with their war with Spain, the English gained a foothold in the Baltic and Mediterranean trades, and English ships now brought back goods which had previously come through Antwerp.

The cold war atmosphere between Spain and England gave birth to another activity which contributed to the growth of English shipping: 'commerce raiding'. Pirate raids (and the officially sponsored 'privateering') expanded the skill of many seamen and could be highly profitable. Hope (1990:144) states that privateering was as significant to the economy of Elizabeth I as automobile production was to Elizabeth II. Capital earned from privateering was used in the founding of the East India Company and the first American

colonies (Hope 1990:150). Commerce raiding also expaned the market and growth of capbilities in those onshore industries that fitted out ships including carpenters, ships chandlers, rope-makers, sail makers, and suppliers of victuals, stores and armaments (Starkey 1988).

This branch of maritime industries is best represented by Sir Francis Drake. Drake's father had been a Protestant vicar and the young Drake grew up with a fervent hatred of Catholics. After an apprenticeship sailing in a bark to France and the Low lands, Drake joined his relative John Hawkins who in 1562 established a trade shipping slaves between Africa and the Caribbean, a market dominated by the Portuguese. This provided Drake with the navigational knowledge he would put to good use when he diversified into pirating, a career made possible by the political climate existing between Spain and England.

In 1577, Drake diversified his activities once more and set off on a venture which would greatly assist the English effort at 'catch up' with the Spanish and Portuguese. With financial backing from Queen Elizabeth he commenced what would be the first trip around the world by an Englishman, including a trip to the Spice Islands. Drake was very aware of the need for foreign input for success. His crew included foreigners with specialised navigational skill (Cummins 1995:73), while Magellan's route was used as the blue print for the voyage and Drake revictualised in many of the same bays and harbours (Milton 1999:30). When he captured Spanish ships, he sought their nautical charts with as much fervour as he did their gold as these were valuable in teaching the ocean routes.

The voyage did much to break down barriers of entry to the trades established by the Iberians. It revealed both the wealth and the vulnerability of the Spanish empire in the East, and provided England with navigational skills and knowledge to enter the East Indies market. Most important, Drake had shattered the reputation which had left many northerners in fear of their Iberian competition. It seemed the market was now open for competition. Unfortunately, the English were about to learn the hard way the difficulties of long range oceanic trading.

The first problem was organisational, in particular the principal-agent problem. The next voyage was led by Edward Fenton who was to take the fleet to the East Indies (Milton 1999:35). Unfortunately, on route he decided not to go the Indies but to stop at the island of St Helena on which he intended to make himself king. However, his crew did not support his regal dreams and the fleet returned to London without having left the Atlantic.

Catch up also involved the acquisition of tacit knowledge through experience. This was a costly process. In 1591, another voyage left under the competent leadership of James Lancaster. However, nothing Lancaster had ever experienced could prepare him for the long time periods in unknown seas without fresh

food and water. Sailing to Ceylon, the ship got lost in the Indian Ocean and with many of the crew sick and dying, the voyage was brought to an end. Of the 198 men who rounded the Cape only 25 returned and two of the three ships that left were lost (Ibid:52). London merchants learnt that the spice trade was a high risk investment which, with their current level of experience, they could not afford to enter. They would not re-enter the spice trades until they learned that the Dutch had entered and succeeded in the trade.

English expansion also incurred problems in the Atlantic. In the same period, an attempt had been made to settle North America with the establishment of a colony at Virginia. However, within three years, the colony disappeared without trace. It would be another three decades before the English would develop an ocean-going trade with North America. Other failures included a number of exploratory trips to find a route to the East via the Arctic.

Despite these failures, the English had gained some vital capabilities. They had companies regularly trading to the Levant and Russia and, now possessed scores of seamen with technical expertise, nautical ability and experience (Andrews 1982:260). Nevertheless, Spanish and Portuguese merchant shipping stood secure in its competitive strengths. However, a more aggressive challenge was about to come.

9.2 The Rise of the Dutch

In the Netherlands a process of imitation is evident. However, it occured in conjuction with an independent growth path which was distinctive to the Dutch environment, in particular geographic conditions which provided a strategic location in regional shipping routes and access to rich fisheries. Another distinction is that much of the imitation that occurred was not of the leading nation in shipping as our thesis would suggest but, of the leading nations in what became supporting industries.

The development path travelled by the Dutch was based around the fishing industry. The inland rivers, lakes and canals of the Netherlands provided plenty of opportunity for fresh water fishing. Eventually, the Dutch took their boats on to the Zuider Zee and the North Sea where the herring fisheries could be exploited (van Zanden 1993:33). However, once the nearest fisheries were depleted, the Dutch were forced to go deeper out to sea to search for fish. This required their sailors to develop deep sea sailing skills and strong boats.

Gaining the capabilities for deep sea sailing involved imitation of southern navigation and shipbuilding methods. Initially, northerners had trouble adopting skeleton construction and men were brought from Mediterranean to help teach the new requirements (Unger 1994:123). Southern ships arriving in port also served as models for the locals. By 1500, Dutch ship carpenters were producing fully rigged ships to the same standards as other European builders (Unger 1978:33). However, the process of imitation was selective. For example, Dutch ship-builders showed a preference for clinker built boats and resisted the

trend to carvel construction. This selectivity was at least partly based on local geographic and weather demands (Ibid:28). The clinker built ship was stronger than the lighter carvel-built boat.

Fishing was a seasonal activity and during the off-season, Dutch ships entered the carrying trade. With fully-rigged ship technology, the Dutch wrestled the Baltic trade from the Hanseatic nations who had previously dominated shipping in the region (Israel 1989:18). Dutch competitiveness benefited from the more southerly geographic location of their ports which became free of ice earlier. This meant they could use the faster ships to pick up cargoes in France, take them to the Baltic and be back home before the winter set in. However, the main factor behind Dutch competitiveness was their low cost. The Dutch use of out-of-season fishing boats and low cost labour gave them a competitive advantage with which the Hanseatic nations could not compare. By 1532, the Dutch had some 400 ships entering the Baltic on an annual basis (de Vries and van der Woude 1997:356-8).

In the sixteenth century, Dutch ship designs began to deviate from the European pattern and develop an independent evolution responding to the demands and geographic conditions of the time. To some extent, change was pre-determined by past investments in shipping knowledge, creating yet another example of path dependent evolution. Gradual changes were made to what was known to work in the past giving birth to a number of variations. The first successful independent design was the buss, a fifteenth century vessel designed to meet the needs of Dutch fishermen. In the off-season fishing boats looked for cargoes, for which the buss was particularly good as it could weather northern storms. Eventually, boats were designed exclusively with cargo in mind. Modifications and improvements led to the evolution of the boyer, a flat bottomed boat of shallow draught which enabled it to travel with ease in the internal waterways of the Netherlands. In the sixteenth century it was taken onto the sea and, as a consequence, shipbuilders had to make a larger boat, building up its sides and expanding the rigging (Unger 1978:35). The vlieboot (or flyboat) was designed even more specifically for bulk carriage (rather than speed). It had a square stern and a broad beam which enhanced carrying capacity. Experience with the flyboat led to the evolution of the cargo boat par excellence, the fluyt.

First constructed at Hoorn in 1595, the fluyt's hull design had a low centre of gravity which was excellent for riding out bad weather (Unger 1978:37). The vessel had an initial length to breath ratio of 4:1 but improvements soon saw fluyts with ratios of 5:1 and even 6:1. The ship's sail area was kept small and its masts were short relative to its carrying capacity. This meant it did not need a large crew to handle the rigging. However, it also meant a slower ship but, as long as the ships were fast enough to conduct the Baltic run before winter came, extra speed was not an advantage. Although longer voyages increased crew wages and victualling costs, they were more than off-set by the reductions in crew size achieved through the use of labour saving devices such as pulleys and blocks for controlling the yards and sails (Unger 1978:37). Ease of handling, small crews and large cargo space gave the fluyt a huge competitive advantage in ocean-

going trade. It enabled the Dutch to undercut the French and British carrying trade by 30-50 percent (Mokyr 1990:69). As Sir Walter Raleigh explained, the Dutch built vessels 'to hold great bulk of merchandise, and to sail with few men for profit' (quoted in Unger 1978:44).

Increased inter-European trade was the conduit by which northerners could observe and learn southern business methods. Marine insurance, partnerships, use of factors, agents and correspondents were all practices that arrived in the northern Netherlands. With growth and diversification came increased specialisation and the arrival of the merchant marine, sailors and skippers as full time occupations (van Zanden 1993:39).

This carrying trade was strengthened by developments in other parts of the economy, in particular, the growth of the dairy industry which provided products to export to France, Germany and the Baltic (Israel 1989:25). The Dutch also developed a number of innovations which helped exploit domestic resources. Key among these were developments in windmill technology, an old power source introduced from the East many centuries earlier. The Dutch needed efficient windmills to help drain lands and remove water management problems for farmers (van Zanden 1993:39). They developed large windmills that were very effective in capturing the wind.

Despite achieving significant growth, by the 1570s, the Netherlands possessed no industrialists or merchants of international stature (De Vries and van der Woude 1997:667). However, political changes were about to spark a new stage of economic growth when the Protestants in the Netherlands revolted against their Catholic rulers in Spain. The war provided many prompts for technology transfer. In 1585, the Spanish captured Antwerp causing a flood of refugees to the north. Textile workers from Flanders and Brabant arrived in Leiden and Haarlem. The war with Spain and naval blockade also provided protection from competitive textile producers in Flanders. The consequent growth in textile production, provided the shipping industry with another cargo and reinforced the Dutch position in the Baltic carrying trade, where they gained supremacy in 1594 (Israel 1989: 50).

It is important to note that much of this technology transfer was not imitation of the leading shipping nations. The new technologies came from nations weaker in shipping than Spain but stronger in industry. It provided the Netherlands with an industrial base that the Iberians lacked.

9.3 Dutch Advance

In the late sixteenth century, the Dutch economy produced many advances consistent with the "advance" stage of the industry life cycle. The low labour-tonnage ratio achieved in the fluyt was just one of many similar improvements that occured. Across the economy, productivity improving investments were applied

in industry, fishing and trade achieving capital/labour ratios of unprecedented heights (De Vries and Van der Woude 1997:694)

The external threat of war was a great stimulus for productivity improvements. As Unger (1978:40) states 'Only more money for warships and mercenary soldiers could keep the Spanish enemy on the other side of the great rivers just to the south'. Consequently, the economy was receptive to advance in production technologies. Technology advanced on a broad front, from animal husbandry to textiles, where the 'Dutch loom' was invented in 1604. In the process, the Dutch were building an industrial base with the most advanced practices. With it came increased domestic demand, capital and competitive cargoes available for shipping.

During this time, the new large windmill was applied to Dutch industry as an efficient energy source. The windmill eventually solved a bottleneck caused by the increased growth in shipping and the economy. Increased demand for wooden ships led to a very high demand for wood sawyers. Wage rates for this skill underwent the highest rate of growth in the economy. In 1592, Cornelis Corneliszoon van Uitgeest found a way to overcome this bottleneck when he took out a patent for a wind powered sawmill. At first resisted by the guilds, the industry located itself in the Zaan region north of Amsterdam where no guilds existed and there were no buildings and few trees to impede the wind. Once wind powered industrial production began, other producers grew in the region, taking advantage of the close proximity to related manufacturers (Unger 1978:6). A modern industrial city grew with a compounding competitive advantage of economies of scale and concentration. Over time, windmill technology was applied to various industrial uses including fulling cloth and hulling rice (Bosscher 1978:218).

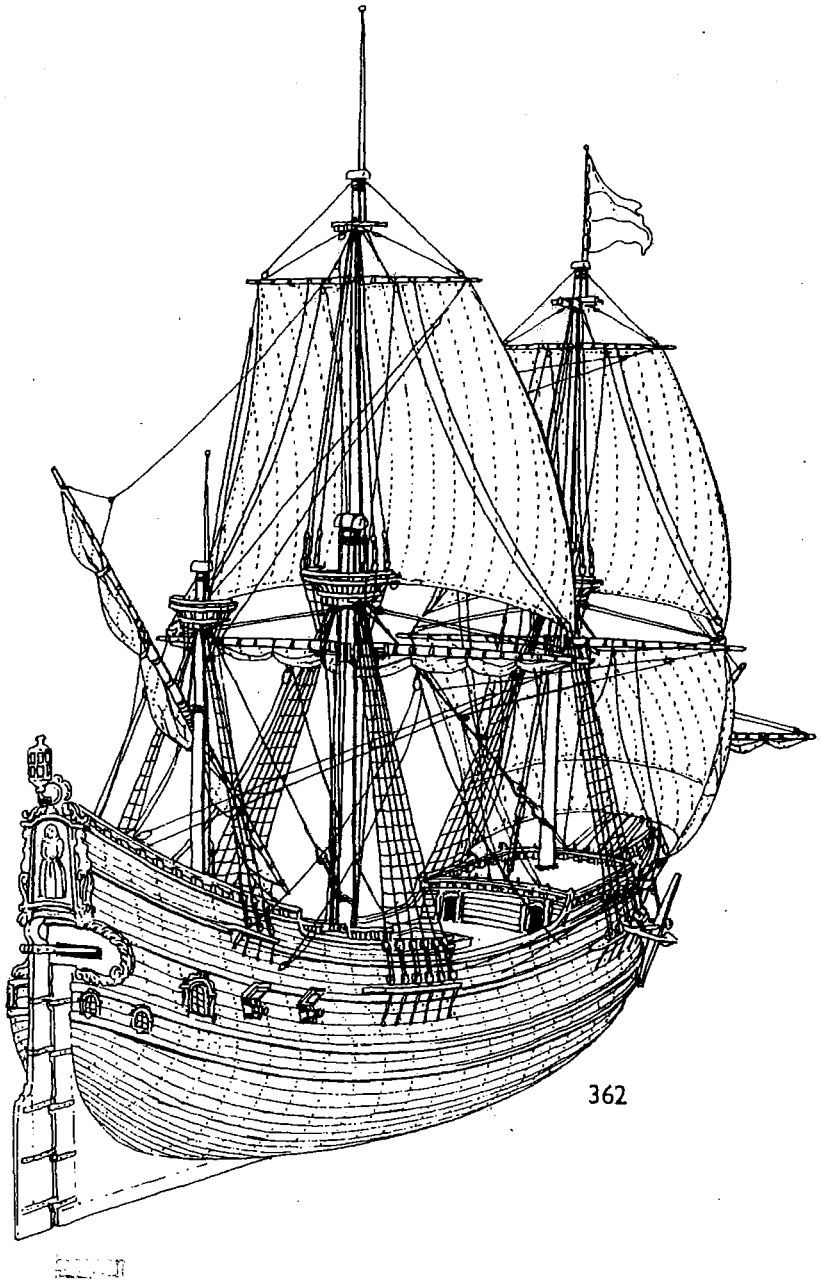
With the expansion of shipping, more wood needed to be imported from the Baltic. This in turn increased the demand for ships going to the Baltic. This supported the cumulative and reinforcing growth pattern that had already begun. The Netherlands was too small to enjoy the benefits of large markets size as stated by Ibn Khaldun (although it's market was not limited to its borders). However, it could benefit from the nature of demand. As suggested by Porter (1990), nations are more likely to gain competitive advantage in those industries which represent a disproportionately high share of local economic activity. This was the case of shipping in the Netherlands.

As the shipbuilding industry grew, it benefited from external economies of scale with which other nations could not compete. The scale of output allowed the industry to build up a huge pool of experience among its workers and allowed producers to standardise production. The large number of wharves, workmen and wood supplies meant that ships could be produced at short order. The industry benefited from an efficient wind-powered wood sawing industry, and other producers which contributed to the development of an industrial cluster. From 1600, the Zaan industrial belt included sailcloth weaving and cutting which

employed as many as 1000 people, whale fisheries (employing 2000 to 2700), the baking of ship's bread, compass making, block and mast making, rope making and certain metal trades such as nail and anchor making (Unger 1978:7&8).

The level of demand from the shipping industry also allowed shipbuilders to benefit from internal economies of scale. They could spread their fixed costs across a larger number of vessels and exploit the advantages of division of labour and contracting of specialised work such as mast-making and block-making. As a result, the shipbuilding wharf changed from a workshop to something more like a modern factory. The introduction of labour saving devices further encouraged the trend to factory-style building techniques. But most importantly, factory style production was the consequence of a standardised design. A relatively standard ship design with some standardised parts reduced the cost of ships and repairs, giving Dutch merchant shippers an even stronger competitive advantage. With 10,000 workers, the Dutch shipbuilding industry of the seventeen century had grown larger than any shipbuilding industry that preceded it.

Energy endowment was a key factor in the high use of machines and wind was not the only power source exploited by Dutch industry. While the rest of Europe relied on wood as its primary source of heating, geography had blessed the Dutch with a unique abundance of peat. It provided a source of competitive advantage in energy intensive industries that other regions could not duplicate (De Vries and Van der Woude 1997:339). The abundant peat supplies fuelled a myriad of industries including brick makers, madder producers, kiln operators, salt refiners, bakers, bleachers, tile makers and many others (Mokyr 1990:62).



The Fluyt was the cargo ship par excellence. Evolving from fishing boats, the fluyt appeared at the end of the sixteenth century. Its flat bottom and round stern gave it cargo-carrying advantages over its competitors and was a major feature of Dutch success in the northern seas (Landstrom Bjorn: 1961, plate no.362).

Plancius combining his roles of vicar and teacher of navigation. Like Linschoten, Plancius copied and translated Spanish and Portuguese works on navigation and, was responsible for training the early Dutch fleets to the East (from the frontispiece of `De Vyerighe Colom', the Fierie Sea columne).

Another source of technological transfer were Jews expelled from Portugal who fled north to Amsterdam. They brought with them productive and commercial talent, wealth and international financial connections. These immigrants had knowledge and contacts by which the Dutch could now consider longer sea voyages. In the early 1590s, trade with West Africa and the Caribbean was launched with a handful of ships by men with a range of commercial connections in Western and Southern Europe (Israel 1989:62). At first expansion was slow, but this changed in 1598 when Spain placed an embargo on Dutch ships visiting Spanish and Portuguese ports. Philip II of Spain was concerned that commercial expansion was strengthening the ability of the rebel provinces to keep fighting against them. Given the alternative of bankruptcy, the Dutch were forced to enter the long distance trades and obtain colonial products at source. The political war that had been going on for three decades now became a commercial war. The Dutch aimed straight for the Spanish and Portuguese off-shore bases, with the intention of usurping their trade and destroying them (Parker 1991:179).

Diving into long haul ocean shipping was not an easy task, even for a nation that possessed a large number of sailors and strong ships. Dutch experience was limited to trades close to Europe. They knew little about the routes to Asia, the Atlantic and monsoon wind systems. Nor did they understand trading behaviour in the East. To make matters worse, the northern novices faced formidable competition in the capabilities and experience of the Iberian sailors. However, technology transfer was aided by the fact that a number of Dutchmen had sailed in the Iberian fleets. Jan Hughen van Linschoten was the most important of these.

Linschoten was born in Enkhuizen, a town closely connected with the herring industry. At the age of seventeen, he went to live in Seville where he had two half-brothers. As an apprentice to his brothers who were merchants, he learned Spanish and the rules of business. After eight months, he went to Portugal where he learnt the art of merchandising. In 1583, he acquired a post as clerk to the arch-bishop of Goa and sailed on the *Sam Salvador* to the Indies where he gained a great insight into the Portuguese maritime tradition. Most important were his observations of how disorganised and poorly equipped Portuguese seamanship was. For example, when a French enemy ship was sighted, the Portuguese crew went into panic, a revelation which did much to dispel the reputation of Portuguese invincibility at sea (Parr 1964:61).

Linschoten spent five years at Goa where he wrote about his experience and incorporated extracts from Portuguese historical, geographic and ethical works that he had access to. When he returned home, the book was published, complete with sailing directions to the East. The book became a compulsory companion for all captains sailing to the east. Linschoten also advised the first Dutch fleet to the Indies including nautical secrets of the Portuguese. However, he suggested that when going to the spice islands, not to sail north up to Goa as the Portuguese did, but to sail straight East. Although this meant a long time at sea, they could use the prevailing westerly winds to get to the islands much without having to rely on the

patterns of the monsoons. In this way, the Dutch had a shorter and less costly route which provided them with a dramatic strategic advantage over the Portuguese.

Despite the advice, the first fleet to the Indies suffered from inexperience and poor management. Of the four ships and 289 men that left, only 3 ships and 89 men returned in 1597 (Boxer 1965:22). However, the modest cargo of pepper they brought with them more than covered their costs and inspired others to follow in their wake and move down the learning curve. The following year, five companies were created sending out twenty-two ships. Within only six years of the creation of the first company, Dutch trade to Asia had already outstripped that of Portugal's (Israel 1989:68).

Another who aided in the imitation process was Plancius, an immigrant from the southern Netherlands who translated and published Spanish and Portuguese rutters, sailing directions and maps. For the fleet that left in 1600, Plancius was paid 500 guilders to provide pilot navigation methods. He was also responsible for the quality of charts and navigation instruments used by the fleet (Zandvliet 1998:40).

This formal instruction provided by Plancius still left the Dutch with much tacit knowledge to acquire and the first Dutch voyages to the Indian Ocean proceeded by trial and error gradually building up a store of knowledge and expertise. Ship logs from these early voyages were studied and, in 1617, the company issued its first sailing orders. By 1627, they had more than mastered the trades and the Amsterdam charter of the company published extensive instructions. With some modification and improvement, these instructions steered Dutch navigators for the seventeenth and eighteenth centuries (Gaastra and Bruin 1993:189).

After the first Dutch voyage to the Indies, a large number of Kirzner-type entrepreneurs appeared to take advantage of the price differential between spices in Asia and Europe. However, they instantly encountered the problem envisioned by Richardson of over-supply. It is questionable whether this was a result of lack of information on other people's activities as planning for knowledge of each other's expeditions would have been hard to keep quiet. It was more likely to be ignorance of their impact on the market. The large number of Dutch companies that initially appeared trading to the East Indies created an unhealthy competition. Bidding against each other at Indonesian ports rose the prices of their supplies and dramatically reduced profits. In 1602, after the political intervention of the States General and Prince Maurice, a merger was agreed upon to create the Vereeigde Oost-Indische Compagnie (VOC) with seventeen directors (Heren XVII) representing the various regions contributing to the original trade. The government gave the company a charter which included the power to attack the power, prestige and revenues of Spain and Portugal reflecting the close connection between state and commercial goals.

The various routes that the Dutch developed over this period brough in a range of commodities that complemented each other. For example, spices brought from Asia would be exchanged at Amsterdam with ships who would be sailing to the Mediterranean or South America (Israel 1989:258). In return silver from the America's could make a return trip. In that way, the nations ships returning from Africa, South America, Asia and the Baltic developed into a world trade system based on Amsterdam.

9.4 Gujarat, China and the Northern Europeans

When the Gujaratis first encountered the Dutch and English, in the first years of the seventeenth century, they were unsure how to respond. Having obtained a workable balance with the Portuguese, they were reluctant to upset them by trading with the new arrivals. Nor did they want to lose any of their own trade to the northern ships. The early period was therefore characterised by animosity. However, by the 1630s the Mughal Court was convinced that if kept within their bounds, the trade of the Dutch and English companies was beneficial to Surat. Although they might provide some competition for local shippers, they also provided local merchants custom for credit and other trade facilities and provided access to European markets.

The northerners did not offer anything new in terms of commercial expertise. In fact, in the Indian Ocean, Europeans were poor relations as borne out in the amount of capital invested. To give a comparison, Pearson (1976:4/5) notes that while the average capital on the 165 ships sent by the East India Company between 1601-1640 was only approximately Rs2,00,000 and, in the 1620s the Dutch had Rs5,00,000 invested in all of India. Some Gujarati ships trading to the Red Sea in the late sixteenth century were worth more than Rs10,00,000 each.

No one illustrates this more than Virji Vora. With an estate of Rs80,00,000 (US$30,240,000 in 1976 terms, see Pearson 1976:125), Vora in the seventeenth century was the richest man in Asia and possibly the world. Virji Vora is believed to have been born to a well established Jain family around 1594-5 (see Gokhale 1979). At the age of 25, he had become a prominent merchant in Surat, and by 1625, the English were calling him the 'prime merchant of this towne'. He had agents throughout northern India and international interests stretching from Malay and Sumatra in the south to Gombroom and Mocha in the North. He dominated the pepper trade with Malabar, traded with South East Asia and was a major ship owner (Arasaratnam 1994: 194)

Vora frequently used his enormous financial clout in the age old strategy of cornering the market. For example, in 1625 the English tried to buy pepper from Vora but balked at the outrageous price he charged. To circumvent the monopoly Vora had established, the English sent their broker to the Deccan to buy pepper, only to find that Vora had outbid him for the available pepper. The English had no choice but to deal with him (see Gokhale 1979).

Vora freely played the Dutch and English East India Companies off against each other and both learned that they could not afford to offend him. The English found they were dependent on the agents of Virji Vora for goods and were frequently in debt to him. This dependence was such that he could force the English to carry his goods on their ships(Gopal 1975: 111).

One Indian Ocean trade where the northerners did make a substantial impact was the spice trade. The Dutch, like the Portuguese before them, sought a monopoly in the spice trade, but were far more successful (Van Zanden: 1993:72-7). Through a combination of ruthlessness and superior military strength they seized key strategic assets; the Spice Islands. In 1605, the VOC conquered the Portuguese fort on Ambon, thereby gaining control of clove production on the nearby islands. They then imposed treaties on the ruler of Ternate, Tidore and Bican by which they were allowed to periodically destroy the young clove trees in the their area in order to reduce the supply and maintain their monopoly. Similar treaties were enforced on the Banda Islands, the only areas in the world where nutmeg and mace were produced. When enforcement of the treaty led to conflict in 1621, the VOC under the local leadership of Jan Pietersz Coen, reduced the population of approximately 15,000, to several hundred. In this way, the Dutch gained control of the spice trade. Although, it took time to plug all the holes in the monopoly, by the 1630s and 1640s the Dutch could claim predominance in the waters around the Spice Islands (Boyajian 1993:146).

As valuable as spices were to the Europeans, they were only one of many commodities exchanged in the Indian Ocean and Dutch power did not extend outside Indonesia for many years. In 1621, the long list of factories that the VOC could produce belied the fact that most were unmanned and all but a few operated at a loss (Boyajian 1993:148).

In the 1640s, the Dutch attempted to impose their naval power over Gujarat by stopping ships leaving their ports from sailing to South East Asia. The Mughals retaliated on land against the Dutch factories who were forced to respect the rights of Mughal seamen (Arasaratnam 1994). Europeans learned as they increased their investments on land that they became more exposed to Mughal rule and the possibility of having their assets seized if they harmed local shippers. The molesting stopped and Indian shipping grew significantly from the middle of the century (Das Gupta 1994: I, 495).

Gujarat trade did suffer some major set-backs in this period, in particular a famine of epic proportions that hit the region between 1630 and 1632. Many people involved in the production of textiles and other export cargoes perished. This dramatically reduced the region's productive base and set back Gujarat's trade and shipping for decades.

In the second half of the century, the region regained its former glory and Europeans were having trouble competing with local shippers. In the 1680s, 'both the English and Dutch were complaining bitterly that they could not compete against indigenous Asian traders who were flooding markets, underselling and moving about everywhere' (Arasaratnam 1995: I, 9).

The organisational structure of the VOC did provide some advantages over Indian Ocean traders. The scope and planning of VOC transactions provided a level of integration and transparency which the small Indian merchant could not compete. VOC ships carried precious metals from the Middle East, East Africa and Japan were exchanged on the Indian subcontinent for textiles, which in turn were exchanged for Indonesian spices (Steensgaard 1973:409). This co-ordination contrasted strongly with the lot of the Indian merchant who did not enjoy such market transparency and were exposed to the vagaries of the market. For example, if too much pepper arrived at the ports of Shihr and Aden, a merchant might experience a loss of up to 40-50% during one monsoon. Similarly, if the big ship from Suez to Mocha failed to arrive, India merchants would have to return home with their goods unsold. The visible hand of the VOC overcame these problems, reducing risks and increasing profitability.

Although the organisation of the European companies provided much to admire, they could not compete with the Indians who were thriftier and knew the ins and outs of the markets. Indians dealt with traders with similar customs and languages whereas, differences with the Europeans often led to complications (Das Gupta 1994: I 417). And their crews, fed on rice, were far cheaper. The Europeans were simply not competitive. The institutional framework provided by the social groups, coupled with greater local knowledge and experience, was more effective than that provided by the joint stock companies.

The focus of Gujarat maritime trade changed during the seventeenth century. Gujarati merchants cut down on the long distance trading to South East Asia and they abandoned their settlements in South East Asian ports. This no doubt was contributed to by the Dutch seizure of Malacca and the spice islands. However, opportunities for growth were occurring in the West, a reflection of the development of Mughal power in the West and the economic directions of the empire (Arasaratnam 1994: 197-8). This included the growing Red Sea trade and the political stability in the Ottoman and Safavid empires which was contributing to an increase in trade (Das Gupta 1994:II 40).

While, Gujaratis basked in the increased trading opportunities provided by shorter journeys to the west, the cutting down of long term trade was occurring at a time when outside the Indian Ocean, long distance ocean routes provided the fastest growth potential and, these were being seized by the Europeans. But even here, Gujarat merchants were benefiting, if not through shipping. Where Europeans had stronger trade links (in China, Japan, Manila and Europe) they opened up new markets for Gujarat (and other Indian) textiles. English and Dutch business created opportunities for commodity brokerage and supply agencies, into which

a number of Gujarati merchants moved. All in all, European trade strengthened the Indian economies (Arasaratnam (1995: III, 45-6). Their custom provided Indians with more options and better deals. They offered competitive prices, prompt payment, and options on a variety of imported goods. While the companies brought capital into the region, individual Europeans were great borrowers generating more custom for the local money market. They also bought ships locally, boosting the Surat shipbuilding industry which was by now considered the most important branch of manufactures in the city in the second half of the century.

From time to time, Europeans dominated particular markets but, as Das Gupta (1994: I,417) notes 'Upon the whole the trade in the Indian Ocean remained firmly in the hands of the Indian ship-owning merchants with only an occasional flutter, especially in the early sixteenth and seventeenth centuries when the Europeans threatened to cut in'. Gujarat shipping was still firmly based on key sources of competitive advantage: flexible organisation, excellent skills, light mobile ships and close relationships with the markets and produce of the Mughal empire. These gave Gujarat shippers the competitiveness with which they could repel competitors in the Indian Ocean. Das Gupta (1994:432) goes as far as calling it a golden period for Indian maritime trade and textiles.

In the China Sea, the arrival of the Dutch did not dramatically change the nature of trade. However, one key contribution was the development of Batavia as a base for South East Asian trade. The Dutch deliberately pursued a policy of encouraging Chinese vessels to visit the port (Gungwu 1990:409). This was a deliberate strategy to exploit the Chinese trading networks in the China Sea. The Dutch hoped to gain a monopoly in the southeast, not through its shipping but through the port, and to exploit Chinese shipping.

In Japan, the Portuguese had been ousted for their Christian evangelising and replaced by the Dutch who took a more secular approach to trade. However, even in this trade, it was the Chinese who dominated, particularly after the 1630s when the Japanese government restricted all Japanese from sailing overseas. From that point, the Chinese came to handle the vast majority of Japan's foreign trade. However, it would be eighty years before Chinese traders could fully exploit the possibilities of this trade because of domestic political problems. From the early 1680s, Chinese shipping was freed of its restrictions and enjoyed a new period of prosperity. Chinese trade to Japan sky-rocketed reaching a disorderly peak of 192 vessels in 1688 when the Japanese government decided to impose a strict quota of 70 vessels a year, including Chinese junks originating from south-east Asian ports (Reid 1993:23). In 1708, the quota was further reduced to 59 and in 1715 down to 30 as Japanese authorities sought to control the outflow of precious metals. However, these official figures disguise the fact that smuggling certainly occurred.

Despite these figures, some warning signs were beginning to appear. Chinese shipping was losing its advantage in shipping technology. Ishii (1988:220n) notes that Dutch vessels sailing from Batavia to

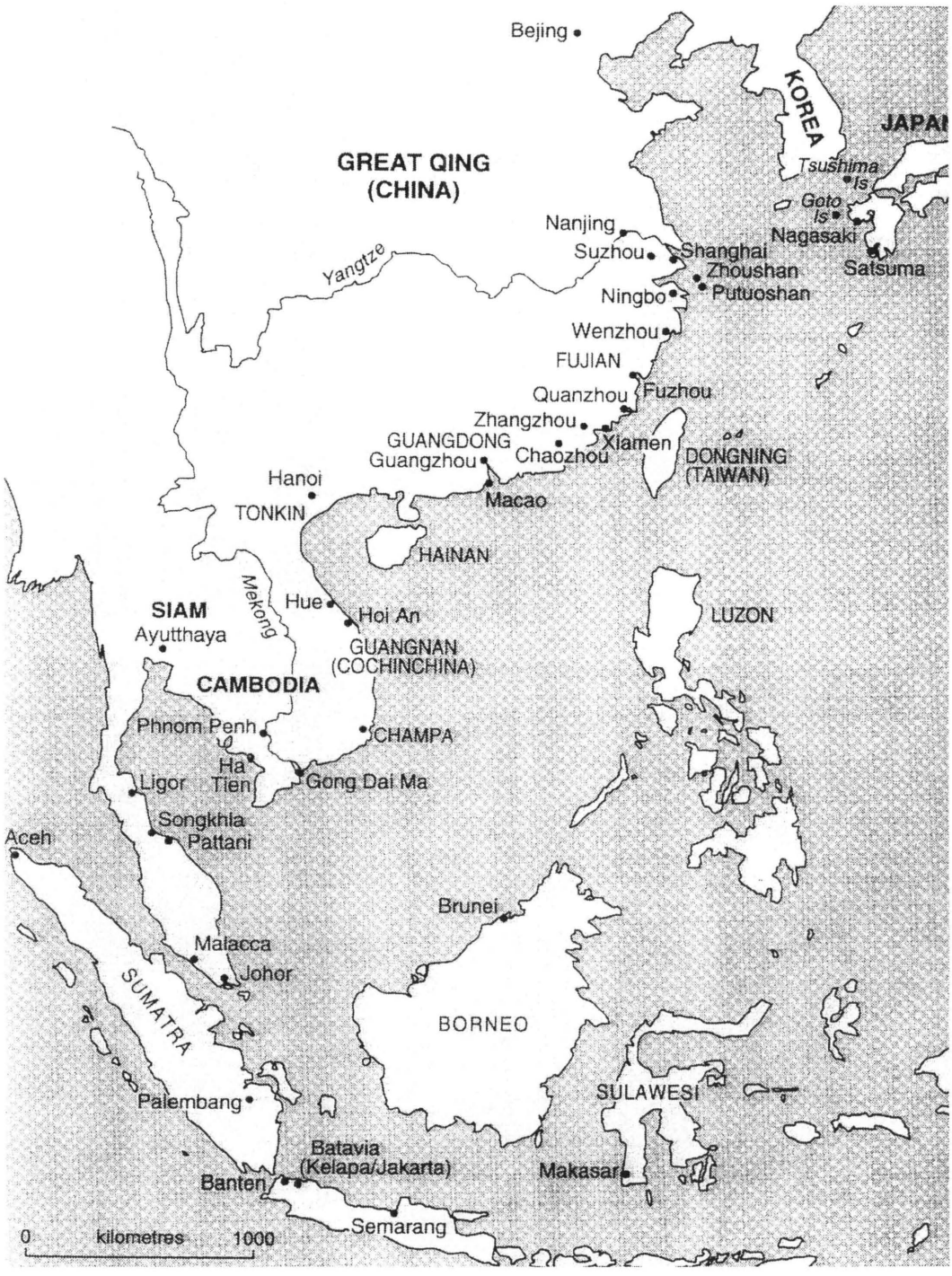
Nagasaki routinely took less time than the Chinese. European fully rigged ships could complete three voyages between Canton and Batavia per year in comparison with only one for the junks (Reid 1993:28). The junks were unwieldy and could sail in a smaller range of conditions than their competitors. They did not attempt to tack against the wind or sail at unseasonable times but, simply sailed with reliable monsoon winds (ibid:21). This put a limit on the growth prospects of Chinese shipping so, we might expect the Chinese to adopt European construction methods. Their failure to do so might be a combination of satisficing in which merchants are satisfied by a less than maximum profit or bounded rationality in which cognitive limitations prevent merchants from maximizing their potential but, it is worth noting that Europeans did not establish ship-building yards in China as they did in India. When Europeans wanted to exploit the cheap quality teak wood in India they established ship-yards by which the locals could observe western building methods. Chinese do not appear to have benefited from such technology transfer born from resource advantages. Secondly, the Chinese still provided formidable competition based on their experience and knowledge of the regional trade and handling of products.

The Dutch had one other key advantage - government support. In contrast to the Fukien merchants who were 'barely tolerated' by their own governments, the Dutch were representatives of their state. Gungwu (1990:240-1) states Europeans trading with Japan:

> dealt with the shogun's officials as representatives of a foreign state. Whether the shoguns were impressed or not, the Dutch were able to continually remind them that their company had state recognition and that they negotiated on behalf of their "king". The Hokkiens (Fukienese) could make no such claims. They could only seek the best possible arrangement that they could get, and they could get only what their hosts thought they deserved...

Nevertheless, the Chinese still held two key advantages in the sea-borne trade of the China Sea (Reid 1993). The first was their foothold on trade in China. European ships could only trade at Canton under much difficulty and with the burden of very high tariffs. The second factor was the peaceful record of Chinese shipping, which stood in sharp contrast to the aggressive record of the Europeans. Reid notes that as a consequence, Asian rulers raised tariffs and other obstacles against European shipping while the Chinese were freed of such constraints.

The following century would throw up more difficulties including a government ban between 1717 and 1727, and a massacre of the Chinese community in Batavia. However, Chinese merchants proved themselves to be flexible to the changing fortunes thrust upon them and continued to dominate East Asian trade. Up until 1842, they were principal carriers not just for Japan and their own country but, also Vietnam, Siam and Cambodia as well as a substantial proportion of the remainder (Reid 1993:13).



South China Sea. Chinese traders and seamen dominated trade in the China Sea (Source Ishii 1998)

From this discussion, it can seen that global shipping during the seventeenth century can still be seen, not as a global industry but, as a series of regional international markets. Gujarat still dominated the Indian Ocean. Dutch had gained leadership on the routes once ruled by the Iberians while the Chinese ruled the Far Eastern waves well into the nineteenth century.

9.5 Crisis in Spain and a Dutch Golden Age

When the Dutch and English first entered the overseas trades, Spain and Portugal stood supreme. However, The Dutch and English were slowly acquiring the capabilities to compete. By 1609, the Dutch had well established trading links in Asia and the Atlantic. This thesis would suggest that at some point of time, a newcomer would wrest its mantle of leadership using innovations that the Iberians have trouble adopting due to the persistence of institutional rules, values and other binds of entrapment. As the following discussion reveals, this did indeed happen in the seventeenth century.

The Spanish and Portuguese had built a competitive advantage based on their superior knowledge of wind systems and routes they had built up over time. They complemented their position with investments throughout Asia and America, supportive government policies and efficient organisation. The combined superiority in skills, infrastructure and reputation led to the creation of an aura of supremacy that further protected them from any challenges. However, the Dutch and English were undergoing a process of catch-up. The Iberians would never be able to maintain a monopoly that spanned the world once other nations had caught up with the necessary techno-economic requirements. The superiority in reputation and experience that had been barriers to new competitors entering the industry no longer existed.

When the Spanish and Dutch signed a peace treaty in 1609 both nations were freed of war-time restrictions on their development. The Dutch found, to their delight, that the innovations they had created provided a competitive advantage with which they could now overtake the Iberian nations on the Atlantic Ocean and routes to Asia.

9.5.1 Organisation and Institutional Advances The biggest institutional innovation came in the organisation of trade. In the early days, there were few Dutch merchants big enough to finance ocean-going ventures. This meant that small merchants would have to pool resources and share the ownership of ships and trading ventures. As a consequence, ownership of merchant ships was spread between timber dealers, shipbuilders, sail makers, brewers, millers etc, in shares of 1/16, 1/32 or 1/64 (Israel 1989:21). A company would be based around a single ship, each ship having its own list of shareholders. Although one person would not by himself own a ship, a share-holder might have shares in a number of different ships (Bruijn 1990:184). This joint activity stands in sharp contrast to Gujarat where a spirit of individualism existed which would never see such joint action. Gujarat also had wealthy businessmen who could afford to buy ships outright. They didn't need to pool resources.

Merchants would hire a ship for a single voyage after which, they would share out the profits. They may choose to re-hire the same ship but, once again, it would be for a single voyage. This structure was possible given the large market for chartering ships. Unless, the merchants intended to continuously use the ship, it made no sense to buy one themselves and incur capital costs while the ship was inactive. In this way, the large shipping district provided external economies that reduced capital costs consistent with Marshallian districts. It is interesting that this existence of separate ship owners did not happen in Gujarat either. The probable explanation for this is that, although joint ownership of ships in the Netherlands came about because of lack of resources, it had the added benefit of spreading and reducing risk. This made it safer to become a specialised ship owner and, consequently encouraged investment. Another likely explanation of this specialisation would appear to be the size of the shipping market, which had grown dramatically. In 1618, the Dutch sent 1,794 vessels to the Baltic alone (Davis 1962:226). By contrast, a century later when Guajarati shipping peaked, the leading port of Surat only possessed 112 ships in total (Das Gupta 1994:I,433). The larger market provided greater opportunity for specialisation and the lesser likeliness that hold up could occur from a small number of charterers charging excessively high prices.

There were exceptions to this structure, the most important being the Dutch East India Company (VOC). The company trading to the Indies did not use fluyts but larger, stronger vessels for the longer run. The market for these ships was much smaller. If the company was to hire ships, it faced the problem of small numbers contracting and hold up. It might also find that ships were simply not available of the type or number they sought particularly given their higher building and operating costs. Consequently, non-replaceability and small numbers contracting led the VOC to integrate backward and build their own ships.

While the Dutch introduced innovations, Spain experienced entrapment consistent with the thesis. To some extent, this lack of commercial aggressiveness would also seem to be a consequence of satisficing. Having met a minimum level of wealth, it would appear that merchants became more interested in social values (Pike 1972:110). The Spanish Atlantic trade entered the kind of 'slow history' that Klein had anticipated occurs when competition declines. However, industrial organisation also appears to have played a large part in innovative stagnation. The concentration of trade achieved with the establishment of the Consulado eventually generated the decline in innovation expected from reduced rivalry. With high barriers to entry and small number of firms, risk taking was reduced consistent with Klein (1977:83). The established merchant houses exhibited a low degree of openness and innovation. Safe behind their protective status, the small group of merchants that made up the Consulado charged high and uncompetitive prices and restricted their shipments to goods they could sell without difficulty. They were slow to exploit new products such as tobacco, a product that became fashionable under the Dutch and the English. Because the state was dependent on credit provided by these rich merchants and because the state itself possessed monopolies in

salt, mercury and other products, it felt no need to break up this monopoly, and trade progressed along a very narrow path.

It was in the trade to Asia that the biggest organisational innovation occurred. Although created to deal with disequilibrium, the Dutch East India Company became a 'national champion' in the Asian trade and, in contrast to Porter's (1990:662) finding that national champions fail 'the test of logic and history', the company was highly successful. It eventually grew to become the largest commercial organisation in the world, with a payroll that at times included 40,000 employees. The amalgamation of many companies into one presented a number of departures from the past. Firstly, it owned not one vessel but a fleet, and combined shipping, freighting and shipbuilding under one corporate structure (Bruijn 1990:184). Secondly, the trade with Asia placed special demands on the organisation. The large scale of operations, long distances, and the lengthy times required a more permanent commitment to the trade (Neal 1990:195). As a consequence, the company which previously committed capital on the basis of each single voyage had by 1612, changed to providing a permanent capital base committed perpetually to the enterprise.

The company achieved a level of co-ordination previously unseen in the world of international trade. The arrival of ships could be co-ordinated to overcome market transparency problems balancing supply and demand in diverse locations. In many ways its activities resembled those of today's multi-national companies in the way it utilised information to help plan and co-ordinate activities in various nations. From the company's regional HQ at Batavia, in modern day Indonesia, the company's international activities were monitored as if by 'an enormous radar screen' (Steensgaard 1973:409). From Japan to Arabia, trading posts and factories sent reports on the political situation and market trends. The information was assessed, along with the performances of the various trading posts, and was used to help prepare plans for the following year. Finance, shipping and other resources were allocated to the various company activities depending on the potential growth suggested by the information received. This was vastly superior to the Portuguese system where individual contracts for specific routes did not obtain the same degree of co-ordination.

Vertical integration of the Dutch company provided another advantage over the Portuguese. Portuguese traders had to make a large payment to the Estado da India for protection; a payment which included a tribute to the Portuguese king. By contrast, the VOC supplied their own protection at cost (Steensgaard 1973:151). This meant protection costs could be determined in advance, allowing the VOC officials to create tighter plans and budgets, while giving them increased power to co-ordinate their political and economic activities.

The Portuguese Estado had continuously been plagued by principal-agent problems and information asymmetries, a problem contributed to by a lack of a decent financial reporting system (Boyajian

1993:122). The Portuguese had not adopted the double entry accounting system introduced into Europe by the Italians. The Dutch did not make this mistake. Jan Pietsz Coen had himself studied double entry accounting in Italy as a youth. The Dutch system was not complete and contained errors, yet it provided information for decision making and pricing far superior to their rivals.

The corporate structure of the VOC allowed management to make decisions at different organisation levels, providing flexibility on which a vast network of trading operations could be built. At the various factories around Asia, staff would deal with local merchants, order stock, maintain the warehoused stock, inspect quality of stock, and maintain accounting records. During the busy season, ships would be occupied with loading and dispatching of ships however, during the off-season there would not be so much to do (Boxer 1965:206).

The company was also instrumental in changing consumption patterns in Europe with its imports (Chaudhuri 1985:82). However, it would take into account European stock levels and sales before making purchases in Asia. This avoided situations of over or under supply, something only a company with integrated facilities and information networks that spanned the world could do.

The Portuguese suffered from a classical transaction cost problem. The contractors who supplied the king's shipping wanted to reduce costs while the merchants who used the shipping wanted better quality shipping. The crown and its military advisors stuck faithfully to the carracks while the Dutch sent out smaller, faster and more manoeuvrable vessels. Faced with a monopoly, they had no choice but to accept space on the carracks while the Dutch who internalised this conflict, improved quality at the same time as reducing costs (Boyajian 1993: 125-6).

However, the viceroy in Goa was closer to the problem and showed more flexibility. In 1616, the viceroy sanctioned the private use of galliots, smaller vessels that could outrun the Dutch (Boyajian 1993:157). This announcement also conceded that the Crown no longer had a monopoly within Asia. Private shipping flourished while customs revenue declined with an increase in customs evasion. However, the crown still provided the ships on the route between Asia and Europe.

Although Dutch organisational changes were clearly superior to the state-organised Estado, it is questionable whether these organisation developments gave any advantage over the private Portuguese traders operating in the Indian Ocean. For these traders based on kinship groups, human capital was the most important asset (Boyajian 1993:122). Skills and knowledge passed from generation to generation and a network of trusted agents more than compensated for these organisational innovations. In the early days at least, the extended kinship networks were also capable of controlling superior sums of capital than the new company. Similarly, these merchants were well aware of the problems of market transparency and

overcame the problem by forming a cartel which reduced the risk of loss due to unforseeable shifts in market prices (ibid:119-20).

The creation of a cartel would lead us to expect a decline in competitiveness. Certainly, aspects of this concentration were shaping as a distributional coalition. These contractors were the only ones who could afford to purchase the contracts which were passed among a group of privileged elite (Subrahmanyam and Thomaz 1991:303). Nevertheless, within Asia, they competed with locals and appeared to maximise their trading opportunities (see Boyajian 1993). However, as efficient as the private traders were, they were to lose out to the Dutch simply because they were reliant on the King's shipping and protection and the Portuguese lost the naval struggle against the Dutch and English.

In the Atlantic, the organisation of Dutch trade had been very different from the VOC. It had been small private shippers that established trading links with West Africa, Brazil, Venezuela and parts of North America. However, these trading centres were vulnerable to aggressive political and military action from Spain and Portugal (de Vries and Van der Woude 1997:398-401). This vulnerability gave rise to the suggestion that a single chartered company be created, like the VOC, with sufficient military strength to defend their trade. However, when a twelve year truce was signed with Spain in 1609, the concept was shelved. When the truce expired in 1621, the idea was raised again and the West India Company (WIC) was created, amalgamating smaller companies into a monopoly. Many experienced investors stayed away from this new company out of fear that its military expenses would undermine its profitability. Battling both Spain and Portugal in the near Atlantic would be a harder task than that faced by the VOC. However, many Jews invested in the company to counter the loss of trading links to Brazil with the recommencement of hostilities in 1621 (Israel 1990:377).

The West India Company was not as successful as its eastern counterpart. Its creation in 1621 was not welcomed by those independent merchant houses trading in the Atlantic and it would be thirty years before the company offered anything new (Emmer 1998:70). Much of its time was devoted to military activities which undermined its profitability. By the time peace came it had been forced to sell of many of its monopoly privileges.

It is questionable whether the monopoly structure that was so valuable in the riskier Asian trade would be so useful in the Atlantic. The defensive abilities of the WIC were only important during the war with Spain after which smaller shipping companies could operate in a lower risk environment but with greater flexibility. It was also more difficult for the WIC to maintain its monopoly in the Atlantic which was more accessible and contained less risks than the more distant Asian trades.

Apart from the trading companies, the Dutch introduced a number of other institutions which reduced the costs of transacting and facilitate the growth in trade. In 1609, the Wisselbank (Exchange Bank) was founded in imitation of the Giro Bank at Venice. Its function was to control money changing and settle bills of exchange. (Schama 1987:345). The Chamber of Insurance was set up by the Amsterdam City Council to resolve disputes and increase confidence by registering and processing policies (Israel 1989:76). In 1614, the Amsterdam Loan Bank was created to help finance trade. Israel (1989:78) states that these Amsterdam financial institutions undeniably helped bolster Dutch trade primacy by providing a resource base and degree of specialisation that none of their rivals possessed. In lowering the costs of obtaining finance, the institutions gave the Dutch lower costs than their rivals.

A vital institution was the bourse, the forerunner of the modern stock exchange. It was a natural evolution from the waterfront markets that all ports possessed. The bourse brought under one roof a place where deals could be negotiated, finance arranged, and shipping and commodity news gathered. The Amsterdam bourse, built in 1611, was arguably the nerve centre of the whole economy (De Vries and van der Woude 1997:147). It was a building of arcades around a central courtyard in which merchants and brokers gathered and traded 'literally everything known to that society'. The scope of Dutch commerce enabled the bourse to provide more investment options than any exchange in other nations. From commodities like pepper to shares in companies like the Dutch East India Company, all could be found. The ease with which commodities could be found and exchanged dramatically reduced the costs of doing business compared to other centres and added another factor to the efficiency of the Dutch economy.

Vital to the operation of the market was information, and here again, by the standards of the day, Amsterdam overflowed with information (De Vries and Van der Woude 1997:149). Ships brought in reports of produce availability and demand from around the world. Early news papers were established, the Amsterdamsche Courant in 1618, the Tydinghen in 1619 and the Oprechte Harrlemsche Courant in 1667. Publications were complemented by intelligence networks of merchants and companies that sought to give the earliest advice on market conditions.

9.5.2 Government Policy Iberian trade had always benefited from the support given to it by the government. However, the Dutch government represented a departure from the countries we have researched to date, in that representatives were elected. This was not a democracy as we know it today for, members were elected for life. However, it presented a huge advance on an inherited monarchy or empire.

An example of this can be seen in the Asian trades in which both the Dutch and the Portuguese had monopoly organisations operating. However, the Dutch company was run by merchants while the Portuguese company was a preserve of the crown. The royal monopoly increased the costs of trade and undermined its competitive strength. At times, it would force local merchants to buy pepper at inflated

prices while continuously diverting profits to finance the religious-based wars in Europe instead of reinvesting it into the fleet. Consequently there were never enough Portuguese ships on the main route that linked Asia to Europe (Boyajian 1993:8). Ships left Asia dangerously loaded to the brim, contributing to a very high loss rate.

By contrast, the government was a key factor in the efficiency of the Dutch state. The Dutch Councils of State were composed of trading merchants who had lived overseas and were conversant with commercial matters (Chaudhuri 1978:5). Most town councillors were either ship owners themselves or had some interest in overseas trade or industry. Consequently, the government played a strong and informed role in the economy. Public authorities supervised a broad range of economic activity, from banking and insurance to manufacturing. The State controlled the unloading of herring at every stage from curing, packaging, storing to marketing to ensure quality control. Dutch textiles were similarly monitored (Israel 1989:413). Laws and foreign policy were designed to benefit trade while, a strong diplomatic and military presence kept Dutch shipping from being overwhelmed by aggressive forces (Israel 1989:411). Dutch governments did not make the mistake of defaulting kings. They paid their debts on schedule, and did not tamper with savings or with the currency. The resulting stable fiscal environment contributed to low interest rates that assisted producers and shippers throughout the economy.

9.5.3 Supporting industries As in all the countries we have looked at so far, leadership in shipping has been associated with an industry cluster which includes a cargo for the ships to carry. The markets for the cargoes of Spain and Portugal were getting saturated and this placed limits on these countries' ability to grow within their specific growth paths.

Much of this saturation was associated with the increase of competition which worked against every one. The rapid increase in the number of suppliers had its inevitable effect with saturated markets. By 1618, the expansion of trade in both Asia and the Atlantic came to an end (Boyajian 1993:144). Merchants in Lisbon, Amsterdam and London had caught themselves in a cost-price squeeze. Their competing had pushed up the prices they paid for goods in Asia but reduced the prices they could resell them in Europe. To make matters worse, Europe then entrenched itself in the Thirty Years war which depressed their markets. For the following decades, traders struggled for a share of a market that in the best of years would only grow slowly.

The main cargo on which Iberian trade was based was bullion. The influx of bullion had created an inflation which reduced the value of silver (Phillips 1990:86). Consequently it became less profitable to operate the new world mines and production was cut back. From the decade 1641 to 1671-80, the mining districts of New Mexico experienced a 21% decline (Hoberman 1991:14). With less cargo, Spanish shipping declined. The drop off in registered ships crossing the Atlantic was from 1,363 to 971 in 1630-9

to 722 in 1640-49, a fall so great that contraband shipping could not account for the fall (Hoberman 1991:15). Other exports also declined, for example hides falling from a peak of 134,000 in the early 1580's to 8,000 in the late 1660's (Phillips 1990:88). This over-investment was not a result of lack of co-ordination due to information weaknesses, although no doubt coordination would have solved the problem. It was a result of intense competition in full knowledge of the status of their competitors. Nations competed in order to increase market share and emerge the victor in a trade war. This period of over-supply had to be endured until a victor or some kind of equilibrium emerged.

Pepper was a key commodity for the Portuguese in Asia, filling 65-89 percent of the cargo space in carracks returning from the East (Steensgaard 1990:118). When the Dutch and English East India companies entered the Indian Ocean with their lower cost organisational structures, they provided further competition that helped fuel a declining price trend. Prices on the Amsterdam exchange show that prices for pepper declined from an index of 145.5 early in the seventeenth century to 57.3 in 1680-4 (ibid).

The main income earner for Portugal in Asia was the sale of protection to Indian shippers. But even this protection racket suffered from saturation as the Dutch and English became competing suppliers in the seventeenth century.

With the saturation of key markets, further growth would only come by the opening of new paths and the Dutch were doing this via their industrial advances. Industrial advance was accompanied by technical innovation and an increased use of machinery across the economy. It included textile machinery, copper stills, presses, multiple blade timber saws, and grinding machines for processing coffee. In the Zaan industrial zone, new style paper mills appeared around 1670 using much heavier and more expensive equipment that produced a smooth, white, high quality paper. The Netherlands became 'the technical research laboratory of the western world' (Israel 1989). The new technologies created exportable products whose competitive advantage was not quantity but, quality. This technical advance was a result of a number of factors. Scarcity of labour and the resulting high wages encouraged development of labour saving machinery, while windmills and peat provided the nation with abundant cheap energy sources.

In contrast to the availability of Dutch industrial cargoes, exports from Spain had never been a vital factor in their competitive success. In the early years, Spanish ships had carried some manufactured goods from Spain in return for raw materials however, Spanish Americans eventually established their own production of manufactured goods, decreasing their need for Spanish imports. The imports now wanted by the immigrants were high quality foreign goods (Kamen 1983:161). Some of the foreign goods would be smuggled to America in Dutch and English ships while others would come via Spain, imported through the connections of the Consulado.

The Dutch were particularly well placed to benefit from the situation as the improvements they made in shipping were complemented by improvements in their industrial base. They could provide the products that South Americans so eagerly sought. Access to manufactured products gave an important competitive advantage to Dutch shipping.

The rules that the Spanish had introduced to reduce costs also provided a window of opportunity for the Dutch and English. Foreign smuggling was made easier by the system of shipping conducted by the Spanish. The fleet system might ensure that bullion got to Spain but it totally ignored colonial desires for supplies. The fleet system meant ships arrived very infrequently. Consequently, colonial Americans were very receptive to foreign boats arriving at their shores loaded with goods. Smugglers provided South Americans with a larger variety of goods at more reasonable prices than those available through the Spanish monopoly (Harring 1963:308). After the Dutch established bases in Curacao in 1636 and the British seized Jamaica in 1655, Spain was more vulnerable to foreign smugglers.

Dutch trading and industrial activities reinforced each other in a manner representative of the Industrial clusters identified by Porter. The 50 million guilders worth of riches that the nation's ships brought in (Israel 1989:258) also complimented activities in domestic industry, the economy developing mutually reinforcing clusters of commerce and industry. Colonial products provided the basis of a number of growing industries. Sugar carried in Dutch ships provided the raw material for sugar refineries which catered for the rising European demand for sugar. By 1662, half the sugar refineries in Europe were based in Amsterdam (approximately fifty) with another dozen or so located at Rotterdam, Middelburg, Delft and Gouda (Ibid:264). In the Zaan industrial belt, numerous plants were turning imported ingredients into processed foods including biscuits, spiced cakes, chocolate, mustard and exotic liquors made from tropical and sub-tropical fruits (Israel 1989:260).

Tobacco, also carried in Dutch ships, sourced a tobacco finishing industry in which local and American leaves were blended to create a cheap flavour-some product with which other nations had trouble competing. By 1700, twenty-three tobacco-spinning and blending establishments were located at Amsterdam. An off-shoot of the tobacco industry was the manufacture of clay pipes which became the main industry at Gouda. Diamond imports were processed by Sephardi and Ashenazi Jews, with highly developed skills that would not be easy to replicate by would be competitors, giving the Dutch a clear comparative advantage (Israel 1989:267). Other industries related to the growth of shipping and trade included delftware, a ceramic product made in imitation of Chinese blue porcelain. A window of opportunity to enter this trade opened in this industry when the VOC had trouble obtaining supplies due to political upheaval in China.

Landes (1998:173) believes that contempt for manual arts was the principal cause of Spanish economic decline, particularly given the dominance of Jews and Muslims in industrial crafts. However, it has to be remembered that Spain's success was never based on its industry. It was based on a reconquista mentality and the exploitation of its South American empire. While the Spanish economy was entrapped in these values on which it had built its success, the Dutch were creating a new road to riches.

The one manufacturing industry that both the Iberian nations possessed with some expertise had been shipbuilding. However, their industry was suffering from high costs associated with high domestic inflation, depletion of domestic forests and an increased reliance on imports from the Baltic. Wages in the shipyards increased and the number of skilled workmen declined, possibly a consequence of emmigration to the Indies and a general population decline in Spain. Much of the slack was picked up in South America where a healthy industry had access to plentiful materials. However, the decline of Spanish shipbuilding had contributed to the loss of unchallenged supremacy. By the beginning of the sixteenth century, Spanish merchants and shippers started to ignore the protectionist laws and foreign-built ships increasingly began to replace native vessels in the carrera as the Spanish industry declined (Clayton 1976:244). In 1613, the protectionist laws had to be amended to allow foreign built ships in the carrrera.

Spanish shipbuilding entered a period of slow history consistent with the hypothesis. The Spanish had once led the way in ship design, but it was foreigners that were now producing the best ships. During the period of Spain's rise, the government had shown a willingness to experiment however, Spanish shipwrights introduced few improvements in ship design during the years 1590-1630 (Usher 1932:197). Much of this entrapment reflects the rigidity of routines identified by Nelson and Winter (1982). The government had attempted to upgrade quality in an attempt to produce the types of ships coming out of Dutch shipyards. It issued requirements stressing the incorporation of newly discovered scientific knowledge which was changing the face of shipbuilding in the north (Clayton 1976:242). For example, Thome Cano, an early seventeenth century expert stated that 'it is extremely neccesary that the builder or master be an Arithmetician and know how to judge tonnage so that he might apply the rules to construction' (quoted in Clayton 1976:242). However, Spanish ship builders did not possess considerable mathematics expertise to do this. Incorporating scientific principles was a radical departure from the normal basis in which a master built on the basis of experience and observation. Consequently, shipbuilders stuck to construction methods in which they had capabilities, and restricted themselves to small refinements in the established type. As a contemporary writer noted, Spain was suffering 'from making its ships without rule or reason, but by the eye and at the caprice of each builder' (quoted in Usher 1932:197). As late as 1691, naval experts were complaining about the lack of scientific thinking in the Spanish industry. Consequently, the Spanish no longer had a technological edge and this contributed to the decline of their shipping (Usher 1932:202).

By contrast, Dutch shipbuilders were reducing costs and advancing technology at a faster rate. Much of this technical advance was a result of shipbuilding's guild-based organisation (Unger 1978). Although guilds have a notorious reputation for hindering efficient resource allocation, this did not apply to Dutch shipbuilders' guilds, which were relatively young. In Amsterdam, where shipbuilders were part of the carpenters' guild, a specialised organisation was not created until 1517. Guilds provided stability, and played a key role in promoting economic growth and technical advance. They trained artisans, producing craftsmen with the highest reputation. They generally had an open policy on labour mobility. This stopped wages from inflating and also allowed men to bring in skills and techniques not locally available. Guilds enforced quality control through a court system which handled customers' complaints. Should the industry require capital equipment that was beyond the financial resources of individual members (eg jacks for hauling wood or bellows), the guilds would acquire the equipment and provide equal access to all members. Guilds never regulated against new production methods but, through their regular meetings, offered a forum for the exchange of technical information.

Guilds benefited from government support, but with the added environmental requirement that Porter (1990:674) says is necessary for government assistance to succeed, namely, rivalry. Authorities set aside land for use by shipbuilders, helped in the development of docks and bought major capital items such as town cranes. As shipbuilding centres were close together, creating a competitive environment, legislators were careful not to drive potential customers to another nearby town(Unger 1978 67-85). However, there were limits to this rivalry. To maintain stability, guilds tried to restrict price competition between their members, so success was determined by technical progress in response to market conditions, a process similar to oligopolistic competition today. Although a technical advance would soon spread to other guild members, the innovator could expect a short-term advantage which, given the size of the product and the number of orders, might be ten years or more. The overall effect was technical progression throughout the industry.

9.5.4 Human Resources The increase in labour productivity across the Dutch economy was aided by investment in human capital. The Reformed church that dominated the Netherlands insisted that its followers should be able to read the bible (Boxer 1965:155-7). Church schools provided the Netherlands with the highest literacy rate in Europe, if not the world, an accomplishment assisted by the establishment of five universities between 1575 and 1636.

As in the earlier economies we looked at, maritime expansion increased the quality and quantity of knowledge available to the Dutch (Boxer 1965:161). The literature available on travel and voyages became the best available in Europe, a lead expressed in the navigating manuals and atlases emanating from Dutch print shops. In all the major seaports a number of teachers taught the science of navigation to aspiring

young navigators (Boxer 1965:166). Some were old sailors drawing on their experience, while others were experts on mathematics and theoretical navigation.

By contrast, scientific and technical retardation was occurring across the Spanish and Portuguese economy. Consistent with our hypothesis, the Jesuit education system that had once been the best of its day became entrapped by formalism. After the founding of the Jesuit order in 1540, its founders analysed the best existing universities, Catholic and Protestant, and built their colleges on the most advanced methods and knowledge. They experimented for forty years before finalising their official study plan, the Ratio Studiorum. At this point, the education system stopped evolving (Saul 1992:114). Teachers and pupils were discouraged from advancing propositions that were not supported by the established and recognised authorities (Boxer 1969:346). The result was a reproductive education system immersed in the values of Catholic Orthodoxy. While the rest of Europe was experiencing an intellectual ferment lead by Galileo, Descartes, Newton and others, the Jesuits kept Portugal and Spain from this cumulative advancement of science. Scientific stagnation saw the Portuguese, who had been leaders in navigational theory and practice, fall behind the pace set by the northerners (Boxer 1969:350). Even some Portuguese manuscripts on navigation were more widely diffused in the Netherlands than in their home-land where some of their greatest works were not even published (Magelhaes Godinho 1993:36).

The church provided another institutional brake on tactical and technical development. From the mid-sixteenth century, increased religious influence of Philip II and the counter-reformation, which sought to reaffirm Catholic values, resulted in a reaction against novelty in science. Church rules and values enforced by the Holy Office of the Inquisition stifled intellectual development. Restrictions were placed on studying abroad and publishing of foreign books (Kamen 1983:120). Local publishing also had to endure censorship. Consequently, the proportion of books dealing with scientific inquiry in Madrid declined from 14% between 1566 and 1600 to under 6% between 1601 and 1625, while books dealing in religious themes rose from 32 to 42% (Kamen 1983:252-3).

9.5.5 Complementarity with Religious Values Despite the restrictions of the rules and values associated with the inquisition, Iberians still gained some strength from the alignment between religious and trading institutions. For example both the Dutch and English had trouble establishing trade in Surat because of the influence of Jesuits at the Mughal court (see Boyajian 1993:147-51). However, in time people make mistakes and, mistakes provide windows of opportunities. For example, in 1613, Portuguese officials mistakenly seized a Mughal trading fleet on the basis that it had evaded paying customs. The incident led to a war between the two nations and Jesuit power at the court disintegrated. The northerners soon received the permission they sought.

In the Netherlands, the church did not always approve of the over-indulgence associated with the consumer society. Calvinists were also against the vanity and materialism associated with money-making. They succeeded in imposing some acts of petty suppression, for example, in 1607, ginger-bread was banned (Schama 1987:184). However, such resistance was only small-scale.

While so many were benefiting from the growth, it would be unrealistic to expect powerful institutional resistance to the new economic system. The new economic system created a society growing in affluence. In 1585, out of the 30,000 inhabitants that lived in Amsterdam, only 65 had taxable wealth greater than 10,000 guilders. By 1686, the population of the city had grown to 200,000 of which 259 had wealth greater than 100,000 guilders. To these people 10,000 guilders did not warrant a mention (North 1997:52-6). Even the Labouring classes benefited from the rising wealth. They enjoyed a variety in diet that was beyond the reach of their counterparts in other parts of Europe (Schama 1987:169).

There were few religious hindrances to economic development in the Netherlands. Even for the Church, the trade presented opportunities as Dutch expansion came at the expense of the Catholic Portuguese and Spanish. It provided an opportunity to defeat the anti-Christ and bring the Gospel to distant lands (Schama 1987:346).

9.5.6 Military Strength The Iberian nations had gained much competitive strength from the fact that commercial goals were fully aligned with the nation's military goals. Military strength would be used to help defend a trading monopoly. However, the ensuing military battles should not be seen as just a battle for trade. They were part of a wider political play-off that once again reflected the 'reconquista' mentality. The Spanish king had been elected Holy Roman Emperor responsible for lands in northern and eastern Europe. He took to this role a desire to promote Catholicism and defeat the forces of Protestantism. This entangled Spain in a series of battles that drained the Spanish treasury. As early as 1598, practically all sources of revenue were mortgaged and American revenues pledged in advance (Harring 1963:313). This deprived the nation of resources with which it might be able to defend its shipping from up and coming imitators, the English and the Dutch.

Superior labour resources were a major factor in the Dutch victory over Portugal in Asia. Although the two nations had similar populations, the Netherlands could draw on labour from Scandinavia and the German states, and place larger military forces in the field. Portugal, on the other hand, had its labour supply milked by Spain before gaining independence in 1640 (Boxer 1969:114). The problem was aggravated by the high death rate on voyages (Boxer 1969:219), a problem shared by the Spanish.

The reconquista mentality affected the ability to raise seamen in yet another way. One problem that Spain and Portugal shared in raising sufficient numbers of sailors was the low standing that the profession had in

both countries (Boxer 1969:213). Sailors who swept the filthy decks of ships could not have the same purity of blood as a soldier. The navy possessed nothing like the prestigious military orders and, it was common for captaincy of ships to be given, not to people experienced in sailing but to infantry officers. This destroyed the attractiveness of a career as a seaman (Goodman 1997:224).

Low labour and social mobility put a brake on the exploitation of talent. Both Spain and Portugal used nobility as naval officers in the belief that noble blood provided courage and 'a talent for facing danger and death without fear' (Goodman 1997:221). This was quite normal in Europe at the time; however, there was a higher chance of being promoted on the basis of talent in England and the Netherlands. Consequently, the Portuguese Fidalgos (or gentlemen of blood) in the Indian Ocean found they were losing battles to Dutch officers with more experience and a better grasp of naval strategy (Boxer 1969:115).

Table 9.1 **Declining Spanish and Iberian Shipping**

Registered Spanish shipping crossing the Atlantic		Outward Bound Portuguese East Indiamen
1621-9	1,363	1530-39 80
1630-9	971	1550-59 51
1640-9	722	1570-79 54
1650-9	412	1590-99 44
1660-9	302	1610-19 56
1670-9	433	1630-40 30
1680-9	368	1651-60 32
1690-9	328	1671-80 25
(Source Hoberman 1991:15-6)		(Source: Boxer 1969:379)

The Iberian nations were entrapped by their own sense of success learned over time. Kamen (1983:193) notes the arrogance of the Spanish and contempt for other nations. In Spanish America, Parry (1966:399) notes how the leaders of colonial society regarded themselves as the heirs of the conquistadors, while Boxer(1969:146) notes the Portuguese 'were convinced that as the descendants of Alfonso de Albuquerque's conquistadors and as the vassals of their mighty king, they were ipso facto vastly superior to the upstart merchants of the European trading nations however wealthy they may be'. This sense of identity with the past, and resulting cultural arrogance formed a barrier to internal progression and has much in common with the cultural aesthetics identified by Schoenberger(1997). Arrogance and aesthetics masked the fact that Spanish tactics and organisation had, by the seventeenth century, become static and out of date (Parry 1966:230). The Portuguese were worse 'They practised no tactics other than a disorderly charge to the war cry of St James and at them! (Santiago e a elles!)' (Boxer 1969:117).

The Iberians persisted with routines in a manner supportive of Nelson and Winter's 1982 proposition that companies have trouble shifting from routines that they have invested in and built up over time. At this

time, the leading naval technology was embodied by the sleek lined and well armed galleon. Although the Spanish had taken a strong role in the development of the galleon, it was the northern nations that more fully exploited the galleon's capabilities. The Spanish maintained the Mediterranean tradition of using artillery to hit and disorganising the enemy just before boarding while the English, limited in manpower, relied exclusively on manoeuvring by the wind and delivering an artillery "broadside". While the English produced vessels that were very light and very well gunned, the Spanish built galleons with forecastle that made it easier to board an enemy ship (Cipolla 1965:86-7). The Dutch defeated the Portuguese for exactly the same reason. A contemporary observer recorded that 'The Dutch vessels which are handier to manoeuvre by the wind, overcome the Portuguese galleons very easily. The Dutch can take to flight when the wind is favourable to the enemy and attack when the enemy is low wind. To the Dutch any small wind is enough, while for the Portuguese vessels a half gale is necessary for movement' (Father Vincenzo Maria quoted in Cipolla 1965:88-9).

The Portuguese lost the naval battle in the 1620s (Boyajian 1993:241) against the Dutch and their English allies. By 1623, the Dutch had 90 ships, 2000 regular troops and 20 forts in the East Indies (Israel 1989:175). In 1630, the Dutch West India Company obtained a foothold in North East Brazil giving them access to sugar, tobacco and brazil-wood.

The Iberians were becoming entrapped in their old patterns of behaviour, belief systems and stake-holders. These are summarised in table 9.2. Standing out is the role of the Crown and heuristics associated with the reconquista paradigm.

Table 9.2 Entrapment of Iberian Shipping

Sources of Competitiveness	Paradigm Heuristics	Sources of Entrapment
Shipping industry		
- Use of artillery before ramming and boarding (military strength).	- Use artillery before ramming and boarding.	- Persistance of routines. Continued use of ramming and boarding tactic.
- Crown support and mobilisation of resources. - Crown organisations act as a store of knowledge and reduce transaction costs.	- Crown as ultimate source of trade revenue and control.	- Royal restrictions on trade routes in Asia. - Decentralised system of contracts. - Consulado and Fidalgoes become distributional coalitions.
- Ship technology.	- Craftsmen build by experience and rule of eye. - Improve naval technology to compete with foreign navies.	- Persistence of routines. Failure to adopt mathematical building methods. - Difficult to retrain to more mathematical ship-building techniques (persistance of routines)
- Skill and Experience.	- A number of rules of thumb, for example sail with the Atlantic wind system.	
- Reputation.		- Arrogance.
Supporting Areas of Economy		
- Expansionary reconquista Mentality.	- Reconquista paradigm with emphasis on Christian/military. - merchants aspire to status of nobility or clergy. - industry seen as low status with connections to Jews and Muslims	- Failure to industrialise. - Reproductive Jesuit Education. - Failure to industrialise.
- Natural resources of South America	- Exploit natural wealth of south America	

9.6 Attempts at Reform

> "The empire in the East is like a ship that is sinking. Everybody shouts we are foundering, but nobody pumps the water out". (Portuguese reformer quoted in G.V.Scammel *The World Encompassed* 1981:290).

As early as the 1620's, Iberians were aware of need for reform. In the East, the Dutch were taking over Portuguese trade routes with superior organisation, technology, strategies and resources. In the Atlantic, the Dutch dominated trade on the strength of their cargoes. However, the reform program failed against the rigidities identified by institutional economics and posited in this thesis.

An improvement in the quality and cost of Spain's own manufactures might have improved the situation. However, industrial advance was inhibited by the high cost structure of a successful economy. Spain's ability to increase its industrial output was aggravated by the high inflation caused by the inflow of silver

from the New World. So bad was Spanish inflation that foreigners could import Spanish wool, create finished woollen products which they would send back to Spain and still make a profit (Kamen 1983:228). In 1619, Sancho de Moncada would write 'the poverty of Spain has resulted from the discovery of the Indies' (quoted in Kamen 1983:234). Although caused by monetary inflation, the effect was similar to that noted in Vernon's life cycle with high domestic wages leading to a decline in the domestic industrial base with foreign locations taking up the reins.

The only way for Spanish producers to combat the rising prices was to offer higher quality, but this was undermined by a feeling of easy money, and a contempt for manual arts (Parry 1966, Hamilton, Landes 1998). In both Spain and Portugal, the social order was characterised by social values that discouraged productive investment. The reconquista mentality did not produce technological advance in domestic industry. Money once earned was not invested in industry. Successful merchants preferred to buy their way into the nobility. Wealth went into buildings, jewellery and other expensive accoutrements connected with a superior social status. Alternatively, it could be invested in unproductive personal loans and government bonds (juros) that paid higher interest rates than productive investments in agriculture or industry (Elliot 1970:187).

Industrialisation would have faced resistance from stakeholders in the existing system. Any attempt to industrialise would be made in the face of competition from high quality imports from Asia. In the absence of protection, local industries had little chance and traders benefiting from the existing system were unlikely to agree to the loss of their income.

During the sixteenth century, there had been a rising prejudice against trade. Merchants with converso (Jewish) backgrounds were particularly keen to distance themselves from their merchant origins. A process occured similar to that identified in Marshall's life cycle of the firm in which third and fourth generation families lose the vitality that their fathers had. Fewer merchant's sons entered their father's professions (Pike 1972:110). Many took the opportunity to raise their status by becoming more closely connected to the prevailing reconquista system. For example, the third generation of the Jorge family, mentioned on page123, entered the church, the army and became major landowners.

The path for reform was intensified when Philip IV (1621-1663) came to the throne. He appointed the Count-Duke of Olivares as first minister, someone who brought with him a mandate for change. Lamenting the state of Spanish technology, Olivares embarked on a reform program (Elliot 1970:188). However, Olivares soon learnt the difficulty of introducing innovations into a system whose institutions and values were built for a different growth path. His reform programme encountered many of the obstacles we associate with organisational reform today, uncertainty, distrust, and opposition by vested stakeholders.

With the intention of turning Spaniards into merchants, Olivares established a number of Juntas dealing with trade and commercial activity (Kamen 1983:210). A number of 'new Christians' (conversos) with experience as successful merchants went to Madrid and put forward their proposals. Unfortunately, while there was plenty of consensus on the need for change, agreement on the cure was less hard to come by (Boyajian 1993:191). The uncertainty associated with modern organisational change programmes was a common feature of the day. A number of writers in the 1620s, including the wealthy businessman and economist Duarte Gomes (mentioned on page 119), wondered whether the Portuguese lost their empire in the East because they had not become proper merchants driven by commercial logic or, alternatively, in becoming more like merchants they had lost the knight spirit that earned them the empire in the first place (Magelhaes Godinho 1993:46).

Gomes comment reflects a common divide at the time. The landed aristocracy asserted the old values associated with the land and the nobility. They disliked the growing influence of commercial ideas and new-wealth, particularly with their association with New Christians. Fortunately, Madrid appreciated the importance of New Christians and Olivares actively protected them from the Inquisition (Boyajian 1993:178).

Gomes also recommended organisation reforms. He had experience as a merchant in the Indian Ocean and suggested creating a Portuguese India Company in imitation of the Dutch company. His suggestion was supported by the Junta de Comercio who advised 'that it would be a good thing to resort to imitation, in so far as this is compatible with our temperament and disposition' (quoted in Elliot 1986:155). Olivares authorised a charter for a Portuguese company in 1628. To overcome fears of royal intervention, he attempted to distance the crown from the company, and created a company board consisting of a president and six directors chosen from prominent businessmen. However, experience of royal intervention in the past had left a legacy of distrust.

Entrenched stakeholders presented another problem. In contrast to the Dutch East India Company which was created when their Asian trade was young, the Portuguese had built up a century of stakeholders and interest groups who would not easily forgo their trading income to a monopoly. In the end, the crown had to give in to private interests and the company was only given a monopoly on the pepper trade, shipping and customs revenue (Boyajian 1993:192). It should be noted that the Dutch West India company encountered similar dissatisfaction on its formation. Despite efforts to placate business interests, the Iberian company was launched in a hostile environment in 1628-9 and under-subscribed. Even the directors were reluctant to serve and invest in the company.

Operations did not go well for the company. The company had some bad luck with a loss of a ship and timing which coincided with famine in Gujarat. However, company directors failed to change the most

crucial aspect of the Cape trade, the quality of shipping. The directors had no choice but to continue using the capital equipment they had inherited or purchased from the royal administration but, even when they built new ships they stuck to precedents and ordered carracks. The persistence of routines and learned commercial behaviour is consistent with the hypothesis. The company was not successful and the Cape trade returned to royal administration in 1633 after which the trade declined even faster.

Olivares had intended the East India Company to be part of a 'Great Project' in which a number of interlocking trading companies would be created. The various companies would compete with the Dutch in trades from the Baltic to the Atlantic and the Indian Ocean. However, the scheme failed for a number of reasons. Firstly, a poorly designed incentive structure undermined the scheme. The bureaucracy created to operate the scheme also had the responsibility of confiscating illegally traded goods. Officers of the company were paid in part out of any confiscations, an incentive system which at times made them very proactive. Their actions aggravated merchants in Antwerp who it was hoped would help fund the scheme, with the inevitable lack of co-operation (Israel 1990:221).

Secondly, the company trading in the Baltic was intended to operate with the assistance of the Hanseatic nations but, they were scared to arouse the ire of the Dutch, Danes and Swedes, so gave the scheme a firm and polite refusal. Only a Portuguese East India Company was created but it was under-capitalised and posed no threat to its Dutch rival before finally being liquidated (Boxer 1985:421). It was an experience that illustrated the difficulties of reform while under the pressure of competition.

Attempts were also made to reform the Consulado and Casa de la Contracion which had become riddled with corruption. However institutionalised relations stifled change as the Crown discovered it needed the Consulado as much as the Consulado needed the crown. The Crown was dependent on Consulado members for wealth and revenue. This relationship of dependence weakened the power of the state to effect change and the inquiry into its operations was dropped in return for a fine of 206,000 ducats (Elliot 1986:157). Institutionalised relationships and vested interests associated with the old economic system kept Spain on its old growth path.

Finally, reform was stifled as conflict between stakeholders in the old reconquista value system and the new market system became more visible. Antagonism towards new Christians was particularly notable. Much of this antagonism stemmed from the privileges and honours the new Christians were receiving in return for loans they made to the government. These privileges and honours might have otherwise gone to old Christians and built resentment between the two (Boyajian 1993:201). When Olivares fell from power in 1643, New Christians were exposed to the full force of the inquisition (Ibid:183). Between 1640 and 1660, many converso merchants were forced to leave Spain to escape religious persecution (Hoberman 1991:267).

The loss of capital, skill and trading networks fell into the hands of Spain's enemy, as many of those leaving fled to the Netherlands and bolstered their already growing economy.

Olivares also attempted to reform the navy but encountered institutional resistance contained in the existing value system and vested interests. His naval reforms included a vigorous shipbuilding programme (Goodman 1997:17) which played some part in the defeat of the Dutch in Brazil. He also tried to break the aristocracy's hold on the highest positions of naval command. In 1624 he removed a top aristocrat from the position of captain general (Goodman 1997:225-7) and abolished the system of naval training for sons of the nobility (the training consisted of little seamanship). However, when Olivares fell from power, the system was reintroduced. He attempted to raise the status of seamen by removing the 'purity of blood' barrier, necessary to gain knighthood of military orders to seaman who had provided 15 years service. The measure was defeated by existing conservative values and forces of the nobility. Olivares naval reforms were smashed on the rock of Castile's military tradition which had developed over the centuries of the reconquista. 'No mere decree by Philip III or Philip IV could change that overnight' (Goodman 1997:252).

In 1647, the Portuguese also tried to overcome the same inefficiencies by replacing nobility as officers with professional seamen with nautical knowledge. Both officers and sailors opposed the system. The fidalgos (noblemen) refused to take orders from seamen and the new system was discontinued (Boxer 1969:217). It was not until the eighteenth century that professional seamen become the rule, not the exception.

Nevertheless, not all Olivares' projects failed. The defense organised by Olivares in South America was highly successful. The Portuguese recovered Northern Brazil and the Dutch were left only with Guyana on the northern coast. In 1648, peace was signed with Spain, the Dutch having failed in their military goals in the Atlantic. However, their trading activities prospered particularly with the development of the island of Curacao as a trading depot. The island's good harbour and close proximity to the South American mainland provided a healthy shipping gateway to South America particularly for slaves which the Dutch brought from their forts on West Africa. The Spanish government would have liked to put a complete end to Dutch activities but, it became impossible to outlaw them, particularly when their own citizens benefited from the trade. Eventually, the Dutch trade in the Atlantic became too big to stop and was legitimised by Spain.

The end of the Dutch war with Spain was not good for Portugal's Asian trade. Portugal had gained its independence from Spain in 1649. When the Dutch stopped fighting Spain, it freed up troops that could now be used to help expansion in the East Indies. Between 1648-52, 10,500 were sent to the Indonesian Archipelago and Ceylon (Israel 1989:245). With superior resources, the Dutch took over Portuguese forts, conquered Ceylon and South India obtaining a monopoly in cinnamon and large control of pepper. In Japan, where the Portuguese were expelled for the religious activities of the Jesuits, the Dutch claimed

another monopoly. With elephants from Ceylon, Japanese copper and Spanish silver they had the commodities by which they captured Bengal trade.

Then as now, growth fed on growth. Trading profits provided more capital for further investment. For example, the capital base of the VOC grew from 6.4 million guilders in 1602 to over 40 million in 1660, even though it had paid out 62 million guilders as dividends to shareholders (De Vries and Van der Woude 1997:670).

9.7 Conclusion

In the early seventeenth century, Europe experienced a crisis of which one feature was a crisis of over-supply as new competitors entered markets dominated by the Iberians. The Netherlands arose from the crisis on the back of new institutional and industrial techniques. By 1648, the Dutch were undisputedly the greatest trading nation in the world (Boxer 1965:27). The pillars of growth included a geographic position that allowed it to develop its shipping skills free from strong competitive pressure. High investment in labour saving technology across the economy reduced costs vis a vis competitors, including shipping where the fluyt created a strong departure from past practice. Immigrants aided a process of catch-up, bringing capital and skills that strongly complemented the growing commercial and shipping sector. Linkages were made into supporting industries that provided cargoes and provided efficient shipping capital. The industries used wind and peat to produce energy far in advance of anything else in Europe. These energy sources were applied to technologies that reduced labour costs and added value of final output. When combined with the high investment in human capital, Dutch industry and commerce had higher value and lower cost inputs to undermine their economic strength.

The Dutch trading empire stretched the globe, the activities in one part of the world providing commodities in demand in another. In that way, the different trades reinforced each other, becoming a collective system based on Amsterdam (Israel 1989:258). The mere size of the Dutch market created economies of scale that helped reduce transaction costs. The Dutch economy represented the most efficient commercial system of its day. Industrial output reinforced the carrying shipping trade creating a high degree of interdependency between industry and commerce.

As predicted by our thesis, the Iberian nations lost their leadership, unable to adopt the innovations of the Dutch due to institutional resistance. There were many reasons why Iberian merchants did not successfully adapt to the changing circumstances. These included the control exhibited by royal stake-holders, the persistence of once-successful routines, and an incentive/ value system that did not provide incentives to invest in industry. It is worthwhile contrasting the heuristics of the Iberians in table 9.2 with those of the Dutch in table 9.3. While the Iberians failed to industrialise, the Dutch developed a strong industrial base. While the Dutch developed standardised innovative ship designs, the Iberians maintained their old

construction methods. While the Iberians never overcame the organisation problems of trading to Asia, the Dutch established and maintained tight control of operations and cornered the market in the Spice Islands.

This was not a crisis of any one firm but an economy-wide process of entrapment. The Iberian Peninsula was entrapped by the reconquista mentality and the institutions that helped propel it to leadership while, it's capitalist prospects were roped by distributional coalitions. As Elliot (1970:187) states 'Castilians, it is said, lacked that elusive quality known as the "capitalist spirit". This was a militant society, imbued with the crusading ideal, accustomed by the reconquista and the conquest of America to the quest for glory and booty, and dominated by a church and an aristocracy which perpetuated those very ideals least propitious for the development of capitalism...'.

It is noteworthy that successful institutional changes were made in the trade to the Indies after the War of the Spanish succession (1701-13) placed the Bourbons on the thrown of Spain, (Phillips 1990:97-8). The arrival of foreigners on the throne broke the institutional linkages and a number of chartered companies were created to develop trade between Spain and the Indies. The Royal Guipuzcoan Company of Caracas established in 1728 benefited in a boom in cacao and eventually wrestled the trade to Venezuela back from the Dutch. The Barcelona Company successfully penetrated the Indies trade with a consequent expansion in agriculture, shipbuilding, distilling and manufacturing in Catalonia. Shipping volumes rose from about 30 ships a year in the late 1710s to about 100 in the late 1770s (Phillips 1990:98).

By about 1750, Spain had regained its commercial monopoly over its South American empire (Phillips 1990:97). However, the world was changing. In the North Atlantic, new paths to growth were being built. The English and Dutch with a greater level of industrialisation were creating new products and adding value to cargoes that filled the hulls of their ships. So important was this advantage that the Dutch who earlier displaced Iberian shipping needed no empire, and the British who later lost their American empire still enjoyed rapid growth in North Atlantic shipping on the weight of this new road to wealth. This was a path to development that the industrially and technically weak Iberian nations were ill-prepared for.

9.3 Competitive Strengths and Related Heuristics of Dutch Shipping

Source of Competitiveness	Paradigm Heuristics
Shipping Industry	
- Organisation of VOC.	- Tight control of Asian Trade.
	- Tight control of sailing routes.
- Possession of Spice Islands.	- Corner market and establish strict control.
- Superior Naval Force.	- Trade with arms and invest in expensive fortifications.
- Shipping Technology (esp: Fluyts) and utilisation of standardised ship design.	- Produce standard model as it reduces costs.
Supporting Aspects of Economy	
- Industrial Base (with high level of competition).	
- Supportive Government	
- Supportive Institutions (bourse, banks, etc)	
- Joint stock organisation	
- High level of Education	- Dutch are best

Don Quixote tilts at windmills. In a golden period for Spanish art, no work captured the changes in society more than the novel `Don Quixote de la Mancha' by Miquel de Cerventes. In a dying age of chivalry, the book tells the story of an ageing Hidalgo who embarks on a career of a knight errant. In the end, Don Quixote is defeated by the `modern' and well meaning figure of Sampson Carrasco, a student taking his bachelors degree at Salamanca. The author himself had no head for business and botched the government posts he held, including procuring supplies for the famous Spanish Armada of 1588.

In this scene our ageing hidalgo attacks some windmills that he has mistaken for giants. Windmills had been introduced into Spain from the Netherlands twenty years earlier where they were used widely as a source of energy for industry (from Cervantes 1969).

Chapter 10

Britannia Rules the Waves

10.1 English Imitation of the Dutch

At the beginning of the seventeenth century, English shipping had achieved significant growth, but the English fleet was still much smaller than the Dutch and Iberians. However, the process of imitation continued, much of it led by the State.

In imitation of the Dutch who had established a direct trade with the Spice Islands, the English created their own East India Company in December 1600. The East India Company quickly grew in significance and showed great flexibility, expanding into a number of new cargoes and routes. The company initially represented a forward linkage of the nation's woollen industry as it attempted to export English textiles. However, it found little demand in Asia for woollens so the company became import orientated with out-going cargo dominated by bullion and the company developed a treasury department, which would obtain specie from Portugal.

Throughout the first half of the seventeenth century, the English East India Company suffered at the hands of the Dutch who had superior resources and organisation. Superior resources provided a number of advantages. Firstly, in times when competition reached a level that required an aggressive response, English fleets were always out-numbered. Secondly, the Dutch could provide local merchants with consistent demand based on regular ship visits (Milton 1999:252). By contrast, there might be up to four years between English visits at an Asian port.

The Dutch also benefited from superior organisation. Although all English voyages sailed for the same company, in reality each voyage was financed by different groups of subscribers. Consequently, each voyage paid its profits out to different people and calculated its profit separately. The result was intense inter-company rivalry and a lack of co-operation between voyages. This dramatically affected profit levels. For example, for some years the company had two groups of factors at Bantam, one representing the company's sixth voyage, the other representing the eight voyage (Ibid:251). Not only did this double the necessary expenses but the factors would compete for goods, bidding up the price. The separation of voyages also made it impossible to co-ordinate routes. While the Dutch could co-ordinate shipping to send cargoes to where they were most demanded, each English voyage was a loose cannon.

In 1657, the English company re-organised in imitation of the Dutch model in which all voyages sailed for a permanent company. However, the English company was still less rigidly controlled than the VOC. In similar fashion to the Portuguese private trade, the EIC had allowed its crew and citizens based in Asia the

right to engage in inter-Asian trade as long as its own interests were not affected (Marshall 1987:279). Initially, this involved clandestine loading of private goods on company ships but eventually led to private traders chartering or buying locally owned ships. These shippers eventually started to include on their ships cargoes for Asian merchants. English trade in Asia now operated on two levels (i) an over seeing company which provided stability, political security and some degree of co-operation and (ii) a flexible private trade. After the reorganisation, English trade grew dramatically. From 1640-1690, sales volumes grew from practically nil to 3.4 million pesos while the Dutch company only grew from 3.2 to 3.9 million (Steensgaard 1990:113).

While the Dutch company operated in the spice trade secure in its monopoly, the English company was forced to flexibly carve out new markets. Most important of these was the textile market. From the 1660's onwards, the EIC began to import into Europe cotton textiles from India. This required a change in consumer habits in England where wool was the norm. The product soon gained popularity as it allowed people the chance to wear lighter clothes in summer, and could be more easily modified as a fashion statement than the woolen products available at the time. However, growth was not even (Chaudhuri 1978:282). By the 1680's, when the trade to India was well established, many private traders began to challenge the EIC monopoly by illegally interloping on the trade. The response from the EIC was a strategy devised by the director Sir Josiah Child. That strategy was trade war, to dramatically step up imports so that the 'unreasonable itch of the interlopers might be put to an end once and for all' (ibid:285). To prevent the market from being glutted, Josiah Child also embarked upon a policy of diversification and market segmentation. He ordered his factors in India to send a variety of products to cater for different markets. For seamen and ordinary workmen, he wanted strong blue and white cloth, for citizens he ordered 'white middling', and for ladies and gentlewomen he requested fine white cloth. The strategy worked in eliminating the interlopers but overstretched the company's resources. The company was left with warehouses full of unsold stock As a result the company's credit collapsed and Sir Josiah Child was forced to resign (Steensgaard 1990:113). This over-supply stands in contrast to the Richardson-type over supply situation which stems from lack of information on investment decisions of other suppliers. In this instance the company was in a strong position to determine supply given its huge market power. This was a strategic consideration that nearly back-fired.

In the North Atlantic Ocean, the English had been the first to learn, through trial and error, the workings of the wind system (Ryan 1996:254). We could expect this to provide first mover advantages. However, the thinly populated North American market offered little in terms of markets or produce. In 1606, the Virginia Company (1606) was established to transport a number of immigrants to North America. As the colonies grew, they would eventually support English shipping by providing markets for English manufactured goods and providing raw materials. However, prior to 1640, the American and Caribbean trades would be of little commercial importance (Davis 1967:9).

The wars between the Dutch and the Spanish during the first half of the seventeenth century, provided a degree of protectionism for English shippers to enter trades left under-served. However, when peace came, the Dutch reasserted themselves. The English could not compete with superior Dutch skill in commerce, shipbuilding and shipping management. Even in Britain's own American colonies, Dutch ships deprived the English of tobacco cargoes bound for Europe.

The English response was a range of protectionist measures and an economy-wide process of imitation. The government introduced a series of navigation ordinances to restrict English trade to English ships or ships from which the cargo originated. Other vital forms of assistance included export bounties for wheat and other grains paid only if they were exported in English ships. They made it impossible for foreign ships to compete in these trades (Davis 1962:311). Most telling was a stinging export duty on coal carried on foreign ships, the effect of which was as telling as the Navigation Acts in ending Dutch competition (Davis 1962:312, Wilson 1965:267).

Naturally, the Navigation Acts of 1651 were not welcomed by the Dutch and, together with other disputes, formed the grounds on which the two nations went to war. Over the following twenty years, there occurred three "Dutch Wars". English motives in the wars were clear. As the Duke of Albermarle stated 'What we want is more of the trade the Dutch now have' (quoted in Wilson 1965:165). The wars achieved this end. The Dutch colony of New Amsterdam, which had been a notorious loophole in the Navigation Acts, was captured by the English and renamed New York. The English captured a number of Dutch ships and in the process, expanded the range of ships in the English fleet to include superior bulk carriers. This provided a balance to the strong and defensible English ships which were only superior in the more dangerous trades (Davis 1962:12-13).

The wars illustrated the importance of English naval power in cementing English commercial activity in the North Atlantic; a protection without which, the English would have had trouble competing with the Dutch (Wilson 1965:184). With royal navy protection, the navigation acts gave English shipping a monopoly in the North Atlantic just as population growth in the colonies created a significant market for outward shipping. The colonies also possessed important raw materials for the return voyage. Timber came from the north while the southern and Caribbean colonies developed plantations from which English ships could transport tobacco, ginger, cotton, indigo and sugar. English shipping entered a period of rapid growth between 1660 until 1689 as England established itself as an entrepot, importing and re-exporting goods from its colonies.

Imitation also occurred in shipbuilding, a process that included protectionism. In the 1660s, the Navigation Acts were extended to limit the use of foreign built ships (other than prizes captured in war) hence

protecting English shipbuilders from imports of Dutch-built fluyts. Dutch ships captured during the Dutch Wars had provided the English with bulk carriers but, as these ships aged and needed replacement, ship-owners demanded replacements of a similar quality. Shipbuilders were forced to respond to these higher standards of demand and reproduced something resembling the Dutch ships. It was in the northern ports at Whitby and Scarborough where this was most successful, fuelled by a demand for ships to transport coal. The rise of new shipbuilding centres reflects the suggestion by Nelson and Winter (1982) that areas strong on old routines are more likely to find it difficult to adopt new routines. The new areas of ship-building were unrestrained by the traditions of the southern ports.

Davis (1962:65) describes this process of adopting Dutch hull forms as the main technical development in English shipbuilding of the early eighteenth century. Under protection of the Navigation Acts, this process of 'catch up' was helped by the fact that Dutch technological advance was beginning to slow.

As a result of the growth of knowledge and capabilities, and the protection of the Navigation Acts shipping became one of England's fastest growing industries between 1560 and 1689 Tonnage multiplied nearly seven-fold in this time (Davis 1962:388). However, the English were not going to supplant the Dutch unless they could replicate the broader commercial-industrial base that underpinned their success. Much of the literature of the day promoted a deliberate imitation of the Dutch. Sir Joshua Child, influential director of the East India Company, listed several points where the English should follow Dutch economic practice including their encouragement of innovation in industry and trade, liberal fiscal regulations, and above all their banks and financial institutions which generated low interest rates and reduced the costs for Dutch businessmen. In 1693, he wrote:

> the prodigious increase of the Netherlanders in their domestick and foreign trade, riches, and multitude of shipping, is the envy of present, and may be the wonder of all future generations. And yet the means whereby they have thus advanced themselves are... imitable by most other nations but more easily by us of this kingdom of England (from *A New Discourse of Trade* quoted in Chaudhuri 1978:5).

Behind a wall of protectionism, England embarked on a path of industrialization, which was in effect a process of imitating the Dutch. From turnip husbandry to ceramics, there was scarcely an area of economic activity which did not have its origins across the North Sea (Wilson 1965:361

At Johnathon's Coffee House in 'Change Alley' a market for financial securities developed along similar lines to the Dutch bourse. Investment options included shares in companies such as the East India Company or stock issued by the Bank of England and by 1694, there were 50 listings on the exchange (Wilson 1965:223). The flow of capital was enhanced by a rise in the number of financial institutions. When goldsmiths started taking deposits and giving loans, they began to take on a banking function, while

their ability to create credit made money more freely available and helped to reduce interest rates. Interest rates were also reduced after the government introduced more efficient measures of money management. The process of imitation was made easier when William of Orange was made King of England in 1689. The Bank of England was created in 1694 in imitation of the Bank of Amsterdam and state finances were tightened on the Dutch model, providing a new level of stability in the financial environment. However, the role of capital and low interest rates should not be overstated. Most businesses at this time were internally financed from reinvested profits (Ibid:372-3).

England also benefited from the influx of skills and technological knowledge of Huguenot craftsmen fleeing persecution in France. These craftsmen brought with them production know-how in precision instruments, watches, cutlery, fine textiles, glass and paper (Ibid:195).

Difficulties in adopting textile innovations once more illustrated that sometimes it is easier to introduce innovations to areas with no or little investments in an industry. In the case of the 'engine loom', difficulties of introduction came from stakeholders associated with the old technology. The engine loom (or Dutch loom) had been invented in the Dutch town of Leiden. With this machine one man could make ribbon equal to that previously made by four. This ability to replace labour did not endear it to organised weavers in England who resisted its introduction for decades. In London, these looms were the cause of street riots in which they were burnt. However, in Lancashire, where there were no well organised craft groups to oppose its introduction, it was in common use by the 1680s (Wilson 1965:194).

The successful process of imitation led observers to make comments about the English that we in the twentieth century became used to hearing about the Japanese during their process of catch up. For example, the Swiss calico printer John Rhynier wrote in 1766 'that (the English) cannot boast of many inventions but only of having perfected the inventions of others...' (quoted in Mokyr 1990:240).

Within a relatively short period, England had developed an industrial base that would fill their ships with a vast array of cargoes. Throughout the same period, the population of the North American colonies was growing rapidly from 300,000 in 1700 to three million in 1776. America was a welcome market for the new industrial goods. British ships took cargoes of cordage, hats, leather, linens and silks to the markets in the West (Davis 1962:24). On the return voyages, hulls contained products from American forests and sub-tropical plantations.

Shipping's expansion also reflected growing home demand for raw materials and foodstuffs (Davis 1962:390), a reflection of the nation's growing wealth. The West Indies and Far East provided a new range of commodities (rice, tea and coffee) to import and re-export, but the fastest growing trade was with

America. By the middle of the century, the trans-Atlantic trade accounted for nearly half of all English shipping.

Table 10.1 Tonnage of shipping cleared from British ports for foreign trades
(000 tons)

	1686	1715-17	1771-3
Mediterranean	18.8	30.3	29.1
Spain and Portugal	24.2	44.1	39.9
Northern Europe	55.2	47.9	89.3
West Indies	34.0	35.7	104.5
North America	33.1	40.3	99.0
East India	8.4	4.3	13.9

(source Davies (1962))

10.2 English Advance and Dutch Entrapment

The superiority of Dutch shipping during the seventeenth century was based on low cost and high quality cargoes, low cost shipping, a supportive government and a number of institutions that increased the efficiency of the supporting economy. However, other countries were successfully adopting components of Dutch success. This included French, Swedish, Danish and even ships from Brandenburg set up companies in competition of the VOC and WIC. Many of these firms were set up by Dutch merchants attempting to side-step the WIC and VOC monopolies. This suggests that with the initial trading risks overcome, the monopoly no longer served the nation's best interests.

The biggest threat came from the English who had acquired skills, experience, organisational structure and economies of scale backed by a supportive government policy.

10.2.1 Economies of Scale, Experience, Specialisation and Skills Over time the English developed skills, experience and institutions by which they could more than compete with the Dutch. As trade developed on the North Atlantic, a number of improvements in productivity were achieved. (North 1968). As markets grew, ships carried more cargo and were less likely to travel in ballast. In other words, with growing economies of scale, shipping capacity was more fully utilised allowing shippers to reduce rates to compete. The growth of a regular and stable trade increased the flow of information on prices and supplies, increased the experience and knowledge of masters and mariners and, as markets became better organised, ships could spend less time in port and more time carrying cargo. Specialist shipbrokers evolved who arranged freight and, shipping agents to organise the loading and discharge of cargoes cut turn around times and delays which decreased the costs of transacting.

Dynamic efficiencies also reduced costs. Changes in rig design meant that instead of a few large sails, smaller sails were used which were both more numerous and more manoeuvrable making it easier to sail

against the wind. The development of the jib, head sails and helm wheel made it possible to sail into westerly winds opening up shorter routes across the Atlantic. The improvement in rig design also reduced labour requirements and costs. At the same time, improvements in packaging dramatically reduced costs of some commodities, in particular tobacco (Menard 1991:263).

The overall effect of these changes was a dramatic increase in efficiency. For example, the Atlantic tobacco trade enjoyed a 1.4% average annual decline in freight rates over 150 years during seventeenth and eighteenth century (Menard 1991:256). By comparison, at the end of the sailing era, European shipping had reached a man-tonnage ratio of one man per 9-14 tons, a two to threefold gain over the Indian dhow system (Austen 1987:82).

Increased experience and organisation enabled the English to exploit more fully their shipping technology (French 1995:31). With greater experience of geographic and navigation requirements, ships could make faster voyages while traders learnt to time their voyages to maximise buying and selling opportunities and reduce time spent in port. As knowledge of the trades was disseminated, it contributed further to expansion. Publications assisted this process and included such titles as *Lloyd's List* (1734), Murray's *A Treatise on shipbuilding and Navigation* (1765) and *The Shipmasters Assistant and Owners Manual* (1778).

In the early days of English catch up, some scientific navigation had been acquired by most ship's masters. Acquiring skills in the most advanced technologies (cross-staffs, quadrants, etc.) was best done through practice at sea. However, as trade expanded, a greater knowledge of mathematics was required. Some private teachers began to offer pre-sea training, which they combined with their other business as instrument makers or publishers of books on maritime subjects. In 1673, royal interest led to the founding of a navigation school at Christ's Hospital, followed by more schools in 1701, 1715 and 1716 (Davis 1962:125). The range of subjects taught can be gauged by 'Cutler & Groom' of Wapping who advertised themselves in 1711 as:

> Teachers of Writing, Arithmetick, Merchants Acompts, Geometry, Algebra, Trigonometry, Navigation, Astronomy, Gunnery, Gauging, Dialling, Perspective, Measuring; the use of Globes, and all other Mathematical Instruments, the Projection of the Sphere, on any Circle, etc. (quoted in Davis 1962:125).

The effect of greater precision in navigation was faster, safer voyages that reduced costs and maximised the use of shipping capital at the time. As in earlier economies, institutions and innovations evolved to increase efficiency and reduce costs. Ports such as Liverpool, Hull, Bristol and Exeter grew into major cities, each with their growing arsenal of docks, shipyards, wharves and warehouses. In 1707, the Act of Union was signed and Scottish ships and ports, particularly Glasgow also contributed to the growth.

10.2.2 Government Policy and Complementarity with Military Institutions The most obvious exercise of government policy that benefited shipping was the naval strength that defeated the Dutch and enforced the Navigation Acts. With naval protection, not only did the British have a monopoly on the American market but, it now had cheap and plentiful supplies of timber and other resources for ship-building at a time when tradition Dutch sources in Norway and Poland were showing signs of depletion (Unger 1978:60-1).

Britain's geography gave it a dramatic competitive advantage in establishing a powerful navy. A large natural endowment of Sussex iron meant the British could make guns at quarter the price of bronze. English ships were all well-equipped with a "heavy weight of broadside". Perhaps the biggest geographic advantage was its physical separation from her European rivals by sea. Britain did not need to need a large standing army and could channel most of its defense into shipping. The Dutch could not afford this luxury since they shared a border with France and Spanish territories (Kennedy 1976:19).

The Navigation Acts were only one part of a huge wave of protectionism behind which the imitation process was conducted in the late seventeenth century. The government provided subsidies to industries, bounties for exports, prohibitions of imports, protective tariffs, etc (Davis 1962:300). The government also introduced an array of supportive legislation. To protect ship-owners, the death penalty was introduced to deter masters from deliberately destroying their ships. In 1730, attempts were made to regulate wages and conditions of merchant seamen and put an end to destructive squabbling. In 1735, restrictions were put on the liability of ship-owners whose cargoes were embezzled by their crews (if the owners themselves were innocent parties) (Davis 1962:313-4).

The navy was both a benefactor and contributor to the growth of English shipping. Through naval battles with other European powers, Britain acquired and expanded colonies with which its ships could trade. This trade in turn gave the English government further economic activity to tax and finance further naval expansion. In this way, the navy and merchant marine propelled each other on a mutually reinforcing path.

The navy also reduced costs for British shippers by eliminating piracy. In the early Atlantic trade, few individual shippers would take action against pirates because of the risk it entailed and the benefits would have gone to others who did not contribute to the action. If the English had a company like the East India Company in the Atlantic, these external economies would be internalised. However, private shippers were unlikely to give away their trading freedoms to a monopoly company, so it fell to the Royal Navy to suppress piracy. Merchants organised themselves to pressure government to provide protection (Price 1991:295). However, it was not in the government's interest to pay for naval intervention unless trade reached levels that justified those costs (Walton 1970:130-7). These levels were reached in the eighteenth century and had dramatic effects on the productivity of shipping. Shippers could spend less money on armaments, for example, in 1729-30, the average ship operating in the Jamaica trade carried 34 guns per

100 men. By 1768, this had fallen to 5. The declining need for defense similarly reduced the manning requirements on board. It also allowed shippers to use ships more specifically devoted to carrying cargo. Finally, with fewer losses due to piracy, insurance costs fell; the 1770 rate being two-thirds the 1635 rate, and they continued to fall throughout the first half of the nineteenth century.

The importance of naval power was confirmed during the Seven Years War (1756-1763), when superior naval power enabled the British to capture Quebec and other French territories in North America. At the same time, French competition in India was neutralised (Keay 1991:339). When Spain entered the war on the side of France, Britain took the opportunity to seize the Spanish colonies of Florida, Tobago, Granada, Dominica, and St Vincent. However, France and Spain got their chance for revenge when the British colony in North America fought its war of independence. French and Spanish forces threw their weight behind the Americans. With the loss of the American empire, the British were at first scared they had lost access to valuable resources and profitable markets. However, Britain had spent the last century building up its industrial base and independence did not stop the American desire for British manufactured goods. The Atlantic trade continued to grow.

Several institutions were created to promote the advance of technology. In 1662, the founding of the Royal Society of London grouped together scientists with a prime objective of advancing technological prowess. Of its eight committees, the 'Mechanical' was the largest, followed by the 'History of Trade' (Wilson 1965:186). Industry became the subject of intense scientific investigation. Robert Boyle examined mining and metallurgy, while Robert Hooke and William Petty investigated shipbuilding, pumps, and various kinds of engines. All three presented papers on textile dyeing.

Of more direct importance to shipping was the appointment of the Astronomer Royal and the founding of the Royal Greenwich Observatory in 1665 to solve problems of navigation and in particular the determination of longitude. Government offered rewards for the development of technology to measure longitude at sea, eventually leading to the success of Harrison's chronometer in 1759. This invention was one which North and Thomas (1973:3) suggest would have occurred sooner if the nation had enforceable property rights that secured the inventor return for his income. However, Harrison received funding from the admiralty as he progressed which enabled him to resource his research. Secondly, the award of 20,000 pounds was equal to a million dollars in 1989 terms (Merson 1989), a sufficient incentive for anyone.

In 1768, the Royal Society persuaded the crown to finance an expedition to the Pacific from where the transit of Venus could be observed providing data which could aid navigation. The resulting voyage of James Cook, in his Whitby-built colliers, also opened up commercial possibilities in the Pacific. The sextant also came out of the British hot-bed of innovation and helped to more exactly measure latitude (Bosscher:

1995a:9). Equally important were James Lind's efforts to combat scurvy. Once achieved this dramatically reduced the costs of labour as fewer men fell sick and died.

10.2.3 Organisation In the Asian trade, British naval might was less important than commercial competitiveness. In the Indian Ocean, the Dutch had gained much competitive strength from their organisation and capture of the spice islands. However, from the second half of the seventeenth century, the VOC faced an increased level of competition, especially from the reorganised English East India Company.

The Dutch responded to this surge of activity by re-committing itself to the old growth path. It reinforced its monopoly by closing down the pepper emporium at Bantam from which these countries were getting their supplies and closed other gaps on the Coromandel coast. By 1689, the VOC had achieved substantial control of the spice and pepper trade.

While the Dutch were escalating their commitment to the markets in which they had already invested much, markets were changing. These products had dominated early Asian trade but, by 1668-70, they constituted only 57% of the company's revenue and only 37% in 1698-1700. The VOC had placed much investment in securing products with declining market share. Between 1680 and 1720, the returning tonnage grew by 125%. However, revenue grew only 78% (de Vries and van der Woude 1997: 437). The growth had not contributed to increased profit.

The English and French, who had less commitment to spices and pepper, diversified quickly into textiles, tea, coffee, porcelain, saltpeter and other goods for which an elastic European demand was beginning to appear. Dutch commitment to the spice islands represented asset specificity with little potential for development. By contrast, the English company, in a more uncertain position, had to try something new and made the first bold but risky attempt to market Indian calicoes in Europe. With less sunk capital, the EIC could easily adopt new areas of trade with far greater potential.

Paradigms built on past success burdened the Dutch with extra costs that undermined their profitability. Forts and garrisons had always been a vital component of Dutch activities in Asia, an investment norm that had its origins as trading warriors going to battle the Spanish and Portuguese (Geyl Vol.1, 1961:184). Chaudhuri(1985:87) states the Dutch did not trade peacefully because they believed that neither the Portuguese and Asian rulers would allow them to trade without the sanction of arms. It was part of the ideology of the day inherited from the days of the Portuguese. It had brought results as they carved out their spice monopoly and other territories. However, the English, Danish and French companies did not attempt to maintain a monopoly and had far lower operating costs. A decision to de-militarise would not have been an easy one. Sir Josiah Child had in fact suggested the English company should increase their

military presence in Asia on account of the advantages it gave. However, as time proceeded, it became more apparent that these military investments restricted flexibility and undermined profitability.

Declining competitiveness also reflects the increased formalisation that we would expect from the hypothesis. The Dutch had always controlled their Asian activities very strictly from their headquarters in Batavia. This tight control was vital in the maintenance of the monopoly. It was, however, a barrier to the development of new markets. By contrast, the English faced less restrictions and operated a decentralised decision-making process which made it easier for traders at the ground level to seize opportunities as they arose. This was most important in their successful manoeuvre in the complicated and volatile textile market. By contrast, the Dutch rules might have maximised profits during stable periods but, in times of changing markets they prevented flexibility.

A particular difference between the English and Dutch companies was that the English East India Company actively promoted the development of a private trade within Asia. This gave the English trade more flexibility and promoted the raising of capital from new sources. By contrast, the VOC vigorously fought the development of private trade, which ironically encouraged corruption among its servants (Mc Pherson 1993:204).

VOC rules also affected navigation. Navigators complained that the restrictions placed on them to give their ships faster times were too restrictive, even when deviations from the rules resulted in faster voyages (Gaastra and Bruijn 1993:196).

Tight control also characterised ship-building, owning and freighting activities of the VOC. In shipbuilding, management in both the Dutch East India company and the Admiralty made the final decision on the shape and arrangement of the product coming out of the yards, decisions previously made by the master builder (Hoving 1995:41). With increased centralisation and rules from above, the opportunities for the spontaneous introduction of innovations and experiments were much reduced. By contrast, the English East India Company contracted out many activities. This was a result of earlier financial hardship when the company was forced to sell of some of its operations. It is uncertain whether this resulted in a more efficient structure, as Bruijn notes some of the English contracts became hereditary (quoted in Neal 1990:222). A self perpetuating group of shippers arose with similar rigidities to that of internal control.

Monopolistic arrogance led to a strategic blunder which opened a window of opportunity for the English. The Dutch had always enjoyed a favourable position in the tea trade as Chinese junks brought tea to Batavia. In 1718, the VOC attempted to exploit its strong position by offering the Chinese fixed prices much lower than normal. The offended Chinese refused to come to Batavia for five years, thus creating an

opportunity for the VOC's competitors to buy tea directly from the Chinese. By 1723 when the junks returned to Batavia, competition was well established (Neal 1990:218).

The Directors at Batavia were not unaware of the deteriating situation. In the early years of the eighteenth century, they wrote:

> The profits have turned into losses, trade is declining, the competition of the English, French, Portuguese, Chinese and Moors, cannot along this extensive coast-line be checked, the spending capacity of the population is diminishing, the sale of cloths... is not one fifth of what it used to be (De Jonge, De opkomst van het Nederlandsche gezag in Oost-Indie, VIII pg116ff) quoted in Geyl Vol.2 1961:348).

And profits were declining (De Vries and Van der Woude 1997:447). Although average profit had only declined from 2.1 million guilders in the 'Golden Age' to 2 million guilders in the period 1680-1730, that profit was earned on a far larger investment base. Average return on investment had decreased from approximately 6% to 3.4% over the same period.

10.2.4 Technology and Supporting Industries This situation was made worse by the fact that Dutch naval technology was no longer in the forefront of labour-saving devices. In contrast to the situation in the late sixteenth century when the fluyt dramatically reduced manning ratios, C.P Thunberg, a Swedish traveller betwen the years 1770 and 1779 observed that 'The Dutch have also occasion for a greater number of men to work their ships than other nations, as their rigging is made after the old fashion with large blocks and thick cordage, heavy and clumsy in every respect' (Thunberg 1795: Vol1,113).

The Dutch were entrapped by the production methods and capabilities that had allowed them to gain their mantel of leadership. In the early seventeenth century Dutch map makers and publishers had provided their captains with the best literature in charts in the world. The Dutch continued to reproduce these old masters while the French and English began producing globes, maps and charts of greater accuracy (Boxer 1965:165-7). While Dutch rivals began applying science to shipbuilding and navigation, spherical trigonometry remained a mystery to the average Dutch navigator who as late as 1740 was still reliant on the old fashioned manuals.

In some cases, the Dutch were prevented by geography from keeping up with the English. Their silting waterways restricted the use of larger ships, including three decked ships that needed a deeper draught. The same geographic conditions (shallow internal waterways) which once proved an advantage to the Dutch, prevented the adoption of technological innovations, an example of factor-specific technological advantages.

Much of the blame has been attributed to the low level of interest in improvements in navigation shown by the company's 17 directors (Heren XVII). Declining ROI and exposure to increased international competition should have shaken the VOC out of its complacency but the Heren XVII had become an elite group increasingly distant from the operations of the company. Unlike in England, where the EIC's charter was regularly renewed and stock-holder's could pressure change, the Dutch charter only came up for renewal on an irregular basis (Neal 1990:221-2). Power was firmly in the hands of the 17 directors. The structure of the whole Asiatic trade rested on a small privileged group, among whom an even smaller number were entrusted with the company's actual direction (Geyl 1961:354-5). In Hirschman's (1970) terminology, there was little chance to exercise 'voice', leaving exit as the only form of complaint for stock-holders. However, the power of 'exit' as a force for change was restricted by the secrecy surrounding the company's accounts and the practice of paying substantial dividends even when trading results did not warrant it.

The pattern of entrapment and isolation of decision makers was repeated throughout the economy and affected supporting industries. In the early days, Amsterdam had an active trading ethos kept alive by the continuous migration of merchants and the rise of these new men into the cities ruling class (North 1997:53). However, after 1680, the rentier (gentleman of leisure living on their investment incomes) mentality began to gain ground. Members of the Regent class who once relied on monitoring trade to draw their revenue could now live off the incomes provided from land, investments and annuities (Boxer 1965:31). They might still possess ties to trading activity but the close association of the past had gone. This was particularly telling in the VOC, leading industries and the government itself. Whereas once, government office holders were involved in and understood commerce, over time, the merchant and regent class became separated. For example, of the 24 Amsterdam burgomasters between 1718 and 1748, only two of them were active merchants (Boxer 1965:47). The practice of electing officials for life meant that little could be done to shake the Regents from their entrenched position of political power.

During the period of growth in the late fifteenth century, the Dutch economy had been characterised by equality and social mobility as new development paths opened up opportunities for advancement. By the eighteenth century, society had a static class structure with an urban patriarch entrenched at the top. As Schama (1987:597) notes, by the eighteenth century 'the great "family" of Dutch culture was in the course of breaking into poor and rich kin'.

The social petrification in the Netherlands stood in stark contrast to the emerging social and economic mobility in England. New industrial technologies and trading opportunities provided a platform by which many Englishmen managed to break through social barriers and improve their status. While, the urban merchants of the Netherlands had evolved into an urban patriarchy, England was characterised by high social mobility. Merchants and bankers such as William Cockayne, Josiah Child and Charles Duncombe

bought large estates, acquired titles and married their daughters into the aristocracy. At the same time, the younger sons of gentry, who did not receive inheritances, often entered trade to make their fortunes. The result was a 'marriage of town and country, of merchant and landed wealth', a relationship which could come to dominate the English economic and social system (Wilson 1965:10). This gentrification of the merchant class would later be interpreted in Marshall's life cycle as bad for on-going entrepreneurial drive. However, it serves as a reminder that social incentives are equally important as profit in generating entrepreneurial activety.

The Netherlands were entrapped in the production techniques of old. Across the nation, industrial technique stagnated. In 1779, an industrialist stated 'One cannot refrain from observing that there are very few industries or trades here which are not in need of improvement' (quoted in Boxer 1970:259). In Leiden, which once led technological advance in textiles, the industry was now criticised for the lack of initiative and aversion to new methods that existed among industrialists and employers. It was a sign of entrapment that marked the whole economy. As Boxer (170:259) states, 'What was good enough for their ancestors was good enough for them and this appears to have been the marked trait of Dutch society in the closing decades of the Periwig period'.

The stagnation in domestic innovation was occurring at a time when other nations were also catching up in many of shipping's supporting industries. In the 1660s, the French King Louis XIV and his finance minister Colbert introduced a mercantalist program with many components of a modern 'infant industry' program. It involved direct state intervention in the economy to encourage commercial and industrial expansion (Lee 1984:166). The state raised import duties and attracted skilled Dutch artisans by providing loans and premises to launch businesses in France. This spelt bad news for the Dutch, for France had been their biggest customer. Eventually, French textiles displaced the Dutch in the Ottoman market, while French ships began to dominate the Mediterranean. The Leiden textile industry, which gave Dutch shipping a key cargo, went in decline. However, France was just one of many nations to embark on a process of 'catch up' and gaining the industrial techniques developed by the Dutch. The same process could be seen in Prussia, Russia, Austria, Denmark, Norway, Sweden, Finland and Britain. The Russian Tsar, Peter the Great, even spent time working in a Dutch shipyard before returning home and establishing a Russian shipbuilding industry (Israel 1989:383). Government intervention combined with the importation of Dutch techniques and skilled workers ate into the Dutch competitive lead.

Once these other nations had learnt the leading industrial techniques, the Dutch found themselves in an inferior position due to high wages. Like Spain and Portugal before them, the Dutch had their hands tied by population restraints which pushed up wage levels. van Zanden (1993:40) goes as far as arguing that labour supply was the central variable in the growth of the Dutch economy. At the end of the seventeenth century, Pieter van Dam complained that in the early days, the VOC could enlist seamen for 8 or 9 florins a month, it

now had difficulty attracting staff with rates of 10 or 11 florins with a month's wages bonus thrown in (referred to in Boxer 1965:72). These rising wage rates are consistent with Vernon's cycle in which industry was transplanted to new locations to reduce costs (although in this instance we are not driven by foreign direct investment. It is worth noting that the Dutch were big investors in the British financial markets (see Boxer 1970:260)).

The high cost of wages had been a key force in developing labour saving technology but now, foreign nations were catching up faster than labour-saving solutions were being found by the Dutch. Furthermore, the declining economic conditions were beginning to discourage investment in new technologies. To some extent, technical advance in industry can be explained by the limited possibilities. Windmills had reached the upper limits of their power generating capabilities (De Vries 1976:94). Peat could not generate the intense heat needed in metallurgy or steam power. Consequently, it could not achieve the technological break-throughs that the English achieved with their plentiful coal supplies. The development path that took the Dutch to riches had in many ways reached a dead end determined by their factor endowment.

The Dutch now started to incur that loss of momentum identified by Porter (1990) in declining related industries. For example, with fewer ships bringing in sugar from the West Indies, the number of sugar refineries in Amsterdam declined to 34 in 1668 to 20 in 1680 (De Vries and van der Woude 1997:466). By the 1720s and 1730s the Dutch were experiencing a serious collapse in their industrial sector (Israel 1989:377). By the second half of the eighteenth century, the industrial decline was widespread, although some industries such as diamond cutting and paper making survived on the basis of the high quality of their output (Boxer 1970:255).

The nation still had a wealth of capital and financial expertise. But, industrial decline did not make it a preferred target of investment. Investors were criticised for investing abroad not locally (Boxer 1970:260) and, many sought preference in the security of public funds (Unger 1978:9).

Entrenched commercial rationality and social-incentives seems to have contributed to the situation. Boxer (1970:261) believes part of the lack of industrial advance can be explained by the merchant values behind the nation's commercial tradition. The merchant enjoyed a much higher social prestige than the industrialist. If an industrialist or craftsman built up a capital base he would set himself up as a merchant and bring up his sons as merchants (ibid). It seems to be yet another example of enduring incentives and values from an old successful paradigm. However, De Vries and Van der Woude (1997:692) dispute this, as merchants were well aware of the importance of industry for their trade. They believe the biggest barrier was 'the structural unviability of most industrial production'. High interest rates, high wages and a strong guilder reduced the competitiveness of Dutch Industry while declining markets discouraged investment in productivity improving investments.

To overcome the high cost structure of the economy, the logical response of the government would have been to reduce taxes to help competitiveness. However, an expensive war with France put a halt to any chance the government would do this. Furthermore, the war had increased the government's debt. The national debt, which stood at 30 million guilders in 1688, had risen to 148 million by the end of the war of the Spanish succession (Boxer 1965:105). This increased demand for finance increased interest rates. By contrast, in 1709, the English Treasury could still borrow money at 6% but the Netherlands had to pay 9%.

The most serious industrial decline occurred in ship-building which suffered from entrapment fully anticipated by the thesis. In 1707, there had been 306 vessels under construction in the Zaan region. This declined to 25 in 1770 and, in 1793 there was 1 (Boxer 1970:256). But long before 1793, Dutch shipbuilders were failing to provide their shippers with capital goods superior to those built in other European nations (Unger 1978:62). Shipbuilding had entered a period of technical stagnation. In his definitive work on Dutch shipbuilding, Unger states (1978:59) that some degree of apathy in ship design was justified. The leading sailing ship technology had proven to be highly efficient, and improved commercial organisation was reducing freight rates without any improvements in design. But, while Dutch builders were content to rely on the successful formulas of the past, builders in the rest of Europe had acquired many of the skills of the Dutch ship carpenters and were improving those skills at a faster pace (ibid:111). Outside the Netherlands, more and more shipwrights designed their ships on paper which made it easier to introduce innovations (Hoving 1995:38). Dutch failure to adopt these changes at the same rate illustrates yet another example of trying to change successful routines built up over time (Nelson and Winter 1982). The process of 'catch up' by foreign nations meant all European merchant shippers now had similar capital goods.

Much of the decline was associated with the loss of markets as other nations caught up and met their own needs. Shipbuilding was an industry that many foreign governments protected and subsidised. They imported Dutch craftsmen and technologies such as saw mills (Unger 1978:9). At the same time as export markets disappeared, other areas of demand went into decline. The declining market reduced the opportunity to experiment and reduced the need and facilities for training. The result was a self-reinforcing downturn in production (ibid:94).

In France, where schools were established with government support as a substitute for guild-based training, shipbuilding became a subject worthy of scientific investigation. In the Netherlands, by contrast, there was no effort to improve training. Dutch journeymen were not averse to actually decreasing the training programme. At a time of declining markets, they were keen to protect their employment from future competition. The stagnation was also seen in the equipment used by Dutch shipwrights, there being little change in hand tools used (ibid:60). The industry had suffered from entrapment associated with increased

centralisation, a consequence of a number of forces. As ships became larger, it increased capital requirements of shipbuilders, making it more expensive and more difficult for new entrants to enter the industry. Those already in the industry cemented their position through their connections and superior organisation skills which gave them superior access to resources and labour, further serving as a barrier to new entrants. By 1750, it was almost impossible for new entrants to enter the industry. Shipbuilding came to be controlled by older families with established wealth. The industry became centralised around a small number of contractors or managers who integrated their shipbuilding operations with other businesses like wood dealing, ship owning and trading (ibid:96). The emphasis of this new organisation structure was on organisation of the wharf and lower cost production rather than improved design (ibid:86 and 109). It reflects another example of the movement from product to process technology identified by Abernathy and Utterback (1975).

As ships became larger and more complex, managerial tasks became more important and the distance between the contractor and skilled carpenter increased (Unger 1978:84). The industry which before 1600 had little in the way of hierarchy was by 1700 characterised by strict class divisions (ibid:95). There were even graduations among the journeymen. As owners became increasingly divorced from the master journeymen, who were now only employees, a vacuum emerged with no one responsible for improving the technical quality of the ships (ibid:117).

As the factory structure replaced the older craft structure, guilds became increasingly irrelevant and counter-productive. The mayors and aldermen of towns took greater control of the guilds while their activities became more formalised and more regulatory (ibid:89). They became tied down by rules. These rules were created over time in response to specific problems as they arose. However, once made, the rules were only changed with difficulty. As a consequence, ship carpenters' guilds became more restrictive of the activities of members. Meetings became less regular and more concerned with governing duties. Even at the VOC yards, standardised ship design had been adopted to reduce the cost of shipbuilding and repair, and the company shipbuilder found that rules and regulations took away the master shipwright's opportunity to experiment and introduce innovations (Hoving 1995:41). The industry was losing its capacity to engage in what, in National Systems of Innovation is called, exploring or searching.

The guilds had a positive effect on shipbuilding technology in times of growth but during stagnation and decline, their goals changed. They became more protective of their market, adopting characteristics of a distributional coalition. Interest in building facilities took second place to sickness, accident, and old age funds of members (Unger 1978:84). The openness to labour mobility was replaced by a fear of unemployment and rules that gave preference to local workers (ibid:91-2). Wage fixing reduced competition and flexibility, and removed an opportunity to reward an especially productive or inventive worker (ibid:100-3). Guilds also sought protective legislation from their town governments, obtaining laws

which required local shippers to have their ships built and repaired in the home town. This increased the cost to ship-owners and merchants. Although the town governments were controlled by the merchants themselves, they passed the acts to ensure their supply of capital goods.

The Dutch had lost the competitive advantage they had previously acquired from their superior capital. Although the admiralty brought in British shipbuilders to introduce new techniques, ambiguity over the results meant little changed (Hoving 1995:38). In fact, both Hoving (1995:38) and Bosscher (1995a) claim that Dutch building techniques could still compete with the British. This suggests the decline of shipbuilding technology played only a secondary role to factors such as the loss of markets. The protection that foreign governments imposed acted as a selection mechanism but the Dutch did not respond with a Downie-style Innovation mechanism as they were entrapped in past technique. Nor can the initial change of leadership be attributed to a significant techno-economic leap or punctuated equilibrium which Perez and Freeman suggest might lead to a change of leadership. The British took the lead with a series of small improvements across the economy

10.3 Conclusion on Dutch Decline

The Dutch decline is consistent with the hypothesis. By 1675, the English and French had overtaken the Dutch in the Atlantic Ocean (Emmer 1998:107). For a period, the Dutch gained some competitive advantage from this position of weakness. The Spanish would certainly prefer to see a strong Netherlands than a strong England that had the resources to pose a greater long-term threat. The Dutch thus became the preferred provider of shipping and commercial services to the Spanish colonies. In the 1680s and 1690s the island base of Curacao prospered as holder of the asiento, the contract to provide Spanish America with slaves. However, after the War of the Spanish succession, even this was lost to England's new South Sea Company.

Although much of this entrapment can be explained in terms of resource endowment and military accomplishment, in many ways, the battle with the English was just another form of protectionism during a catch up process. Dutch decline supports the hypothesis of institutional entrapment. Advance was also restricted by rules that restricted flexibility. These rules increased profitability during periods of growth but prevented Dutchmen from adapting to new opportunities. As Klein (1977) would state, static efficiencies were gained at the expense of the dynamic. Rules were also one way increasingly distant decision-makers could control activities but, as the distance grew, these decision makers left their underlings with inappropriate incentives. The persistence of these rules could be interpreted in a number of ways, from the institutionalisation of incentives to the dangers of a tightly controlled mechanistic organisation, but there is no denying that the rules and heuristics were based on an earlier successful pattern of competition which changed in the eighteenth century. The rules and heuristics that tied Dutch resources to a slow path might not have been so damaging if new entrants could arrive with new ideas. Unfortunately, across the economy

people were protecting themselves staking their claim and forming distributional coalitions. Like the shipbuilding guilds, their concern was protecting their position not advancing technology. Finally, the decline is also associated with factor specificity of technology in peat, wood and wind that were not applicable to the new technologies that the British were about to unleash.

As Hoving (1995:41) notes 'The unbridled energy, the over-enthusiastic belief in the endless possibilities the world had to offer that seemed to characterise the beginning of the seventeenth century, is painfully missing in the eighteenth'. Once decline had set in, it gave birth to mistrust and jealousy (Boxer 1970:262). For example, political divisions that had always existed now deepened and undermined attempts at reform. Inter-provincial jealousies sometimes prevented agreement on improvements of road and canals that crossed boundaries while, pro and anti-orange factions blocked each other's sensible suggestions for reform.

Table 10.2 Entrapment of Dutch Shipping

Sources of Competitiveness	Paradigm Heuristics	Sources of Entrapment
Shipping Industry		
- Organisation of VOC.	- Tight control of Asian Trade.	- VOC rules creat barrier to entry and Heren XVII become Distributional coalition.
	- Tight control of sailing routes.	- little innovation in routes.
- Possession of Spice Islands.	- Corner market and establish strict control.	- Escalation of Commitment to Spice Islands during times of changing markets.
- Superior Naval Force.	- Trade with arms and invest in expensive fortifications.	- Persistence of routines with continued investment in arms which raises costs vis a vis competitors.
- Shipping Technology (esp: Fluyts) and utilisation of standardised ship design.	- Produce standard model as it reduces costs.	- Rules that emphasise costs reduce innovation in design - Owners become more distanced from production
Supporting Aspects of Economy		
- Industrial Base (with high level of competition).		- Guilds become a distributional coalition. - Factor specificity (peat/wind) reaches end of technical possibilities. -shortage of coal supplies.
		- Urban Oligarch becomes distributional coalition.
- Supportive Government - Supportive Institutions (bourse, banks, etc) - Joint stock organisation - High level of Education		- Arrogance
	- Dutch are best	

By the end of the eighteenth century, the Dutch Golden Age had truly ended. James Boswell, who visited the Netherlands, described a very different picture from the century before: 'Most of the principal towns are sadly decayed, and instead of finding every mortal employed, you meet with multitudes of poor creatures that are starving in idleness' (James Boswell quoted in Boxer 1970:238). The causes reflect a recurring pattern of economic systems; catch up by imitating nations and Dutch entrapment.

The English economy and its shipping had advanced along an explicitly stated path of 'catch up', actively seeking the leading industrial and organisational methods of the day. The result was an economic system with related commercial and industrial sectors that strongly represented the Dutch system it had so strongly tried to replicate. Ships returned to England with goods from all over the world, many of which were re-exported. By 1770, England was re-exporting 30% of those imports to Europe and London had staked its claim as the world's leading entrepot(Wilson 1965:161).

10.4 Gujarat's Decline in the early Eighteenth Century

During the seventeenth century Gujarat had been the busiest and most active trading region of India. It entered the eighteenth century with 'the strongest export and import trade, shipping and merchant entrepreneurship in the Indian subcontinent' (Arasaratnam 1994: 88). However, the region was about to enter a rapid decline. The 112 vessels based in Surat in 1701 declined to about 20 by 1750 (Das Gupta 1994: I, 433). The total trade of Surat which measured approximately 16 million rupees at the beginning of the century was down to 5 million by 1740, and half of this trade was now being carried by the English, another tenth by the Dutch (Das Gupta 1994: VI 195). Local ship owners had virtually been wiped out.

Gujarat's shipping strength was based on three key sources of competitive strength: its strategic location as the gateway to the Mughal economy; flexible organisation structure, superior skills and experience in the Indian Ocean trade; and a highly competitive textile industry which provided the ships with key cargoes. One by one, those sources of competitive advantage fell over.

10.4.1 Decline of the Mughal Economy At the end of the seventeenth century, the Mughal empire presented a wonderfully successful economy. A century of conquest and territorial expansion provided the empire with enormous resources. As the range of land under Mughal rule increased, the tax burden was spread over a wider range of people. At the same time, buoyant local and regional markets increased the sources of wealth available to local Lords. The economy showed itself open to change with new crops introduced from America (maize and tobacco) and, as we shall see, artisans were very capable of adopting foreign technologies.

The economy possessed many of the factors we associate with success: a small government provided political stability yet gave businesses high levels of autonomy; a flourishing market economy based on competition and individualism; and a number of commercial institutions reduced the costs of performing transactions. Natural resources and highly skilled producers gave northern India highly competitive producers in the most important industry in the world at that time, textiles. This supporting economic system was a key aspect of the success of the shipping industry.

In the first half of the eighteenth century, the Mughal empire, which provided Gujarat shippers with access to the hinterland markets and produce, fell apart. With that decline, they lost a key determinant of their competitive advantage. The decline of the empire actually exhibits many of the patterns outlined in this thesis as rigid incentive systems based on outdated technologies.

Much of the cohesion of the empire was lost during the reign of Aurangzeb (1658-1707), who wanted to impose vigorously the Islamic belief system on the empire. Previous tolerance of the religious diversity began to erode as the political culture came to be defined more in Islamic terms. In 1669, it reached the point where the Bania and Hindu merchant communities in Surat threatened to leave the city en mass to escape the persecution of the local Islamic judge (Richards 1993:176). Social divisions had become more important.

The Mughal Empire presents a common picture of an empire in decline. An old and feeble dynasty loses its earlier vibrancy and buckles in the face of subjects who rise in revolt. Certainly, the emperors were becoming more distant from the key technologies that created the empire. While early emperors such as Akbar had shown an active interest in military technology, in later years official interest in weaponry was 'occasional and haphazard at best' (Richards 1994:288). The Mughals seem to have been content with the military technologies that brought them success in the past. Consequently, in the seventeenth century, the Mughals began to fall behind other contemporary powers.

With stagnant technology, expansion came to an end and this had implications for the incentive structure of the empire. The incentive for the Mughals had always been land and the income it provided. When expansion came to an end, there was less new land available to reward the Mensabdars. The pie stopped growing so tension now arose over shares of the pie, as Das Gupta states:

> ... there was a struggle not only for jagirs but for well placed and remunerative ones... as the income of the noblemen fell steadily they put more and more pressure upon the zamindars, that is the class of gentry who actually and permanently held much of the land in the empire. Naturally much of this pressure was passed on to the peasant... (1994: VI 185-6)

The old technology could not generate expansion but the old paradigm and value system remained in place. The Mensabdars were seeking revenues within the system as a distributional coalition, seeking increasing returns without increasing the region's productivity.

The internal incentive structure of the Mughal system had always provided some opportunity for milking at the expense of improvement and maintenance of the principal economic resources. Mensabdars were regularly moved about to stop them from consolidating too much local power. The consequence was that they felt no long term commitment to their territory. The priority for the Mensabdar was to take as much as possible from the territory, spending as little as possible on improvements before moving on to the next territory (Landes 1998:157). Those areas dependent on irrigation particularly felt the effect which came in the form of famine.

A giant leap towards instability occurred with the death of the emperor Aurangzeb in 1707, which led to a series of bitter conflicts over accession to the throne (Richards 1993:281). All this weakened the central authority, undermining the whole system of revenue collection and security. Regulations preventing abuse of revenue collection fell into disuse as regional lords resorted to open tax farming. Although the encroachment of nobles as distributionary coalitions is consistent with the hypothesis, the weakening of rules was not anticipated.

To escape the political instability and associated tax farming many merchants moved to European settlements. For a short time, even the grandson of Abdul Ghafur retired to the English settlement at Bombay, before returning to Surat (Das Gupta 1994: X,222). Many Gujaratis moved to European ports on the Coromandel serving as financiers and brokers in direct competition with the local Chetty sub-castes (Arasaratnam 1995 XIV 36-7). As they took more to on-shore positions and left the shipping to the English, they lost what naval experience they had and their investment in shipping declined (Arasaratnam 1995: XIV 31).

As nobles became increasingly more corrupt in their capture of income, merchants were squeezed and increasingly unable to raise the business capital of earlier days. At Surat, this squeeze was exercised by the Governor Sorab Khan (Das Gupta 1994: IX, 148-162). Attacks from the Marathas in the south had deprived him of income. Receiving no support from the disintegrating imperial court, the governor found he did not have sufficient revenue to pay for his soldiers and associated retinue. He had become heavily in debt to the leading merchant in the city, Mohammad Ali (the son of Abdul Gafur). Eventually, he began the squeeze, arresting merchants on jumped up charges, imposing prohibitive fines and confiscating property. Before long, the merchants revolted against the governor, raising their own army with which to defend themselves. Mohammed Ali contributed 2,000 troops to the defence while even the English and Dutch East India Companies joined in. The governor was eventually replaced but, Mohammed Ali was arrested and

died in jail, with much of the family fortune plundered by the new governor. The fall of the family of Abdul Gafur symbolised the fall of a great merchant city.

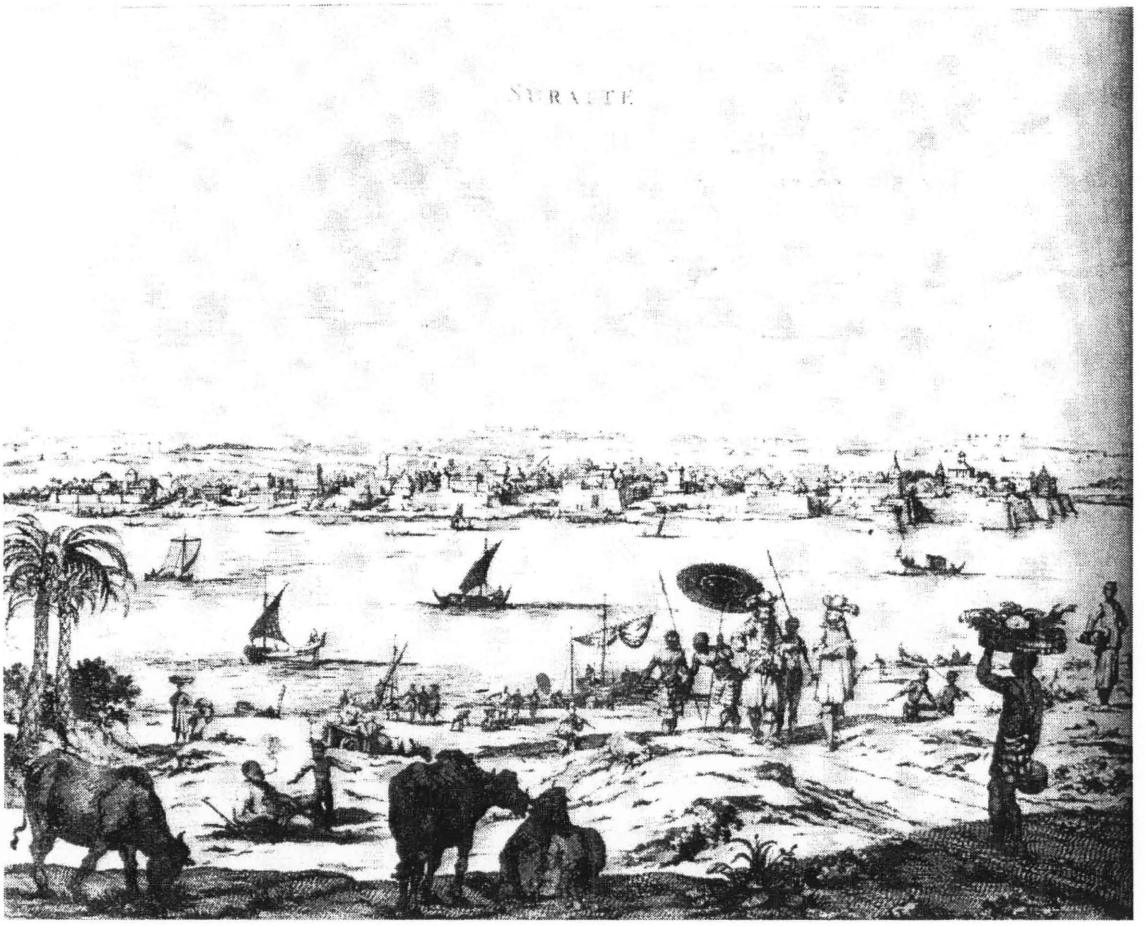
The system was imploding and, with a weaker central administration came a rapid decline in law and order that hit trade hard. Caravans organised by private merchants could no longer travel from Surat to Agra in safety (Richards 1993:278-9). As conflict riddled the trade routes, the port of Surat was increasingly cut off from the markets and production centres in the hinterland. A key source of competitive strength had fallen over. However, this crisis was not a Perez-type socio-economic crisis where an old technology confronts the new. It was a case of a system imploding with incentive systems and the goals of distributional coalition being incompatible with a stagnant economic pathway.

10.4.2 Saturation and Shifting Patterns of Demand In 1701, the number of ships based at Surat reached an all-time high of 112 and tonnage of about 20,000 tons (Das Gupta 1994 XII: 111). That year, the markets were suffering from saturation (Das Gupta 1979:137-8). 'The entire Indian Ocean was suffering from over-trading and prices were depressed in every market'. In 1701, it seemed the limits of the Gujarat growth path had been reached. The economic path it was travelling based on textiles and maritime supremacy in the Indian Ocean could not generate future growth. To continue to grow, Gujarat shippers would have to enter new markets or find alternative ways to stimulate trade.

To make matters worse, in subsequent years, key Indian Ocean trading partners became rattled by political instability, including instability in the Ottoman Empire, civil war in Yemen, and the collapse of the Safavid dynasty. These had been key markets for Gujarat. The old shipping routes on which Gujarat had been so competitive were disappearing.

Under this new environment, the well-defended shipping supplied by English ships became a more attractive option to Asian merchants. These were a higher-cost option than that provided by local shippers but, they provided greater security from political dangers and, in the political climate of the eighteenth century more and more Asian merchants were prepared to pay that price (Marshall 1987:283). It could be argued that the English were benefiting from a politically induced selection mechanism.

Ironically, the political and commercial decay in the western Indian Ocean occurred at a time when the eastern Indian Ocean was experiencing a growth of activity bolstered by a growing trade with China. However, it was not the Gujarat shippers who would reap the rewards of this growth but the English, who were created a new path of economic development. The English were gaining leadership in the Indian Ocean on the basis of strong, defensible ships, joint stock companies working in conjunction with private traders, territorial enclaves in which they escaped the worst of the Mughal Empire decline, and the development of long distant oceanic routes.



A distant view of Surat and its river. Surat was the major port of the Mughal empire attracting merchants from around the world. In the foreground can be seen some Europeans (from Baldaeus, *Naauwkeurige Beschryvinge* 1672).

English traders were building up experience and distribution networks on the long sea routes to Europe and China. These seas were more dangerous, for both political and environmental reasons, and the Europeans had the strongest ships to cope with these conditions. Consequently, it was English ships that took Indian textiles to England and China, not those from Gujarat.

10.4.3 Organisation The English had always had difficulty competing with the low cost and flexible family networks in the Indian Ocean. However, organisational improvements were being made in their trade. In the 1670s, the English East India Company had made a deliberate decision to concentrate on the long trade routes between Europe and Asia, allowing private merchants to participate in the intra-Asia trade if they chose to. Many servants of the EIC chose to take the opportunity this trade presented. Using their savings and loans from local merchants they started businesses which initially resembled those of the locals.

During the eighteenth century, the organisation of English private traders became more sophisticated. They established 'Agency houses' in various ports between which representatives (supercargoes) would travel with the ship who would take commercial decisions anywhere on a voyage (Arasaratnam 1995:XIV 39). This ability to make decisions on the spot gave the decentralised structure of the smaller agency houses great flexibility in responding to changing market and environmental forces, something the highly centralised English East India Company could not do. The private traders could also travel to Dutch-controlled areas that the EIC, for diplomatic reasons, would not wish to enter. Private traders did not have a diplomatic role to perform so could operate with greater aggression than the large East India Company. Consequently, the inherited rules of the EIC placed some limits on company growth but not over-all industry growth. Due to the complementary nature of the EIC and Agency house activities, the EIC did not impose its weight as the established stakeholder and hamper the growth of the new organisations.

In terms of flexibility, the English now had an organisational form that put them on a par with the Gujaratis but, other features would make them even more competitive. English private traders benefited from the support of the EIC which had built up territorial enclaves separated from the declining and corrupt Mughal Empire. This meant English traders were in a better position to deal with political pressure. As the trade grew, these enclaves grew in significance. Fort St George for example, grew into the prosperous town of Madras (Ibid:38).

A symbiotic relationship existed in the opium trade. The EIC provided protection to the private traders and in return, the private traders distributed opium. The EIC managed the opium production in India, but because of its contraband nature, played no part in the shipping or sale of a drug to China for fear of losing its trading rights and tea purchases. To overcome this problem, the EIC sold its opium crop to agency houses in India who then forwarded it for resale in China.

The English merchant combinations were able to attract capital from a wider variety of sources than the local traders. When the EIC paid private traders for delivery of opium, it would be done with a bill of exchange that could be cashed in London. This gave investors great confidence to invest money in the private trade (Marshall 1987:297). In this way, agency houses like Jardine Matheson grew to substantial size.

English private traders and agency houses transformed the structure of Indian maritime commerce in the eighteenth century (Das Gupta 1994: VII 153). As Indian Opium and textiles were taken to markets in Europe and China on an unprecedented scale, the individual Gujarati merchant of the Indian Ocean could no longer compete. The Muslim nakhuda and the bania of Surat were replaced by the Agency houses of Calcutta, Madras and Bombay integrated in a broader global commerce. As Das Gupta(1994: VII 134) notes:

> there can be no doubt that by the turn of the nineteenth century not only was the European ship dominant in the Indian Ocean but that the Indian ship had sailed into oblivion.... the magnificent Gujarati fleet, particular prominent on the Red Sea run, gradually dwindled into insignificance, while in the Eastern Ocean the Calcutta fleet of the private British merchant won the supremacy of the ocean and at the close of the century had far outstripped the achievements of the Gujaratis even at their peak.

10.5 A Need to Reform

Under such conditions, it could be expected that the Indians adopt English shipping and commercial technology and seek a share in the faster growing trade routes. Indians were not averse to borrowing technology from foreign cultures if it was likely to benefit them and were most likely to adopt foreign technology in those areas that most threatened Indian interests (Qaisar 1982: 131). They realised early on that the secret of European naval supremacy lay in the strength of ships nailed with iron, the effective use of artillery, and navigational skills. They lost no time in adopting the new techniques. As early as 1507, a Portuguese style galleon was built in Gujarat for an Arab merchant (Qaisar 1968:25). During the sixteenth century shipbuilding throughout Asia was subjected to European influence, leading to the gradual adoption of sturdier construction and heavier armament. As a consequence, improvements in Asian technologies were a factor in defeating Portuguese efforts at imposing a monopoly (Meilink-Roelofsz 1962:124).

Ahmadabad, one hundred and forty miles north of Surat, was the administrative center of Gujarat. It was a major manufacturing town, particularly for textiles (from Baldaeus, *Naauwkeurige Beschryvinge* 1672).

Asians were quick to recognise the importance of European naval technique, strategy, tactics and armaments (Meilink-Roelofsz 1962:123). European weapons became a highly coveted commodity acquired through trade and Indian craftsmen showed they were more than adept at making foreign style weapons. Bernier, who visited India in the 1660s, said of their production of muskets and fowling pieces, 'Sometimes they imitate so perfectly articles of European manufacture that the difference between the original and copy can hardly be discerned' (quoted in Qaisar 1982:53).

Differences between European and Indian technology levels were not too great in the seventeenth century and Indians could quite easily adapt European technology if they saw the need. The transfer of shipping technology was aided when Europeans began using Indian shipyards for building and repairs. The Dutch, English, and Portuguese were all regular clients of the Gujarati shipyards (Arasaratnam 1994: 248, Gopal 1975:199). Such was the skill of the ship-carpenters in Surat that the English chaplain Ovington wrote:

> The Indians are in many things of matchless Ingenuity in their several Imployment, and admirable Mimicks of whatever they affect to copy after... the very ship-carpenters at Suratt will take the Model of any English vessel, in all the curiosity of its Buildings, and the most artificial Instances of workmanship about it , whether they are proper for the conveniance of Burthen or of quick sailing, as exactly as if they had been the first contrivers... (Ovington (1929:166-7))

Indians had the skills necessary to build the capital required for the fast growing long haul voyages that the English were exploiting. Consequently, we would expect the technologies to be uptaken and rapidly diffused, thereby allowing Gujaratis (and other Indians) to retain their market shares in Indian Ocean trade. However, in contrast to classical theory, the technologies were not rapidly adopted. This emphasises the point that it is not enough to simply learn how to use a technology, the environment, value system and technological endowment must be supportive of that technologies diffusion.

Throughout the seventeenth century, local ships were the best ships to use in the Indian Ocean. Asian vessels could not, by the very nature of their ownership and functions, suddenly be transformed. The light dhows that could move so flexibly through the waters did not have the strength to carry a large collection of cannon. To carry the cannon required to provide the defensive qualities needed in the new competitive environment, a stronger structure was needed. This reflects Salter's (1966) observation that a capital item, like a ship, embodies a specific technology. Technology upgrade can only occur with investment in fresh capital. Even the large merchant ships of Gujarat that were armed with cannon did not have them laid out so that they could be used effectively. It took time for Indians to adapt their ships to incorporate cannon. This was a gradual process for although Asian ships may have been armed, their vessels were primarily merchant vessels. By contrast, European ships were designed with warfare as part of their function. It

intention of linking Europe to the riches of the East, not carrying goods between foreign countries. Europeans were forced to do this when no one in the Indian Ocean was interested in European goods. Hence they had to carry foreign goods to foreign markets in order to raise money for the homeward trade. For the Gujaratis to become pure 'carriers', it would require a change in viewing the industry and was very risky.

10.6 Entrapment in the Textile Industry

In the long run, any recovery would have been handicapped by an eventual decline in the competitiveness of Indian textile production. This did not happen until the late eighteenth century, but it is worth noting for it undermined the long run ability to revitalise Indian trade and shipping. As discussed in chapter 7, Gujarat had gained much competitive strength from its cargoes and in particular, textiles. However, new production techniques in England undermined India's position in what had been the most central of industries.

Britain's industrial revolution initially took away the European export market then, to make matters worse, Indians found they now had to compete with textiles imports in their own home market (Das Gupta 1994:VI,202). Although Indian textile production entered 'slow history' This was not a recent phenomenon. Apart from the increased specialisation of the fifteenth century, there had been little change in the production technologies for centuries. Nor can slow history be attributed to a decline in rivalry. It can however be linked to by a number of factors consistent with this hypothesis including the entrenchment of distributional coalitions, entrapment of industrial technique through specialisation, factor dependency and commitment to established markets.

Factor endowment in the local environment was not as advantageous for new production techniques based on mechanisation. The success of Indian textile production in Mughal days was based on relatively simple equipment and favourable factor endowments in cotton and labour. Further advances in the industry were likely to come only with the creation of more advanced equipment. However, investments in machinery were not compatible with the Indian factor endowment in which money was scarce and labour was plentiful (Naqvi 1968: 156). As a consequence, the production technology did not advance as quickly as that in England where labour was less plentiful. In fact, the Indian industry experienced very little change, if any, either in the apparatus or the operation of the weaving trade (Naqvi 1968:148).

The rate of technological advancement was also a function of the knowledge resources available in the environment. Gopal (1975: 242-4) suggests education was a key factor in limiting advancement in Gujarat. Secular education was insignificant and heavily loaded with religion, ethics and philosophy. It was of little value to merchants and artisans who were never exposed to higher education. Merchants and Artisans were apprenticed at an early age, receiving their practical education through their social groups. Skills were passed on from generation to generation. In this way, education reproduced the old techniques of

production. Apprentices were not taught to innovate and their education required no knowledge of reading and writing. They were invariably ignorant of the theoretical bases of the technology they used, so lacked the skills to devise innovative technology.

Gopal (1975: 201 & 102) also believes that exploitation by the government and middlemen removed any incentive for producers to try to improve quality and increase production. During the seventeenth century, Mughal nobles increasingly resorted to milking the textile trade. Gopal also suggests middlemen used their market power to become more exploitive. As the key link to the market it put the middleman in a position of dominance in the relationship with which he could extract more than his fair share from the exchange. However, Arasaratnam (1995: XVI 259) notes that Indian weavers had much more independence than their counterparts in Europe who, in the eighteenth century, became wage-workers under the factory system. The Indian weaver maintained his independence and was aided by the fact that for most of the seventeenth century demand for the weavers product outstripped supply. The Indian weaver and merchant were dependent on each other.

Although exploitation by middlemen does not look a likely cause, the nature of the relationship did contain a barrier to innovation supportive of Langlois's (1988:420) recognition that a decentralised market of specialists can be a barrier to innovation. Langlois observed that the decentralised nature of markets makes it very difficult to co-ordinate complex reorganisation of production (and suggested a centralised organisation might be able to handle this problem more effectively). The problems of market decentralisation in Gujarat seem to go one stage further in that market decentralisation was a barrier to innovation per se. As the Gujarat economy became more efficient and merchants and producers became more specialised, they concentrated on their own spheres of responsibility. The middlemen separated the producer from the market. This meant the weaver had no say in the selection of quality or quantity of textiles to be produced. This left the weaver little room for discretion and little room to introduce innovations that increase output (Gopal 1975:235). Unfortunately, the merchants who did possess the market knowledge showed little interest in the technology and productive process (Arasaratnam 1994: 191). In this way, the efficiencies from specialisation restricted innovation.

Gopal (1975: 243-4) states the situation was made worse by the linkage of profession with caste. Caste rules precluded any meaningful dialogue between the trader, the artisan, and the man of learning. No cross fertilisation of ideas could take place. It also meant that any productive technology requiring a systematic change was unlikely to occur. Olson (1982: 157) specifically identifies the castes as distributional coalitions, controlling entry to occupations and lines of business, keeping craft secrets while using group power to maintain income share.

Finally Gopal also considered the role of religious beliefs that encouraged businessmen, once they had attained success, to plough their money not into production but into religious ceremony, buildings, and charity. He quotes Virji Vora as an example who led the life of an ascetic in his old age, spending much of his fortune seeking religious merit.

10.7 Conclusion

Gujarat shipping rose and fell on the strength of its associated economic system and illustrates many of the causes of decline outlined in this hypothesis. Although this thesis applies the life cycle to shipping it seems to also fit the decline of the Mughal empire. Expansion in the empire came to an end when its leaders became more distanced from the front-line technologies. Military success had provided resource growth but Mughal leaders were entrapped in old military technologies and growth came to an end. Internal incentives created under an era of expansion remained and were unsuited to an era of low or non-existent growth. They were short term and based on milking of existing resources eventually creating destructive distributional coalitions. It reached the point where merchants had to go to war against their own government.

The key cause of decline was the fall of the Mughal empire which deprived shippers of cargoes, markets and infrastructure. Political decline presented a huge environmental shift which changed the sources of competitive advantage. This should have presented a signal to the merchants to enter the trade routes that the English were now exploiting, however, the Gujaratis did not possess the same advantages as they did in the Red Sea trade. Under neo-classical thinking, as price signals indicated stronger defensible ships were preferable to the dhow, we would expect Indians to shift to the British technologies and the longer ocean routes. However, Indian shippers were entrapped by path dependency and long-held commercial rationalities. The Gujaratis had in the seventeenth centuries developed skills, experience, knowledge of routes and contacts in the Red Sea with which the English were hard pressed to match. In the China and Atlantic trades, it was the Europeans who held the advantage. Gujarat merchants would have had no trouble adopting the shipping technology of the Europeans. However, a commercial mentality of individuality and peaceful trading made it difficult for them to imitate the changes required for the fast growing long haul routes. Leaving these high-risk areas for the English, Gujarat merchants preferred the safer on-land opportunities that growth in these trades provided.

Finally, a favourable factor endowment in labour and a competitive commercial structure turned out to be two-edged swords for the competitiveness of Indian shipping. Indian industry was highly developed with a great degree of specialisation and commitment to labour inputs, which prevented the industry from taking a more mechanised path of development. Entrapped in a paradigm of labour intensity and the individual merchant, the great age of Gujarat shipping came to an end.

Table 10.3 Entrapment of Gujarat Shipping

Sources of Competitiveness	Paradigm Heuristics	Source of Entrapment
Shipping Industry		
- Expertise and contacts in Indian Ocean.	- Trade to mid-points like Malacca but do not sail into foreign oceans where capabilities are not so developed. - Manage sailing activities in line with the Monsoon winds.	- Little experience in faster growing routes outside Indian Ocean (Static economies over dynamic). - high cost of change as new routes are risky.
- Light ships with few armaments that are fast and cheap to run.	- Trade peacefully.	- Little experience or capital invested in defensive ships when market changed. - Embedded Technology (ships can not easily be modified)
- Reputation		
Supporting Areas of Economy		
- Well developed market of specialised experts	- Don't integrate but rely on market. -Try to anticipate consumer preference and meet with supplies. - Try to obtain market power.	- Specialised routines and decentralised markets inhibit cross-fertilisation - technological lock in and factor specificity with high skilled labour force.
	- Individualism	-castes as stake holders become distributive coalitions re holding of information and inhibiting technological upgrade
- Flexible organisational structure of family firms	-Teach what has brought success in the past	- reproductive education
- Quality family based education	- Mughal-land linkage	- When new land supplies dried up lead to infighting of stakeholder
- Peaceful empire which allowed trade to grow		- Access to hinterland lost with imploding empire
- Productive hinterland providing cargoes		

Chapter 11

The Industrial Revolution

11.1 Coal, Iron and Steam Technologies

As in the previous cases, English shipping grew on the back of the productivity improvements in the domestic economy. In fact, during the eighteenth century, the most consistent feature was continuous improvement. 'The age is running mad after innovation' wrote Dr Johnson (quoted in Wilson 1965:311). Up until 1760 improvement was achieved through imitation, after which point the English developed new ways to reduce costs, add value and create new products, a process aided in no small part by the widespread acceptance and promotion of innovation in the earlier phase.

Industrialisation progressed with the normal specialisation that we witnessed in previous chapters except that in this instance, it was associated with factory production and a broader range of production technologies. Farm workers who previously produced many of their own supplies in their cottages moved to the cities and gained specialist jobs in the new factories. They now had to buy some of the products they previously made at home and, items like soap, became specialised industries benefiting from economies of scale of the larger operations. The domestic market grew as productivity grew and this rapidly expanding market provided an incentive to introduce new technologies and new products. The result was a cumulative industrialisation, producing a new variety and quality of products, and the industrialist became a new social and political force.

This eighteenth century wave of industrial innovation coincided with the foundation of the Society for the Encouragement of Arts, Manufactures and Commerce (1754). In the north, the Manchester Literary and Philosophical Society and the Birmingham Lunar Society became institutions by which technical ideas and information were exchanged. There was a high level of interaction between engineers, scientists, and businessmen. Thus, industrialists such as Mathew Bouton and Josiah Wedgewood included mathematicians and scientists among their friends (ibid). Technical advance gathered apace with the publication of journals, encyclopaedias, dictionaries and year-books which recorded technical and industrial advances (Wilson 1965:371). However, it would be wrong to over-emphasise the importance of science. Britain's early advances were made by 'tinkerers' with little formal technical schooling. Advances in the cotton, iron, and machine tool industries did not require a high level of scientific understanding but a high level of aptitude by mechanical amateurs (Mokyr 1990a:244).

One important group of stakeholders in the old system that would successfully oppose change were those associated with the woollen industry. This long-established and powerful group did not appreciate the imports of cheap cotton textiles that the East India Company was bringing into the country. In 1701 and

1721 they persuaded the government to impose barriers on the importation of cotton. This protection had unexpected consequences. The resulting gap in the local market for cottons encouraged local people to take up cotton production in imitation of the Indian product. Being a new industry, it was not restricted by guilds and other vested interests and became one on the most dynamic and technologically responsive industries in the country.

The expansion of the British economy inevitably increased pressure on the country's limited resource base. Most important was the demand for wood that was used as a domestic and industrial fuel and for construction of the country's boats, buildings and machinery. As the country's forests were depleted, England became reliant on wood substitutes; coal and iron. However, the coal mining industry was also restricted by bottlenecks once the easily accessible surface coal deposits were depleted. The country still had plenty of coal at deeper levels but the deeper pits were susceptible to flooding. The most urgent technical problem of the time was the need for a machine that would raise water from the pits (Klingender 1968:5). In the same way that the Dutch solved their bottleneck with technologically advanced windmills, the English looked for a technical solution.

The problem attracted the talents of many ingenious inventors, including Thomas Savery who patented a pump driven by a steam engine in 1698 but, it was not until the development of a stronger engine by Thomas Newcomen that the problem was solved. The engine was further refined by John Smeaton (1724-1792) who decreased the fuel requirements of the machine and therefore, the cost of extracting coal. When James Watt, an instrument maker at Glasgow University, introduced a separate condenser, the machine's fuel consumption came down by two thirds. Between 1718 and 1834, improvements in the pumping engine meant the amount water raised per weight of coal leapt from 4.3 to 109 million pounds (Klingender 1968:7).

Improvements in the steam engine reflect patterns of technical inter-relatedness as advance in one technology relied on advances in other technologies and these technologies propelled each other on a cumulative path of development. The steam engine made it easier to extract coal for use in the production of iron while, improvements in iron production improved the efficiency of the machines extracting coal. Key innovations in iron production included the smelting process introduced by Darby and the processes of puddling and rolling introduced by Henry Cort in 1783 and 1784. Improvements in coal moved hand in hand with improvements in iron production, an advance in one leading to an improvement in the other. Throughout the whole process of continuous improvement, English workmen gained a greater awareness of the potential of mechanics, developing their skills in the creation of modern mechanical engineering.

As iron became cheaper, it was utilised in other areas of the economy. Its use in waterwheels revolutionised English textile production. The use of iron extended the life of wheels, reduced maintenance costs and

increased their efficiency. Most important, it made it possible to build bigger wheels generating a dramatic increase in horsepower. By 1780, the cost per unit of energy from a wheel had declined perhaps 20-30% over its cost thirty years earlier (Tylecote 1992:42). British industry now had a power source more powerful and cheaper than any it had known.

That energy source had the potential to revolutionise industry, a reality that came about once Arkwright created his water frame. England could now develop highly mechanised factory production in the textile industry. As a result of the increased efficiency from factory production, the price of cloth declined 85% between 1780 and 1850 (Mokyr 1990a:111). England was opening a new path of development based on coal, iron and steam.

We might expect some stakeholders in the old economic system to resist changes that displaced their expertise, power and livelihood, an examples of this did occur. In Nottingham, the use of the stocking frame for low quality goods led to a machine wrecking campaign by the Luddites (Von Tunzelmann 1981:161). In Manchester, the discipline and squalor of factory life led Engels to suggest that class warfare lay ahead. But class warfare did not come. The changing social relationships were too complicated and fragmented to result in a general uprising. Different regions developed at different speeds and the pace of social change was not dramatic (Rose 1981:275). Finally, the higher classes were prepared to give some leeway. In the 1820s, public schools were reformed to provide an education that emphasised higher morals and standards. A resulting concern for the broader general welfare combined with a fear of discontents led to an atmosphere of conciliation, one result being the Factory Act of 1833 and other social policy that sought to improve the lot of the working classes (Rose 1981:269).

11.2 Shipping and the New Technologies

Eventually, the new technologies were applied to shipping. The replacement of wood with iron in the shipping industry opened up many new possibilities. The most important advantage of iron was its strength. Stronger materials meant bigger ships could be built, overcoming the size limitations imposed by wood. Strength also meant thinner and lighter hulls leading to increases in dead-weight cargo capacity of up to 35% (Pollard and Robertson 1979:14) (the later adoption of steel would decrease hull weights by another 15%). However, the cost of iron was still not competitive and ship owners were slow to adopt iron ships.

It took some time for the cost to decline and iron did not become the dominant material until the mid-nineteenth century, after which the industry underwent many changes. Between 1850 and 1880, the price of iron had declined by half and this made it a more competitive material for the use in ships. At the same time, improved techniques in metal working led to cost improvements in ship-yards. Consequently, between 1850 and 1880, both steam and sailing ships under-went a substantial increase in the use of iron (Harley 1985:174). Other factors to include when considering iron were the route traveled, for example, in

the Pacific Ocean, there were few areas with the ability to repair and maintain iron so wood would be the preferred material (MacGregor 1993::26). With continued productivity improvements, the widened diffusion of skills needed to repair iron ships and an increased scarcity of wood, iron slowly began to dominate the industry.

It also took some time before the steam-engine was used on ships. The first experiments were not restricted to England. In the United States, John Fitch began experiments with a steamer on the Delaware during the mid 1780s. In France, trials were conducted on the Soane near Lyon in 1783. The French, with their superior scientific base, could have established a lead in steamship technology, but their industrial and scientific advance was stunted by political turmoil associated with the French Revolution (Burton 1994:65). It was Britain that had the skill and knowledge base that most complimented the new technologies. With its lead in coal and iron resources, entrepreneurial engineers and experience of steam technology, it took the lead in steamship development and in so doing, developed first mover advantages in productive capabilities that other nations lacked.

The technology (and associated growth of knowledge) developed in three stages. Each stage went through a process of development until a plateau was reached in which it seemed the technology could go no further. Then a break-through would occur (Greenhill 1993:11). Each technological breakthrough was preceded by a period of experimentation and followed by a period of refinement. The first stage was the 'paddle steamer' which by the middle of the 1820's was operating on short sea, river and lake services in British, European and United States waterways. However, the paddle steamer had limited applications for ocean-going transportation as undulating ocean swells could leave the paddle out of water, rendering it momentarily useless (Ibid:16). The depth of the paddle in the water would vary on the course of a single journey as its load of coal was used on a voyage. A more reliable form of propulsion was needed.

The second stage was the replacement of the paddle with a 'screw propeller'. The concept of screw propulsion grew from an idea of Archimedes, two centuries before the Christian era. The Dutch had used a similar device to raise water to higher levels as part of their water management techniques. There were at least five attempts to apply steam technology to the screw before 1836 but, the existing engine and boiler technology was not yet up to the job (Lambert 1993:137). Lambert says the key factor behind the people who broke through with the innovation was not any leap in design but, their ability to acquire finance to design and exploit the technology. This occured on May 1836, when Francis Petit Smith, a tinkering farmer built a 2ft long boat which he tried on his farm pond (Corbett 1993:85). With financial support of a wealthy banker they built the 'Archimedes' (In July, of the same year, a Swedish army officer Captain Ericsson, who had lived in England for some time, also worked with a 2ft model boat had similar success. Ericsson had the backing of US navy Captain Robert. F. Stockton and together, they sought to capture US naval market).

With other backers, Smith formed the Screw Propeller Company to exploit the patent and develop a product they could sell to the admiralty. However, the company found that property rights embedded in a patent have no guaranteed value when (i) reliant on the government as a major target customer and (ii) there are small numbers contracting. With government as a customer the technology became tied to other stake-holder divisions. While the Whig elite supported the technology, the Torries offered little support, and a change of government in 1841 worked against the project. The admiralty delayed purchasing the screw until its technical success could not be denied, but by this stage the company had fallen apart (Lambert 1993:145). The admiralty then picked up the technology at a cheap price. They had used their market power to break down the value of the patent. Pioneering does not always pay and the company collapsed. It is noteworthy that the great engineer Brunel, who picked up on the technology, saw no point in patenting ideas at this time, a reflection of the low value of such property rights at the time (ibid).

Brunel had earlier suggested starting a trans-Atlantic steam service to the directors of the Great Western Railway, thereby providing a transportation service that ran from London to New York. However, using steam powered shipping to cross oceans was a great departure from the prevailing rationality of the day. Even Brunel's father had previously stated his lack of faith in the technology. When asked to work on a project to operate steamships between England and the West Indies he replied 'As my opinion is that steam cannot do for distant negotiation, I cannot take part in any scheme' (Rolt 1970:190). Not surprising, when Isambard Brunel put forward his suggestion, it was met with a combination of silence and uneasy laughter . The suggestion shared the absurdity of Henry the Navigator's ideas four centuries earlier. The key problem was fuel. Until this stage, steam engines used a great deal of coal and were uneconomical for use on long voyages. In long distant ocean voyages, the ship would need constant refuelling points or carry large quantities of coal. Not only was the large amount of coal required expensive but, storing the coal until it was used took up space that would otherwise be used to carry cargo. The obvious answer might seem to build a bigger ship but any 'rational' person of the time realised a bigger ship required more fuel. Brunel broke the bounds of this rationality. He realised that the carrying capacity of a ship was not determined by its volume but by the resistance that a ship encounters from the sea (and hence its fuel requirements) is determined by its surface area. Mathematically, the carrying capacity of a ship increased as the cube of its dimensions but the power required to drive it through the water only increases as the square of those dimensions. In other words, as a ship grew bigger it would need proportionally less fuel. It now seemed likely that an economic steamship could be built as long as it was built to the correct proportions.

The first steamship built by Brunel's company was the Great Western, a paddle steamer which was not proving a commercial success (Rolt 1970:203). After seeing the earlier success of the *Archimedes,* Brunel decided the next ship must be powered by a screw. He hired the *Archimedes* for some months and conducted tests on it using eight experimental screws. He also changed the internal gearing. The engine of

the Archimedes drove the shaft through straight gears. Brunel saw this as inefficient preferring to use four sets of tooth chains (ibid). The results were incorporated in the building of the *Great Britain.* Being the first screw propelled trans-oceanic ship and the first made out of iron, this 3270 grt giant heralded a new age of shipping.

Unfortunately, the Great Western Steamship Company had limited success and was wound up in 1852 (MacKenzie-Kennedy 1993:6-9). The technology was still too limited in its applications. Of the 9934 vessels listed in Lloyd's register in 1853, only 187 were steam vessels, a mere 2% (Greenhill 1993:26). The problem continued to be fuel. More economical engines were provided by the last important breakthrough, when the process of compounding which had been used on land was applied to the marine steam engine. The process of compounding expands the steam twice, therefore getting more use from the coal and reducing coal requirements (and costs).

Once again this process relied on advances in different technologies. Maritime use of the compound engine had been limited by the weakness of existing boiler design and materials (Griffiths 1993:106). Eventually, advances in the making of steel (with the converter patented by Henry Bessemer and the refinement of the open-hearth process by Siemens, Martin and Gilchrist Thomas) meant that stronger steel boilers could be made to withstand higher pressures. By 1874, the first deep-sea commercial steamer fitted with a triple expansion engine was built. It presented a new age of sea power in which steam technology could finally prove more economical than sail.

This technical inter-relatedness was just one of many external environmental factors in Britain that shaped the path of development (Starkey 1993:127). The increasing world trade centred on London encouraged people to invest in the new technology. As more of the nation's industrial output was sold abroad and demand for imported resources climbed, shipping grew in volume and competitiveness. This competitiveness intensified the pressure to reduce costs and improve quality (Starkey 1993:132). It created a competitive compulsion for innovation consistent with Klien (1977) and Porter (1990).

Britain's early lead in the industry also reflected the coal, iron and engineering development on land. The capital goods that would be used in steamships were produced in greater quantities in Britain than in any other nation. As marine technology developed, it became a contributing arm to the industrial cluster already blossoming on land. The engineers who designed machines for use at sea co-operated and formed learned societies with their railway and general engineering counterparts, providing a cumulatively growing pool of knowledge and experience.

Competitive pressure also played a role as the United States was producing a highly competitive merchant navy in the first half of the eighteenth century and later, the age old European national competition once

again reared its head in the form of a naval arms race (Starkey 1993:132). Naval support was particularly important as the navy was not hindered by a need to show a return on capital so, could be more experimental with its engine types and hull forms (Greenhill 1993:19). The navy had, for example, produced the first British steam and sail vessel to cross the Atlantic, the *Rhadamanthus* in 1833. However, the navy also had its own institutional inertia and heuristics which could frustrate an engineer like Brunel who wrote 'they have an unlimited supply of some negative principle which seems to absorb and eliminate everything that approaches them... It is a curious and puzzling phenomenon' (cited in Rolt 1970:223).

With steam power, shipping was freed from its reliance on winds and ocean currents. Ships could travel where they wanted, when they wanted. However, steam was not the most suitable form of power on all routes. Because of the need to carry coal onboard steamships, it limited their economic range. On longer voyages, sail was still the most economic form of shipping (Harley 1988:863), unless the route had a number of coal bunkers on the way from which the ship could refuel. Competition from steam technology and new areas of research associated with the new ships (eg: hull shapes) actually helped to inspire technological advance in sailing ships. Over time, steamship technology improved, reducing the costs and increasing the range of the new technologies. These improvements came from improved machinery which reduced coal consumption and staff required to stoke the engines, the building of larger ships which meant bigger loads could be carried without a corresponding increase in labour requirements and, the cost of building ships decreased with advances in the iron industry which reduced the price of iron.

Table 11.1 illustrates many of the economic advantages stemming from improved technology. Over the 18 years the cost of the coal used on the London-Bombay route declined from 21 to 13.5, the size of the crew was reduced and the ships themselves became cheaper to buy. Many advantages came from the economies of scale from being able to build larger ships. Larger ships needed fewer men and less coal per ton of ship. When combined with cheaper port rates, it enabled shippers to reduce their costs from 46 to 16 shillings per ton. At the same time, sailing ships to California (one of the world's longest routes) halved their price (Harley 1988:864-5). Such reductions in the price of transport increased opportunities for manufacturers could land their product in foreign ports at a cheaper price and this stimulated the growth of trade and shipping.

The transformed economic system was characterised by industrial and commercial activities that reinforced each other in much the same way as had happened in the Netherlands in the seventeenth century, but at a higher technological level. Britain became the leading industrial nation on the basis of a reinforcing industrial cluster of iron, coal, textiles, and steam power. As the population and industrial production increased the demand for imports of raw materials created a derived demand on which shipping rose.

Table 11.1 Declining Freight Rates: Steam and Sail
(Source Harley 1988:864)

	Steamship on run to Bombay		Sailing Ship to California	
	1873/4	1890/1	1873/4	1890/1
Freight Rates (shillings per ton)	46	16	70.7	33.2
Costs:				
Ship Prices	L53,000 (2000 ton ships)	L28,000	L19.5 (Price per gross ton)	L10.9
Wages	134	156	127	126
Port charges	100	71	100	88
Coal	21	13.5		
Physical Changes :				
Crew size	3.9	1.9	2.5	2.0
Ship weight	100	90	100	93
Coal consumption	2.1	1.5		
Economies of larger ships:				
Ship Size	1,500	3,000	1,000	2,000
Crew Savings	24%		30%	
Ship Cost Savings	14%		6%	
Coal Savings	42%			

11.2.1 Organisation During this period, technological and legislative changes led to changes in market structure. In particular, the economic system was dramatically freed from legislative restraints and privileges. Earlier, Adam Smith among others, had attacked the monopoly position of companies like the East India Company who used their position to buy as a monopsonist, sell as a monopolist and, restrict the volume of commercial activity in the process (Smith 1921:73). The EIC had hotly defended its monopoly but, political forces were shifting as the new system gave birth to new stake-holders. Industrialists, in particular the cotton kings of Lancashire were frustrated with the company's inability to sell British goods in India and China, the largest markets known to man (Keay 1991:451-2). Their stance reflected a new confidence of the manufacturers in the competitiveness of their product (until this time, their attacks on the company had actually been the reverse; attacking imports of Indian textiles into Britain posing an 'unfair' competition for the domestic product). The power of the industrialists helped to bring the monopoly to an end and the Asian trade was thrown open. At this time, the risks of the trade had been long overcome and the security of a monopoly could not be justified. The nation possessed a wealth of navigators with experience in these trades. Unleashed, they contributed to a dramatic growth in shipping in the region.

Another noteworthy legal change was the repeal of the Navigation Acts in 1849, which opened the colonial shipping routes to competitors from foreign nations. Not only did the repeal do away with the inefficiencies of the legislation, it also reflected the confidence of English shipping in its ability to defeat the competition. Britannia ruled the waves and could comfortably take on all comers.

Another legal change affecting organisation and ease of raising capital was the limited liability legislation of 1855. The old companies of many partners that spread risk became a thing of the past. A single ship could be launched as a single company. If the ship made a loss, the new laws meant that liability was limited only to that ship (and company) and earnings could not be used to underwrite debts incurred by other single ship companies owned by the investors (Green 1985:226). The new law gave birth to scores of one-ship joint stock companies, often owned and managed by small groups of investors (Hope 1990:316). Entrepreneurs with capital, connections or experience in trades (perhaps from serving in the East India company) seized the opportunities the new technologies and legal protection gave. Many investors established family firms, some with partners. It was this proprietary capitalism that dominated tramp shipping.

Tramps were a form of shipping that did not sail to a fixed route or schedule. They sailed to where ever there was a cargo. This form of shipping enjoyed an annual growth rate of 7% percent between 1870 and World War One (Hope 1990:318). Tramp shipping included both single ship companies which rose and fell with each succeeding boom and slump, and others that were more enduring and lasted for over a century (Middlemiss 1989:10). Generally, tramp companies were small, financed from the savings of the ship owners, friends and reinvested profits (Sturmey 1962:395).

Tramp ships travelled the world, where and when the cargoes dictated. It was a form of shipping made possible by the development of telegraph technology which informed shippers in advance where cargoes lay. Telegraph and Cable made communication easier and took a lot of the risk out of business as goods were sent less by speculation and more to order. It also allowed an increase in contact between the buyer and seller, with the elimination of the middleman. This led to reduced prices and increased business. Brokers had almost complete knowledge of the rates being paid in the main chartering centres for the various trades and the ships receiving those rates. This open information, large number of firms, and relatively low costs of entry made the tramp market highly competitive, perhaps the closest thing we have seen to perfect competition in the industry. In this fiercely competitive environment, tramp owners were characterised as hard-driven businessmen fiercely competing with other ship owners (Sturmey 1962:395). By 1914, tramps constituted 60% of the nation's fleet (Hope 1990:338).

The remainder of the fleet mainly comprised liners. Liners sailed to a regular schedule thereby increasing the value they provided to customers with a regular and reliable service. The idea of running at a specific time regardless whether the ship had a full load involved considerable risk but, it was hoped this would be

more than offset by attracting better paying cargoes such as cabin passengers and mail which were attracted to a fast regular service (Davies 1985:54-55). This situation has strong similarities to the regularity of shop hours identified by Alchian (1969). Regular hours reduced search costs and waiting times for customers. Although companies must hold a higher inventory of sailings, the greater value provided to customers allows them to recoup this through higher prices. The greater number of sailings also allows liners to gain greater usage from ships that would otherwise be under-utilised. Steamships were well suited to scheduled sailings as they were not restricted by wind conditions. In the early days, steamships involved a substantial investment that was beyond the small player. For that reason, the principal mail and passenger lines were created as chartered companies from the start.

Liners sit comfortably with Potts connection-based view of the economic world. The liner's regular scheduling and enduring relationships with the ports to which they sail developed into strong connections. On the basis of these enduring connections, capabilities and efficiencies were developed in handling goods and mastering the local winds and conditions. Further connections were then developed with the local hinterland via the regional transportation services. By contrast, tramp connections were less enduring, with the exception of their brokers or organisations such as the Baltic exchange which provided information on cargo availability. That is not to say that a tramp might not enter on a regular run, for example the route from Britain to South America, but their was less rigidity in the tramp trade.

Probably the most famous of the new liner companies was P&O. The company was started by Brodie McGhie Wilcox, a ship-broker, and Arthur Anderson, who had spent time in the British navy before joining Wilcox's company. The two formed a partnership and became ship owners in 1825, sailing a schooner to Portugal. In 1834, they issued a prospectus for the Peninsula and Orient Steam navigation company and in 1837, they gained the contract to carry mail to the Iberian peninsula. The mail contract was vital and saved the company from bankruptcy in these early years (Davis 1985:43). The contract was eventually extended through the Mediterranean. By 1840, they owned 7 ships, growing to 23 in 1850 and 51 in 1867 (Howarth and Howarth 1986:73). P&O grew in the wake of the East India Company's decline and the growth of the British Empire. Two thirds of its passengers to India were government employees, the company to a large extent being an unofficial arm of the Raj (Hope 1990:341).

However growth was not stable, disequilibrium giving birth to an organisational response. The negative effects of strong competition on the liner trades was often felt and, as early as 1850, some companies felt the need to co-operate on minimum freight rates (Hope 1990:318). The movement to inter-company agreements gained apace in the difficult years of the 1870's. At this time. the opening of the Suez Canal had dramatically reduced the length of voyages to the East and the total number of ships needed. The surplus of ships on the world market contributed to some defensive manoeuvres by shipping companies. Competing lines frequently amalgamated, either through merger or take-over, giving birth to lines such as Union-

Castle, Shaw Savill and Albion, and Elders and Fyffe date from this period. This process of amalgamation increased the merged firm's resource base and market power.

A second defensive option was to limit the competition between them by forming conferences. A shipping conference is a cartel in which shipping lines operating on similar routes agree to regulate competition between themselves and restrict new entrants from competing on the route. Many shippers were naturally discontented with this situation. However, a Royal Commission on Shipping Rings conducted between 1906 and 1909 (and other similar inquiries) have found that conferences were necessary to assure stability of rates, regularity of service and improved facilities (Davies 1985:60).

The process of amalgamation and conference building did not hit the tramp industry. Tramp owners were the more individualistic side of the industry, conducted by businessmen who held a personal pride in the achievements of the ships that bore their family name. They held a personal incentive that the managers of large liner companies lacked. Liner companies were run more and more by people with skills in accounting and negotiating, whose office work increasingly distanced themselves from the every day running of the ships. They welcomed co-operative action with other companies. Consequently, the English shipping industry bore two structures; one oligopolistic (liners), one perfectly competitive (tramps).

11.2.2 Government Policy and Empire The British government continued to assist shipping and the development of the new steam technology. A major form of assistance were postal subventions which subsidised ships carrying mail. To get a mail subsidy, a company had to fit in with the requirements of the admiralty who took a strong role in guiding and promoting the new steam technology. These subsidies contributed 20-40% of operating costs (Hope 1990:272) and were vital in establishing transoceanic steamships as a viable commercial prospect. The Great Western Steamship Company found it could not operate without a subsidy and was wound up in 1852 (MacKenzie-Kennedy 1993:6-9, Rolt 1970:215). A subsidy enabled the Cunard Line to annihilate non-subsidised American competition and dominate the Atlantic. Other companies to benefit from the subsidies included Royal Mail, the Pacific Steam Navigation Company and P&O.

The diffusion of steamship technology was aided by the development of long distant trades in wheat, wool, meat, coal and manufactured goods. British steamships travelled to foreign ports where British-built railroads provided another key artery in the commercial system opening up the hinterland of places such as Canada and India. From India came jute, indigo, hides, tea, rice and raw cotton. From Canada came lumber and grain while, South Africa gave diamonds and gold. Rubber first found in Brazil and West Africa was distributed through tropical colonies, particularly Malaya and Ceylon. Sheep were introduced into Australia and New Zealand, a new source of wool and meat once refrigeration was invented. It was through this process, that the world divided into industrial and non-industrial nations, taking a shape that

would remain for the next century (Lewis 1978:7). Although not in the empire, Argentina became an extension of this structure in that it was a provider of primary products such as beef, to Britain (Duncan and Fogarty 1984:16). As the colonies became richer from their exports to Britain, they in turn became a ready market for Britain's manufactured goods. The resulting commercial system developed reinforcing arms of commerce, industry and shipping, the lead in one field reinforcing her strength in the others.

British rule enhanced the developing country's ability to obtain capital on the London markets, by enhancing law, order, and stability, and thereby reducing the risk of investment (although often the benefit went to the white elite in those countries). In this way, Cadbury, Lever Brothers, Rowntree, Fry, Liebig's Extract of Meat and Bovril all grew, with investments in foreign plantations, agencies and trading companies that ensured the supply of necessary resources (Chandler 1990:265).

British advances in railway, steam ships, and iron hulls provided the technologies by which trade volumes soared. Railways, cold storage works, and other large scale enterprises could not be built without capital. Wealth generated by the industrial revolution found itself on London capital markets where it was lent to foreign governments developing their nations commercial infrastructure. Foreign companies might raise money through the London stock exchange, a process that was helped by the introduction of limited liability. Much of the British capital that financed railways, cold-stores, plantations and other transportation facilities was raised in this way.

However, it was not necessary to be ruled by Britain to be part of this process. The infrastructure of the United States was developed largely with finance from Britain. Similarity in language, culture and institutions also helped to reduce the risk of investment although shipping between the two nations remained in the hands of the British.

11.2.3 Supporting Industries and Technologies British shipping rose on the support of the most advanced supporting industries of the day including ship-building and the most advanced cargoes. Supporting industries grew into Marshallian districts deriving significant economies of scale. On shore industries might originally grow at a location because of their access to raw materials, for example steel for shipbuilding, clay for ceramics. Industry growth would create a pool of skilled labour in the region that would move from employer to employer as demand dictated. The concentration of so many firms in a region meant that common standards of worker training and qualification would be available to all employers. Pools of specialised labour were constantly available to any employer in the region through the local labour market. Trade Unions acted as local labour exchanges. They also helped maintain common qualifications of high standing among workers through the apprenticeship system they administered. Senior craftsmen would train and organise the workers under their control.

Given the high quality of labour available through the market and the fact that training and organisation was performed by senior workers, administration costs for the various firms were very low. Employers did not need to invest in managerial or planning skills. Firms remained relatively small and were family owned and managed. They concentrated on a narrow range of products in which they specialised. The low capital requirements of firms made entrance to the industry relatively easy while competition between firms helped to maintain standards. This industry structure has been labelled 'Proprietary capitalism' (Lazonick 1991) and Personal Capitalism (Chandler 1990), the key characteristics being Marshallian districts of industry concentration where firms enjoyed external economies in which a large number of firms shared infrastructural investments in communication, distribution and training. These firms were vertically specialised, horizontally fragmented, proprietary firms with low overheads and highly skilled craftsmen.

The arrival of steam and iron totally changed the nature of shipbuilding. Previously, shipbuilding had been spread over a large geographical area, nearly every port having its own repairing and building facilities. In contrast, the industry was now defined by access to key supplies and became concentrated in three areas, the Clyde, the north-east coast and Belfast.

The industry was based on a totally new skill base, and the old timber and sail craftsmen-based industry went into obsolescence. People came to the industry, not with a background in shipping, but with new iron-coal engineering skills. David and Robert Napier were pioneering entrepreneurs arriving with backgrounds as blacksmith and iron founder (Smith 1980:260-2). They built their first marine engine in 1816, which they followed with the *Rob Roy*, the first steamship to cross the channel between Clyde and Belfast. Their first shipbuilding yard was on the Thames; however in 1841 they moved to Govan on the Clyde River, launching the region's great tradition of iron shipbuilding.

The Napiers provided their employees with the engineering capabilities required in the industry and, from their works came a new stream of entrepreneurs. David Todd and John MacGregor had been managers in David Napier's works before opening their own yard in 1836. John Elder, who patented the marine compound engine, had been employed as chief draftsman with Robert Napier before commencing his own business (later becoming the Fairfield Shipping and Engineering Company). Also from the Napier yard were J and G Thomson who founded their own shipyard at Govan in 1851, later known as the Clydebank Shipbuilding and Engineering Company (Smith 1980:264). William Denny came from a family of shipbuilders but it was after working in Napiers that William Denny and Brothers of Dumbarton was created. By 1850 the reputation of the Clyde was attracting shipbuilders from other places. By 1876, there were more iron ships built on the Clyde than the rest of the world put together (Pollard and Robertson 1979:62).

At Belfast, the first shipyard was established by Robert Hickson to provide an outlet for the production of iron plates for his Belfast Iron Works. The company was later bought by his yard manager, Edward Harland, becoming Harland and Wolff. On the east coast, Palmers began building their own iron steam colliers to send coal from their mines to compete with the railways. Also on the east coast, Armstrongs began constructing hydraulic machinery before moving on to warships.

The head start obtained by the British enabled them to build up economies of scale that made it hard for foreigners to compete. The steel industry could make longer production runs, thereby reducing costs (Pollard and Robertson 1979:46). The large market made it possible for shipbuilders to specialise in certain types of ships, particularly in the building of tramps (Pollard and Robertson 1979:46). This allowed shipbuilders to economise on the equipment they needed and allowed them to build before orders had arrived.

Many of the new steamship companies formed strong associations with shipbuilders. Shipbuilders gained repeat orders and an opportunity to specialise in certain types of ships. In return, the ship owners received vessels at lower prices (Pollard and Robertson 1979:92-3). For example, the White Star Line completed an agreement to have all their steamers built and designed by Harland & Wolff in Belfast (MacKenzie Kennedy 1993:42). In return, the shipbuilder offered not to build ships liable to compete with White Star services. The two co-operated with their ideas. The flow of information contributing must have contributed to the line's ability to meet the market with hitherto unknown standards of comfort. For example, their ship designs placed first class cabins amidships, clear of machinery and propeller vibration, instead of the usual end of the ship.

Cunard obtained financial backing from the engine builder R.Napier (MacKenzie-Kennedy 1993-10). In return, Napier gained a guaranteed market, which must have encouraged him to invest further in the new technology. The relationship reflects the quasi-integration identified by Richardson (1972) in which both firms gain from increased stability and co-ordination. Between 1839 and 1852 all Cunard contracts for paddle steamers were given to Napier who built the side-lever engines while sub-contracting the hulls to various affiliated Clydeside builders. The relationship lead to a flow of information including, for example, what size ships would be needed given the need to store coal on board.

However, Cunard was rather conservative in developing new ideas, preferring to let others take the risks (MacKenzie-Kennedy 1993:183). While many pioneering companies went bankrupt, Cunard would only adopt an idea once its success had been proven. The failure of many first movers illustrates the dangers of being a pioneer. However, the environment of expanding global trade did much to favour early movers adopting the technologies in a growing market.

11.3 The Coal and Steam Based Economic System The backbone of the new economic system was the coal industry. A huge natural endowment of coal provided the energy source by which many of the new industries were powered. In 1925, the Royal Commission on the Coal Industry stated:

> The paramount importance of the coal mining industry in the economic and social life of this country is a common place.... With the exception of agriculture to which it is a close second, the industry employs more men than any other; not less than one twelfth of our population is directly dependent on it. It is the foundation of our iron and steel, shipbuilding and engineering trades, and, indeed, of our whole industrial life (quoted in Fletcher 1975:2)

Most important, coal was the cornerstone of British maritime supremacy (Fletcher 1975:4). It fuelled the construction of ships, the fuelling of ships, and gave the British an export cargo that allowed it to charge lower rates on return journeys. Once the British had developed first-mover advantages with the new technology, they could move into other nations and provide strong competition for shippers based there.

Other technological developments continued to reduce costs and advance the possibilities of trade. The opening of the Suez canal reduced the London to Bombay trip from 10,667 miles to 6,274 and reduced the coal requirements for steamships on the longer routes. The development of refrigeration meant that meat, fruit and dairy products could be transported in a fresh state. Costs were reduced with the introduction of mechanical appliances for loading which reduced time in port and enabled ships to make more voyages.

As British industry rode an increase in world trade that it was doing so much to shape, the profits provided capital with which British firms could invest in the latest technological improvements. With the most sophisticated ships, and devices such as conferences, the British defeated their foreign competition. British tonnage, which stood at 2.77 million tons in 1840, grew four-fold in seventy years, to 11.56 in 1910 (Davies 1985:69).

By the middle of the nineteenth century, Britain produced 'about two thirds of the world's coal, about half its iron, five sevenths of its steel, two fifths of its hardware and about half its commercial cotton cloth' (Kennedy 1988:152). Its iron and coal driven merchant fleet, that carried manufacturing goods out and raw materials in, was by 1890 larger than the rest of the world put together. It was part of a reinforcing system of coal resources, flexible family firms, Marshallian districts and practical craft workers. Ships built on the Clyde were chartered and insured in London where Lloyds achieved a position of leadership. In London, the City's financial institutions provided the capital by which the system advanced.

Table 11.2 Competitive Strengthes and Related Heuristics of British Shipping

Sources of Competitiveness	Paradigm Heuristics
Shipping Industry	
- Flexible Family Tramp Firm	- Company is a vehicle for family to gain prosperity and autonomy - Self financing
- Ship technology	- Use all-purpose vehicles (the tramp).
- Liner Companies/ Conferences	- maintain stability by reducing price competition.
Supporting Aspects of Economy	
- Iron and coal supply	- Use coal powered vessels
- Skills/experience	- Practical man
- Education/Royal Society, etc	
- Family Firms	- Company is a vehicle for family to gain prosperity and autonomy
- Expansion of Empire, government policy and naval support.	
- Reputation	- British are best by definition
- Ports and infrastructure	- rely on British facilities

11.4 Early US Shipping

Before the United States gained its independence, American colonial ships could fly under the British flag. This enabled them to receive some benefits of protection under the British navigation acts, as well as advantages in being tied to the strongest merchant navy in the world. In particular, as British colonies in the Caribbean became more settled, New England shippers could gain experience by carrying grain to their colonial connections in the West Indies (McCusker 1979;12). Complementing this was a process of imitation in ship-building where British immigrants transfered their skills to the colony where a vast supply of timber enabled quality ships to be built at a low cost. However, the vast bulk of American domestic and international shipping at the end of the eighteenth century was conducted by foreigners, in particular the British (Bates 1892:95).

United States trading relationships did not change after independence and were still strongly shaped by the British imperial trading system. The south still served markets in Europe while northern fish, farming and forestry products found their primary market in the British West Indies. However, US ships no longer sailed under the British flag and were now treated as foreign in the British West Indies where they had once carried their grain (North and Thomas 1968:9). Barred from routes to which they previously had access,

merchants from Salem, Boston, New York and Philadelphia expanded their scope of shipping activity. Ship owners from Salem took the early lead, Elias Haskett Derby sending his barque *Light Horse* to St Petersburg in 1784 while in the same year, a group of New York and Philadelphia merchants fitted out the *Empress of China* for the Far East. Having opened new markets, US shipping surged forward aided by Napoleonic Wars which distracted European competition and, for a time gave American shippers the chance to enjoy the benefits of neutrality. So profitable was maritime trade that it was the focus of all the nation's risk capital and provided the basis of many American fortunes, such as the Astors who reaped reward from carrying furs to China (Bates 1979: 30-32).

From 1789, advance in the industry was supported with a range of protective measures introduced by the government. For example, an American ship bringing Hyson tea from the East would pay a duty of 10 cents per pound compared to 45 cents in a foreign vessel (Bates 1892:94). They were given a virtual monopoly on their coastal trade and dramatically reduced port duties. By 1810, approximately 90% of American international trade was carried on US ships (Bates 1892:99) and, although this percentage would fall with the return of European ships after the Napoleonic wars and the removal of protectionism, the fleet continued to grow.

This early period of imitation and capability building was followed by a process of advance as Americans innovated to meet the particular needs of their industry. For the north Atlantic, heavily built 'packet ships' with reasonable speed and good cargo-carrying capacity were designed to handle the rigors of this ocean. For the fast developing trade to China, a line version of the packet was employed. These were the progenitors of the 1840's 'clipper' used in the trade to China, California and Australia where speed was an advantage. Chapelle (1935:281) states that the clippers "are unquestionably the most over-advertised ship type in maritime history", as writers have painted a false picture of the importance of the ship. They appear to have captured the imagination because of the high level of competition in the Far East trade (McGregor 1993:33) but, they only represented a small proportion of the ships annually constructed. The bulk of the US fleet in the nineteenth century were schooners. These ships, which originated in Europe in the 1700's, had gaff sails with 2 or more masts. These were fast ships but had less carrying space than square-rigged vessels. During the nineteenth century, Americans added more masts that could propel faster, bigger ships. On the back of growing trade and innovative technology, the nation succeeded in building the second largest mercantile fleet in the world by 1850 (Greenhill 1993:10).

Perez and Soete (1988) would lead us to expect a window of opportunity is created at the beginning of a product's life. Consequently, we would expect Americans to match Britain in iron and steamship technologies. As early as 1778, John Fitch successfully piloted a paddle wheeled boat on the Delaware. Advance in steam was propelled by Robert Fulton who visited England in 1803 with the intention of studying painting but, became more interested in mechanical innovations. He conducted considerable

research in Europe on steam propulsion and, as an agent of technical transfer, returned to the States where he built his first steam boat in 1807. With his partner Robert R Livingston, he acquired monopoly rights to steam navigation in New York state (Still, Watts and Rogers 1993:44-5).

The many broad waters of the United States were ideal for steamboats and paddle boats were soon plying other rivers. However, diffusion of steam power was inhibited to some extent by the inability of American iron foundries to produce some of the shapes required for steam engines. Its use in American coastal waters was also slowed by monopolies awarded by some states to steamship companies, such as that given to Robert Fulton in New York. It was not until a Supreme Court decision outlawed such grants in 1824 that coastal steaming spurted (Bauer 1979:45).

Americans also built the first steamship to cross the Atlantic Ocean when a group of prominent Savannah entrepreneurs created the Savannah Steamship Company. Their vessel, with the original name *Savannah* left the United States on the 24th May 1819. Twenty-nine days later it arrived at Liverpool, having used steam power for only 85 hours and sail for the remainder (Rolt 1970:190). However, steam technology was in its early days and the cost of fuel and equipment made it an expensive exercise deterring further advancement into the area of steam powered ocean trading. The US experience with the *Savannah* illustrates the difficulties of being a first mover in that are still many uncertainties.

It would be another twenty years before the British made their first steam powered voyages across the Atlantic. The British Cunard line began to dominate the steam market aided by subsidies from the British government for carrying the mail. Shortly after, the US government decided to provide mail subsidies to American steam companies, giving birth to the Ocean Steam Navigation Company, the New York and Havre Steam Navigation Company, and the New York and Liverpool United Mail Steam ship Company (more commonly known as the Collins Line). In 1855, Commodore Cornelius Vanderbilt also commenced a line, attracted by the mail contracts. In the west, the Pacific Mail Steamship Company and United States Mail Steamship Company were born.

These companies became embroiled in 'milking' scandals. Two of the stockholders in the United States Mail, Law and Roberts fraudulently appropriated shares in the company eventually owning the bulk of the stock (Myers 1907:285n). To make matters worse, both the Pacific Mail and United States Mail Steamship Companies were receiving very large subsidies (a total of $900,000 per annum). Cornelius Vanderbilt, who ran steamships across the Atlantic, knew that these lines could do their job with half the subsidy. He blackmailed the two companies to a tune of $40,000 a month (just under half a million a year) not to set himself up in competition (Myers 1907:287).

In 1865, Congress voted an even bigger increase in mail subsidies for the Pacific Mail Steamship Company to carry mail between San Francisco and Asia via Honolulu. In 1872, another $500,000 per annum was added. Eventually, the Ways and Means Committee investigated the subsidy and found that nearly one million dollars in bribes had been paid to get the subsidy voted through (Myers 1907:476-7). Americans showed themselves as being just as able as the Chinese Mandarins to put milking ahead of national efficiency. However, a democratically elected government would not endure such misappropriations in the long term and no US president would be able to use navy funds to build a summer palace as occurred in China (see next chapter).

The growth of the merchant marine came to an end with the Civil War, after which it virtually ceased to exist (Still, Watts and Rogers 1993:79). The war disrupted important trades, such as the vital cotton trade. It also led to large increases in the price of insurance as 100,000 tons of shipping were lost to Confederate raiders (Safford 1985:96). At this time many owners abandoned the industry altogether, redirecting their investments to coastal or foreign shipping, or transferred their ships to foreign flags. Consequently, tonnage levels in 1879 were half what they had been in 1857 (ibid).

The civil war was only one of a number of factors that contributed to the decline of US shipping. American success in the industry had largely rested on its cheap wooden ships built from its large timber resources. As iron started to prove itself superior to timber, the Americans lost what had been a competitive advantage. At the same time, trade to Europe was hurt by a rise in protectionism in Europe and their colonies (Krooss and Gilbert 1972:84).

Finally, the changing nature of the American economic system undermined the position of shipping. No longer a merchant driven society dependent on foreign imports, the United States was building a strong industrial base of its own with an expanding population and frontier moving west. There were more profitable avenues for investment than shipping.

The retreat from the sea is no firmly illustrated than in the career of Cornelius Vanderbilt (see Myers 1907, Patterson1989). Cornelius was born in 1794 to the son of a Staten Island farmer who also ran an irregular ferry service across New York Bay to Manhattan Island. Cornelius found ferrying more attractive than farming and in 1811, with $100 from his mother, he bought a piragua, a shallow boat with which he hauled freight and passengers across New York Bay. Cornelius gained a reputation for reliability and in the second decade of the nineteenth century he began operating schooners on both the East and North Hudson Rivers.

It was not possible to operate steamships in those days as the pioneer Robert Fulton had been given a state monopoly. Thomas Gibbons was prepared to fight the monopoly and in 1818, he hired Cornelius Vanderbilt to pilot a steamship in return for the substantial sum of $1,000 a year. Cornelius also took over a

dilapidated inn where his passengers rested on route. His wife ran the inn making a healthy profit. Eventually, Cornelius started building his own steamships and ran lines to Albany, New Haven, Providence and Boston. New York at the time was enjoying a rapid population growth providing Cornelius with a soaring customer base. By 1835, he was worth half a million dollars, ranking him among New York's wealthiest. In tribute to his nautical skills, people began to refer to him as "the Commodore". Cornelius went on to establish maritime links with the West Coast (through Nicaragua) and, as mentioned above, ran steamships across the Atlantic with the aid of mail subsidies.

Cornelius's son William Henry Vanderbilt became interested in railroads, buying the Staten Island Railroad which at the time was having trouble surviving. By cutting expenses and linking the railroad with a line of ferries, William Henry turned the railroad around. Cornelius also began to invest in the railroads that linked with his ferries. In 1858, he sold his shipping link to the West Coast for $20 million, at a time when investment opportunities on the New York Stock exchange were dominated by the stocks of railroad companies. Cornelius invested in railroads, particularly those entering New York. He also stopped trying to compete with the British steamships on the Atlantic, eventually divesting of all his maritime activities. In 1867, he became president of the New York and Hudson Railroad. He then purchased the New York Central Railroad which he merged into his previous acquisition. The 'best steamship manager of the time' (Bates 1892:146) was becoming a railroad king. By the time Cornelius died, he was the richest man in America. His fortune of $90 million was more than twice the size of his nearest rival. Born to the sea, his wealth matured on land, a reflection of the changing US economy and a turning from the sea.

The experience of the US merchant marine in the nineteenth century is clearly paradoxical. At the end of the eighteenth century, the nation gained knowledge in new markets, new routes and established contacts with new buyers and suppliers. Under the protection of high tariffs and the Napoleon Wars, and bolstered by a domestic economy that provided strong demand for imported cargoes, commodities for export and plentiful wood supplies to build ships, the nation had built the second largest fleet in the world by the outbreak of the US Civil War. We would expect these capabilities and endowments to serve the nation well in the steam age but a deficiency of iron engineering skills allowed the British to leap further ahead. The turning from the sea personified by Vanderbilt stands in sharp contrast to other chapters where domestic economic growth has facilitated the growth of a merchant fleet, but perhaps if more detail was available in earlier periods we might find there were periods in which domestic growth absorbed capital that might have otherwise gone into shipping. If so, the US experience would not appear so unique and might merely be a consequence of timing for, as we will see in chapter 13, the expected linkages eventually appeared and helped to build a US steamship industry.

Chapter 12

Changes in the East

12.1 The Decline of Chinese Shipping

In chapter six, it was revealed that the development of Chinese maritime trade was part of a broader process of commercialisation in the economy. This prosperous system created spin-offs in terms of knowledge resources, supporting industries, capital and demand conditions that under-pinned the industries success. Given that the industry's success stemmed from the economic system to which it was part, we would expect decline to affect all parts of that system. We would expect Chinese decline to be associated with some combination of lock-in to specific technologies, path dependency, entrapment by rules and values (both formal and informal). Attempts to change would initially be hampered by arrogance and uncertainty about the need for change, undermined by the prevailing rationality and paradigm and stake-holders forming strong distributional coalitions. The Chinese experience is consistent with the thesis.

The first elements of this pattern of decline can be revealed in a document of 1793. At that time, the British government sent a mission led by Lord MacCartney to visit Peking and obtain increased trading rights and establish a representative at the Chinese capital. The resulting edict from the emperor Ch'ien-lung to King George read in part:

> We, by the Grace of Heaven, Emperor, instruct the King of England to take note of our charge...
> ... As to what you have requested in your message, O King, namely to be allowed to send one of your subjects to reside in the Celestial Empire to take look after your country's trade...
> ... The Celestial Empire, ruling all within the four seas, simply concentrates on carrying out the affairs of government properly, and does not value rare and precious things. Now you, O King, have presented various objects to the throne, and mindful of your loyalty in presenting offerings from afar, we have specially ordered the Yamen to receive them... Nevertheless we have never valued ingenious articles, nor do we have the slightest need of you country's manufactures..... Hence we have issued these detailed instructions and have commanded your tribute envoys to return safely home.... (quoted in Teng and Fairbank 1954:19).

The passage reveals an arrogance and ignorance of the changes in the world or any need to change. It is consistent with the modeling of the world and information filtering process identified by Simon (1959:272) in which 'the decision maker's model of the world encompasses only a minute fraction of all the relevant characteristics of the real environment'. Trapped within the Confucian model/paradigm, the Chinese still saw themselves as rulers of the four seas while the Westerners were mere barbarians. The prevailing rationality and education system entrapped the Chinese in their ancient belief that the Middle Kingdom was the centre of civilisation. However, China no longer ruled the waves and was losing its technical supremacy

in the cargoes that filled the boats and the knowledge resources that had generated maritime innovation. Worse still, no one in the Middle Kingdom had any idea of the developments that Europe was making.

However, at this time, the Chinese still had some reason for their high sense of self-belief. Throughout the eighteenth century Europeans certainly viewed China with enormous respect. Philosophers during the enlightenment saw China as a utopian state that they hoped to emulate. As mentioned earlier, even Adam Smith, in his avocation of specialisation and division of labour, seems to have been influenced by descriptions of porcelain production at Ching-te-chen (Adshead 1995:296).

At the end of the eighteenth century, the Chinese mode of economic development with its hydraulic projects and national network of canals made China a wonderfully productive economy. Agricultural production, which accounted for most of a nation's productivity even as late as the eighteenth century, was higher per hectare in China than the West (Braudel 1984:151), albeit a more labour intensive method. The economy showed a continual ability to adopt and grow throughout the Ming and Ch'ing (1368-1911) dynasties. The amount of land cultivated in that period increased, doubling between 1600 and 1850. New crops were introduced and changed the face of agriculture. Fresh strains of early ripening rice and American crops like potatoes and peanuts were introduced (Jones et al 1993:28). These crops could be used in dry land areas not previously exploited, expanding the nations agricultural frontier. As a consequence, Chinese society became more rural and even more market orientated. There was a rise in the number of goods traded and in the number of market towns. Merchants and guilds rose in power and status under the force of this commercialisation. Private enterprise expanded with industries coordinated through a network of rapidly increasing density. Those industries showed themselves to be highly responsive to the ebbs and flows of market forces (Elvin 1973:284-7).

The Chinese did not exhibit the social rigidity expected from decline. In fact, social relationships in the countryside were changing. One cause of this was the recurring peasant rebellions. Sparked by famine, flood, drought, rapacious officials or usurers foreclosing on mortgaged land, there were frequent occasions when the peasants reached boiling point. The possibility of being murdered caused recurring discomfort to landlords who gradually decided owning serfs was not as attractive as it had once been. The institution of serfdom came to an end. This, and the practice of dividing land estates on death resulted in a society which Elvin (1973:258) describes as 'one of the most fluid in the world, lacking any of the status or caste restraints which typified late pre-modern Japan or India'.

This was an economy displaying all the pillars of growth that modern economists seek - a wealthy, socially mobile, market-driven economy. According to Murphey(1970:8), per capita income at the beginning of the nineteenth century was equal to, or greater than, European levels, even though Europe was in the process of an industrial revolution. However, this may be overstated, Adshead (1995:319) states that the per capita

income of Europeans was double that of China at the time. Nevertheless, realitive decline had set in. Jones (1990:7-8) argues that economic expansion was not accompanied by a per capita increase. There was 'extensive' growth but not 'intensive'. Similarly, Elvin (1973:204) noted that although vigorous economic growth occurred between 1500 and 1800, 'invention was almost entirely absent'. The economy experienced growth within the established paradigm with existing patterns of behaviour, relationships and productive activity. Change might occur but, it did not significantly alter those established patterns.

Inevitably, this decline hit the shipping industry. The Chinese had gained their initial superiority on the experience and skills they had developed, organisation sources that helped raise capital and enforce transactions, superior technology in ships and cargoes, supportive government policy and, in the China Sea, the restrictions it placed on foreign merchants entering China gave it a firm advantage on a key leg of the trade. However one by one, those sources of competitive advantage had been eroded.

In the early nineteenth century, the Chinese were still the leading shippers in the China Sea. Anthony Reid (1993) estimates the Junk trade of the South China Sea to measure 74,190 tons at this time, while Viraphol (1977) estimates the combined tonnage of Chinese and South East Asian based junks in the inter-Asian trade at 85,000 tons. By contrast, prior to 1833, the English East India Company never had more than 30,000 tons in the region. However, the China Sea was just one of many markets for the British. As early as 1771-3, the English had more than double that tonnage in the Atlantic trade alone (see Davis 1962:298-9).

Chinese shipping reflected a path dependency centered on the China Sea. While Chinese shippers had developed skills, experience and contacts in the East Asian trade, Europeans were developing new paths to riches. Western fleets had access to the world market. They sailed every ocean in the world with markets in each, developing economies of scale with which the Chinese family firm could no longer compete. British private traders could borrow EIC funds at Canton and repay them in London, while the joint stock financial structure meant English firms could assemble capital from an array of sources, from civil servants to army officers (Das Gupta 1994:155).

However, in the first half of the nineteenth century, the Chinese were still secure in their competitive strengths. Even after the opening of the Treaty ports that gave Europeans access to the Chinese market and removed a protected source of strength for the Chinese, European merchants were unable to compete. They lacked the 'intimate knowledge of the markets and the skill in assorting and laying out cargoes, which the Chinese had acquired through centuries of experience' (Wong 1960:122).

Slowly but surely, the Europeans began eating into the Chinese market share. The Chinese had also lost their technological edge in shipping technology. Crawford (referred to in Reid 1993:28) notes European

fully rigged ships could complete three voyages between Batavia and Canton each year compared with only one for the junks. Chinese merchants began to use European ships instead of those of their compatriots. However, this was not well received by their compatriots. In 1844, a Chinese supercargo who accompanied his cargo on a European ship was nearly seized by the authorities on his arrival in China for 'patronising a Foreign Vessel to the detriment of his own countrymen' and spoiling the junk market (Wong 1960:123). This caused the British government to claim that all Chinese merchants living in the Straits area (Singapore) were British subjects and were given documentation. Chinese merchants now regularly used European ships to transport their cargoes.

In the face of such competition, we might expect Chinese shipbuilders to adopt European construction methods. There is little information on why this didn't happen however, it would seem there was little opportunity for the Chinese to study European construction methods. At the end of the century, the steam ship would make the advantage complete.

Eventually another competitive strength fell away. Much of the competitive strength of Chinese shippers had come from the cargoes they carried. Throughout the nineteenth century, this supremacy was also lost. In 1800, China was still producing 33% of the world's manufactured goods. However, by 1860, their share was 19.7% and by 1900, it was down to 6.2%. During the same period, Europe's share had grown from 28.1% to 62% (Kennedy 1987:149).

The lack of significant invention in the techniques of production suggests a shortfall in Chinese science. Not that science failed to make progress in China but it did fail to advance at a rate achieved in the west (Jones 1990:11). Thinking in terms of national systems of innovation would suggest that Europeans had a developed a system which more rapidly generated innovation and the development of such institutions as the Royal Society and the Royal Observatory at Greenwich might support such a case. However, China had long had its Imperial Bureau of Astronomy and, as from 1645, a Catholic missionary had always been in charge of the bureau (Teng and Fairbank 1954:17), reflecting some openness to Western innovations. However, astronomical advances were not widely distributed as they were in the West and Westerners came merely to advise the Emperor.

Chinese thought and education was changing in a way that reflected the economy had solved many material problems. From the fourteenth century, neo-Confucianist philosophers moved away from the material world and practical thought, and increasingly started to explore the 'mind' and 'spirit' (Elvin 1973:225-234). As the nation's top intellectual thinkers moved away from exploring the physical world, the growth of a modern science based on mechanistic and quantitative approach to phenomena was unlikely to occur, with negative consequences for science and technology. To some extent this retreat from the practical-technical is consistent with the thesis in that those with power were becoming more distanced from core activities; a

variation on Marshall's life cycle or Schumpeter's (1942:160-1) depiction of leading capitalist families becoming divorced from those values that placed them in their priviledged position. This could be seen in the long finger nails growing on the hands of Mandarins who never saw manual work (Wong Chu-Ming 1963:166). It reflected a distance between those who worked and those who had education and power. The consequence was a lack of attention to developing new production techniques. This stands in dramatic contrast to Europe where knowledge resources were increasingly applied to the problems of industry, and institution such as the Society of Arts were created to facilitate this link.

Formalisation had certainly acted as one cause of stagnation in Confucian education. Once a highly rational mode of thought, Confucianism had became traditionalist and conservative (Balazs 1964:32). The reproduction of past successful thought resulted in examinations becoming formalised with a preoccupation with style. Education became repetitive with little in the way of advance. This can be seen in geography. In the late eighteen century, when British mariners had mapped the globe from New Zealand to Greenland, the Chinese still thought of the world as flat with China located in the centre (Lenz 1997:152).

However, the links between science and technology should not be stressed too strongly. It presupposes that industrial technology in the west advanced on the basis of scientific advance and, this was not the case until the nineteenth century. Industrialisation in Britain during the eighteenth century had only a weak connection with scientific thought (Jones et al. 1993:31). Most of the industrial advances were made by artisans with little scientific knowledge. They could be described as industrial 'tinkerers' (Landes 1969) and held no scientific advantage over Chinese artisans. Chinese artisans were very capable of making the products of the early industrial revolution and had already made their own water powered spinning machines. A true 'technological gap' did not open up until the second half of the nineteenth century when developments occured in the steel, electrical and chemical based industries. We need a better explanation for entrapment.

Another explanation for the slow rate of innovation can be found in the market would where the routine-based path dependency. Langlois (1988) had noted that markets of decentralised specialists can create co-ordination problems in implementing complex change. The Chinese example seems to illustrate an even greater problem of market-based specialisation in that it can reduce the chances for innovation in general (as it had in Gujarat). Market growth had led to increased specialisation. Artisans specialised on producing goods with little attention given to the workings of the market. Merchants specialised in distributing goods with little thought given to how the goods were produced. The result was a rising gap between producers and merchants and in many cases, intermediaries and contractors increased this gap. The consequence was those with capital and the keenest awareness of market forces had no interest in production technology At the same time, producers lacked the capital and marketing sense to create any significant leap in production technology (Elvin 1973:277). Consequently, no significant leap occurred. As in India, market-based

specialisation had stunted domestic innovation. By contrast, in the United Kingdom, young industries were being created by men like Josiah Woodward, who had crafts skills and an entrepreneurial eye for the market (McKendrick 1982).

Consistent with this specialisation was the market-based rationality of the time. With little investment in facilities and suppliers, the culture was commercially or transaction based, not management orientated. If a merchant had problems getting supplies, he never sought a technical or productive solution as he had no knowledge in this area. He sought solutions in the market place, where he had developed his skills. Solutions to bottlenecks or periods of rising and falling demand could be met through the market, an answer made possible by the efficient forward and backward linkages that existed. For example, if demand was high for cotton, wages would rise and encourage some of the hundreds of thousands of peasant households to divert their labour from agriculture to the cotton industry and, when demand fell the peasant's labour would be redirected into farming. The market was so efficient that it was unnecessary for merchants to become directly involved in production. As Elvin (1973:277) explains 'They could hold almost all their capital in relatively liquid form as working capital and avoid tying it up as fixed capital. This gave them much greater potential freedom of action, and spared them embezzlement of materials by spinners and weavers. With no benefits to be had from acting otherwise, this arrangement was congenial to the merchant temperament'.

However, industries with internalised co-ordination were also suffering. For example, the ceramics industry was also suffering from specialisation which had previously reduced costs and enhanced quality. But technical perfection came at the cost of entrapment. Increased centralisation of the industry under the state increased efficiency and quality of output, but reduced the chance for individual creativity (Medley 1989:265). While large scale production reduced experimentation in China, the small state owned factories in Europe were given regional monopolies, government support and freedom to experiment and innovate (Atherbury 1982:127). In England, individual potters competing in a proprietary capitalist system proceeded on a path of continuous improvement. The industrial revolution was producing new products such as bone china and new techniques such as transfer decoration that more than held their own with the traditionally produced china-ware. As early as 1791, the English East India Company no longer found it profitable to import Chinese porcelain to Europe.

Although centralisation had reduced the number of kilns in China, I have found no evidence to suggest that there were fewer kilns competing in China than Europe where the industry was younger. Consequently, the decline cannot be attributed to a relative lack of local rivalry. Nor can state control take the blame, as many of the kilns in Europe were state owned. The investment in rigid specialised routines and centralised control would seem to be the cause, thereby supporting the thesis. The fact that both market- and firm-

coordinated producers were entrapped provides some support for the importance of historical investment in routines, rules, and procedures.

Another explanation for the lack of technological advance in the Chinese economy might be the restrictive nature of its bureaucracy. The long-term investment strategy of businessmen was strongly shaped by their environment. And the Confucian government who gave merchants a low ranking in society, did not create a stable or optimistic environment for investment. When combined with the riots and uprisings which posed a constant threat to merchants assets, the long term strategy of successful merchants was to invest wealth either in the safety of land or, in education so that there family could obtain a higher social standing and perhaps enter the bureaucracy themselves. As Joseph Needham (1963:139) observes 'it was evidently impossible for the mercantile classes of Chinese culture to acquire anything like the positions of power and influence in the State which they attained in Europe'. Consequently, they did not invest in proto-industrial development as did the merchants of the west. However, Hao (1970:7) states that the theoretically low ranking of the merchant was misleading. When the government sold degrees to raise money, wealthy merchants could buy into the gentry and merchants through guilds experienced a rise in status and power over this period. The Ch'ing dynasty was a period in which markets were growing and businessmen became respected and influential citizens. In fact, it appears the state was actually reducing its role in the economy during the Ch'ing dynasty (1644-1911). Government revenue figures at the end of the eighteenth century show that the share of the economy in the hands of the government had actually decreased. The government's share of GNP in China was 5% of GNP, compared with 10% for the United Kingdom (Adshead: 1995:246).

Murphey (1970:13) suggests merchants benefited far more from contact with officials than they suffered from taxation or periodic special exactions. Officials showed an increasing appreciation of market forces and a symbiotic relationship developed between the two (Elvin 1972:292). The role of merchants in the economy and its source for revenue were of value to the state who increased their support. However, this still diverted merchant energies away from technology. Chinese merchants invested their energies and capital into building relationships with scholar officials. Strong relationships overcame the vagaries of Mandarin control and the possibility of legal bans on trading, and increased the chance of official favours. So, while political obstacles to economic growth during the Ch'ing dynasty may have been minimal, the incentives generated by the scholar officials continued to shape business behaviour within the established mode of development. Cultivating relationships was more profitable to merchants and hence a more worthy area of development than improving techniques of production.

Perhaps more telling than the size of the state was its changing role. While in the Song dynasty the government took a leading role in diffusing innovations, during the Ch'ing dynasty, 'the Chinese government ceased almost entirely to provide any kind of public services' (Mokyr 1990:234). This could

reflect that the most obvious techno-economic break-throughs under the Confucian paradigm had been achieved and, there was little left for the official-scholars to do but sit back and take their share of the distribution of wealth. The government began to resemble one of Olson's distributional coalitions, taking revenue but offering little in the way of infrastructure or services. The imperial system had become a sort of protection racket, a ritualised arrangement whereby the elite lived off the people (Jones et al 1993:29). A consequence of this was a vital part of the economy was no longer involved in 'search' and 'exploring' and contributing to the National System of Innovation.

The government retreated from economic activity, preferring to let the guilds carry out bureaucratic and legal functions of commerce (Jones 1990:18). The guilds were certainly closer to the activity and in a better position to control activity. With decentralisation, we would expect an increase in competitiveness; however, the guilds also administered rules and their jurisdiction over their members was absolute (Morse 1909:27). Through coercion and the practice known as 'cessation of all business' (ie: stop trading) they could impose their will on traders both inside and outside their membership. The resulting tyranny restricted freedom of enterprise and individual initiative. Guilds allowed industry to grow but not at the expense of another members' income. Their concern with market share and corporate welfare could define them as a distributive coalition. By restricting competition this group had evolved into a distributional coalition that restricted innovation.

However, Jones (1990) does not see guilds as the cause of limited growth, but as a symptom of the way Chinese society was organised. Guilds, personal relationships and other networks, through their rules and moral standards reduced costs between transacting parties. They increased efficiency within an existing mode of development. But new forms of techno-economic activity involved transactions between people outside of existing relationships and networks. By contrast, Europe had developed a legal system which made it safer for merchants to do business with strangers. However, the lack of independent law in China stopped the entrepreneur from safely going it alone. The rules and controls of guilds allowed an impressive degree of market expansion but, they impeded market deepening into new areas. Businessmen were entrapped within existing modes of economic development.

Elvin (1973:314) describes the Chinese economy of the Ch'ing dynasty as being caught in a 'high level equilibrium trap'. The high level of agricultural and water transport techniques, and the near complete resource use gave the economy a structure that was almost incapable of change through internally generated forces. Its farming and transport technologies were so good that 'no simple improvements could be made' (Ibid). Its transportation and commercial system had reached the limits of efficiency from which no further reduction in transaction costs could be achieved within the existing paradigm. As agricultural productivity per acre approached the limits of what was possible without new industrial-scientific inputs, the nation experienced a decline in per capita production. Farmers had less additional output to trade and this reduced

their demand for other products, reducing the opportunity for the market to reward innovation. At the same time, resources were becoming scarce making it more expensive to produce capital goods while labour, fuelled by population growth, was becoming cheaper. This provided no incentive to innovate with labour saving machines or improvements in the manner of the Europeans.

In summary, the decline of innovation was caused by a number of features: guild rules and restrictions, formalisation of education, specialisation in the market and larger organisations, merchants entrapped by a market based value system, and the retreat of mandarins from technological enhancers to distributional coalition. China was entrapped in what had been a successful economic system.

12.2 China's Failure to Imitate

We would expect an external threat to wake China up to the new reality and the need for reform. Certainly, the first realisation of any European supremacy came with the Opium War (1840-1842) in which bamboo canons and crossbows proved no match for modern British weaponry (Merson 1989:156). The result was a humiliation for the Chinese who were at last forced to acknowledge the supremacy of western technology. The European victory led to the signing of a number of treaties in which treaty-ports were opened where foreigners had unrestricted freedom of residence and trade. China could no longer deny the new reality and the need to imitate was now apparent. However, this opened up a new range of problems including the problems of identifying what aspects to adapt, and of overcoming vested interests and values, insufficient skills and infrastructure and, the problems of managing change itself.

The suggestion that foreigners were in some way superior involved not only a new way at looking at technology for the Chinese but, a need to un-learn many of the things that had been taken for granted in the past. They had to re-evaluate their view of the world and their position in it. In particular, the nation had to go through a process of accepting that it was in their best interests to imitate people that they thought were inferior. The new policy met with the inevitable resistance. Consistent with Schoenberger (1997), many of the problems came because the new requirements confronted old aesthetics. Much of the resistance to western models was on ideological grounds. For example, Wo-jen (quoted in Teng & Fairbank 1954:76) led the attack against changes in education 'if these brilliant and talented scholars... change from their regular course of study to follow the barbarians, then the correct spirit will not be developed, and accordingly the evil spirit will become stronger'. An educational programme placing students in US schools came to an end when the students failed to kow-tow in front of a Chinese official in Washington. Such attitudes undermined the certainty with which the new policy would receive on-going support.

Even though imitation was seen as necessary, another problem was deciding how far to go. Even among the proponents of change, there was not universal agreement about how much western science, technology and institutions should be adopted. For example, Li Hung-chang (1823-1901) who was 'probably the least

conservative high official of his day', thought Chinese political and social institutions were superior to those in the west (Teng and Fairbank 1954:86-7). Yet Li was a leader in the modernisation programme.

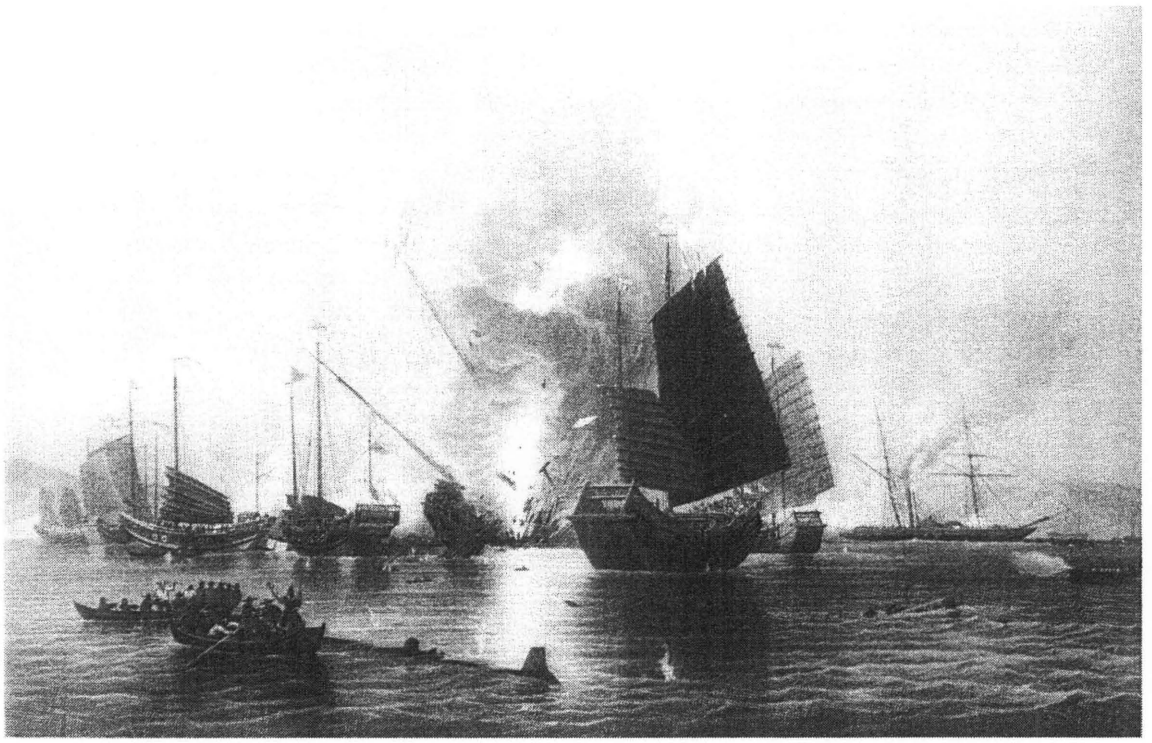
From the outset, shipping had revealed itself as a key industry. Attempts to adopt modern shipbuilding are described in Chen (1968). During the Opium War, British steamships had made a deadly impact. They travelled with ease and constantly terrorised the Chinese people who christened them 'The Demon Ships'. No-one was more aware of this fact than the officials in charge of the military operations. Lin Tse-Hsu, who served as Imperial Commissioner at Canton from 1839-41, took an early lead in promoting technology transfer. He wrote to the Emperor seeking funds to build western style ships and armaments so that China could 'learn the superior skills of her enemy and how to control her' (quoted in Chen 1968:30). However, consistent with the thesis, key decision makers had become isolated from the country's productive activities. The court had no idea of the significance of the new technologies and, with the Emperor hearing only distorted reports of Opium War defeats, Lin Tse-Hsu's memorandum came to nothing.

Without court support, Lin became the first official to persistently to adopt western means of maritime technology. From Canton, he actively sought information on western commerce, geography, and shipping and, is thought to be the author of *Hai Kua Tu' Chih* (Illustrated Record of the Maritime Nations). The motive in this early phase of imitation was defence, so Lin's focus was not on buying ships but creating capabilities for building stronger ships. By the 25th April 1840, they had achieved some success. The Chinese Repertory reported:

> Two or three schooners have just been launched on the river at Canton; they are built after the European models, and are, we suppose, to be attached to the imperial navy (quoted in Chen 1968:19).

After the battle of Amoy in 1841, the English found a ship-building yard containing a large amount of timber and a 300 ton ship in the process of construction along European lines. The English reported that the Chinese 'had evidently made a great step in advance in the art of shipbuilding-indeed, the longer the war lasted, the more the Chinese found themselves led on by the 'impulse of necessity' to attempt great changes...' (quoted in Chen 1968:32).

But these were sailing ships. Wooden ship technology was compatible with existing Chinese capabilities. Building iron steamships would require skills and investments that China did not possess. Experiments building steamships achieved little as they lacked the necessary industrial infrastructure. It is worth recalling that the growth of British steamship technology was associated with inter-connections with other technologies and environmental conditions. This technical inter-relatedness burdened the Cantonese effort, as Yen P'ao T'u Shuo reported 'Unfortunately the craftsmen at Canton possessing no machine to make machines, cannot build big ships' (quoted in Chen 1968:46).



HMS Nemesis in action against war junks. During the Opium Wars, these 'Demon Ships' opened the Chinese to the realization of superior Western technology and the fact that they no longer ruled the four seas(National Maritime Museum).

Near the end of the War, the importance of supporting the modernisation efforts at Canton was finally recognised by government policy. Over the next two years, the imperial court issued about thirty imperial edicts on ships and guns (Ibid:52). The edicts displayed a recognition of English superiority, and phrases such as 'it is necessary to change' and 'must not follow old methods' were repeatedly used. Provincial governments were given instructions to improve and purchase ships, and continue the work made by Lin's men at Canton. Unfortunately, the edicts received blanket opposition and, once again the opposing arguments were couched in very strong rationale, in particular environment barriers to adapting the technology (Ibid:58-9). The government of Chihli reported that their local waterways were too narrow and shallow for the new ships. Kiangsu noted that the ships were not suitable for their local conditions and added that with a shortage of strong wood and skilled shipwrights, they would not able to build ships hastily that were equal to the foreign ones and, even if they could, they would be useless because nobody knew how to operate them. These reasons given by provinces were all valid and eventually, the emperor had to give up the idea of introducing the new ships. For a year or so after the war, interest in modernisation at the court and provinces continued but eventually, with no war-time pressure to upgrade, became a low priority.

The pressure to modernise reappeared in the 1850s and 1860s with the Taiping rebellion and, once again, it was those in the forefront of battle who pioneered change. The scholar-official Tseng Kuo-Fan was made 'the captain of war' during the rebellion and developed a keen interest in the modern weaponry, in particular steamships. This time the court was quicker to appreciate the need for modernisation and gave instructions to proceed with plans for shipbuilding. However, with little experience, this was not going to be easy. The *Annals* describes the results from Tseng's first attempt to make rafts to carry guns:

> Unfortunately the rafts made were useless and no one has ever seen warships or is able to take the initiative. They look at one another and are at a loss. Nevertheless Tseng labours day and night asking advice from them all (quoted in Chen 1968:15).

Although strongly motivated to imitate Western technology, nothing of his life in China had prepared him for the task. Luckily, Tseng came upon two petty officials who know something about ships and presented him with plans for several types of ships. Tseng established shipyards at Hengchow and Hsiang-tan where experimentation proceeded but, as this note to the court reveals, they lacked the skills and capabilities to achieve their goals:

> several sample boats were built. None of them, on account of the lack of skill on part of the shipwrights, and the smallness of size, can surmount the waves of the Yangtse, nor can they stand the shock of the cannon (ibid).

Tseng wanted to build a steamship. We should recall that the British developed their steam-engine and steam-ship technology over a century of gradual development. In theory, a follower can catch up rapidly without enduring development costs however, early Chinese attempts to make a Steamship had all ended in failure because they had no opportunity to closely examine a steam vessel. Tseng Kuo-fan bought a ship which allowed his men the chances of further investigation. Unfortunately, Tseng had no way of knowing if he was buying a mechanically sound ship, so unfortunately bought a reject from the Western sellers (Ibid:38).

In 1861, Tseng moved his headquarters to Anking where his mechanics and engineers worked on all kinds of machines including a steam engine that was successfully demonstrated on July 30 1862. The engine was followed by the construction of a model steam ship after which, Tseng instructed Hsu Shou to build a full sized steam ship. With opposition from local officials and no foreign help, he attempted to build a small steam ship with existing Chinese tools and equipment. But, as Tseng's own words to the emperor reveal, 'Although a small steamer was built its speed was so slow that it showed we had not yet learnt the proper technique' (quoted in Chen 1968:40).

Before they could imitate, they had to learn how to imitate. They eventually realised that to overcome technical and capability problems, foreign machines and workers had to be used. This lesson was learnt by Tseng Kuo-fan and his technical experts who planned the establishment of a machine shop at Shanghai in 1864. They recruited Yung Wing (a graduate of Yale and the first Chinese returned student from America) to go abroad and buy foreign machinery (Ibid 42-5). A foreign machine shop in Hongkew Shanghai was rented and strengthened by the arrival of the new machinery. Unlike at Anking where the Chinese strove by themselves, the arsenal at Shanghai included 6 or 7 foreign mechanics (French and English) to help with the process of modernisation. The first steamship was completed in 1868 and named by Tseng *Tien Chih* (Calm and prosperous). Four more were completed before Tseng's death in 1872.

Tseng established a translation bureau (whose first 4 books translated were *Treatises on Steam Engines, Catechism on the Steam Engine, Practical Geometry,* and *Coal and Coal mining)* and inaugurated a scheme by which 30 Chinese students were sent abroad. At the now named Kiangnan Arsenal, he also established the country's first military engineering school where mechanics could learn western techniques with the assistance of foreigners. Importing foreign workers and machines still left many problems. Another early moderniser was Tso Tsung-T'ang who recognised the following problems in establishing a modern shipbuilding yard in the Chinese system:

> first, the difficulty of selecting a place for a shipyard; second, the difficulty of finding and buying steamship machinery; third, the difficulty in engaging head mechanics; fourth; the difficulty of raising and accumulating a huge amount of funds; fifth, the difficulty that the Chinese are unaccustomed to navigation and that after the

> completion of the ships we would still have to engage foreigners; sixth, the difficulties of the numerous requirements of expenditures for coal, salaries and wages after the ships have been completed, all of which would have to be paid every month, in addition to which from time to time the ships would have to be repaired. Seventh, in this unusual enterprise it is easy for slander and criticism to arise; one person initiates the plan, another carries it out, while a third is a mere bystander; and if the enterprise fails near its completion, then both public and private loss will result. With these several difficulties, it is no wonder that there is no man who cares to take the responsibility.... At the beginning they will worry about the lack of accomplishment; then they will criticise the expenditure as being too much, and will probably also say sarcastically that we have lost our national dignity (from Tso Wen-hsiang-kung tsou-kao quoted in Tang and Fairbank 1954:82-3).

Beyond resource constraints and the problems of acquiring capabilities are a host of other problems including the need to compete with the new technology while still in a process of learning. The British could benefit from their first mover advantages. The chances for failure are high and expose the modemiser to ridicule. It is not surprising that people erred on the conservative side. Finally, it reinforces the fact that no industry is an island. It requires a supporting infrastructure that trains staff and supplies the necessary supplies. A technology gap was opening between China and the Western nations. However, it should be noted that at the same time, US ship-building was also having a slow time adapting British technology, even though it had a modern iron industry and could easily recruit immigrants speaking the same language. It should also be noted that Britain had developed its expertise over a century and, although some of the development costs might be avoided by imitation, the task of catch up involved many complications.

12.3 Imitation - Steamship Companies

Steam-ship businesses were the first and for a long time, the only field in which Chinese could view an example of modern Western entrepreneurship (Liu 1959:436). The commercial operation of steamships in China took off after 1860 when a number of foreign firms began to operate steamships under the commercial freedom given them by the treaties. The foreign companies operated in China as joint stock companies, and Chinese compradore merchants showed a willingness to invest in the companies (Compradores were Chinese who acted as go-between for foreign companies operating in China). For example, when the American firm Russell & Co set up the Shanghai Steam Navigation Co., one-third of the company's stock was sold to Chinese merchants. Similarly, when Jardine Matheson set up the China Coast Steam Navigation Company, it retained less than half of the stock, issuing the rest to Chinese and foreign merchants in the Treaty ports.

Recognising the importance of water transportation to the Chinese economy, the government established in 1872, the China Merchants' Steam Navigation Company to compete with foreign firms. However, attempts to introduce modern technology into an economy with incompatible values and institutions were fraught with difficulties. In theory, the company was a joint stock enterprise with shares issued to private

individuals. However, the company was founded by a top official, the famous Li Hung-chang, and operated within an agency of the government, 'the Bureau for Inviting Merchants to Operate Steamships'. Many of the old administrative routines and values were carried over.

Li Hung Chang's principal advisor for the project was Chu Ch'i-ang, a gentry merchant who personally owned junks and was a commissioner of the Chekiang Bureau of Sea Transport. He was previously in charge of the sea-transportation of government rice, a position for which he received commendation for his supervisory, negotiation and dispute resolution skills. His combination of maritime experience at the highest levels and respect by captains and helmsmen seemed to make him ideal for the new position. Unfortunately, all his knowledge of Chinese junks was to little avail when confronted with steam ships. The first ship he purchased was over-priced by some 60% (Hao 1970:139). His second purchase was only slightly better, and the first wharf he acquired was for a similarly inflated price. When dealing with foreign sea captains, he found himself in another position of incompetence. When he dismissed Captain James.W.Connor for recklessness and putting a 'squeeze on the crew', the subsequent legal activity suggested that Chu either did not know how to get good men or failed to handle them properly (Hao 1970:139).

In 1873, Chu was replaced by Tong King-sing who had previously been employed as a compradore by Jardine Matheson and Co. The British Company had given Tong an intimate knowledge of the steamship business. Consequently, Tong was probably the most experienced Chinaman in the field and personally owned steamships (Hao 1970:140). Tong brought to the company other Chinese compradores with experience in the treaty ports. He also employed American and English captains, engineers, and marine superintendents to run the ships. Foreigners were even employed as superintendents on the wharves and warehouses, this later group employed not so much for their expertise but, for lack of faith in the Chinese (Liu 1959:443). He also rallied the support of the Chinese merchant guilds to develop an effective system of attracting freight. Tong immediately brought success. One of the British company's observed that the expenses for the ship Nanzing had declined from 7,000 taels to 4,000. With loans from the government, the company's fleet grew from four ships (totalling 2,435 tons) in 1874, to 17 ships (11,706 tons) by 1876 (Ibid:440). In January 1877, the company purchased the entire fleet and shore properties of Russell & Co.'s Shanghai Steam Navigation Company, the company had become the largest steamship operator in China (with 33 ships totalling 23,967 tons).

Success opened up new problems and requirements of supporting industries and infrastructure. Subsequent investment in Hirschman(1958:100) style backward linkages was required to overcome shortages in imports needed for productive activity. The company needed a coal supply, so Tong was instrumental in establishing the Kaiping coal mine in 1878. To transport the coal, a railway was built from the mine (Tang

and Fairbank 1954:108). The availability of this new energy supply led to the establishment of a number of modern enterprises including cement, bricks and tiles (Hao 1970:144).

Even though the company was run by a manager experienced in Western methods, the Mandarins had created an administrative framework with which they were familiar. The Company was operated under the traditional 'government supervision and merchant operation' system under which, the security of the manager's position and the existence of the enterprise was tied to a particular group of bureaucrats (Liu 1959:437). This made it difficult for managers to take a long term view of their position in the company. Even the officials (including Li), were not always sure of the company's permanence, with the consequence that managers and officials were not able to link their personal future with that of the company and hence, took the opportunity to profit while they could. This short-term thinking accentuated the already bad 'tax farmer spirit' typical of Chinese government-business relations and even Li was not above putting personal gain ahead of state policy.

However, the company benefited from government financial assistance. These included large loans, tax concessions and, when the company was contracted to carry tribute rice, the government paid a rate at least twice that charged by foreign firms. But these advantages did not offset the negative consequences of official interference. The government aid only prompted the officials to meddle further in the affairs of the company. Two officials, who negotiated for government loans and rice carriage contracts, each received no less than Tls 20,000 every year as their share of the government payments for the rice transport (Liu 1959:444). They also recommended protégés for lucrative posts in the company (as did other supervising officials). Although foreign companies operating in China also had to deal with nepotism and corruption, they were free of this level of government interference. By the early 1880's, the Chinese company's offices and warehouses employed two or three times the number of men actually needed (Ibid:444). Cheng Kuan-ying, a manager in the company described the problem:

> The personnel recommended by the officials are neither scholars, nor farmers, nor artisans, nor merchants. They are men who have never had any sort of experience. Some of them want to be secretaries and receive a salary without doing any work. Others seek posts as pursers on board steamers, the actual work being done by assistants while they themselves sit and wait for their share of the spoils. Still others become assistant managers at the branches of the company. They frequently entertain the local authorities and wastefully incur expenses without contributing anything to the operation of the company. (Cheng, Sheng-shih wei-yen, quoted in Liu 1959:444)

Nevertheless, the Chinese company was able to provide reasonably efficient shipping services and made sizeable profits between 1877 and 1893. However, for a number of reasons, the profits were not used to expand the size of the enterprise. One was that the preoccupation of the managers with their immediate

personal gain. Tong and his colleagues paid themselves very high interests rates for money they lent the company and, at other times, Tong borrowed money to finance their private real estate investments. The managers' actions reflect an inability to take a long-range view of the company's future and their place in it; a consequence of the traditional short time scope of Chinese businesses, the tendency to milk and the uncertainty of the business environment (Hao 1970:150). Liu (1959:438) suggests that these same environmental factors also acted as a disincentive for Tong to invest time in improving his understanding of technical matters. As a consequence, he did not study or adopt 'innovations essential to effective entrepreneurship'.

Another factor limiting reinvestment was the practice of paying shareholders a guaranteed minimum dividend of 10 per cent. In contrast, the foreign companies operating in China persuaded their share-holders that it was sound business practice to reinvest a good portion of their profits. This reduced the need to raise loans, in turn reducing their debt repayments. In this manner, the foreign fleets enjoyed long-term growth, lacking in the Chinese company.

The Chinese industry may have fared better if other private companies were started and, in 1877 and 1882, two attempts were made to establish private steamship companies. However on both occasions the official patrons of the government-sponsored company opposed any new competition (Liu 1959:453). The companies did not eventuate. Although all saw the need for a domestic steamship company, steamships were seen as too important a technology to be in private hands. The institutions, relationships and business practices inherited from the past stunted the growth of the industry. It is notable that in the treaty ports where compradors were free from Mandarin control, Chinese shipping companies were established by compradores who had gained the necessary management capabilities from their experiences working for foreign companies (Hao 197098-99, 120-124). For example, the Ningpo Steam Navigation Company was established and registered as an American firm in 1877. Many companies were created in partnership with foreign merchants. For example, the Greaves and Co (Hung-an kung-ssu) was established by Chinese and British merchants with 70% owned by Chinese compradores who had worked for Jardine Matheson & Co, Butterfield & Swire, and China Merchants Steam Navigation Co. Such activities were reliant on foreign support which it seems they gained due to the mutual benefit to such companies; but one can only wonder what the Chinese could have achieved if completely unleashed.

12.4 Conclusion on Chinese Decline

When a firm or an industry faces decline we might expect the businessmen that comprise that industry to respond by innovating or imitating those that are succeeding them. We find such expectations in Downie's 'innovation mechanism' or in the National System of Innovation school's 'desperate search'. As Downie anticipated, not all innovation attempts will succeed and Chinese international merchants did not deliver such innovation. In table 12.1, we re-visit the sources of competitive strength and related heuristics that

initially delivered Chinese success and find that in many instances, China was entrapped by its past. This is more than a Schoenberger-type cultural crisis of the firm for it affected the whole economy. It is also not explained by a neutral environmental shift that selected one competitor over another for the environmental shift was in fact created by one of the competitors. Nor can it be seen as a technological leap (or punctuated equilibrium) suddenly entrapping a competitor in an old technological regime for, the competitive advantages of Britain did not rely purely on steam technology but on a number of strengths that grew cumulatively and allowed them to gradually catch up and pass their Chinese competitors. In the early days, Chinese shippers had no need to adopt superior aspects of European trade because, over all, these minor advantages were not enough to threaten their position in the China Sea. By the time, Chinese did wake up to the extent of their relative loss, the task of catch up was no longer a small issue, but a situation requiring systematic change on a broad front.

Chinese decline is consistent with the hypothesis in terms of its persistence of routines, values and stakeholders. It also sheds light on the importance of the environment and the fact that no industry is an island. It requires supporting industries to provide capital, machinery and demand. It needs educational facilities to provide skills, and financial capital for investment. To try to create an industry without these ingredients is laden with difficulty as China discovered. It took so long that, in the meantime, the West leapt even further ahead. The Chinese experience also illustrates the difficulty of imitating after a period of success. Success strengthens the entrenchment of values, methods of business and vested interests.

China did experience a socio-institutional crisis. The most blatant illustration of this was the Taiping rebellion. However, this was not a pure crisis of the Perez-type where an old techno-economic system is confronted by the new. Certainly, the old regime had been discredited with the Opium Wars and the leader of the rebellion had been educated in a Western, Protestant schooling. However, other factors were at work, in particular, demographic pressures. The population had grown from 143 million in 1741 to 430 million in 1840, yet land available for production had only increased 35% (Merson 1989:168). This created immense pressure that came to a head at the time of the rebellion.

Even if the Chinese steamship company had been a success, it is unlikely that China would have regained a dominant position in international shipping. The Chinese economy was failing to produce internationally competitive cargoes. The economy was in-ward looking. China's share of foreign trade never exceeded 1 1/2 per cent and, in dollar terms by the end of the 1920s was in the same league as Chile and New Zealand, and far behind Argentina, Australia, and the Federation of Malaya (Murphey 1970:45-6). In an age where British shipping could dominate cross trades, lack of international trade might not seem capable of stunting the development of China's ocean-going shipping, particularly with the development of communication devices such as cable. However, by now this thesis has made apparent that the availability of domestic cargoes and markets plays a strong part in developing a merchant marine. A domestically-based trade acts

as an incubator allowing a country to develop capabilities, economies of scale, institutions and infrastructure with which they can move on to the cross trades.

12.1 Entrapment of Chinese Shipping

Sources of Competitiveness	Paradigm Heuristics	Sources of Entrapment
Shipping Industry - Organisation, experience and expertise in East Asian trade and waters	- Restrict sailing activities to East Asia and meet Indian Ocean Traders at middle points like Malacca. - Manage sailing activities in line with the Trade Winds	- Static economies gained at expense of dynamic efficiencies. - satisficing and bounded rationality
- Ship Technology (Junks)	- Use high quality locally built ships	- Embodied Technology (but given long time frame, could have bought new technology when old capital needed replacement. - Costs of Change (difficulty of retraining and acquiring tacit knowledge and new capital)
- Reputation	- Chinese provide best service for transporting goods in East Asian waters.	- Arrogance/parochialism
Supporting Areas of Economy - Technology/Education (knowledge resources)	- Aspire to provide Confucian education for family. - China and the Chinese are at the centre of the universe	- Reproductive education - philospophical retreat from practical - Little development of geographic knowledge
- Internal Peace and Government Infrastructure (and support at times)	- Build relationships with officials. - Milking and nepotism are consistent with Confucian values. - Government supervision/ merchant operation is an effective practice for many industries.	- Mandarins entrenched as distributional coalitions. - Mandarins become more distanced from productive activtities - Persistence of routines (milking, nepotism and method of organisation).
- Market of high quality specialised produces of supporting industries/ - High quantity of domestic demand and sophisticated consumers.	- attempt to acquire market power - attempt to anticipate consumer preference and meet through purchases.	- Guild rules reduce innovation. - Guilds arise as distributional coalitions - Decentralised market restricts innovation
Productivity of Agriculture	- Peasants and agriculture are accorded high value (over merchants)	
		Other Sources - Uncertainty over change process - Rise of Conflict (eg:Taiping Rebellion)

While compradores in the treaty ports showed interest in the new techniques they had been introduced to, traditional Chinese merchants showed a strong reluctance to enter new fields (Hao 1970:4). Even when they became aware of superior western technologies, few traditional merchants invested in industrialisation (Hao 1970:147). It would take a brave man to risk large sums of money and time on production techniques he knew little about, so the attitude of the Chinese merchant was 'stick to what you know'. There was some good economic reasoning behind the conservatism (Murphey 1970:53). Western-style industrial projects took a long time to generate a return that matched traditional commodity trading and money lending. Chinese businessmen were driven by market forces and a system of rationality that told them to stick to their existing path of development.

Change was also limited by uncertainty; uncertainty over what was required and whether support from the imperial court would be continued. The balance of power between the proponents and opponents of change was determined by the circumstances at the time. War increased the pressure to modernise. With the peace of the 1870s and 1880s, the pressure for reform cooled in favour of the conservatives, who preferred to use government funding for their own use. A policy of self-strengthening of the state was replaced by self-profiting by individuals. The Empress Dowager providing the worst example when millions of taels of silver raised to build a navy were redirected into the rebuilding of her Summer Palace (Tang and Fairbank 1954:90).

It would take action either from outside or from the top to shake China off its path of development. Change from the outside did occur in the form of foreign investment but the levels were simply too small to have a major impact. Change from above was attempted but was hand-tied in a number of ways. Mandarins were limited by their own value system and skill base. The policy was placed in the hands of scholar officials therefore, any policies or solutions would be interpreted within their pre-existing outlook and would need to fit within the Confucian framework, principles and patterns of administration. This system tied the new enterprises to a bureaucracy that did not fully understand the motives of a businessman or the importance of costs, prices and the market. It also saddled the enterprises with traditional Chinese bureaucratic behaviour including nepotism and the fleecing of funds by officials. The young enterprises had a mill-stone around their neck.

12.5 Imitation in Japan

Not long after the Opium Wars opened China to the realisation that it needed to imitate the West, an external threat bought Japan to the same realisation, namely, the black ships of the US Navy under command of Commodore Perry which, in 1854, forced the nation to drop their policy of seclusion and allow the Americans to trade (Allen 1981:23). Four years later, the British, French and other nations also gained permission to trade after the might of western naval prowess had been illustrated.

At this time, Japan would appear to have even less chance than China of imitating the West. Japan seemed like a land from the Middle Ages with sword wielding knights, subservient peasants, tradition-bound merchant guilds and hearty feudal lords (Whestney 1987:1). This backwardness was reflected in its international commerce. In 1854, the nation did not possess a single ocean going ship (Miwa 1985:123). Yet within sixty five years, it had built the third biggest maritime fleet in the world and, in another fifty it had the biggest. To account for the success that Japan had we need first to examine key aspects of the economic environment.

Japanese society was embedded with institutions that strongly resembled those of China. Samurai had come to play a similar role as Mandarins. Samurai had been Japan's warrior class. However, during Japan's long period of peace, they could not perform their traditional function as warriors and, the lords kept them on as retainers, paying them an annual allowance of rice. Forbidden by their class to become involved in industry and commerce, they became a ruling intelligentsia, performing a similar role in society as the Mandarins in China. In so doing, the writing brush came to replace the sword as the real instrument of power (Burks 1985:22).

Like their counterparts in China, the ideas and ethical norms of this intellectual classed were shaped by Confucianist philosophy. From the ruling class, Confucian values permeated through Japanese society which came to reflect that in China with four classes: samurai, peasants, artisans and merchants, in this order of ranking (Amioka 1985:324, Hirschmeier and Yui 1981:11-13).

Another institutional rigidity was the emphasis on loyalty and obedience to superiors. Japanese followed orders from above and had become accustomed to established patterns of conduct. This hierarchical obedience was reinforced by powerful peer pressure. All individuals belonged to some group to which they contributed and by which they were supported Hirschmeier and Yui 1981:47). These included bands of samurai, guilds, merchant houses and most commonly, the 'five family' groups responsible for rice deliveries. In a society striving for external peace and internal harmony a behavioural discrepancy by a member of a village or group could bring shame on the whole group. Consequently, the group forced individuals to comply with group interests. Enforcement was achieved in a number of ways but, the most powerful tool was fear of expulsion from the group. In a group-based society where 'saving face' and etiquette were very powerful forces, individuals found it preferable to suppress their own ideas. Decision-making came to be based on solidarity as opposed to majority. The individual counted for little and this could stifle individual initiative.

Despite these rigidities, Japan in the nineteenth century possessed some key differences from China. Firstly, the dominant Confucian paradigm had been imported into Japan. The Japanese had learnt it was

possible to import technologies and improve their quality of life. By contrast, China had few experiences of this type. For the Chinese foreign meant inferior and this would make a key difference in their attitude and confidence in the process of imitation.

Secondly, several internal factors were working to undermine the socio-economic structure of the Shogunate. They included an increased interest in the ancient history and literature of Japan by many scholars who wanted to cast off foreign Chinese and Buddhist influences. The publication of the *History of Great Japan* informed the literate classes of a time when emperors ruled Japan, not the Shogun (Allen 1981:24, Fukasaku 1992:17). Scholars espoused nationalistic virtues including a return to beliefs associated with the Shinto religion and the divinity of the Emperor. This 'Kogugaku' (national scholarship) was particularly popular among the western clans who had been subdued by the Tokugawa during the civil war.

At the opposite extreme to the nationalists, but sharing a strong intellectual current against the incumbent regime, was the school of 'Dutch Studies' (Rungaju) (Fukasaku 1992:17). Western books (with the exception of those dealing with Christianity) had been allowed into the country from 1720 (Masao 1985:371). The channel for this western knowledge was through the Dutch merchants based at Nagasaki. By the end of the eighteenth century, Dutch Studies had been added to the curriculum in most of the domain schools and provided alternative models to the existing regime. It also provided an awareness of the superiority of western technology.

Economic factors were also worked to undermine stake-holder content with the current regime. In Edo, competition among the sojourning lords led to competitions in expenditure as they vied with each other in displays of prestige (Allen 1981:26). This put pressure on them to raise their incomes, and by the second half of the eighteenth century, many were feeling financial strain. Some responded by creating industrial and trading enterprises in their hans (domains). Others resorted to raising loans and becoming indebted to merchants. At the same time as Lords were increasing their expenditure, a series of natural disasters undermined agricultural output. These two factors meant that Lords had less money to pay their samurai who had to shoulder a cut in income. Many impoverished samurai were forced to pawn their swords, armour or insignia of rank, or alternatively, take up occupations below their status. When a series of crop failures hit the peasants, these impoverished and dissatisfied Samurai were instrumental in leading peasants in revolt. This situation stood in stark contrast to that in China which was still providing a prosperous standard of living with far less call for change. In reference to China between the 1830s and 1850s, Robert Fortune stated 'that in no country in the world is there less real misery and want than in China' (quoted in Murphey 1974:30). Clearly, there was a big difference in the level of entrenchment of the existing regime and as Gersick (1991) notes the depth of a structure determines the extent of resistance to gradual change.

An important difference between China and the Japan is a subtle difference between the key stakeholders; Mandarins and Samurai, and their related education. While Chinese concentrated on belles lettres, Samurai had a more practical approach to learning (Yoshio 1985:72). Samurai never forgot their role as warriors and still learnt martial arts and still saw their role as protectors of the nation (Amioka 1985:328). There was a common realisation that industrial power was the basis of western military strength. To that extent, change was more consistent with the values of entrenched stakeholders and therefore less likely to engage resistance. The raison d'etre of Samurai was to protect the nation while Mandarins sought social harmony.

Impoverished Samurai were very aware that the nation's defenses had been run down as they experienced the humiliation handed out by Commodore Perry and the US Far Eastern Squadron. Consequently, after Perry's visit, the government of the Shogun and some of the domains all seized opportunities to grasp Western technology. For example, the domain of Fukui began building small guns, batteries and gun-powder after the western model and, in 1857, built a two-masted schooner after Dutch and American models (Madoka 1985:57).

At the national level, the Shogun also realised the need for greater openness and a commitment to catch up with the West. He now sought the advice of Lords he had previously strived to keep in a state of weakness (Yoshio 1985:74). He bought weapons from the Dutch and lifted the ban on the construction of ships. Samurai advised the Shogun to establish an institute for Western Studies (which later became the nucleus of Tokyo Imperial University). The British established an English school at Nagasaki in 1858 and the French were encouraged to establish the Yokosuka naval complex in 1865 and a French Language school at Nagasaki (Madoka (1985:64). The government sponsored diplomatic missions to the United States in 1860, Europe in 1862 and France between 1864-7 (Burks 1985:160). Although their purpose was principally foreign relations the visits also served as investigations of institutions and culture.

Students were sent to Holland in 1862, Russia from 1865 and the United Kingdom from 1866 to study navigation, naval affairs, and foreign relations. Between 1862-67, 92 students were sent overseas by the national and domain governments (Burks 1985:154). After international travel was liberalised, many samurai went overseas to study as private individuals, particularly to America. Between 1868-1902, 11,248 Japanese went overseas to study (Burks 1985:152). It is worth noting that the Chinese also sent students overseas starting in 1846. Between 1872-7, 120 Chinese were sent to America and others went to Europe (Minoru 1985:181). However, when the Japanese returned they were incorporated into an economic system that could incorporate their skills. By contrast, returning Chinese found there was little connection between overseas study and the internal structure. For example, 'Western Studies' had become part of the Japanese curriculum but not in China and, there was little connection with the political structure. Consequently, 'the pipe line for the introduction of western knowledge and technical skill was extremely thin' (Minoru 1985:181-2). China was exhibiting a lock-in similar to that recognised by David in 1985, only in this case

we are dealing with intellectual values not typewriters. It also reflects the difficulty of imposing autonomous change when systematic change is required.

Imitation involved changes for values and stakeholders in the old regime and the policy of modernisation resulted in economic and social dislocation for many groups. The export of silk hurt the silk weaving trade as prices for their raw material rose. Cheap imports led to the decay of old Japanese trades and many went into hardship. Merchants enjoyed a rise in status, but this incurred the jealousy of the samurai who felt a loss of social and economic position. The new pattern of resource distribution strain caused by the was undermining the old social order and the legitimacy of the Shogun (Allen 1981:29).

These difficulties contributed to revolution of 1868, when the Shogunate was overthrown in a revolution lead by by lower Samurai from the clans of the West. The emperor was taken from Kyoto and made the figure head of the new regime. Together with the creation of popular slogans, the Emperor was used to gain co-operation from the peasants. This symbolised a return to traditional Japanese virtues at a time when the nation was having to come to terms with dramatic change and westernisation.

In many ways, the Meiji restoration reflects a socio-institutional crisis identified by Perez when a new techno-economic system confronts the old. It should be stressed that the Shogun was not overthrown because it was conservative showing die-hard resistance to change (Yoshio 1985:79). In fact, the new government was initially more nationalistic than its predecessors. For example, it ordered all students sent abroad by the Shogunate to return home and wanted to expel all foreigners working in Japan. However, the government soon realised that these activities played an important part in gaining access to technology that would strengthen the nation. They expanded the overseas study programme, but their overall modernisation programme was far more nationalistic in nature (Jones 1985:224).

The Japanese government functioned as an 'organisation-creating organisation' (Stinchcombe quoted in Whestney 1987:16) in that it mobilised resources and used them to create new organisations. The whole feudal system was dismantled. The hans lost their independent administrations and were replaced by a system of prefectures around a stronger centralised government. Centralisation was made easier with the introduction of three key Western technologies. Railways, telegraph and postal systems improved communication and transportation making it easier to co-ordinate control for a central government (Whestney 1987:10). Western organisational models were examined in order to find the most suitable for Japan. The navy was modelled on the British navy. The communications system was based on the British; the Police on the French; the banking system on the American; and the legal system was based first on the French and then the German (Whestney 1987:5). Models were chosen on the basis of their previous success, the best fit for Japan, and those nations it had the most contacts with.

The government created two key government departments to promote the industrialisation process. These were Kobusho (Ministry of Engineering and Public Works) established in 1870 and, Naimusho (Ministry of Internal Affairs) which oversaw agriculture and textiles. Kobusho (sometimes referred to as the Ministry of Industry) was given the responsibility of building pilot enterprises, and promoting industrial enterprise by the private sector (Fukasaku 1992:25). The emphasis of the Ministry of Industry was on heavy industry: mining, shipbuilding, railways, machinery, construction and armament, the over-riding goal being national defense and the establishment of a communications system. Many of the Samurai who made up the new bureaucracy had gained some experience of administration and western technology during their time administering their domain governments. Many had personal experience of industry and almost all had at least some exposure to Western studies.

The government also realised the need to use foreign workers. It realised that instead of wasting time with local experiments it could pay high salaries to foreign technicians to teach the Japanese foreign technologies. Over 500 foreigners were employed by the Ministry of Industry in its initial years passing on their skills through on the job training and formal training in enterprise schools (Fukasaku 1992: 20). However, in areas where foreigners were used for their expertise, Japanese were to eventually learn their skills and assume full operation.

The financial difficulties in imitation were many faceted and compounded by the fact that foreign loans in Japan were seen as shameful. First, was the problem of acquiring foreign exchange to pay for much needed imports of machinery and raw material. In this area, Japan had luck just when it needed it most. In the early years after the Meiji restoration, silk crops in Italy and France failed, leading to a high demand for Japanese exports (Allen 1981:40). Silk became the principal export for Japan (ahead of tea, rice and the less important, craft-work such as pottery, fans, Japanese-style paper, lacquer and bronze ware). The second financial problem was accumulating capital and channeling it into industrial enterprises, a problem augmented by the Meiji government's nationalistic character that would not tolerate foreign investment. The initial intention of government was to rely on private enterprise, but the results were disappointing. Outside of government, four groups existed who had the potential to supply capital for industrialisation projects; the traditional merchant houses, the former feudal classes (higher class samurai and nobles); the landlords, and the new rich who were prospering from the newly created export opportunities. Like the traditional merchants in China, each of these groups were held back by their lack of experience and confidence in the new untried ventures. This reflects the importance of compatibility of capabilities in assessing leadership with new techniques.

The government attempted to induce investors into new areas of production however, the level of capital was too weak and technical and managerial difficulties too great (Fukasaku 1992:21). Market activity was clearly not going to creat the desired shift in techno-economic pathes. Given that market incentives would

not create the necessary systematic change, the government found it had to perform the role of entrepreneur. It invested in industry start-ups across the economy.

The scale of government investment in industry was not large and their achievements were modest. As in China, many suffered from bureaucratic inefficiency and inexperience with the result that many were managerial and financial failures achieving very limited technical success (Ibid:20-21). Despite these failings experience in modern industrial enterprise had been gained, something that would not have happened if left to the market. State enterprises became a model that the private sector could imitate. Government patronage also helped to overcome some of the initial technical difficulties and set up costs which private enterprises would not have been able to endure. However, these enterprises were at the start of their learning curves and their poor profitability placed a heavy financial burden on the government.

The government, who believed industry should be in the hands of the private sector, sold factories, mines and other enterprises in the 1880s. The purchasers included businesses started by ex-officials and old merchant houses. The enterprises were sold at low prices which reflected their poor performance but also served to give the new owners a good start in the industry. The prices were determined by officials who would work closely with their 'seisho' (merchants by the grace of political consideration) candidates. These close ties saw the seisho industrialists received blatant favouritism bordering on the scandalous yet, despite the favouritism, the new owners proved their worth as entrepreneurs (Hirschmeier and Yui 1981:96). Clearly this system was not too different from the government-supervision- merchant operation programme in China, however as lavish as these subsidies were, they were used for investment and milking did not appear on the same scale as in China. This probably reflects a continuation of routines and incentives in China, and also the greater confidence that Japanese entrepreneurs could have in the long term. The Japanese approached Westernisation on a broad scale and this must have helped individuals in Japan have greater confidence in the long term. By contrast, the Chinese approach was piecemeal. In Japan, the emporer changed into military uniforms in the style of Western monarchs (Hirschmeier and Yui 1981:76), something that would never happen in China. If businessmen in each nation needed confidence in the change process before they invested, the Japanese were clearly at an advantage.

Politically favoured companies in Japan gained quasi-monopoly positions in their local markets. However, Hirschmeier and Yui (1981:98) believe that a monopolistic stage was needed by Japan to build up the capabilities on its path to modernisation. Given the technological gap vis a vis the Western nations and the limited purchasing power in the Japanese market at the time, it was necessary to encourage a small number of large enterprises in order to survive. The treaties Japan had signed with the foreign powers did not allow it to protect infant industry with tariffs. As an alternative, government showed favouritism to these companies through lavish subsidies, privileges and strong government purchases became a necessary form of industry assistance.

The imitation process continued to confront the values and stakeholders of the old regime as old values were either discarded or remodelled to fit the needs of the time. However, some old values aided the process of imitation. The fact that the Restoration was performed in the name of Emperor (and thus in the name of ancestors) meant that loyalty to Japanese values strengthened this process. The nation's acceptance of obedience to above also made it receptive to instructions to modify. As Hirschmeier and Yui (1981:11) notes 'Among the most important assets which modern Japan owes to the Tokugawa period are basic attitudes like maintenance of communal discipline, dedication to hard work, desire for learning, respect for seniority and hierarchy, loyalty to communal groups, submission to authority and adherence to tradition'.

Changes in the education system received the inevitable resistance. Conservatives lamented what they saw as moral degradation and sought a return to moral education in schools. The Emperor Meiji himself, after a tour of schools in 1878, was so alarmed that he believed the process of westernisation had gone too far and commissioned *The Great Principles of Education* (1878) after which, there was an increase in Confucian morality in the curriculum. Many students who had studied overseas had difficulty establishing themselves in a society based on seniority. As a consequence, many returned not to the establishment but to teaching, research and education administration (Burks 1985:156).

The materialism associated with western technology and business methods stood in sharp contrast to traditional values and led to a call to combine Western technology with Eastern morality. Attitudes to business needed redefining and government promotion attempted to create an acceptable face for businessmen as the nations new Samurai. Entrepreneurs now did 'business for the nation and not for profit' (Hirschmeier and Yui 1981:126). Company officials rose in prestige and were treated as the new gentry.

Although Samurai were in the forefront of change, transformation on this scale rarely occurs on an even front and many Samurai suffered from dislocation during the process. The break up of the feudal domains deprived them of their positions and income, while the creation of a western style conscript deprived them of their status as the nations warriors. Yet, under the old values system and incentive structure, earning money from commerce and industry was below their class. A number of Samurai revolts broke out, most importantly the 1877 Satsuma Rebellion that was eventually crushed. The socio-institutional crisis was not buried with the Meiji restoration and the government had to placate these key stakeholders. From this time on, the government recognised the importance of absorbing the Samurai class in the new economy. To compensate for their loss of income, the government gave Samurai interest bearing bonds which many into some kind of business venture, with loans and guidance from the government. With little business experience some very bad results eventuated. However, Samurai made particularly valuable contributions in education and administration which were closer to their previous professions.

Although Samurai could present the biggest barrier to economic transformation, they had qualities that could be of use in the new regime, in particular, discipline, education and a belief in public service. The process of economic transformation required confidence, strength and optimism or, as Hirschmeier and Yui (1981:142) state, 'the early Meiji period favoured the strong men who could operate fast and efficiently brandishing their abacus like swords in battle'. These were the samurai. The change in values and introduction of new technologies allowed individual aspirations to be achieved. Educated low class Samurai, were aware they were entering an era of great possibilities where effort and ability would be rewarded. Educational achievement was encouraged by parents who saw the possibilities that could open for their children. However, individual success still paid homage to old values. While the graduate could now rise 'quickly', he still needed to display 'submission' to the group and the principle of human harmony (Hirschmeier and Yui 1981:122). Rules of Merchant Houses might change to reflect the times but obedience to the new rules and ancestral line were as important as ever.

Clearly, the economic transformation did not occur without difficulties. These included the conflicts of values and stake-holder associated with the old economic system. Mistakes were also made during modernisation. However, a greater systematic effort was made to absorb the new than in China, creating a more favourable environment to introduce a modern shipping industry. Fukasaku (1992:17) states that 1860 to 1887 represents a period of change with little economic growth. After an initial period of confusion and reconstruction, the economy entered on a period of expansion where per capita national expenditure grew at an average of 2% between 1889-1938 (Fukasaku 1992:22). Not only did this expansion provide modern capabilities but economic growth provided demand for imports, products for exports and capital for investment; all favourable conditions for growth of a shipping industry.

12.6 Imitation in Japanese Shipping

In the 1850s, Japan's maritime technology was in a pitiful state. In 1636, the Shogun had banned Japanese from going abroad and international trade was forbidden with the exception of Chinese, Korean and Dutch merchants who were restricted to the area around Nagasaki. While international shipping was banned, the Tokugawa government actively encouraged domestic shipping. Public works were built to help develop coastal routes which were used on an unprecedented scale (Yui 1985:x). Shipping was particularly active on the ocean route between Edo and Osaka which was initially developed to provide sake (Japanese wine) to the capital. However, there was a huge difference between the shipping requirements of this domestic coastal trade and that required for international navigation.

From the 1850s, the shipping industry became an early focus of attention. After all, it was the superiority of Commodore Perry's 'black ships' that had so badly humiliated the nation. The ships came to symbolise the power of the new scientific age (Masao 1985:370). Japanese officials reacted immediately by endeavouring to build western-style vessels. The Mito han was ordered to start construction of a Western-style ship with

the result that the Ishikawashima shipyard was started in 1853. The following comment from the man who drew up the plans exposes the nation's lack of experience and the significance of tacit knowledge:

> On order of the government I translated a book on shipbuilding, and theoretically I know how to construct a ship, but of course I have never before built one nor even sailed in one (quoted in Hirschmeier and Yui 1981: 107).

The Japanese were clearly experiencing the same difficulties that the Chinese experienced in trying to imitate a technology from a point of complete ignorance. The task was made worse in that the book that the Japanese builder translated and on which he based his plans did not describe a modern ship. When the builders completed their first western boat, the Asahi Marua, they found they had constructed a seventeenth-century East India ship, which is what the book had described. Nationalistic hans such as Satsuma also embarked on shipbuilding programmes but, they too were stifled when they realised the sailing ships they were building were out of date. Realising the technical difficulties in building steamers, the han eventually put an end to its shipbuilding programme.

An opportunity for more direct learning about Western ship construction was provided in 1854, when a visiting Russian frigate was shipwrecked and the Japanese were asked to build a replacement (Fukasaku 1992:28). The offer was eagerly accepted and officials, carpenters and blacksmiths were sent to assist and learn modern shipbuilding technology. The Bakufu were eventually to build ten other ships of the type built for the Russians. Experience with the Russians introduced the Japanese to the benefits of direct learning from foreigners as a method of gaining foreign shipping technology and, a naval school was established at Nagasaki using Dutch instructors. A shipyard was attached to the school and in 1857, a small steamer was successfully built under Dutch supervision. This growth of knowledge was augmented in 1862, when the bakufu sent naval officials who had studied at the Nagasaki Naval School and other workers to Europe for the purpose of studying shipbuilding technology. These experiences were significant in finding methods in which foreign technology could be imported and assimilated (Ibid). The Shogunate also imported ships from the west (including 59 Steamships and 12 Sailing ships from the UK, 11 steamships and 15 sailing vessels from the US). The need to repair and maintain these ships increased the need for shipyards and in 1864 the Yokosuka shipyard was established. In all cases, the prime motive in early imitation of western shipbuilding technology was defense.

When the Meiji government came to power in 1868, it regarded maritime industries as key components in the policy of industrialisation. The government considered shipping a pivotal industry for the advancement of foreign trade, balance of payments and defense. Cautious of the dangers of foreign exploitation, the authorities were also well aware that loss of control over domestic waterways had spelt disaster for other Asian nations (Chida and Davies 1990:5). But the years of isolation meant the nation was exceptionally

weak in these industries. At least China had experience navigating and sailing in the China Sea. Concern for the industry was heightened by the huge technical gap that existed between it and the West. For more than two centuries, Japan had no ocean going shipping industry, so had to build up the capabilities for ocean going shipping almost from scratch.

The initial focus of maritime policy was to create a modern shipping business organisation as quickly as possible (Miwa 1985:124). However, an 1869 decree allowing Japanese to possess western ships produced only one noticeable undertaking (Fukasaku 1992:21). The skills and infrastructure required were very different from that possessed by its traditional coastal shipping based on tiny wooden wasen. It required managerial skills, educational arrangements, physical facilities and a market that just did not yet exist. The tiny group of entrepreneurs interested in ship-operating were not capable of introducing such large scale systematic and institutional changes so, it was left to the government to effect a change that the market could not generate.

As in China, the government established the first domestic steamship company. In 1870, the Kaiso Kaisha was established to operate coastal routes around Japan. The company used government-owned vessels under the supervision of state officials. The Company was reorganised in 1872 and made semi-public, under the new name of the Nippon Postal Steamship Company, it attempted to provide a liner service between Osaka and Tokyo. Although it had been given very lucrative shipments of tax rice and other government privileges, the company suffered through bureaucratic inefficiency. 'Its vessels were uneconomical, its seamen and engineers were unskilled and its management was poor'(Chida & Davies 1990:6). The company did not prove viable and was dissolved in 1875. This early Japanese experience was very similar to that in China.

The Government recognised if it was build the industry's capabilities, it would have to change its policy. It decided to let private enterprise own and operate the businesses but provide protection and support in an attempt at building up a fleet that could compete with the world's best. Government transferred its ships to the only company in Japan capable of running a fleet of this size, Mitsubishi Shokai (Yui 1985:xiv, Miwa 1985:125-6). Property rights were now transferred to entrepreneurs. Nevertheless, the government remained a major force in assisting catch up by providing very high levels of resources and guidance.

Mitsubishi was started by Iwasaki Yataro (1834-84), a lower grade samurai of the Tosa han (Chida and Davies 1990:6). The Tosa han had been in the forefront of modernisation before the Meiji restoration. While working in the han, Iwasaki had been given responsibility for armament procurement (including ships) in the han's Nagaski and Osaka offices. In 1870, he used the han's ships to enter the coastal trades. The following year, the hans were abolished and the han enterprises were transformed into an independent company. Iwasaki became its manager. He eventually took over the company, bringing to it a samurai

mentality 'In the whole of the Japanese Empire there shall be no other enterprise surpassing us in managerial ability' (quoted in Hirschmeier and Yui 1981:139).

In these early days, the young Mitsubishi Shokai was only involved in coastal shipping. All Japan's foreign trade lay in the hands of foreign ships. However, with government help it quickly expanded. Government demand initially pulled the company onto the ocean highways in 1874, when the Japanese embarked on a military expedition across the seas in Formosa (Chida and Davies 1990:6). The government bought thirteen steamships from abroad and Mitsubishi was given the task of managing them. The military campaign was a success and, on its conclusion, Mitsubishi was allowed to retain the ships in return for a nominal fee. However, as part of the deal, the Government instructed Mitsubishi to use these vessels between Yokohama and Shanghai, thus began Japan's first ocean-going liner service. It brought Mitsubishi into conflict with foreign liners, in particular the American Pacific Mail Steamship Company. Mitsubishi won this struggle when, with the aid of the state, it was able to purchase its rival's ships and shore facilities. In this way, Japan built up its experience and expertise of operating ocean-going liners. This Yokohama-Shanghai line was the first of a number of government subsidised 'ordered routes'. The government's policy of ordered routes gave Mitsubishi experience on ocean liner operations but with the protection of government subsidies.

Importing foreign skills was a key part of technology transfer. Most of the senior staff, including engineers and navigators were obtained from overseas during this period (Ibid:19-20). In an effort to build up domestic expertise, the government gave additional payments for the training of seamen, and Mitsubishi established a seamen's training school. In 1882, the school was taken over by the state, forming the basis of the Tokyo University of Mercantile Marine. The government established a number of educational establishments during the 1880s to meet the needs of the growing industry. As a consequence of this training, Japanese seamen gradually took over the posts occupied by foreigners. By 1892, the first Japanese Captain was given charge of a ship and by 1897 all deck officers (including coastal vessels) were Japanese. It took longer to gain the necessary expertise in areas such as cargo handling, passenger reception, insurance claims and global navigation and, the last foreign captain did not leave until 1920.

The close relationship between Mitsubishi and the government continued during the Satsuma Rebellion, when it was contracted to carry troops and war supplies (Ibid:8). When peace came, this high level support was cultivated, allowing Mitsubishi to diversify its commercial operations into other aspects of foreign trade including banking, warehousing, mining, shipbuilding, trading and railways. This growth had occurred with the support of the government politician, Okuma Shigenobu. However, political intrigue led to Okuma being ousted and his opponents next turned on Mitsubishi (Miwa 1985:126). The company was ordered to refrain in any other side business and concentrate only on shipping. It was a judgement based not on economic rationality but pure political interest. Not all government intervention was welcome.

The government had actively supported Mitsubishi in an attempt to create a company strong and competitive enough to take on the foreign companies. In the process, the company had built substantial market power in the local coastal trades, much to the dissatisfaction of small ship owners and the general public. The government responded to the complaints by providing half the capital for the creation of a new company, the Kyodo Unyu Kaisha (based on a combination of existing smaller firms). The new company provided direct competition on all Mitsubishi's domestic routes (Chida and Davies 1990:89). However, aggressive competition in a small market was destructive and both suffered serious losses. Both companies drastically reduced their freight rates in a destructive competitive bout (Nakagawa 1985:4). Eventually, the government ordered the companies to amalgamate forming a new joint stock company in 1885, Nippon Yusen Kaisha (NYK). This was now the only state-aided shipping firm to which the government guaranteed an 8% dividend. The company's management was strictly supervised by the Ministry of Communication who instructed the company to provide fourteen specified services, mainly around Japan but, included short international routes to China, Korea and Asiatic Russia.

NYK's first attempt to open a long distance ocean service was the Japan-Bombay line. Opened in 1893, NYK sought to carry raw cotton at rates cheaper than those provided by the existing shipping conferences led by P&O. The entrance of a new competitor was not welcomed by the conference and two years of cut-throat competition ensued. However, NYK had the support of the Japan Cotton Spinners Association, the people who bought their chief cargo. NYK survived the competition and was admitted into the conference in 1896, hence establishing Japan's first ocean liner service. Trade between India and Japan soared, growing four-fold in the ten years prior to 1902 (Nakagawa 1985:4). NYK grew hand in hand with this trade, and eventually expanded into other distant routes including Europe, North American (Seattle) and Australia.

The action of the cotton industries serves as a reminder of the importance of the supporting industries and underlying economy in industrial development. The growth of the Japanese economy and increasing demand for transport services would eventually lead to the creation of other companies. In the Kansai District (Western part of Japan) many small companies were engaged on coastal routes using second hand steamships. Their numbers increased significantly during the Satsuma Rebellion, creating excessive competition once the rebellion was over (Chida and Davies 1990:9). To remedy the situation, the government recommended amalgamation and, in 1882, fifty-five small firms agreed to join together to form a new joint stock company. Initially, the Osaka Shosen Kaisha (OSK) as it was to be called, with its small-scale wooden steamships was no match for NYK and only operated in the coastal trades. However, with government assistance the company eventually acquired a number of steel steamships, and in 1890 it commenced its first ocean going service to Korea.

These companies were strongly dependent on the government. For example, the gross profit of NYK in the financial year ending September 1983 was only about 930,000 yen. The government subsidies it received amounted to 900,000 yen, or 97% of its profit (Miwa 1985:132). Government demand during war was another key support, the Sino-Japanese war helping the companies out in the mid 1890's. Despite these advances, at the out break of the Sino-Japanese War, domestic shipping still accounted for only 10 per cent of the nation's ocean-going services (Chida and Davies 1990:17). Nevertheless, the country now had two companies with experience and capabilities in ocean going steamships, something it had not possessed before.

OSK, and NYK became known as 'shashen' (company) shipping companies. They operated liners receiving state aid and protection. Tramp shipping eventually appeared as the domestic economy grew from the many small shippers that operated on Japan's coastal routes. In contrast to the government supported shasen companies, these 'shagaisen' (non-company) enterprises were unsubsidised. With no government support, Shagaisen had been reluctant to turn to steamships because of the high cost and running expenses, and they lacked the skills needed to operate steamships, and in the early days, Japan did not have sufficient demand for cargo at the freight rates required to sustain un-subsidised powered vessels (Chida and Davies 1990:10). However, in 1885, the Government prohibited the construction of large scale wasen. Over time, virtually all the large sailing ships were replaced by steamships. Shagaisen eventually expanded into international waters, crossing the short distance to Korea and China. In the years following the Sino-Japanese War (1894-5), they expanded so rapidly in number that they eventually surpassed shasen tonnage (Yui 1985:xvii).

Having created two major companies, the government continued to encourage an expansion of capabilities, and its attention turned to developing specific routes (Miwa 1985:130). From this point subsidies were awarded not for any particular company but for the route and mileage they covered. This led in 1896, to the introduction the Navigation Promotion Law and Shipbuilding Promotion Law. The first of these provided subsidies for ships over 1,000gt in proportion to the distances covered while, the Shipbuilding Promotion Law encouraged local construction by granting subsidies for ships built over 700 gt (Chida and Davies 1990:17). These laws offered a break from past policy in that the assistance was open to all companies, not just the chosen shasen (although initially, only those with strong financial backing benefited). The two laws were successful in raising the size and power of Japanese ships and the smaller companies were now competing more successfully in the tramp market. However, the same success was not being achieved in the long distance scheduled routes. To solve this problem, the Distant Sea Liner Subsidy Law was introduced granting subsidies to ships on these routes.

After the 1896 shipping legislation, a third major company was created by Asano Soichiro, a prominent businessman with experience as an operator on coastal routes (Yui 1985:xvii). His decision to enter ocean-

going shipping led to the establishment of a third shasen company, Toyo Kisen Kaisha (TKK). In 1898, the company began a service across the Pacific Ocean to San Francisco, the direct result of the new legislation (Miwa 1985:133).

Some shipping companies developed as a result of integration from other industries, the most prominent of which was Mitsui Bussan. Mitsui was an old merchant House founded by Hachirobe Takatoshi, a masterless Samurai, in the seventeenth century (Hirschmeier and Yui 1981:61). Takatoshi had become a key player in the Edo retail textile market, eventually building up a chain of shops and expanding into wholesale and banking. In 1872, Mitsui established a general trading company, later known as Mitsui Bussan. It traded items such as rice, coal, raw silk and tea among its Japanese branches and for export. One of its founders, Inoue Kaoru, went into cabinet forming a valuable contact in government and, during the Satsuma rebellion, Mitsui Bussan obtained healthy contacts providing army supplies. In 1876, the company took up an offer from the government to export coal from the government operated Miike mines. At this time, the British company Jardine Matheson had the largest share of the Shanghai coal market. However by 1880, Mitsui's shipment surpassed their leading competition (Tatsuki 1985:307-8). This introduction to foreign trade led to an expansion of its shipping operations and the opening of branch offices in Shanghai, Tientsin, Hong Kong and Singapore. By 1890, Mitsui Bussan had emerged as a substantial operator of merchant shipping using its own vessels and those of foreigners and other shagaisen owners (Chida and Davies 1990:11).

Mitsui is one of a number of large diversified 'General Trading Companies'. They are a unique organisational form given the extremely diverse range of activities in which they operated. The government encouraged these giants as foreign trade was new to the country and small Japanese manufacturers found linguistic, cultural and geographical barriers daunting. The GTC's had economies of scale and scope which allowed them to carry some risk, diversify their product range and spearhead the nation's exporting effort. Controlling both imports and exports meant their own ships and the ships they contracted could be carrying loads on both legs of the journey. Consequently, the dispersed range of their activities increased their viability. By 1900, Mitsui Bussan handled about one third of Japan's total foreign trade (Hirschmeier and Yui 1981:191).

If the GTC's did not have enough shipping capacity, they would operate the ships owned by other companies. Many men of fortune invested in ships, attracted to the profits the industry, even though they had no experience or interest in running a ship or collecting cargoes such as coal, lumber, rice and sugar. For this they relied on the General Trading Companies who would operate their ships on a charter basis. NYK, OSK and foreign merchants might also operate these ships. This arrangement favoured growth in the industry as many smaller shippers found the capital requirements of ocean-going shipping restrictive but, could enter the industry leaving others to manage their ships. Other advantages of separating the ownership

and operating function were (i) the division of risk. Owners concentrated on capital investment while operators sought to maximise chartering earnings (ii) the close relationship between the two strengthened operators' resistance to depression in that it could obtain flexible rates (iii) operators were not handicapped by capital restrictions and could eventually handle large fleets with very little capital invested (Chida and Davies 1990:41-3). Under this flexible arrangement, the amount of shagaisen shipping grew rapidly so that by the end of World War One, shagaisen tonnage was almost double that of the shasen ships.

The trading company Mitsui was particularly adept at identifying cargoes and available ships given its world wide trading network, and grew to be the largest charterer of shagaisen ships, operating ships totalling 1,280,000 dwt in 1916, far surpassing NYK's 460,000 gt and OSK's 400,000 (Nakagawa 1985:10). Many of Mitsui's ships were devoted to the same cargo behind Britain's success, coal. Coal mines run by Mitsui provided ships with a full outward cargo which allowed them to charge lower rates on the return leg and still earn a profit (Nakagawa 1985:8).

The shipping departments of trading companies such as Mitsui and Suzuki played a key role in developing the nation's maritime skills. They acted as 'incubators' for talented shipping operators who later became top managers of lines that included Kawasaki, Kokusai and Daido shipping (Nakagawa 1985:16), the latter acting as a 'pure operator' without owning one ship of its own.

Japanese expansion into the long distance liner trades took a leap after the Russo-Japanese war (1903-4) when the three shasen companies made a concerted effort to develop their liner services. NYK steamships began a service to Calcutta, which increased trade between India and Japan. It also began a monthly service to the United States and Australia. In 1905, OSK opened a service to Dairen and TKK began a South American service.

Despite the importance of government support in the growth of the industry, the policies required adjustment and were not without inefficiencies. For example, one problem with government legislation in the early 1900's was that it gave subsidies to ships travelling a route regardless of their load. It also only covered a small number of enterprises who were attaining some degree of monopolisation and excessive privileges (Miwa 1985:135). At the same time, the government was enduring significant financial burden. This lead to a policy change in 1909 in which tramp and near sea routes were no longer eligible for a subsidy. Subsidies no longer increased with the size of the ship and elements of the legislation that lead to over-lapping subsidies were also removed. The improved policy had the desired effect. The loading ratio (ie: how full the ships were) on ships climbed from only about 10% in 1890 to about 40% following enactment of the policy (Miwa 1985:136). This increase in loading was also a consequence of growth in supporting industries that provided cargoes to fill the hulls. The rate of industrialisation in Japan rapidly quickened with exports tripling in the late 1890's (Nakagawa 1985:6). Cargoes included exports of cotton

and yarn to Korea and China, silk and silk cloth to the United States, and coal throughout Asia. Imports included raw cotton, sugar and rice from India and America, and ironware, plastics and manufactured goods from Europe and the US. Textiles would become Japan's principal export growing from large cotton mills established in the 1880s with government loans. During the first thirty years of the twentieth century, the textile industry would account for over half of Japan's exports (Fukasaku 1992:23).

The companies also benefited from government investment in education. NYK and OSK were operated as joint stock companies using highly skilled salaried managers who had graduated from colleges and universities (Nakagawa 1985:320). These managers did not move from one company to another in response to movements in the labour market as in the United States but took a long term view of their company's position in line with Japanese trade and the world economy. However, seamen in companies other than these were employed on a single voyage basis (Wray 1985:317).

By 1912, NYK owned 280,000 tons of shipping, OSK had 130,000 tons and TKK more than 70,000 tons (Yui 1985:xviii). The industry had advanced with strong aid of the government which by 1913 provided a 14yen subsidy for each ton operated by the principal firms compared to the 3 or 4 yen that some German and British liners received (Nakagawa 1985:314). However, Nakagawa states 'it seems that the more economically backward a country was, the heavier the subsidy had to be at the start of its industrialisation'. Japan may have benefited from the advantages of backwardness compared to China in that it was less entrapped by a successful paradigm, but in comparison with the leading shipping nations, there were no such advantages. Europeans might accuse the Japanese of cheating with the extra help given by their government, but the Japanese could equally claim that the Westerners had a head start ie: possessed first mover advantages.

The Government led-imitation/industrialisation process had provided the shipping industry with supporting industries, knowledge resources, infrastructure and shipping enterprises that had gradually acquired the capabilities to compete in international trade. Japanese shipping was well positioned for the huge opportunity that the first world war was about to be presented to it.

Table 12.1 Growth in the Japanese Mercantile Marine

	Steamships (in thousand gross tons)	Sailing Ships (in thousand tons)
1873	26	8
1894	169	45
1904	797	327
1913	1,514	828

(source Allen 1981:95)

12.7 Conclusion The Japanese experience in the second half of the nineteenth century is consistent with the imitation stage of the industry life cycle as posited in this thesis. It is note-worthy that imitation occurred not just in shipping but, across the economy. As Table 12.1 shows, the Japanese industry had made great strides with substantial increase in tonnage from the 1850's when the nation did not possess one ocean-going ship. Unfortunately, the source for the table does not provide information on the size of the sailing ships so it might be dangerous to assume that they are all ocean-going sailing ships. If they were, we could probably assume that the sailing ships were used on routes not served by coal supplies. Unfortunately, little information is given on this point.

The successful growth of knowledge and productive capabilities in Japan stands in sharp contrast to the experience of China, which seemed to be in a better situation to make the transformation. Given that the two nations possessed similar education, value and social systems, and similar commercial and institutional environments, it poses the question 'why were their experiences so different?'

One of the key explanations is the level of openness to foreign technologies. China had little experience of imitating. For the Chinese, foreign had always meant inferior. This was no irrational bias. Two thousand years of history had taught them that this was fact. The Japanese had no such barriers to imitation. Even the dominant Confucian value system that they were replacing was an import from China.

A second important difference is the economic environment and recent history that set the pre-conditions for change. The leading stake-holder in the Japanese economy had endured substantial economic hardship and were more amenable to a change process. By contrast, Mandarins experienced no such dislocation.

A third important factor is the level of leadership of the change process. In Japan, the emperor set the example by wearing a Western-style military uniform, something no Chinese monarch would ever consider. In so doing, uncertainties and ambiguities that can hamper change processes were over-come by more definite leadership of the change program. With the Japanese government simultaneously opening a number of Western-style enterprises, this gave enterprises more confidence in making long term investments in the new technologies. The managers of the Chinese Merchant steamship Company saw no broad-spectrum advance. Theirs was a modern branch grafted onto an old tree. The Japanese gained a new tree. In this light, it is worth noting the difference between traditional Chinese merchants and those who had experience with Westerners in the Treaty ports. The differences in their acquired knowledge, routines and contacts played a great difference in their entrepreneurial activities with the new techniques. However, Japanese merchants, who had even less experience in international trade were given time and outlets by which they could gain the necessary knowledge with government assistance. In this light, entrepreneurship can be regarded not only as extension of past investments in knowledge and contacts but, it is also

something that government can nurture with support, access to knowledge and a requirements to continuously improve capabilities.

It is noticeable that in both countries, the government started the first sole steamship company after-which both companies were privately run with government support. It is significant that the Japanese managers did not seem to have milked their companies as the Chinese did. The Chinese continued with their old routines and heuristics of milking. By contrast, Samurai, who never forgot their job was to protect the nation, rallied to slogans such as "Rich country and strong army". Their values were more compatible with the requirements of the change process.

Despite Japan's success, the imitation process was not smooth. The Satsuma rebellion and the Meiji Restoration were major backlashes against the change process and one can only wonder what could have happened if the military action at the wrong time resulted in less progressive leadership.

All in all, the biggest difference between the two nations was the level of commitment to the old regime. China's 2000 year old paradigm with its accumulated institutions, stake-holders, routines, relationships an values were so entrenched that any significant process of adopting foreign technologies was going to be fraught with problems. This reflected Gersick's comment that a nation with the strongest commitment to the old regime would have most trouble changing. It was in this environment that the Chinese attempted to build a modern shipping industry, and failed.

Chapter 13

Towards the Twentieth Century

13.1 Evolution of the US Economic System

In the last half of the nineteenth century, the American economic system began to show a new face shaped by a large market and the opening of the continent's resources. By 1880, the American population was one and a half times that of Britain and by 1900, it was double. From 1870 to 1914, GDP grew five-fold compared to a doubling in the UK (Chandler 1990:52). In many ways, growth was a consequence of industrialisation which was a process of imitation of European technologies. Before the Civil War, the American economy was predominantly agricultural and commercial. By the end of the century, its commercial sector was bolstered by a strong industrial sector. In 1860, the four leading industries were cotton textiles, lumber, footwear and grain milling. By the turn of the century, the top four were machinery, lumber, printing and publishing, and iron and steel (Licht 1995:129).

The US economy had successfully imported technologies from Europe and adapted them to their own regional requirements. The transfer of industrial technology to the United States occurred in those places with a similar environmental conditions to that of their European production centres. Particularly important was access to raw materials. New industrial locations grew up at places such as Trenton, New Jersey where immigrants from Staffordshire found suitable clays to build a ceramics industry and, at Waterbury Connecticut, copper and zinc deposits provided a basis of industry which attracted skilled brass workers from Birmingham England (ibid:108). Albany, Troy and Buffalo became iron producing centres but, with 95% of the nation's anthracite coal being located just fifty miles north of Philadelphia, it was here the industry would make its name. In Pittsburg, iron mills employing 2-300 competed using the skills of iron craftsmen. Ohio developed a number of industries reflecting its broad resource base while at Chicago, at the end of the industrial belt, a great trading city developed fanned by water and rail links which redistributed agricultural products from the west and industrial products from the east.

Not all new industries were imitative. Americans also seized commercial opportunities made available by the latest developments in science. In the mid-80s, at Rochester, George Eastman perfected a small hand-held camera (the Kodak) which provided the basis for the world's largest manufacturer of photographic equipment. George Westinghouse invented an air brake for trains before founding Westinghouse Electric Company to manufacture electrical generators and appliances. At the same time, Thomas Edison who began as a telegraph operator, began experimenting with telegraph technology before moving on to invent the phonograph and build the nations first electrical power station in New York. His company Edison General Electric was responsible for commercially developing a number of new technologies (not necessarily invented by them). However, the leading business men and firms were rarely the pioneers in technology (Gilbert and Krooss 1972:147).

Industrialisation coincided with an increase in government activity in the economy. Until the Civil war (1861-5), the government had played only a minor role in advancement. From the moment the war started, the North introduced a new political-economic direction. In 1861, the Morrill Tariff gave protection to American industry while the Morrill Land Grant College Act of 1862 granted land for the building of colleges devoted to 'agriculture and the mechanical arts'. In 1863, the National Banking act created a national banking system and currency. Federal income tax was introduced while several bills were introduced which gave grants for rail expansion. A number of new federal bureaucracies were created including the Department of Agriculture, the Bureau of Printing and Engraving, the Office of the Comptroller of Customs, the Office of Immigration and, the National Academy of Sciences was created to boost technological development. Most importantly, the government, particularly the military, became an important consumer of industrial products. Industrialisation also benefited from a protective tariff policy which shielded American producers from foreign competition. Edward John Ray (1991:343) found that between 1870 to 1914 the most rapidly expanding industries in the United States were those protected by the 1870s tariff structure.

Imitation in the new environment led to a stage of advance consistent with the thesis which, in turn, opened up new commercial methodology and paradigms. At this time, new transportation systems provided by the railways were integrating the North American continent into a large integrated market, the size of which was not available to Britain. The result was a reshaping of the economic system. Such changes did not occur without pain for existing stake-holders. Schoenberger (1997:222-4) gives an example of John Burrows, a leading merchant in Davenport Iowa who underwent economic dislocation with the arrival of the railways. Burrows had built a successful business with investments in relationships with wholesalers and suppliers, warehousing and transportation facilities. The arrival of the Chicago and Rock Island Railroads in 1854 offered speedy regular services to Chicago, not St Louis where Burrows had established many contacts. Because small quantities could now be transported with ease, Burrow's large warehousing facilities, which had been an asset in the pre-rail days, became an expensive liability tying up his money. The change in temporal and spatial arrangements brought about by the train de-valued the resources, skills and relationships he had invested in. Burrows tried to adapt by diversification in flour mills, a saw-mill and a reaper factory but nothing worked. The new environment brought by the railroad required business methodologies too alien to Burrow's familiar way of doing business. Within five years of the railroads arrival he went bankrupt.

The opening of a national market meant firms no longer catered for small regional markets but now served a large mass market. A new economic paradigm appeared in line with the new economic environment. It favoured mass production, large integrated organisations and the gospel of scientific management which grew out of the system at the turn of the twentieth century. While the typical firm in 1860 had been family owned and operated, highly specialised and labour intensive, the new American economic system was increasingly characterised by large multi-functional corporations. Although the objective of integration may have been market power (Galambos 1994:246), the resulting corporations evolved other economic

advantages. They could invest in large production facilities that created massive economies of scale and dramatically reduced unit costs of production. By locating production processes within a single plant, vertical integration could provide a smoother flow of production. To ensure that sales kept up with the large scale of output, successful organisations also had to invest in a large marketing and distribution networks. Finally, they had to invest in management who would plan and co-ordinate these various production and distribution activities, (Chandler 1990:8). Managers created sales and organisational strategies for the new giants. They organised and administered accounting and production systems, company rules and regulations and reported back on results.

The new organisation form meant that not only could economies of scale be gained but also, economies of scope. Companies expanded the scope of their activities and diversified their activities into related products and services. Vertical integration also reduced transaction costs, a factor which became more important as products increased in technicality and sales staff needed to be more familiar with the product to gain a marketing edge. Chandler (1990:9) called this economic system 'managerial capitalism'. The new organisational form reflected the peculiarities of the American environment, in particular the large national market and resource base, shortages of skilled labour which lead to new technologies and high machine usage and, transportation and communication improvements such as the telegraph which allowed co-ordination over long distances.

As organisations became bigger, they needed a steady supply of skilled managers and education institutions started to provide courses in management. It became possible to get academic training in accounting and the first book on cost accounting was published in the 1880s (Gilbert and Krooss 1972:158). The Wharton School of Commerce and Finance, founded in 1881, at the University of Pennsylvania was the first university to offer courses in business. In the decade after 1899, commerce schools were set up at the Universities of Chicago, California, New York and Harvard. Engineering graduates also flowed from the universities. In the 1880s, the Massachusetts Institute of Technology, Purdue, Wisconsin and the Stevens Institute of Technology all established mechanical engineering departments (Chandler 1990:82). These institutions trained the American Mandarins who would maximise the efficiency of the economic system. The philosophy behind greater workplace machinery and division of labour had its own guru in Frederick Winslow Taylor who had spent time in the employment of Cramp's shipyard. His experiments at Bethlehem steel works showed that by analysing the productive process in high detail, 'Scientific Management' increased the output and efficiency of workers, shaping mass production to a mass market.

By the turn of the century, America was appearing as a land of economic giants with an economic system based on mass production and distribution which exploited economies of scale and scope, standardisation, and the intensive use of natural resources. The strength of American firms lay not in technology but the organisational abilities associated with mass production and distribution (Nelson and Wright 1992:1939). This system had successfully adopted many European innovations and, with its own distinctive system, was generating a far higher level of output.

13.2 The Rebirth of United States Shipping

In each chapter of this dissertation to date, industrialisation has normally complemented the growth of shipping. It increases the capital available, domestic demand and increases production in supporting industries. However, American wealth and population was growing so rapidly during this time, that the domestic market provided better opportunities for investment than shipping. Secondly, the country's resource base was so vast that it was not very dependent on imports. Despite this domestic orientation, books in Europe fearing an American invasion first appeared in 1901 and 1902 (Nelson and Wright 1992:1938). However, when American producers did finally look off-shore, they increasingly chose not to export but to invest in off-shore production facilities, thereby denying American shippers a cargo.

Such international shipping as did occur was still in the hands of foreigners, in particular the British. Even many US companies preferred to sail under the British flag due to high US costs. The local industry was burdened with high wage rates. The Scientific American reported in 1872 that the average American seaman earned $40 per month compared to $12 for the British, while the American first class engineer earned $240, three times that of his English contemporary (Bauer 1988:286). The industry was also burdened by the high price of local ships. Britain's iron-steam industrial cluster had also created economies whereby British ship owners could buy iron hulled steamers for one third of the American price (Ibid:242). Although Americans had developed a healthy iron industry, its expertise lay in rails, nails and structural shapes for bridges. Ships required shapes and plates that local mills did not have the skills or capabilities to produce (Ibid:289). The high price of local ships could not be circumvented by importing because of the high tariffs protecting the local industry.

Growth in the industry was also hampered by government policies (Safford 1985:96). Ship owners who had transferred to foreign flags during the war were denied re-entry to their native registry, but the biggest government imposed barrier were the trade restrictions on ship imports. By the late nineteenth century, communication and transportation links were regular enough that US ship owners could have easily bought British ships. However, US law dictated that American companies buy their ships in America, a reflection that American military goals were not in alignment with the development of the industry. The military required ships so the local ship building industry received protection which pushed up the price for shippers. Whereas British shipbuilders enjoyed a similar legislative protection during their process of catch up, British shippers were also protected and hence could absorb the higher costs. By contrast, American shippers had to compete against the leading shipping nation with one hand tied behind their back. A policy of subsidies to ship owners might have offset the handicap of high ship costs however, proponents of free trade regularly defeated such proposals at Congress. Government policy supported its shipbuilding industry at the expense of its ship owners and operators. Ironically, the long term growth of shipbuilding depended on the health of its shippers.

In much the same way that protective legislation tied ship owners to a protected and costly shipbuilding industry, shipbuilders were also tied to protected and costly iron industry. The nation's iron producers were could sell iron competitively on the world market, protective tariffs gave them the opportunity to charge high prices at home (Allin 1979:77). In this way, protective legislation created a multi-tiered cake of inefficiencies that hamstrung American ship owners.

The problems with iron did not stop innovation in wooden ship-building. During the 1880's and 1890's four and five masted schooners of over 1000 tons were common(Starkey 1993:142). One seven master was even built. However, this technological trajectory held less potential than the iron steamships trajectory pursued by the British.

Although the profits paid by ships that flew the US flag (in foreign trade) were not attractive, some maritime activity still warranted investment. Americans made large investments in domestic shipping which was protected from foreign competition by cabotage laws. Tonnage in coastal and lake shipping increased markedly over this period so that by 1910, there were nine tons of shipping in the protected coastal trade for every one in the foreign trade (Safford 1985:100). Secondly, many Americans who wished to invest in international shipping registered their ships in foreign countries so that they could buy cheaper foreign ships and reduce the costs of operation. By 1901, the number of international trading ships under foreign flags owned by Americans was 75% of that flying under the American flag (ibid). Britain was the preferred flag of convenience.

In the last quarter of the nineteenth century, a number of institutions were created to help develop US capabilities and the growth of knowledge in marine technology. In 1874, schools were established in all the leading port cities, a result of the advocacy of the naval captain Stephen.B.Luce who hoped that effective training would offset the influx of foreign seamen into the merchant marine, provide competent crewmen and help reduce the appalling number of groundings, collisions and fires which plagued American ships (Allin 1979:72). In the same year, the United States naval institute was created, an organisation dedicated to the professional and scientific examination of naval and maritime problems. The United States Naval war College was founded to encourage thinking on naval problems, including mercantile problems. In 1894, W.H.Webb created an institution to supply training for the construction of steel ships, the Webb Institute. The importance of these institutions lay in the future when self taught pioneers were increasingly replaced by institutionally trained businessmen.

A large number of organisations tried to affect the condition of the merchant fleet in this period. The New York Ship owners association was one of the first, representing its members before congressional committees and petitions but, it achieved little. Others concerned with problems of the nations carrying trade included the New York Chamber of Commerce and Board of Trade, but they also achieved little. However, a major institutional advance was the creation of a Department of Commerce and, a Bureau of

Navigation within Treasury (Allin 1979:75). This provided the industry with the political and administrative organs in government to oversee the merchant marine and report on commercial conditions.

Other institutions created during the late nineteenth century to serve the industry included the Captain and Vessel Owners Association, the Port of Wardens, the Board of Trade, and the Philadelphia Maritime Exchange. These helped to secure improvements that one member alone could not achieve and created economies of externalities by spreading the cost of their activities among their diverse members. The American Society of Mechanical Engineers served broader interests while labour formed itself into a number of unions organised along trade lines. Numerous schools, professional associations and publications helped spread the latest developments in naval architecture (Thiesen 1997:27).

Despite these advances, at the end of the nineteenth century, total tonnage flying under the American flag was substantially smaller than that of the United Kingdom. However, growth in the domestic economy was creating Hirschman-type linkages into maritime transport with the development of new companies and expansion of maritime capabilities. Early growth was primarily in protected trades or results of non-maritime companies solving their transportation needs. On the Pacific Ocean, the Pacific Mail Steamship Company was joined by the Oceanic Steamship Company. This organisation was started by a San Francisco entrepreneur Claus Spreckels, who started the line in 1880 to carry sugar from his plantations in Hawaii (at that time an independent kingdom) to the refinery in California. The company eventually expanded to Australia and received subsidies from the British colonial government (Heinrich 1997:77).

In the last three decades of the nineteenth century, vertical integration also provided the industry with new companies in the Atlantic. The Pennsylvania Railroad was the biggest company in the world at the time and a leading example of corporate capital. Under its head J.Edgar. Thompson, it developed an integrated transportation systems which included a transatlantic steamship line, thereby providing a continual transportation system from the mid-west of the United States through to Liverpool (Heinrich 1997:55). The Railroad was also instrumental in starting a transatlantic link to Antwerp. Together with Peter Wright and Company Shipping Agency and a small number of investors, it created the International Navigation Company. Because they used four British built ships, its tonnage was not considered part of the American Merchant Marine. They were registered in Belgium (Heinrich 1997:57).

The railroad industry was also responcible for the creation of the only other American company on the Atlantic. The Baltimore and Ohio railroad gave birth to the Atlantic Transport Company. It is no coincidence that railmen outside of New York took an interest in developing this route (Navin and Sears 1954:294). In New York, railmen had no need to develop the trade due to the large number of foreign ships arriving. The southern companies had to develop ocean-going shipping to feed their trains. Although established as competition, both these lines eventually added New York as a terminal port for their operations.

In 1901-2, the Atlantic Transport Company and the International Navigation Company became part of a larger process of corporatisation. These companies were small fish in a big pond which was becoming increasingly competitive as growing French and German shipping were taking the market towards an over-supply situation; a situation in which the weakest would lose. The great Wall St financier J.P Morgan considered the competition to be ridiculous. The situation resembled that identified by Richardson (1960) in which individual companies create over-supply because of poor coordination. The situation also bore similarities with that in the seventeenth century which gave rise to the Dutch East India Company. Ships rushed out of New York on the same day in an attempt to be the first to reach Europe (de la Pedraja 1992:5). If they distributed their sailing's more rationally, the result would be a more dependable and profit service. Morgan had created US Steel and amalgamated many of the railways and now weaved his magic on the shipping trade. The two American companies were amalgamated and combined with the British White Star and Leyland Lines. The new company, International Merchant Marine became the fourth largest industrial corporation behind US Steel, Standard Oil and American Tobacco Co. With 130 steamers, it was the largest merchant fleet owned by any one company in the world, although most ships were still registered under the British flag (de la Pedraja 1992:8-9).

Other integrated companies born at this time included the Great Northern Steamship Company created by the Great Northern Railroad Company in 1900, after its tracks reached Seattle, in the hope of establishing a Pacific based carrying trade which complimented its on-shore carrying. The Dollar Steamship company was created to carry Dollar's lumber products. Investment by companies such as Dollar reflects Silver's (1984) proposition that a potential supplier might be reluctant to risk investing in a developing market so the original company has to fill the gap in order to meet its own needs. Given that the 'mother' company understood the markets on which shipping services are derived (in Dollar's case, the lumber market) it can make the investment with greater awareness of the level of risk.

The Spanish-American War provided other opportunities for growth. The defeat of Spain opened up trading opportunities in Cuba and Latin America. Although on a smaller scale, it led to a pattern of growth with similarities to British expansion with the growth of the British empire. Victory gave the United States two new colonies in Puerto Rico and the Philippines which would require shipping services. In the same year, 1898, Hawaii was also annexed. Routes to Hawaii and Puerto Rico were now covered by US coastwise laws, giving local carriers protection under the Navigation Act. The Matson Navigation company started in the 1890's to take oil to the sugar mills on Hawaii. The American-Hawaiian Steamship Company, created in 1899 with sugar plantation shareholders, also benefited from the exclusion of foreign carriers. At the same time, the New York and Cuba Mail Line was born, and the Munson Steamship began trading to the West Indies. Most of these companies were created as an extension of existing commercial activities, lumber, sugar and oil. Although established as a solution to transportation problems, these companies did not restrict carriage to their own goods and became public carriers.

Some companies did restrict carriage to their own goods, such as the United Fruit Company which strongly illustrates the new pattern of economic co-ordination that was growing in the United States at the time (see Read 1983). The company was started by Captain Lorenzo. D. Baker, a fisherman who, in the off-season, brought bananas from Jamaica to New England. The demand for bananas was growing rapidly as a consequence of the increased migration and wealth stemming from industrialisation and population growth in the United States. However, the banana trade provided many difficulties for shippers who might arrive at a port and find no supplies available, and those that were available varied in quality and maturity. The shipper had to judge whether he should accept what was available or move on to another port and hope for something better. It added great cost to performing transactions in the trade. To make matters worse, bananas were a perishable fruit so profitability was directly influenced by the speed with which a ship sailed back to the USA. Weather and other delays in the Caribbean contributed to an average loss of about 15% (Read 1983:182). Even on arrival in the USA, some ports would prevent landing out of fear of disease and many shippers suffered for lack of distribution outlets. Finally, if two ships arrived in the same port at the same time, the market would be glutted (another portrayal of the Richardson problem). These market problems of high risk, irregular supplies, imperfect market knowledge, lack of quality control and a concentration on short term profits over long term market development were eventually solved by integration.

Technology helped overcome many of these problems. The replacement of sail with steam ships which were bigger, carried more cargo, and were faster, reduced the rate of perishability and allowed more sailings every year. Technological developments in railways and refrigeration also allowed the company to develop new markets in the mid-west while telephone and telegraph improved communication and the flow of market knowledge.

Organisational advances also helped to overcome the difficulties in the trade. In 1899, Lorenzo's shipping services were amalgamated with plantations in the Caribbean and distributors in the United States. The merger created the United Fruit Co., an integrated company that controlled the flow of bananas from point of production to point of sale. The company's 11 steamships and 12 chartered ships were integrated with production, purchase and marketing functions. The new organisational flow reduced the perishability of fruit and increased the reliability of information which dramatically reduced the costs of bringing bananas to the market. Horizontal integration into a number of production areas also reduced risk of natural disaster that might hit one region but leave others intact. Inside the company there was increased specialisation of tasks as different areas became responsible for their part of the trade flow. Finally, with 80-90% of all banana imports into the US, the company had a control over price and sales which provided more predictably and higher revenues for the company which encouraged further investment.

Diversified integration allowed United Fruit to displace the leading firm in the European banana trade. The British shipping line Elder Dempster had obtained the government mail subsidy to operate the route to Jamaica, a Caribbean linkage which provided access to bananas. This company eventually acquired a

company to distribute its fruit in a process of vertical integration not too dissimilar to that of Boston Fruit. The new firm that was created, Elders & Fyffes was innovative, moving rapidly into refrigerated ships. However, it did not integrate as deeply as United Fruit into a wide source of banana crops. When a violent hurricane destroyed Jamaica's banana crops the company turned to United Fruit for alternative supplies. In return for a guaranteed supply of fruit, United Fruit gained 45% of the company's stock. In 1910, United Fruit acquired the company outright, a consequence of its deeper integration.

United Fruit was just one of many vertical integrated companies that appeared at the time. Another integrated proprietary company in Latin America was W.R. Grace and Company who initially carried guano before expanding into sugar plantations, textiles and Chilean nitrates. Oil companies also invested in their own shipping. A number of these young US companies, including Munson Steamship, Grace and United Fruit sailed under the British flag. Local wages and ships were simply too expensive. Either the tariffs on imports needed to go or the local shipbuilding industry needed to dramatically reduce costs before shipping would take off.

Under the existing government policy, the future of US shipping was dependent on improved capabilities in domestic shipbuilding. The development of capabilities to build iron ships first gained pace during the Civil war. Realising that the government would need iron clad ships, shipbuilders invested in new machinery and yard expansion (Thiesen 1997:20-1). For example, W.Cramp and Sons converted from wood to iron during the war building their first iron ship for the northern navy. By 1872, Cramps were fully involved in iron shipbuilding (Baker 1976: 1.12). Its early customers included the young steamship corporations plying the international sea-lanes such as the Pacific Mail Steamship Company, and the American Steamship Company (Heinrich 1997:59).

The father of iron shipbuilding in America was John Roach who had learnt the moulding trade at a pig iron works in New Jersey before buying his own company. In 1853, he became the sole owner of Allaires's Etna Iron works, which he converted to a marine engine shop in 1862. He subsequently bought the Morgan Iron Works and the Frankin Forge and the Allaire Works at that time owned by Commodore Vanderbilt. Having bought out all his major competitors and consolidating his work force he ended up with 'the finest marine engine works in the United States' (Baker 1976:1.23). The Roach yard was pivotal to the industry's process of catch up. In 1881, it was the first to introduce pneumatic power tools and in 1883, John Roach was the first to begin rolling suitable plates at his mill in Chester. In 1881, they built the first American-built tanker, the *Standard* for the Standard Oil company.

Iron shipbuilding became based on the Delaware River because of the availability of supplies of iron (Baker 1976:1.11). The Delaware gave birth to a Marshallian district with specialist proprietary owned producers. Sub-contracting relations stretched back into the iron mills. Given that the first iron ships were all custom built and required custom built parts, close proximity was important to the success of the industry reflecting a form of quasi-integration identified by Richardson (1972). As Charles Cramp stated,

'nearly every piece of iron entering into (a metal ship) must be made to special order, and this fact, together with the necessity of rapid delivery demands that iron mills should be near the shipyards' (quoted in Heinrich 1997:52). The federal government also assisted the industries development, helping to finance a harbour improvement programme (with support of the Captain's and Vessel Owners Association) which deepened the river to accommodate larger iron steamships.

Despite this process of catch up, American iron shipbuilding lacked the precision of other engineering industries and was still well behind the English. For example, inefficiencies in cutting procedures were such that Charles Cramp claimed 'in the early days the crap heap was the largest mound in the yard' (quoted in Thiesen 1997:19). Americans were still dependent on Europe as a source of technology transfer. For example, Charles Cramp took his supervising engineer on a fact finding mission to Britain where their discussions included compound engineering technology. One of the people they spoke to was the chief engineer of the British liner *Italy*, whom they ended up employing and taking back to America with them. By 1872, the shipyard was building ships with compound engines for the American Steamship Company (Heinrich 1997:62).

Over time, the patterns of production and organisation emerging in the US were applied in ship building. As the industry grew, shipyards required greater administrative duties. The Cramp yard became so large, that its founder, William Cramp delegated the administrative duties to his sons so that he could continue to supervise the men. The greater scale of plant and production also meant a larger work hierarchy and increased division of labour. During the civil war, nine occupations worked on iron hull construction. By World War One, the division of labour was such that forty eight occupations now did the job (Thiesen 1997:20). This process of simplification and specialisation occurred in the shadow of Frederick Winslow Taylor and other efficiency experts (Taylor had actually worked at Cramp's yard before going to Bethlehem steel). It took control of output away from the skilled worker who was seen as having too much control over output (Heinrich 1997:142).

As capital requirements increased, many of the proprietary owned shipyards eventually began incorporated. In 1872, William Cramp and Sons became the William Cramp and Sons Ship and Engine Building Company although in this first instance, family members remained the sole shareholders. Incorporatisation did however protect the private assets of the family members. Eventually, as the company expanded, the Cramp families control became more diluted.

The government played a key role in the catch up process. When Congress ratified steel as the preferred material for warships, navy demand provided the opportunity for many to invest in the plant for steel hulled ships (Misa 1995:96-7, Bauer 1988:290, Heinrich 1997:105). This activity gave birth to a Military-Industrial Complex based on the Roach and Cramp shipyards and the Carnegie, Midvale and Bethlehem iron and steel plants (Heinrich 1997:99). The navy helped to facilitate technology transfer. When it imported engine plans from England for the cruiser USS Baltimore, it gave the Cramp shipyard a chance to

create more powerful engines based on the triple-expansion engine (Ibid:103). The navy's policy of placing ordinance officers with European ordnance companies also provided a path for technology transfer as the officers gained experience and brought it back to the States (Misa 1995:98). Naval contracts also provided the funds by which yards could upgrade their facilities; however, it took time to develop a working relationship between the yards and the navy. Inexperience caused some yards to under-quote while naval requirements frequently changed. These tender relationships brought Cramps to the verge of bankruptcy while Roach was forced to close his yard. Clearly, the form of relationships identified by Richardson take time to build and can be considered an investment in their own right.

As the shipbuilding industry increased its investment and experience in the latest technology, the price difference between American ships and British ships began to close. In the early 1880s, the price differential was 25%. By 1888, it had closed to 15% (Heinrich 1997:107). However, the industry still suffered from a small demand that did not allow it to achieve the same level of specialisation that the British shipyards achieved (Ibid:129).

By the end of the century, the shipbuilding industry had increased in experience and was beginning to adopt the characteristics of mass production associated with other areas of the US economy. In 1898, the New York Shipbuilding Corporation built a new yard at Camden which incorporated a number of innovations; the use of templates for plates and shapes, prefabrication of large structural assemblies, an extensive overhead crane system, and installation of heavy equipment on to the ship before launching. It produced a number of cargo ships for the young shipping companies. Its first ship was the M.S Dollar. Its second was for the American Hawaiian Line.

Between 1865 and 1913, American maritime industries had undertaken an impressive 'catch up' process. As Allin (1979:101) states:

> They built schools to train naval architects, admirals and seamen. They learned to organise capital, make shipbuilding tools, heat steel and build and sail a navy. They carried business organisation almost to perfection, obtaining almost complete control of the trade that mattered , The North Atlantic ferry service.... In only one respect did they fail. They failed to build an American marine.

Americans still had to learn the complexities of international ocean commerce. By the onset of the first world war, the American merchant marine still carried less than ten percent of the nation's foreign trade (Bauer 1988:298). US shipping was still very much handicapped by a lack of organisation, experience and skills in foreign trade that the leading nations, Britain and Germany possessed. These countries also possessed active government support, a consequence of their linking military and transportation needs. By contrast, the US military still thought primarily in terms of coastal needs not transoceanic, consequently, it did not favour government support for an international merchant marine (Safford 1985:101). True catch up by the Americans would only occur when military goals and industrial expansion were in alignment, thereby giving shippers access to efficient supporting industries.

13.3 Twentieth Century Catch Up

Between 1890 and 1910, British tonnage continued to grow from 10 to 18 million tons. However, British share of world shipping had fallen from 50% to just under 42% as other nations embarked on a process of imitation (Sturmey 1962:4). This was still a phenomenal market share built on flexible organisation, marketable cargoes and superior shipping technology and experience. However in the first half of the twentieth century, a process of catch up and advance was occurring consistent with our thesis.

The first world war dramatically effected global shipping by providing a form of infant industry protection. The nations involved in the thick of the war needed their shipping resources to aid their war effort. As Britain's efforts in particular were focused on the war, American and Japanese shippers could enter those trades vacated by what had been superior competition.

Asian markets were left entirely open to Japanese products (Yui 1985:xx). This created a huge window of opportunity for Japanese businessmen to increase their capital, skills and experience. Japanese shipping went through an unprecedented boom. Its network of routes grew to include Africa, the East Coast of South America and all the regions of Southeast Asia. Many new firms rose to prominence. Shagaisen bloomed dramatically on war time demand, out-distancing the Shasen who could not switch to more profitable routes because of their commitment to government subsidised routes (Miwa 1985:145). Japanese tonnage increased from 1,514,000gwt in 1913 to 2,841,000gwt in 1919, and the loading rate had climbed to 70% (Ibid:136-7). Japan now ranked as the third largest maritime nation behind Britain and the United States. This burst in Japanese activety was an entrepreneurially driven expansion, not governmental (Yui 1985:xx). However, after fifty years of government guidance, the country had acquired the capabilities in steam ship technology by which the industry could now generate its own start-ups.

American shippers also enjoyed the window of opportunity provided by World war one. It opened up new opportunities to enter trades previously dominated by Europeans who redirected their shipping to war time support roles. In their absence, American companies increased their knowledge, experience and investment in new foreign markets.

For the Americans, World War One also provided the long awaited re-alignment in military and shipping goals. President Wilson had long seen the merchant marine as an important pillar in global power and prestige (Safford 1979:143). He linked a decrease in tariff and expanding foreign trade to a policy of support for a strong American merchant marine. However, he initially came across strong resistance from the private sector who were concerned that the nation was edging away from the principles of free enterprise. Private enterprise was certainly benefiting from the war. Shippers were growing without the legislation, enjoying the benefits of neutrality and very high war-time freight. This encouraged investment into the industry. The successful expansion of companies in the industry signalled to people with money, such as John D. Rockefeller and Averill Harriman (son of a railway magnate), that maritime activity was

now returning good profits. Under such circumstances, government intervention might not seem necessary. Nevertheless, heightened war-time activity increased the demand for more shipping and these changed circumstances allowed President Wilson to pass the 1916 Shipping Act which established the United States Shipping Board 'to promote, investigate, regulate and administer the shipping industry' (Bauer 1988:298). This ensured war-time shipping needs were met.

One of the Shipping Board's first tasks was the creation of the Emergency Fleet Corporation (EFC) which was responsible for meeting the needs of Americas war effort. The resulting 'Bridge of Ships' to France became the largest industrial undertaking ever attempted in the United States to that time. Meeting the shipping needs of a war across the Atlantic required a massive investment in new shipyards and led to some important changes in shipbuilding. The most notable change from this huge war-time demand was an accelerating trend towards fabrication and pre-assembly, mass production techniques originally seen in the New York Shipyard (Heinrich 1997:94).

Initially, the EFC was handicapped by lack of experience, and managers learnt as they went. While Americans eventually acquired the capabilties to efficiently produce the required ships, it is hard to imagine this occuring in a a competitive commercial environment without the protection of war and war-time demand. At the beginning of a steep learning curve, the scheme encountered delays, waste and numerous clashes of personality and policies (Bauer 1988:299). In time, they mastered the neccesary capabilities and the output on the Hog Island yard was phenomenal. At its peak, it employed 34,000 workers and could produce more than all the yards in the UK combined. So great was the number of launchings at Cramps that, instead of bringing in dignitaries from town, they would call the company's restaurant from where a brawny cook named Maggie would come, swing a bottle of champagne and send the ship on its way (Heinrich 1997:165).

By the war's end, the United states had the world's largest merchant marine at 13.5 million tons (Bauer 1988:301). However, it is one thing to have ships. It is another to be able to manage them competitively (Bauer 1988:301). With the war over, the Americans did not have the industry skills or trade routes to utilise such a vast tonnage and, their seamen were still the most expensive in the world.

To remedy the situation, the government passed the 1920 Merchant Marine Act. Under the act, private entrepreneurs were given the chance to charter the ships on 'essential trade routes', gaining experience after which they could purchase them. This scheme was very similar to that in Japan however, there was one key difference. In a culture that valued independent producers, the Shipping Board encouraged the formation of small steamship lines in preference to assisting the larger corporations, a policy which attracted speculators without the managerial capacity or experience to compete with foreign carriers.

A depression which hit the industry between 1920-2 was unfortunate for the scheme (Kemble and Kendall 1979:151). However, the depression was in many ways a consequence of the American policy. Most of

the steel ships built for the Bridge to France were not delivered until 1921-2, unleashing a huge supply of shipping on the world market. To make matters worse, the Japanese fleet was also growing and, once European shipping returned to commerce action, the inevitable over-supply was manifest. Safford (1989:142) goes as far as saying that most of the US fleet should never have been built. We would expect the government to have greater coordinating power than individual shipyards and therefore be able to avoid this problem however, it would have been very difficult to halt this policy in a job-hungry post-war economy.

In the resulting depression, the number of US carriers declined from 200 in 1920 to 39 in 1923 (Heinrich 1997:199). However, some firms did succesfully acquire the capabilities to compete internationally. The Farrell line purchased the Shipping Board's service to South Africa and developed it into a strong commercial enterprise. The Board started a new United States Line and operated it profitably until 1929 when they sold it to a syndicate led by the International Merchant Marine (de la Pedraja 1992:71). American Export Lines also grew out of this period and, with cheap ships from the government, mastered the route between the East Coast and the Mediterranean. Other companies that used the cheap ships to expand their operations included Lykes Brothers Steamship Company, Waterman Steamship Corporation. With a number of investors with coffee interests, the Delta Line began in 1919, to provide coffee merchant in New Orleans with direct shipments from Brazil, eventually moving into the export of agricultural machines, lumber and petroleum products (de la Pedraja 1992:88).

The subsidised Matson line which had begun in the previous century on the protected route to Hawaii expanded in the Pacific, taking routes previously run by the British Union Steamship Company of NZ, a subsidiary of P&O. The American company also benefited from the fact that the British could not share in the San Francisco-Hawaii route which was considered domestic shipping and preserved for American ships (Hope 1990:360). This leg of the Pacific trade contributed healthy income towards the company's costs.

Many of the new shipping lines were the product of vertical integration in yet another example of Hirschman-type linkages propelling the development of capabilities. Henry Ford established his own line to carry Model T's to foreign markets while Bethlehem Steel operated the Calmar Line to bring iron ore from Venezuela. The Roach shipping yards were re-opened during the war and purchased by W.Averill Harriman, the heir to a railroad fortune. In 1919, he also started the United American Lines under the Shipping Boards programme. However, like most new trans-oceanic ventures of the time, it failed and was eventually sold to Hapag in 1926.

With the effect of the great depression that followed, 10 million ships lay idle and a number of US shipyards went out of business including William Cramp and Sons and Bethlehem Steel Company's Haarlan Plant. To make matters worse, technical advances were rapidly laying the American fleet obsolete (Baker 1976:1.29). In particular, diesel engines were now common place on the most modern ships. To remedy the situation, in 1928, Congress established a construction fund under control of the Shipping

Board and, dramatically increased the subsidies for carrying mail. Under the new Board, forty six mail routes were established and each contractor was to build a certain number of new ships to service the route. The ships built in this period were state of the art (Kemble and Kendall 1979:161). Unfortunately, the law was poorly drawn and lacked efficient criteria and procedures (Bauer 1988:305). It did not even require ship operators to use their income to build new craft and most companies used old ships left from the war time production. Almost all lines were given the maximum subsidy available. Consequently, ships could sail thousands of miles to deliver a few pounds of mail at immense profit to the owners (de la Pedraja 1992:111). The subsidies fell into a raft of shady proceedings eventually exposed by a Senate select committee including unearned and exorbitant salaries and bonuses, secret expenses and a raft of other devices (de la Pedraja 1992:112).

To overcome these shortfalls, a new Merchant Marine Act in 1936 created the US Maritime Commission under Joseph Kennedy to oversee modifies subsidy provisions (de la Pedraja 1992: 113). The Commission administered cheap loans for construction of new vessels. However, being drafted during the depression, the new act's principle concern was employment so, included a requirement of 100% American crews on freighters and 90% on passenger vehicles seeking the subsidies. Working conditions of the crew were protected with a mandatory three-watch system and minimum standards for quarters. As welcome as these changes were to an under-employed labour force, US labour was expensive and this undermined the competitiveness of the US fleet.

If the government did not introduce these laws, American owned ships would have a greater chance of competing internationally because they could have employed foreign crews and in poorer work conditions. It would have presented a variant of the International Product Life Cycle with investment fleeing to those nations with cheaper labor (I say a variant in that ships are mobile capital). With an eye to the free market, the logical question would be 'should Americans, given the cost of labor, be involved in shipping at all?' This would have benefitted American share-holders but not American labor. Perhaps the policies can be seen as a stakeholder conflict decided under conditions of democracy (in conjunction with the need for military sea-transportation).

In contrast to the high wage Americans, the Japanese were a low wage/ low cost producer, a particular advantage in a depressed market. The Japanese fleet consisted mostly of old imported second hand vessels and the age of the fleet was the second highest in the world (Nakagawa 1985:3). Japanese wages were also much lower than their main competitors (Miwa 1985:144). Consequently, during the years 1929-1939, when on average, the US fleet shrunk by 2.4% each year and the UK fleet shrunk 1.1%, the Japanese fleet grew by 3.0% (Sturmey 1962:392). Another low cost operator to emerge in this period was Greece (3.5% growth). The Norwegians also continued a steady climb based on a high level of flexibility to changing market conditions.

Table 13.1 World Major Ship owners in 1926

Ship owners name	Number of ships	Gross Tonnage
US Maritime Board	1,056	5,162,334
P&O	451	2,481,984
Royal Mail	495	2,117,490
I.M.M	104	1,134,396
Cunnard	108	1,035,229
Ellermans	213	973,801
Furness Withy	207	903,320
HAPAG	146	792,732
NYK	136	706,375
Holt	85	661,369
NDL	138	562,729
Generale Transatlantique	100	561,249
K Line	101	503,866
OSK	138	458,379
M.M	56	447,291

(Source: Kawasaki in Nakagawa 1985:23)

Low cost advantages did not relieve the Japanese of the worst of the decline. Many of the leading shagaisen companies also disappeared from shipping. In 1927, the gigantic Suzuki trading company went bankrupt causing panic all over Japan (Yui 1985:xxi). Many Japanese companies survived by diversifying. For example, Kokusai Kisen diversified into Atlantic routes and began operating a liner service between Europe and Japan using cargo ships. In 1931, NYK and OSK signed an agreement to cooperate on routes to avoid excessive competition and over-lapping investment (ibid:xxii). They also co-operated on joint accounts on parallel lines and in the use of overland facilities. This co-operation enabled them to mitigate some of the destructive elements of competition during a time of vulnerability.

The Japanese also benefited from organisational advantages. These included the flexible relationships between shagaisen operators and ship owners which allowed them to gather around them the necessary ships as demand sought (Nakagawa 1985:3&18). Another factor was the close relationships between exporters and shippers, as the British complained at the time:

> The fundamental cause of the recent Japanese success is the superior Japanese methods of organization in particular the system whereby Japanese banking firms, export houses, and shipping companies work in close connection ... It follows from this that the real remedy for the decline in British shipping would be to rationalize their organization and take a leaf out of the book and work in closer contact with the banking and exporting interests concerned... Whereas the peculiar history of Japanese industry has brought about the concentration of many enterprises of various characters into the hands of a few big families, involving forms of industrial and commercial organization of the horizontal cartel type, the English individualist tradition has lead to a certain inelasticity and to a reluctance to co-operate with outside interests. (Quoted in de la Pedraja 1992:100).

Japanese shippers also benefited from the rising demand for shipping services in their home country. During the inter-war period, Japan continued a period of rapid industrialization. The growth of heavy industries led to a growing demand for imported raw materials such as iron ore, coal, phosphorus ore, salt and raw cotton; as well as increasing the demand for foodstuffs. At the same time, trade in high value goods such as raw silk, cotton and silk cloth, cotton yarn and chinaware also increased (Nakagawa 1985:12).

During the period of depression, Japanese shipping continued to grow through strong entrepreneurship, growing domestic demand, cheap wages, government support and the correct application of the most suitable ships to each service. The nation strengthened its position as the third largest shipping fleet with a number of companies ranked among the world's major ship owners.

One American company to suffer at the hands of the vibrant Japanese was the Dollar Line who operated in the Pacific. The Dollar Line had held the predominant position on the San Francisco-Orient route using high quality ships. It was to aid competition on this route that the Japanese government's plan to merge KYK and TKK first materialized and, to finance the crack ships necessary to win the route, the government provided the maximum subsidy the existing legislation provided (Miwa 1985:139). While the Japanese line received this injection of funds and technology, the Dollar line also suffered from wasteful management (de la Pedraja 1992:100) To stave off bankruptcy, the company was taken over by the US Maritime Commission who changed the name of the company to American President Lines. In the US free market system, it was generally believed that inefficient government management would lead to the collapse of the company. However, government management freed the company from satisfying stock holders with profit and concerns with take-over fights. The company's sole concern was to provide quality shipping service. With an injection of capital, sound management and increased demand stemming from World War two, the company emerged strong and profitable at the end of the war.

During the shipping depression, the government picked up the pieces of a number of ailing companies. Ironically, during this time when private enterprise was corruptly milking the subsidy system and falling into operational difficulties, the United States Line and the Panama Line which were run by the government were operating very efficiently. However, any thought of extending government ownership ran against the value system which placed private enterprise at the top (de la Pedraja 1992:113).

Table 13.2 **Tonnage by Nationality 1939-1948 (from Sturmey 1962:139)**

	1939		1946		1948	
	Tonnage (000)	%	Tonnage	%	Tonnage	%
Japan	5,427	8.8	1,200	1.7	1,370	1.9
United Kingdom	16,892	27.5	13,340	18.3	16,046	22.0
United States	8,722	14.2	40,882	56.1	26,199	36.0

On the outset of World War II, the United States had built the seond largest fleet in the world. In 1937, 155 liner vessels owned by 17 firms received operational subsidies from the government (Whitehurst 1983:82). Another 230 vessels operated without subsidies creating a US liner fleet of 385 vessels (tramp shipping was minimal). When combined with the nations other shipping, American tonnage was second only to Britain while its' fast growing rival in the Pacific had the third largest fleet. These positions briefly changed during World War two, when history repeated itself. As in the first World War, a new Bridge to France had to be built and American shipbuilding reached staggering levels. Mass production techniques and contracts that rewarded performance meant that in 1943 alone, 12.5 million tons was launched from American yards (Bauer 1988:309). The War Shipping Administration also undertook a huge training programme to provide the officers and men for the vessels. It included the establishment of the US Merchant Marine Academy, seven training ships, and schools around the country. These institutions trained 270,000 seamen, 10,000 officers, 7,500 radio officers and 5,300 pursers (Ibid:310). The US mercantile fleet experienced a four-fold increase in size. By contrast, the fleets of America's competitors had been decimated.

At the war's end, one hundred and thirty shipping companies and 4,500 vessels gave the United States a staggering 60% of the world's tonnage (although 70% of the cargoes were for relief and military supplies) (Ibid:311). Once again, the Americans had the world's largest fleet. Despite the massive leap in productive capabilities and capital the lead was once again short lived, a reminder that an industry is more than a production function of resources, labour and capital. Carrying cargoes supplied by the US army state-side to the US army across the Pacific and Atlantic is very different to establishing a range of commercial contacts throughout the world. Nor did the acquired capabilities compensate for the continual problem of high wages. Within a few years the British had wrestled that mantle back off them with their huge experience and global wide investments for managing commercial shipping in global routes.

Chapter 14

Britannia Shares the Waves

14.1 British Entrapment

As the previous section described, several nations had gone through a process of catch up, slowly acquiring the skills and capabilities that Britain was so ably exploiting. Initially, Japan and Germany grew by exploiting new trading opportunities arising from South American independence, immigration, and Pacific routes. The United Kingdom felt no losses from these developments; in fact the British had largely ignored Pacific routes. This provided a window of opportunity for the imitators to develop their maritime capabilities. When the first World War redirected British commercial shipping towards the war effort that window of opportunity widened for Americans and Japanese, and the Pacific was becoming a Japanese lake. As the twentieth century progressed, Americans, Japanese, Scandinavians and Greeks dramatically increased their share of world tonnage while Britain floundered.

In 1890, over 10 million tons of shipping sailed under the British flag, a phenomenal amount representing approximately 50% of the global total (Sturmey 1962:4). Yet, over the next half century, the British share of world shipping declined dramatically. By 1960, its market share had fallen to 16%, soon to decline even further. Total British shipping had grown to nearly 21 million tons, but it had failed to ride the development paths that others would use to dethrone Britannia. There are two principal explanations for this. Sturmey (1962), in his definitive study of the decline focuses on barriers to growth within the British industry. For Sturmey, the critical period for British shipping was between 1920 and about 1958 when tremendous changes occurred in trading patterns, competition, ships, cargoes and passengers. The British industry was slow in adapting itself to these changes. It was an industry geared to maintaining its position of supremacy, not to the meeting of changes. When it woke up, the world had moved. By contrast Davies (1985:80-1) suggests that British shipping reflected the state of the British economy in general. For Davies 'shipping is an integral part of a nation's economy and accurately reflects both its relative efficiency and its international competitiveness'. As the British share of world trade declined so did its shipping. Both explanations are consistent with the recurrent patterns of entrapment.

British competitive advantage had been based on supportive government policy, superior technology and organisation, supporting industries, skills, experience and reputation. The last three of these were lost as other nations caught up and acquired the skills and experience to compete. Eventually, the other sources of competitiveness also disappeared.

14.1.1 Shipping Technology At the end of the nineteenth century, the British steamship represented the zenith of shipping technology at the time. In the first half of the twentieth century, the steamship was challenged by the arrival of two technological options. These were the replacement of coal with diesel-oil as a fuel, and the replacement of the steam-engine with the internal combustion motor. The British were not averse to innovating with these technologies (Fletcher 1975:5-6). As early as 1886, British ship-

builders had built an oil-powered steamer. British builders also built the world's first ocean-going motor vessel; a tanker ordered by the Royal Dutch/Shell Group. Although the UK played a significant role in the development of these technologies, British shipowners were slow in diffusing them. British shipbuilders as a whole remained wedded to the steamship and with some reason. Early diesel engines had a tendency to break down under less than ideal conditions whereas, the tramp steamer had been improved to the point where it was efficient, reliable and economical (Ibid:10).

Even as technological bugs were removed, there still remained uncertainty over the availability of oil. 'For every person who asserted that the future would provide abundant supplies of low priced oil, there were several to announce either the world's supplies of oil would shortly give out, or that the trusts controlling its distribution would never allow the using public the advantage of low prices' (Ibid:6). Some shippers hedged their bets by building vessels that could burn either coal or oil while, some advocates of coal refused too give in without one major last ditch effort promoting pulverised coal with its advantages of efficiency, saving of labour, and steady steaming conditions but, it suffered from technical drawbacks (Fletcher 1975:8).

During World War One, many navies around the world, including the British turned to oil helping to remove these uncertainties. However, this did not lead to mass conversion. One reason was timing. During World War One, a large proportion of the British fleet was destroyed and British owners could have taken the opportunity to buy replacements that embodied the new technology. However, with a shortage of ships, freight rates were very high and owners were keen to take the ships most readily available. That meant locally produced steamers, ships built during the war, and foreign acquisitions (Fletcher 1975:10). Consequently, by the 1920s, when questions of oil availability and reliability had been solved, these businessmen found they had high levels of investment sunk into the old technology - a situation augmented by a shipping depression in the 1920s that shattered investment possibilities in any new shipping technologies. Consequently, in 1925 motor ships accounted for only 3.9% of British merchant fleet compared with 21.4% Sweden, 18.1% Denmark and 12.9% of Norway's (Robertson 1988:193).

Although uncertainty over oil supply may have been solved, other uncertainties remained. As late as the 1930's the case for the motor-ship was still not clear cut. The Liverpool firm of T&J Harrison (the Charante Steam Ship Company) looked very carefully from 1925 onwards into the potential of motor ships to enhance its profitability (Robertson 1988:196). Their research was governed by the principle that 'any innovation must improve their expectation of profit over the whole range of trades in which the company was involved'. They also conducted tests on a number of means of propulsion and applied DCF investment analysis, yet continued to order coal-fired steam engines in the 1930's. In this instance, it was also necessary to consider, among other things, routes travelled. Motor ships were not always the best buy. In 1935, motor ships still only accounted for 16.6% of the British fleet compared to 48.6% in Sweden, 41.9% in Denmark and 36.6% in Norway (Ibid). Scandinavians were also using faster ships than the British who seemed to hold a genuine belief that slower ships would provide a superior economic performance

(Sturmey 1962:352). However, this belief may have been an act of faith (Ibid) that helped resolve cognitive dissonance.

Domestic factor endowments also contributed to British persistence with the coal-powered steam-engine. The principal economic advantages of oil were it required less space and had lower fuel consumption (Fletcher 1975:5). Savings of 30-50% in fuel made the new technology attractive, particularly for countries like Norway which had to import its fuel. The United Kingdom had high quality coal, and no oil, therefore the economic advantages were not so great for them. The difference was probably not just transport costs but, the sense of certainty in the fuel that the British environment provided. This is an example of Salter's (1966) observation that diffusion of technology can be affected by variations in local factor costs. Short time horizons of businessmen also affected investment decisions. The reluctance to switch also reflected a preoccupation with lower first costs than in longer run economies of operation.

In contrast to the hesitation of British businessmen, the Japanese government actively promoted the building of these new 'crack ships' in yet another illustration of the key role of government policy in directing advance. However, Sugiyama (1985:258-9) states that the building of new ships was not always beneficial to private enterprise. The government was sometimes more motivated by prestige in its attempt to upgrade the quality of tonnage. The question whether to turn to diesel-powered motor ships was widely discussed noting that although it brought higher earnings and lower running costs, the higher initial costs did not always guarantee the expected profit.

The first attempt by the Japanese to use diesel motors was in 1923 when OSK trialed one in a small vessel operating on an inland sea route (Yui 1985:xxii). This success led to their deployment on emigrant ships travelling to South America. In the following two years, Mitsui and NYK also began using diesel on some of their routes. The successful introduction of diesel by these major companies was followed by the competitive introduction of large, modern, high speed ships. OSK ships achieved record speeds to New York through the Panama Canal, providing a successful operation carrying raw silk and vegetable oil, earning a profit even in the midst of the depression (Nakagawa 1985:14). OSK's success with high speed ships stimulated research at the government's Naval Architecture Experiment Tank where it was discovered a single screw ship with an appropriately designed hull, rudder and screw could save 15% on fuel requirements. The new technology was immediately applied by the major companies who used them on the New York route, a route characterised by high value cargoes and speed was a competitive weapon.

The British Government also introduced a number of initiatives to help their industry. In 1935, it introduced a scrap and build plan whereby ship-owners were provided with loans if they scrapped old tonnage and replaced it with modernised ships. However, unlike in Japan where a similar scheme led to some fleet modification, English ship-owners were slow to respond and the scheme was abolished. Admittedly, part of the scheme's failure was a result of changing circumstances when an increase in activity made it economical to use old ships (Sturmey 1962:109). The government also provided bounties to assist

ship owners and forced the industry to set up a Tramp Shipping Administration Committee to promote co-operation among shipbuilders. The committee had some success in limiting some of the negative effects of competition during a period of very low rates. However, the British government had less influence over its much larger industry than its Japanese counterpart, and forces of decline continued to set in.

14.1.2 Path Dependency - The General Purpose Tramp British shippers were also slow to respond to the changing demands of global shipping. Like the Dutch, Spanish and Chinese before them, the British suffered from arrogance. The industry had learnt from experience that they were the world's most competitive shippers. Having been in this position for so long, the generally accepted fact was 'that the British industry was best by definition' (Sturmey 1962:96). By the time that international competition became serious, the idea was so embedded that the crumbling of that paramountcy occurred almost unnoticed (Ibid:396).

British shippers followed the industry norms that had carried them to global leadership. They continued to provide all purpose vehicles while other nations created more specialised vessels to meet the needs of particular trades. For example, Scandinavians made increasing use of refrigerated holds for the Mediterranean fruit trade. They showed a flexibility and entrepreneurial attitude in sharp contrast to the British who clung to traditional attitudes (Ibid:94).

The fastest growing category of specialised vessels was oil tankers, a reflection of the booming demand for oil. World tanker tonnage soared from 11 million tons in 1939 to 38 million in 1960 (Sturmey 1962:262). Yet the British were slow to seize the opportunities this type of vessel offered, despite the fact that the British admiralty and oil companies owned half the world's tanker fleet in 1913 (Ibid 1962:74). British ship-owners were entrapped by an aesthetic of what constituted a good ship. They were experienced with all purpose carriers and they were aware of their versatility. To the British ship-owner, tankers weren't real ships but, floating pieces of pipeline (Hope 1990:369). When the British oil company, Anglo-Saxon sold off its tanker fleet to raise capital for exploration and transportation, it was the Norwegians who bought the vast majority, not their fellow countrymen (Sturmey 1962:76).

By contrast, the US was making a huge investment in tankers. In yet another example of vertical integration, oil companies such as Sun Oil built and purchased tankers to meet their own transportation needs (Heinrich 1997:179). This section of the market provided rapid growth for the US industry, a consequence of the rising demand for oil. Between 1914 and 1923, the US tanker fleet grew by 1,400% in number and 2,500% in tonnage (Bauer 1988:290).

Many of the US tankers were not registered under the US flag. Like British businessmen, the American government who wrote the 1936 Merchant Marine Act failed to recognise the importance of tankers. This oversight deprived oil companies of subsidies, so they were the first to flee a country that imposed higher costs and restraints on shipping. US flag tankers simply could not compete in the international market (de

la Pedraja 1992:160-1). In 1946, a group of oil companies created a register in Liberia which, along with Panama and Honduras, would become the flags of convenience for this growing sector of the industry.

14.1.3 Organisation Klein's (1977) assertion that a decline in competition leads to slower innovation is supported by the liner part of the market. Sturmey (1962:352-7) notes that the little effort to investigate the economies of faster ships and other areas of improvement can be attributed to the industry structure in the liner trades. The conference agreements provided stability but gave little incentive to break from conventional modes of thought. The barriers to entry associated with the conference helped maintain British tonnage at a high level but, in the long term increased inefficiency opened up windows of opportunities for new entrants. Aggressive competition was explicitly avoided and liner-companies had an overwhelming tendency not to take an action which might invite reprisals. By contrast, foreign operators with little market share were not restricted by these fears, and enthusiastically seized opportunities to win trade from increasingly inefficient liner-companies.

One might of thought that a competition like the Blue Riband, for the fastest ship across the Atlantic, might have stimulated innovation. In the early years, the competition did have an impact but as racing became more specialised, the technological innovations had less impact on merchant shipping. For example, speed would acquire great use of fuel which was uneconomical combination in merchant shipping.

The necessary flexible response was also hampered by the distance managers of these companies now were from their core activities and information on the industry. Industry growth and reduced competition had helped to distance ship owners from ships and the smell of salt (Ibid:395). Leading ship owners were more accustomed to co-operation rather than aggressive competition. The enlargement of organisations isolated the owner from the shipmaster and the associated commercial intelligence. Working from offices they increasingly judged operations through balance sheets rather than the detailed competitive problems on any particular route. A reflection of this change was the increased social position that ship owners now held. They became socially important figures, the purchasers of land and the recipients of titles or, as Weiner (1981) would put it, they had gone through a process of gentrification. The result was a business elite distant from its core activities and problems. It augmented an arrogance that beset the industry. This is an example of what Marshall(1890) was personally witnessing when he wrote his life cycle of the firm.

Long term adaptability was also hindered by the organisational-management structure of the companies in which families had emerged as entrenched stake-holders. Even when companies merged, family members from the old merged companies still dominated the board of directors. Family management made the industry less attractive to people who had the ability and ambition and the industry suffered from a shortage of good management (Sturmey 1962:396).

Table 14.1 Structure of British Shipping Industry in 1960

	ton	%
Liners	8,764,000	50
Tramps	3,304,000	19
Tankers	5,457,000	31
Total	17,525,000	100

(adapted from: Chamber of Shipping, see Davis 1962:361)

Given the emphasis of Klein (1977) and Porter (1990) on the importance of rivalry, the highly contested tramp side of British shipping might have been expected to show more innovative vigour than the liner trade. However, the competitive model did not prove to be show the longevity we might expect from orthodox economic theory. In fact, British tramp shipping was routed. As table 14.1 shows, tramp shipping which at the beginning of the century comprised 60% of the fleet was down to less than 20% of a similar total. There are a number of reasons for the demise of British tramp shipping however, standing out is the fact that continuing with past commercial rationalities and paradigms proved a far stronger force on the industry than the benefits of competition.

As a high wage nation, British tramp owners needed to keep at least one step ahead of low wage competitors in the adoption of larger and faster vessels yet, by 1914, advance had practically stopped as the industry accepted the reliable economical ships as the embodiment of the ideal tramp. The reliable tramp ship was to the English what the fluyt had been to the Dutch, an excellent trader with which they learned to maximise economies. They knew these ships well so built their strategies around them. Use of their technology became a core heuristic. As Sturmey (1962:78) notes 'The tramp-owners as a whole were cheese-paring by nature, meeting competitive pressures by continuous economies within traditional ship types, but rarely taking a longer view and endeavouring to reduce costs (or increase receipts) by spending money on ships designed for existing conditions'.

This outlook was particularly damaging when ships were dramatically increasing in size. Size offered a number of economic advantages (Hope 1990:416). In 1968, a 5000 ton ship would cost 85 pounds per ton to build compared to 35 pounds for a 20,000-tonner. A large ship might require an engine 10 times more powerful but, it could carry 40 times the weight of cargo. Average running costs also declined with size, for example above 65,000 tons crew costs remained static. Although these figures come from later in the twentieth century, they reveal an economic phenomenon that had been occurring throughout the century. The British did not invest in larger ships

One possible explanation is the small size of British ports which limited their ability to handle large tankers and bulk carriers. Sturmey(1962:166) notes that 'ship owners were unduly conscious of the limitations of the British oil terminals in handling the biggest tankers'. However, given the fact that a tanker on

international routes might never visit Britain, the decisions are an example of bounded rationality and perhaps availability bias, in which the readily available and observable information is given unjustiable cognisance. The result is a false consciousness, an example of the local environment restricting a more rational view of global change.

Family tramp firms lacked the necessary capital to switch to large ships such as tankers (Sturmey 1962:61). The possibility of raising money through debt or issue of shares existed but the industry had a tradition of self financing. Like other proprietary corporations of the time, they avoided outside capital in order to retain control of the company within the family. Like the Gujaratis three hundred years earlier, strong competition housed an individualism which stunted versatility.

The shunning of outside finance was also a reflection of business norms. These companies had grown from small beginnings by reinvesting profit. External finance was never a key factor in their mental outlook. In fact, during the nineteenth century some companies did take the opportunity to borrow but, heavy debt left them vulnerable during the depression of 1904-11. Many lines failed and the industry took the lessons to heart. The unwritten rule became financial conservatism (Ibid 106-7). Consequently, the small owner of two or three tramps saw investment in tankers as a risky and high debt project compared to what he knew he could do best.

The company that was most responsible for imbuing ship owners with a conservative stance was Royal Mail. On becoming chairman of the Royal Mail group, Owen Philipps (later Lord Kylsant) commenced an expansionary programme which saw the company's tonnage grow from 92,352 grt in 1903 to 165,511 in 1906. The company continued to expand and acquired a number of companies including Elder Dempster & Co in 1910, Pacific Steam in 1910, Glen Line and Lamport and Jolt in 1911 and Union Castle in 1912. Most of this expansion was financed through the issue of debenture stocks, a method which raised finance but left control in the hands of the original small family business (Green 1985:233). After the war, expansion was also financed by cross share holdings, particularly with Lord Pirrie of Harland & Wolff ship-builders. Together, the two exercised unchallenged influence over the finance, strategy and organisation of the group. Nevertheless, family control does not always mean conservative management and, the company was quick to invest in the most advanced technologies, including the motor ship. During the war, the group had made healthy profits with which it continued to expand. Expansion did not stop during the slump that followed, and more external finance was raised through loans by which the Group came to encompass 140 companies (not all of them in shipping) by 1926 (Hope 1990:365). By 1928, the group was highly in debt and now relied on a period of rapid growth but this slump lasted longer than previous downturns. The company collapsed in 1930. By this time the fleet comprised nearly 15% of total British shipping. Its decline sent a powerful message to other owners not to use external finance.

These norms were born from a historical process of learning that determined business behaviour as the century progressed. They restricted financial options of businessmen who did not seize contrast strongly

with the innovative financial techniques introduced by foreign entrepreneurs like Daniel Ludwig of the United States and the Greeks Aristotle Onassis and Niarchos. These entrepreneurs financed rapid expansion through external loans using long term charter contracts signed with the oil companies to guarantee the cash flow to meet loan repayments (Strange 1992:66).

Another financial consideration which affected decisions was comparative profit. In the early days, the tanker market offered lower profit margins than the British were used to so, they did not consider switching. This left a window of opportunity open for a new competitor to gain an entrance into the industry.

Finally, we must also consider the number of distractions, uncertainties and red herrings that abounded throughout this period of change. A number of factors could have blurred British businessmen from seeing the need to upgrade. During world war one, British ship owners earned high profits as the government paid handsome rates for the use of their ships. In such circumstances, high profits could be earned without a technical upgrade. Immediately after the war, there were shortages of shipping. British shipbuilders had full order books replacing the war-time losses (Burton 1994:182). Between the wars, the depression defined the economic environment and made new investment an unattractive option. Then world war two arrived, followed by a post-war shortage of shipping and very high profit rates which once again seemed to endorse the correctness of the policies (Sturmey 1962:400). Full realisation of Britain's relative decline was also obscured by an expansion in world trade which provided some growth and stability in overall tonnage. It hid the fact that faster paths to growth were being developed by other nations who were increasing their market share.

Uncertainty made efficient decision making difficult. For example, in the inflationary period following world war two, there was an expectation that, after the original burst of activity, a slump would occur as happened after world war one. The effect of this uncertainty on decision making is illustrated by Sir John Denholm of J&J Denholm who explains:

> When the second war was over, my brother and I decided we had either to get out, or go right for it. We'd have done nicely if we sold out then, but we made the decision, and we went ahead while other firms waited for the slump that never came... It seemed unfair to inflict the whole gamble on our share holders.... by 1951 we had seven ships, all of them built or bought at prices we could never have hoped for if we had waited to see what would happen (quoted in Hope 1990:399).

J&J Denholm expanded but many other tramp owners held off waiting for the expected slump in shipbuilding prices only to witness 16 years of rising prices.

14.1.4 Supporting Industries It is now time to consider Davie's explanation that the decline was a reflection of the health of the British economy and its international trade. The health of the economy was

important to the extent that it created a demand for shipping, had healthy cargoes to fill hulls and other supporting industries provided low cost inputs which helped attain competitiveness.

At the outset of the First World War, Britain still enjoyed a healthy trade based on those industries that characterised the industrial revolution. Textiles, coal, iron and steel still contributed to two-thirds of British export earnings (Harley and McCloskey 1981:64). This over-commitment to old industries left Britain vulnerable to changes in the international economy, in particular rising protectionism which shielded a process of imitation in a number of countries which were once markets for British goods.

However, Germany and the United States were not prepared to just imitate, and developed a new range of products and production technologies as outlined in the previous chapter. With new products and production techniques, these nations enjoyed an increasing share of world trade while Britain's share continued to decline. Although British industry was strongly committed to the old industries, it was not stagnant. New industries were rising in importance in both foreign exchange and national income figures (Harley and McCloskey 1981:69). However, the transition was occurring at a dramatically slower rate than that in the new industrial power houses. Technology and commerce was now changing at a faster rate than the British had ever experienced. The compression of time and space, that Schoenberger recognised undermined American competitiveness in the second half of the twentieth century, was undermining British competitiveness in the first half. To get a foothold in the new opportunities they needed to respond at faster rate than they were used to. However, American first movers established themselves so quickly in the British market that local firms barely had a chance (Chandler 1990:275).

Table 14.2 Changes of world leadership in industrial production, 1870-1938

Percentage Share of World Industrial output of Top Five Nations

Nations	1870	1913	1926-9	1936-8
Britain	31.8	14.0	9.4	9.2
United States	23.3	35.8	42.2	32.2
Germany	13.2	15.7	11.6	10.7
France	10.3	6.4	6.6	4.5
Japan	-	1.2	2.5	3.5

(Source: Based upon F.Hilgerdt (1945) Industrialisation and foreign Trade, Geneva: League of Nations, Table,1. Printed in Dickson 1986)

In some instances, adoption of new technologies was hindered by environmental factors. In the same way that British coal enabled it to take the industrial mantle from the Netherlands, Britain lacked a Niagara falls or rivers flowing from the European Alps that allowed Germans and Americans to exploit electrochemicals (Chandler 1990:279). Lack of a cheap, powerful water based power also affected production of non-ferrous metals such as aluminium.

In the textile industry, Sandberg (1981:115) notes efficiencies in the British labour market actually created a barrier to the adoption of the most modern technology. American and Japanese manufacturers, facing a shortage of cheap skilled labour, adopted the ring spindle which could be operated by low skilled female

labour. The new machine provided great savings to the new competitors. The British, who did not face problems of skill shortages, would not have achieved the same benefits from the new technology so did not adopt it. This is an ironic situation in that British mechanisation had surpassed Indian textile production two centuries earlier under very similar circumstances, yet another reflection of the recurring nature of the forces of entrapment. In this case, it is the recurring nature of local factor costs as identified by Salter (1966).

The nature of the British market also created a barrier to the adoption of many of the new production technologies coming out of America. The United States could exploit new mass production technologies because it has the mass market to which it could sell. By comparison, when Britain adopted new products it served smaller specialist quality markets (Alford 1981:330).

Adoption of foreign industrial techniques was strongly inhibited by the structure of Proprietary Capitalism. Many of these rigidities have already been noted in the family dominated shipping lines. Small industrial firms, like tramp shipping companies, could not by themselves muster the capital necessary to invest in larger scale production, management and distribution systems that was propelling America to industrial leadership. With less capital and a desire to keep family control, British firms were hesitant to engage in risky investments and new and untried products and processes (Chandler 1990:335), a factor we have already seen in tramp shipping. This in sharp contrast to America where large corporations, with their industrial R&D laboratories, their accumulated specific stock of knowledge, their competence in large scale R&D projects, production and distribution and their financial resources had a capacity for advancing technology with which a perfectly competitive model could not compete.

The desire for families to retain control meant they were reluctant to seek funds through increased debt or the share market (Chandler 1990:335). Consequently, British firms never made investments that would allow them to benefit from the economies of scale or scope that their counterparts across the North Atlantic were achieving. The changes that were made were smaller, more evolutionary within the confines of the old organisational form (Ibid:262). If British firms amalgamated in an attempt to obtain economies of scale, they still continued to use the same old plants. Economies of scale achieved by the Americans remained elusive.

Family Management groups became entrenched stakeholders. While managers in the United States were increasingly promoted by ability, British family members inherited the leadership of the family firm, effectively becoming a distributional coalition. Nowhere could this be seen more vividly than the textile industry, which between 1880 and 1940, was the biggest industry in terms of output, assets and employment (Chandler 1990:332). Writing in 1928, John Maynard Keynes noted 'There is probably no hall in Manchester large enough to hold all the directors of cotton companies, they (run) into thousands. One of the first things should be to dismiss the vast majority of these people, but the persons to whom this proposal would have to be made would be precisely those directors' (quoted in Chandler 1990:333).

Lazonick (1990) provided a different explanation of decline in the textile industry which was equally compatible with the idea of entrapment and inertia. He believed the persistence of old craft control methods blocked the uptake of automated spinning and weaving technologies that were being adapted in the USA. The internal organisation of British firms saw the senior worker establishing a key position controlling output and the performance of subordinates. It was these minders, not the capitalist owners who recruited, trained and supervised the work-flow. This form of organisation had been fundamental to British success in the industry (1990:113). However, as key stake-holders, these minders were not going to welcome new machinery that sought to replace them. The power to introduce these changes was also limited by the weak power of the capitalists who owned the plants. With managerial control being exercised at the minder level, capitalists did not develop the managerial skills that arose in the US where large firms with top down hierarchies developed and the high level of competition between firms only weakened their power over these workers further.

Across the nation, distributional coalitions developed inside firms. Skilled senior workers had the organisational skills to create very strong unions that would create a barrier to the adoption of automated production. The union position was not helped by management's traditional reliance on the market for labour. Faced with fluctuating hire and fire policies, workers sought a property right position, not in terms of career within a particular firm but, in terms of a right to work with particular types of machines or materials (Lorenz 1994:392). As these demarcation lines were drawn, unions organised to reinforce such rights. Demarcation was also a result of a high degree of specialisation among the highly skilled workers.

As the position of workers became more uncertain in a declining economy, unions became more defensive, responding with vigour to even minor changes in machinery or materials. Demarcation divisions make it difficult to co-ordinate labour as efficiently as Japan where workers identified with the company and co-operated with the various machines and materials they used. Demarcation lines also made technological change a long, difficult and costly exercise. Burton (1994) notes that in the shipbuilding industry, when new technologies were introduced, demarcation disputes held up orders leading not only to higher costs but also lost customers. The loss of work made the unions even more defensive and, as the economic pie got smaller, unions became distrustful that employers were increasing their share at the worker's expense.

Insecurity in the workplace bred new problems which undermined competitiveness. Burton (1994:229) notes that theft and absenteeism became expensive problems in shipyards. Workers were responding to the deteriorating situation with a rationality that said 'make as much out of a job as possible because there might be nothing once the job was over'. Consequently, men stayed away from work at the beginning of the week and caught up on the weekends when they earned overtime rates. As a ship they were working on neared completion, they would deliberately slow down to put off redundancy if nothing else came in. These were symptoms of a Perez-type soci-institutional crisis.

Perhaps the biggest barrier to adjustment was the deeply embedded culture and institutional base. Education was a prime example. Public schools turned out excellent administrators to maintain stability in Britain's empire, but did little for the ideas of technical advance. These values of honour and public worth were not very different to Japan where they had been turned into an asset. In Japan, there had been a deliberate attempt to promote industry and commerce as honorable careers. Perhaps the biggest difference was that in England, there was little science in the curriculum. Science and working with hands to make money were not values endorsed by a society who increasingly saw industry as an area unworthy of a gentleman. The problem would not have been so confining but the public school formed the model for state schools. As late as 1902, the state system of secondary education was developed by public school graduates with the belief that the best form of education was that which they had received (Weiner 1981:21).

At university a similar pattern existed. Undergraduates were discouraged from pursuing commercial careers. Like the public schools, Oxbridge was the model for other universities, providing an education in political leadership with little introduction to the industrial world. While America and Germany were developing new science based education, English talent would not be given the skills to generate technological advance. An interesting illustration of the outlook of academia occurred at the turn of the century when a donor offered 100,000 pounds to establish a school of naval architecture at Cambridge. He eventually withdrew his offer in disgust after learning students would have to qualify in Greek (Pollard and Robertson 1979:144). Even, the Royal Society became more distanced from industry and more concerned with science (Von Tunzelmann 1981:148). The inevitable result for industry was a woeful shortage of skilled, scientific staff. While Japanese shipbuilders benefited from a flood of graduates in marine sciences, Britain's academic institutions produced little of similar skills. This resulted in reduced R&D expenditure and commitment.

An aversion to science also existed on the shop floor where the practical craftsman held sway. British shipbuilders did not have any faith in the ability of scientists to contribute to shipbuilding 'because scientists did not know how to build ships, and it was felt that only people who had passed through a proper apprenticeship in the yards and shops were likely to know enough of the problems involved in shipbuilding to be able to arrive at satisfactory solutions' (Pollard and Robertson 1979:148). While Britain emphasised the values of the 'practical man' and technological levels that had brought them success in the past, other nations developed deeper understanding.

An example of the limited scientific approach to shipbuilding can be seen in the development of the turbine by Parsons (Burton 1994:222). Development on the turbine proceeded on a pragmatic way with no attempt to understand for example, the fundamental physics and mathematics of blade design. New development was left to other countries, notably Japan, the Netherlands, Sweden and Germany. There was little appreciation of basic science and systematic analysis. As late as 1958, R&D in shipbuilding was running at one per cent of net turnover (ibid).

The fact that innovations still came fairly regularly from the British Isles suggests that British industries had not entered Klein's (1977) slow history. Even the Liberty ship which propelled American shipping forward was based on a British design, but it was America which revolutionised their production with the introduction of mass-production techniques. The difference is clearly not the rate of innovations per se, but the rate of their diffusion, and other nations were developing and diffusing innovations quicker.

There was also a failure to develop more sophisticated marketing practices. Companies lacked clear market strategies while even the nations most successful selling and advertising practitioners had little or no understanding of the basic concepts of marketing. As Alford (1981:328) states 'advertising was regarded as a means of popularising what was produced, not as a means of exploiting what had been discovered about consumer tastes and wants'. Burton (1994:224), who examined the shipbuilding industry, suggests that the failure in marketing and selling grew out of a long history of customers beating a path to the British door. While others were doing their utmost to satisfy customer need, British builders declared themselves the best in the world, failing to notice the changes around them.

Weiner (1981) believes the nation had experience a move from technology and commerce, a reflection of a "gentrification" of the leaders in the economy. On success, business men bought land and retired to the country to enjoy it. Here they enjoyed the prestige of being a landowner and acquired the trappings of the gentry. This process had been occuring since the mid-nineteenth century. As a consequence, the countries most able men became divorced from the world of commerce and industry. Company directors became aloof from management, their board rooms exhibiting a gentleman's club atmosphere which nourished cautious policies. Nowhere was this more apparent than the prestigious Institute of Directors which inhabited three mansions in Belgrave Square. Its director general once explained that 'directors are a kind of aristocracy; they should be men of parts, and they should have interests outside business... you could say we have a gigantic old boys network' (quoted in Weiner 1981:149). The goal of the gentleman-industrialists was not the wholehearted pursuit of economic growth but, gentility. The result was a conservative managerial culture which braked growth, placed stability ahead of growth and resisted institutional overhauls. It was as if Marshall's life cycle had become an industry/economy wide life cycle.

These values also reached the government. The Tories, in particular believed that economic forces should be made to accommodate established patterns of social relationships (Weiner 1981:98). Conflict and uncertain change was to be avoided while, materialism should be minimised. Regulation conquered laissez faire. The comparison with China, where the Mandarins sought to preserve social harmony, is striking.

Success had provided the English with a healthy sense of self belief and, like the Chinese and others before them, it inbreed a sense of moral superiority which created a barrier to adapting foreign production techniques. Americans were seen as being obsessed with size, speed, mechanisation and money. Gentleman-industrialists, like Peter Menzies of ICI, put down American materialism saying it would be

wrong to 'take up the American patter' (quoted in Weiner 1981:142). Samuel Courtauld (1876-1942), chairman of the company of the same name, admired the technical achievements of the Americans but even he confessed 'I view the so-called Americanisation of Europe with the utmost dislike. I doubt whether American ideals of living - purely materialistic as they are - will finally lead to a contented working nation anywhere when the excitement of constant expansion has come to an end'. Prime Minister Baldwin who came to power in 1923 and dominated British political life for the next 15 years shared these sentiments. A Midland's industrialist himself, he assured both business audiences and the general public that they need not abandon traditional standards in favour of apparently more successful foreign ones (Weiner 1981:142). Once more there is a strong similarity with China who rejected foreign production technologies in a desire to protect the nations values.

The UK economic system had produced its own aesthetics and this extended down to the workplace. American success was contrasted to an English founded on the values of humanity, honour and craftsmanship. Even leading engineering magazines objected to American ideas of scientific management with the comment that 'there are fair ways and unfair ways of diminishing labour costs...' (quoted in Weiner 1981:143). Wayne Harkin of Texas observed this pride when he inspected British shipyards:

> I found among these men a real pride in their accomplishments and indeed they have a right to be proud. Skilled craftsmen are in evidence all over the place. What amazed me was the fact that they had been able to turn out the quality of work with the facilities. (quoted in Burton 1996:236)

The desire to avoid social disharmony and conflict was a very real issue and added a cost to change that Americans certainly weren't having to face. Britain possessed highly skilled specialised workers who would have suffered very real dislocation from the change to an unskilled mechanised industry. Both employers and employees showed some preference to try to squeeze more out of the existing technologies, with the inevitable reduction of incomes and in some cases, loss of quality (Lazonick 1991:46).

The cargo whose decline most hurt shipping was coal. Between 1913 and 1938, British coal exports halved from 77 million tons to 38 million, and further still to 7 million in 1960 (Hope 1990:368 and 399). English shipping had derived a marked competitive advantage from the fact that it had an outward cargo, coal which in the days of steam engines which had a vast global demand (Davies 1985:80, Sturmey 1962:70 and 73). Coal exports declined with the rise of oil, an increase in foreign output of coal, and more efficient use of coal which reduced its use. The decline of coal was particularly damaging to Britain's tramp shipping which was well adapted to the coal trade.

The reliance on coal as a supporting industry and the limitations of family firms in the tramp trades are well illustrated by the Cardiff based 'British Steamship Company'. Cardiff at the turn of the century was the largest coal exporting port in the world (Middlemiss 1989:11) and had a large tramp fleet going to the Mediterranean, the Black Sea, and Latin America where the return cargo was grain. The British Steamship Company was one of a number of companies founded by John Cory a master of coastal traders

(Middlemiss 1989:109-113). In 1854, he started his own business drawing on close association with Cory Brothers, coal exporters of Cardiff, and William Cory and Sons who operated colliers. In 1874, John Cory bought his first steamships and his fleet grew rapidly to number 19 in 1884. As befitting an age of proprietary capitalism, his sons were brought in as partners in 1885, the eldest taking over the business when his father died. By 1891, the company had become the largest importers of iron ore in South Wales. By the outbreak of the first world war, the company had 23 tramps and a world wide market for its unique blend of coal.

World War One cost the company dearly, with war-time losses halving the size of the fleet. However, worse was yet to come with the decline in coal exports. Cardiff shipping suffered greatly and in 1923, more than half of the city's tramp-owners crashed. However, sound financial management enabled the Corys to survive. But other aspects of the company's business were declining. Imports of iron ore were stopped in 1927. By the Second World War, the company had only three tramps, only to lose all of them in the hostilities.

With experience being their only remaining asset, they survived by chartering ships and making the occasional purchase, including the company's only motor ship in 1959. However, ships were getting bigger and more expensive. The family firm could not afford to build an expensive bulk carrier which meant they could no longer be competitive in the tramp trades. By 1989, they were no longer a shipping company but operate as shipping agents under the name Raymond Cory. They were a well managed company that reflected the rise and fall of the British fleet.

The other key supporting industry was shipbuilding, but by now it was relatively easy to buy ships from other nations. However, Sturmey (1962:401) notes the tendency of British to continue building tonnage in Britain when better and cheaper ships could have been obtained from overseas. For example, the knowledge that tankers could be built more cheaply on the continent during the 1930s did not lead to buying abroad. It was just another reason for not having tankers at all. The owners would stick to their old routines and complain about British prices.

However, the importance of linkages to weak shipbuilding industry should not be overstated. As Robertson (1988:192) notes it was not the builder who determined the specifications of the ship. The builder might make suggestions however, the buyer had their own technical representatives who would over-see construction and fitting out. In the early days, the close technical relationship between builder and ship owner had increased the flow of information and led to increased efficiency. However, close relationships can become a weakness if one partner becomes inefficient and weighs the other down or alternatively, if communication is based around old patterns and norms and does not change with the times. As Lundvall (1992:357) notes investment of time, information and trust in such relationships can lead to rigidities that restrict more flexible change. It was a particularly harmful linkage given the integrated nature of the industry in Britain. Many shipbuilders and shipping companies had close associated companies.

From the Second World War until the late 1950s, government restrictions stood in the way of foreign built ships as the government sought to preserve foreign exchange in the difficult post war environment (Hope 1990:399). After these restrictions were lifted, ship owners often bought British ships out of goodwill to their fellow countrymen, an expensive gesture for some. In the 1960s, P&O continued to give orders to Fairfield shipbuilders even though Japanese could provide the ships much more cheaply. When Fairfields collapsed in 1965, P&O suffered as an unsecured creditor. As Sir Donald Anderson stated 'our gesture of goodwill towards British shipbuilding turned out to be very expensive for us, and of no help to the shipbuilding industry' (quoted in Howarth and Howarth 1986:171).

14.2 Attempts at Reform

The Atlee Government (1945-51) was the first government to give a high priority to raising industrial productivity and created a number of policy measures, the most well known being the Anglo-American Council on Productivity (AACP) (see Tomlinson 1991). It was established in 1948 as a non-governmental body and comprised members representing both management and labour. It also included employers representatives from the United States. Americans were keen to raise British productivety as part of its concern for European prosperity that gave rise to the Marshall plan.

The inclusion of Americans should have made the process of technology transfer relatively easy. The Council certainly had open access to information. The programme included plant visits, exchange of production techniques, productivity measurement and other economic information. Forty-nine teams were created dealing with specific industries and another seventeen dealing with specialist subjects such as management accounting. They revealed factors leading to high US productivity as including 'extensive use of mechanical aids', 'appreciation by work people of need for higher productivity' and 'managerial techniques' including modern methods of costing, production planning and control and work study methods. Despite this free flow of information, the AACP failed to have an impact.

The AACP failed for a number of reasons. Stake-holder resistance was one of them. The principal employers' representative (FBI) had initially welcomed the AACP as it believed it would clear it of many of the negative comments made about British management. By contrast, the results actually stressed the failure of management technique in Britain. This raised a defensiveness among employers. Some of the employers' defensiveness held some validity. Much of the AACP's comments were devoted to spreading the gospel of scientific management which many saw as inappropriate to British industry. Britain did not have the mass American market which offered greater opportunities for standard costings than the small scale, craft orientated firms of Britain. Many of Britain's smaller firms, who were most in need of reform were not involved with AACP's findings.

Tomlinson also suggests that the AACP failed because the productivity teams and their reports were simply inadequate to deal with problems that were so deep-seated. For ideological reasons, the government was

not prepared to take an even more interventionist role in the workings of industry. Government kept its distance. Timing did not help. The immediate post war environment was highly profitable for British businesses who were operating in a seller's market and must have undermined employers' sense of a need for change. The post war environment in Britain was also one which desired stability as a preference to economic growth. This is in sharp contrast to France who, having recently been occupied by Germany, seized the opportunity to upgrade their productivity with American techniques. The external threat for Britain was not so great.

Commitment to reform was also undermined by uncertainty. The new American methods with high investment levels and bureaucratic administration were superior in times of stable growth and expanding mass markets, but would those conditions continue? British producers had experienced protracted recessions in the past and they were concerned that the post-war boom would be followed by a slump and they would be left with expensive irreversible investments. The old method of production which relied on the market with low administrative overheads, may have been more adaptable during periods of instability. This uncertainty undermined commitment for change.

Lorenz (1994:388) notes that virtually 'every plan for rationalisation of enterprise organisation in the shipbuilding, engineering and cotton industry ... floundered on the reluctance of conservative majorities to commit themselves to serious programmes of institutional reform....'. Declining profitability and the collapse of major producers eventually led producers to agree on the need for serious reform in shipbuilding, cotton, automobiles and various branches of engineering. In 1962, the Shipbuilding Employers Federation presented a plan for reform to the unions. However, by now the problems of uncertainty and trust undermined co-ordination of the various reforms proposed (Lorenz 1994:392). Negotiations for reform operated in an environment of fear that the other side was trying to shift the longer term distribution of returns in their favour. The eventual results in most cases amounted only to local modification of the craft system.

During the second half of the 1960s, the urgency of the matter was obvious to all and significant changes in work organisation finally occurred. Local employers negotiated a series of productivity agreements offering greater job security in exchange for increased flexibility and inter-changability among the skilled trades. Recognising the severity of the crisis shipbuilders accepted the need for reform. The existing craft system was modified but, it was not replaced by the more successful bureaucratic administration of work. The changes that were made only amounted to local modifications of existing craft arrangements with piecemeal adjustments. Consequently, it was not accompanied by substantial improvements in competitive performance. Planning techniques remained rudimentary while skilled workers and shop level foremen continued to play a key role in co-ordination of work. British employers could not implement change successfully because they lacked experience with more bureaucratic methods. Like the Mandarins in China, their attempts at change were limited by their own skill base and capabilities. Past investment in skills and established stake-holders kept Britain on the old economic pathway.

Britain became the 'sick man of Europe'. Between 1945 and 1977, it had become a country conscious 'of accute and apparently insoluble economic problems: troubled by the consistent lag behind other countries in economic growth, lacking in pride and self confidence and given to moods of fustration, despair and at times desperation' (Cairncross 1981:415).

14.3 Discussion

The British experience is consistent with the thesis as the nation had become entrapped on the path of economic development that had carried it to primacy. On the back of coal, iron and steam technologies, family firms developed skills, capabilities and heuristics that brought them success. They reinvested profits and gained a technological edge with which others could not compete. Institutions were created to exploit these new technologies, in particular the unions which trained and facilitated an efficient allocation of labour. Marshallian industrial districts grew whose products provided key cargoes and capital goods for the shipping industry. Success showed that British techniques were the best, and they were. However, when superior techniques arrived British shipping and industry were entrapped by an arrogance, institutional and belief system which slowed down the pace of change. Britain was suffering from an over commitment to the products, organisational forms and production technologies it had developed in the industrial revolution.

British ship owners neglected the opportunities associated with the tanker, the diesel powered motor ship, and the importance of speed as a competitive factor. When other nations arrived with new techniques they were perceived as cheating. It reflected a pre-occupation of old techniques and a lack of self criticism. Liners showed a greater ability to survive than the perfectly contestable tramps, a reflection that a large number of small competitors has trouble adapting to change that requires greater co-operation and higher levels of finance. It also recognises that profit maximisation is an insufficient explanation of business motives. Autonomy, family pride and the desire to adhere to firmly-held values are equally important when understanding commercial behaviour.

Finally, adaptability was hindered by uncertainty and mistrust. As the situation deteriorated, groups who previously welcomed change protected their position in the economy, in the process becoming distributional coalitions. Interestingly, the position of labour appears to be more defensive on shore where union and management formed antagonistic polar blocks. It is worth noting that, in shipping, the Maritime Board, which was created during World War One with representatives of both employers and unions, created a habit of agreement (Sturmey 1962:286). However, this positive outlook was not enough to stem a long decline.

Table 14.3 Entrapment of British Shipping

Sources of Competitiveness	Paradigm Heuristics	Sources of Entrapment
Shipping Industry		
- Flexible Family Tramp Firm	- Company is a vehicle for family to gain prosperity and autonomy - Self financing	- Norms of not using external finance limited opportunity to compete on size. - Reluctance to reduce control. - Families become a distributional coalition.
- Ship technology	- Use all purpose vehicles (the tramp).	- failure to shift to faster, larger specialised ships.
- Liner Companies/ Conferences	- maintain stability by reducing price competition.	- Ship owners become distant from productivity.. - reduction in competition and increased barriers to entry
- Flexibitiy in Asian Trade		
Supporting Aspects of Economy		
- Iron and coal supply	- Use coal powered vessels	- Slow to move to diesel
- Skills/expereince	- Practical man	- Unions become distributional coalitions
- Knowledge Resources (Education/Royal Society, etc)		- Slow to move to science based engineers ie: persistance with routines and reproductive education.
- Family Firms	- Company is a vehicle for family to gain prosperity.	- Families become a distributional coalition
- Expansion of Empire, government policy and naval support.		- Decline of empire and rise of protectionism -industries more independent with growth.
- Reputation	- British are best by definition	- arrogance
- Ports and infrastructure	- rely on British facilities	- British ports are too small for large ships therefore don't enlarge
		Others Uncertainty Distrust

14.4 A Brief Note on Shipping in the Second Half of the Twentieth Century

By 1960, British share of global shipping had slipped to 16%, a huge decline from the beginning of the century when it propelled more than half of the world's ocean going vessels (Sturmey 1962:4). New growth paths were opening with markets in tanker shipping, bulk ore carriers, containerisation and the increasing growth of Pacific Ocean trade.

Table 14.4 **Principal Merchant Fleets 1953 -1973 (million grt)**

	1953	1963	1968	1971	1973
Liberia	1.4	11.4	25.7	38.6	49.9
Japan	3.3	10.0	19.6	30.5	36.8
Britain	18.6	21.6	21.9	27.3	30.2
Norway	6.3	13.7	19.7	21.7	23.6
Greece	1.2	7.1	7.4	13.1	19.3
USSR	2.3	5.4	12.1	16.2	17.4
USA (1)	27.2	23.1	19.7	16.3	14.9
USA (2)	14.2	11.6	12.0	11.3	12.4
Panama	3.9	3.9	5.1	6.3	9.6
World Total	93.4	145.9	194.2	247.2	289.9

(Source: Central Office of Information:1974)

Table 14.4 illustrates the changing status of the leading maritime nations in the post-war period. Unfortunately, these figures belie processes that make it hard for us to measure industrial leadership. In terms of pure tonnage, the Americans possessed the most tonnage in the first two periods however, much of this was surplus from the war. The second figure for the USA does not include this reserve fleet giving a substantially smaller figure. However, even this does not reveal the true extent of American shipping as much of the Liberian and Panamanian shipping belong to American companies fleeing their national flag to escape the constraints of American maritime law. American companies became significant owners of tankers, a market which grew dramatically in this period, and pioneered the advent of containerisation. While Liberia tops the table from 1968 onwards, most of its shipping is owned, controlled and managed from the United States.

In the first half of the twentieth century, Greek shippers such as Aristotle Onassis figured highly among the Flag of Convenience owners, however, the introduction of more favourable government policy and tax laws saw many of these ships converting to the Greek Flag (Sturmey 1962:393). Hence the rapid growth of Greece in this period.

We can see in table 14.4 that by 1971, Japan had replaced Britain as the largest pure national fleet, a reflection of the strength of its local domestic economy, the strength of its export industry and demand for imports and the fact it's ship-owners did not use flags of convenience at this stage. Consistent with Porter's realisation that competitive advantage stems from early home demand, Japan gained leadership in bulk ore shipping and also has a large number of tankers, a reflection of their domestic demand for bulk imports. Japan also pioneered new areas of shipping such as car carriers. The importance of the domestic home environment looms large in Japan's post war shipping success.

Norway (along with Greece) are strong on the cross trades, shipping between foreign nations that does not include their domestic ports. This suggests a declining role for the domestic environment in generating competitive advantage. However, Norwegian shipping draws strongly on its home based cluster which includes 20% of the world's ship insurance market, classification of 15% of the world's fleet, ship-gear

producers, educational facilities and brokerage houses. In contrast to the low cost Greeks, this cluster generates transport solutions at the high end of the value spectrum (see www.norwegian shipping.com).

Chapter 15

Conclusion

This thesis set out to explore the forces that determine the rise and fall of industrial leadership. It attempted to do this by applying an industry life cycle model to the shipping industry. While much has been written on the shipping industry, providing a wealth of information, no one has taken a long-term view of shipping from the stand-point of the economic literature. Merchant shipping is an ideal industry to research given its international nature and the age of the industry, thereby giving insight into international competitiveness and industrial development over a long time-frame.

A historical view of an industry has much to offer in analyzing how an industry and competitive behavior changes and evolves over time. There are 'economies of time' that have a strong impact on an industry's performance. These include the legacies of past investments and the effects of first or early mover advantages. The historical approach also provides an opportunity to examine industrial behavior in a variety of contexts. Finally, it helps to reveal a chain of causation that is lacking in many statistical approaches to industrial analysis. For these reasons, I hope my thesis will contribute to the body of knowledge on industrial development.

The industrial life cycle was posited on the basis of existing literature, particularly the growth of knowledge, evolutionary and institutional literature, which lend themselves to patterns of industrial growth and entrapment. On this basis, this thesis set out to examine whether industrial leadership can be explained by a four staged process of imitation, catch up, advance and entrapment. However, this thesis has exposed something more complicated.

15.1 Imitation and Catch Up

In the first stage we expected awareness of the advantages in adopting foreign technologies, overcoming the barriers to adoption and final adoption of those technologies. As knowledge and capabilities is built and buttressed with supporting institutions, these nations then enter a 'catch up' stage. The earliest economies we examined do not support a strong process of imitation. Certainly the Chinese borrowed some aspects from the Arabs and Hindus and vice versa, but most early development was indigenous. Though difficulties of communication in the early period may have contributed to this lack of imitation, the main reason is the regional nature of early shipping. Shipping was a highly risky industry in which a mistake could lead to loss of life. Consequently, shipping technology had to be well matched to the environment in which they operated. This resulted in light dhows in the Indian Ocean ships and heavy junks in the China Sea. Regional variation also reflected the availability of local resources including bamboo, wood and iron.

European shipping showed clearer examples of imitation in productive technologies and in shipping this included the compass, stern-post rudder and lateen sail. Yet, even here, European shipping technology

reflected the demands of the Atlantic Ocean and available resources, the inheritance of the northern and southern traditions and was punctuated by the state sponsored R&D of Prince Henry.

Clearly Medieval shipping followed three separate evolutionary paths reflecting the demands of the Atlantic, and Indian Oceans and the China Sea; and the associated resource base. The demands of the rough Atlantic and international exploration led Europe to develop the best early trader for long distances. However, in the Indian Ocean, it found it could not compete with the light-structured dhow, which was more specially designed for the environment, particularly the light winds.

With the rise of the Dutch, British, Americans and Japanese a clear process of imitation, catch up and advance emerges. In the case of the Dutch and the English, it reflects the similarity of the seas these nations traveled to the nations they imitated (the Iberians). It also reflects the greater ease in communicating technologies as time progressed and distances shortened. In these later nations, imitation of shipping technology was also associated with imitation of supporting industries. This reflects the systematic nature of shipping through its linkage with cargoes, but also the importance of clusters in industrial leadership.

A key question confronting us is why were successful imitating nations not entrapped in their old economic system? The first answer is the new economic activity was compatible with the old economic system and did not produce restrictive conflict. Chinese shipping was only clamped down on when it conflicted with defensive goals as it exposed the nation to piracy. In Spain and Portugal, shipping was a natural extension of the reconquista mentality while Europeans all saw shipping as a means to increase national wealth and defense.

Standing out during this phase is the importance of government support. Given the first mover advantages of the established leaders, government support was invaluable to the success of the imitation process. Such support included finance, infrastructure, educational facilities, high levels of demand, monopoly status in the early phase of development and incentives to make improvements. A notable feature of government policy in these years is the commitment to continuous improvement and expansion of capabilities.

An aspect of the imitation process, linked with the ability to get government support, is the consistency of the new growth path with the country's religious and military goals. The military linkage is further linked with the existence of external threats as an agent for change. Where a new path is not fully consistent with the existing institutional infrastructure and value system, a process of legitimization or amalgamation of values is necessary. Effective occurrences of this, such as in Meiji Japan, came from above.

In many cases, external threats served to shake economies out of their old patterns of production. This included Sung China, Spain (threat of Muslims), the Dutch (threat of Spain), the English (Spain, Dutch and French) and Japan. Even though the USA was not under threat, its shipping was seen as an important part

of its defensive strategy. However, war obviously was not restricted to these nations. For example, we could very well ask why the Mughals did not shake up its productive systems when attacked by the Maharathas? In this case, the Maharathas were a land power so naval forces were not so important and secondly, as stated in the thesis, the Mughal leaders had retreated from technology.

One final aspect to consider is the role of luck. Chance events have played a key role in shaping industrial leadership. One need only contrast the voyages of Cabot and Columbus and wonder if the Potosi silver mines were located in Newfoundland what differences would have occurred between sixteenth century Spain and England and their later development paths.

The opening of windows of opportunity during imitation assisted the catch up process. Mistakes by the incumbent leader could open windows of opportunity, as seen in the Dutch handling of the Chinese trade at Batavia or the Portuguese at the Mughal court a century earlier. Wars were another common opener of opportunities as they deflected the incumbent's resources and shipping and provided a level of protectionism to the imitator. Finally, a window of opportunity appears to exist in those activities outside the rules of the incumbent, such as the Spanish fleet system, which left the market unattended for long periods and provided a window of opportunity for the Dutch

15.2 Advance

A process of advancing technologies was important in the rise of all countries looked at, with the exception of Gujarat. A process of technological advance is not supported in the history of Gujarat. Gujaratis adopted the best practice technologies which, at that time, had been well disseminated around the Indian Ocean but, this was not followed by any technological advance. Their competitiveness was based on environmental factors (supporting industries and strategic location) and the experience and skills they built up over time.

The causes of advance are varied. Some were spin-offs of existing military and religious institutions such as Chinese naval and Taoist spin-offs. In the case of Dutch windmills and other labour saving devices, or British steam, they were a response to bottlenecks occurring as the economy went through a growth phase. In all cases, they reflected a high level of education in the economic system. A factor that must have contributed to superior European seamanship was the greater diversity of seas that they sailed in from the sixteenth century on-wards. They were exposed to the greatest range of conditions, the greatest range of problems and therefore, had to generate the greatest range of solutions.

Table 15.1 Competitive Advantage from Industry and Environment

	China	Gujarat	Iberia	Netherlands	Britain
Advantages Specific to Industry					
Shipping technology	Y	N	Y	Y	Y
Specialised skills/Experience	Y	Y	Y	Y	Y
Organisation	Y	Y	Y	Y	Y
Reputation	--	Y	Y	Y	Y
Advantages from Environment					
Supporting industries	Y	Y	Y	Y	Y
Knowledge resources	Y	Y	Y	Y	Y
Government policy	Y	Y	Y	Y	Y
Linkage to Empire	Y	Y	Y	N	Y
Infrastructure	Y	Y	Y	Y	Y
Factor endowment	Y	Y	Y	Y	Y
Compatable religious/military	Y	Y	Y	Y	Y

Our expectation was that advance would occur on a broad front with a new Perez-type tehno-economic style affecting all pillars of competitive advantage. Perez originally linked her techno-economic style with an advance in one factor of production eg: coal. To that extent, we do not have a complete match in places like China where different factors affected shipping and on-shore industries. A 'paradigm' is a better word to use as it is far more encompassing. And here there is some evidence for support. As table 15.1 shows, competitive advantage relied on strengths not just on in the industry, but in the supporting environment which also benefited from the wave of advance. In all cases, the road to leadership was linked with expansion across the domestic economic system and foreign markets. This obviously reflects the derived demand and systematic nature of shipping. Growth in the domestic economy provided better access to capital, markets, cargoes, led to the development of economies of scale and industrial clusters, increased opportunities to build experience and increase specialisation. In many cases, it also lead to increased educational endowments and this aided technological advance. But perhaps an industry that does not rely on derived demand would not show the same level of dependency.

Coupled with Perez's idea of a techno-economic style was the idea of a leap in best-practice technology, and this was not supported in all cases. When the British surpassed the Dutch (and Chinese in the earlier period) the improvements were not in the nature of a leap, but of many smaller improvements. Clearly both leaps and continuously minor improvements can affect leadership.

15.3 Entrapment

Although we speak of a process of entrapment, all the economies showed remarkable versatility. For example, Gujarat incurred a significant trading shift from the East Indian Ocean focused on Malacca to the West Indian Ocean with its focus on the Red Sea. The Portuguese evolved from a crown based system to a system of private enterprise and contracts, while the Netherlands evolved through many stages. It is wrong to see these economic systems in static or limited terms. However, at some stage, the economy lost its vitality or lost its ability to accommodate change or generate innovation.

A Perez-type socio-institutional crisis in which institutions associated with the old techno-economic style are confronted by the new are clearly evident in China, Spain and Britain. However, the hypothesis is not supported with Gujarat and Netherlands. Guajarat incurred a crisis but it was not the Perez-type crisis we were expecting where the old confronts the new. Gujarat's crisis was a consequence of the Mughal empire imploding. The Netherlands experienced a crisis of decline but once again, it was not the old confronting the new. Although the British certainly developed some superior technologies in the eighteenth century, when the British first surpassed the Dutch, it was not on the basis of a superior economic style but superior resources, in particular military. Netherlands then experienced a crisis with loss of markets due to the fact that many nations were embarking on catch-up and taking away old markets.

From the work of Klien(1977), this hypothesis suggested that decline would be linked to increased industrial concentration. We would expect this process to reduce the vibrancy of the industry. This study has revealed a number of instances of increased concentration from the Portuguese Fidalgoes to the British liner and conference system. This thesis reveals that such concentration repeatedly occurred in attempts to gain market control, increase market transparency and reduce risk of price shifts. In some supporting industries, it was also associated with technical possibilities that allowed the exploitation of economies of scale but increased the capital requirements of the industry. In the case of Dutch guilds and Spanish Consulado these strongly contributed to a decline in vibrancy. However, this did not occur in all cases. For example, the Portuguese private traders developed a cartel that maintained its competitiveness. However, at the Asian end of their activities, competition would have kept them in an efficient and flexible state. In Britain, the corporate liners had the finance capacity to make the transition, while the highly competitive British tramp shipping showed the least ability to respond to the changing environment. In this instance, concentration would appear to be more amenable to change that requires increases in resources.

An interesting finding of the study is that the most competitive industries became entrapped and did not respond to the available opportunities. In this respect, the case of Gujarat and British tramp shipping are strikingly similar. These were proprietary firms with family control being an incentive, which was clearly more important than profit maximisation. Chinese shippers also operated in a very competitive environment but did not produce the technological innovations that Europe produced. High levels of competitiveness in key supporting industries similarly did not produce technological innovation. Clearly, even economic systems with high levels of rivalry can become entrapped by structural entrapment (caused by specialisation), paradigm entrapment, and entrapment in the supporting economic system.

A feature of this thesis was the importance of saturation. It is a pattern that occurs time and time again. For example, Gujarat found the markets of the Indian Ocean saturated prior to its decline. Spain found the seventeenth century silver market flooded while Portugal later found the same with pepper (even the United States suffered from saturated shipping markets in the twentieth century). Saturation represented a limit to growth within the existing path of development and is associated with new entrants to the market performing catch up. It is a reflection of the Richardson problem on a large scale. In such circumstances,

we might expect producers to diversify or an illustration of Downie's innovation mechanism. The nation to emerge from such an over-supply situation was one that opened up new paths to growth, such as the Dutch proto-industry which emerged from the seventeenth century crisis or the British in the Indian Ocean.

There is a clear linkage between the concepts of path dependency and technological frontier. The Dutch development path reached a frontier when the limits of its wood-peat based technologies were reached. The British, with an abundance of coal, found it hard to move from a development path kept on their path to diesel/electrical-based activity. More recently, Abramovitz (1986) noted that post-war convergence reflected the fact that the United States had reached a frontier and consequently other nations found it easy to catch up. There are some similarities to Vernon's (1961) product life cycle, in which he saw other nations advancing in an industry once it had become standardised. But how do you define a technological frontier when this thesis has shown technological advance after advance? Certainly, at the frontier, technology has stabilised. We can no longer add significant value or reduce costs with the existing system. This process of saturation and advance is consistent with the thesis. The key is probably 'within the system'. For example, Britain was capable of generating improvements in shipping that the Dutch couldn't because it had a different resource base. It is the purest example of entrapment. The reason that Japan in the twentieth century could introduce so many innovations in the industries that the United States thought were 'mature' was because the Japanese were traveling a new growth path.

An interesting aspect of entrapment is the repeated pattern in which Chinese, Iberian, Dutch and English merchants tended to buy land and education for their children on success, a reflection of the Marshall life cycle but on an industry wide basis. There are two aspects to this. Firstly, investment in land was wise given it is safe, and there were not the broad range of investment opportunities that we have today. However, it is also linked to what Weiner called a process of gentrification ie: a chance to assimilate into the social class that the entrepreneurs were always considered below. It must be remembered that often the incentives of entrepreneurs were not just profit but to raise their social standing and that of their families. This last aspect was the completion of a goal that put them on a path to entrepreneurship in the first place.

We have a tendency to think of social mobility as a key contributor to economic growth. This can be found in Olson's position of distributional coalitions. This hypothesis shows the effects of social mobility and economic growth as a two way process. It is economic growth and change that delivers social mobility. For example, the Dutch, Chinese and English periods of growth clearly led to periods of social mobility. As growth declined and less change occurred, distributional coalitions seemed to develop proprietary rights in their social-economic positions. However, it should also be noted that when China went through its period of economic decline, social mobility had actually increased. The decline was not due to social forces but, a lack of changes in productivity stemming from a persistence of routines, heuristics and beliefs.

At this point, it is worth considering North and Thomas's statement that 'A stationary state will result when there is no inducement in that society to undertake those activities that lead to economic growth' (1973:1).

This history has revealed that access to resources to develop technology was equally important, and at times, more important than property rights, lending some support to Schumpeter's (1942) innovation "by decree". Monopoly rights were key contributants to maritime advance in Portugal with Prince Henry's research into the African trade and the two great East India Companies, but they could also limit the diffusion of technique as seen in the monopoly steam-ship rights in early New York.

An important aspect is the alignment of incentives with the old development path. We saw how, in the Mughal empire, the incentive system relied on expansion to reward its members however, when expansion stopped its members milked the system. They continued to seek rewards consistent with their value system and skill base. This meant seeking short-term returns and becoming distributional coalitions in the process. The expansion stopped with a reliance on the old firearm technology as the emperors distanced themselves from technological advance. It is interesting to compare this with criticisms of the US performance in the 1980's where share market investors and corporate executives became pre-occupied with short term ROIs. When stakeholders are established and expansion stops, it is ripe territory for the development of a rentier class. Of course, the development of a rentier class with its distance from core activities is also a reason why expansion slows.

The rate of technological change is an issue identified and a number of patterns have occurred. Klein's fast to slow history occurred in China and the Netherlands, but not in Spain nor Gujarat. Technological advance was not a factor in Gujarat's rise or decline. The Spanish break-through, with the discovery of America, owes more to luck than any technological superiority over its neighbours. Only after America was opened did Spain go through a period of 'fast history'. This eventually was followed by 'slow history' a century later. A more consistent pattern is a global quickening of technological change as seen with the English who advanced on the basis of 'fast history' but were surpassed by others producing faster history.

On the psychological level, there was a constant re-appearance of cognitive barriers to change including cultural myopia and persistence of learned schema, values and routines. These can be seen in the English 'practical man' and 'all-purpose tramp', Chinese Confucianism or the Iberian reconquista. When confronted with the new, fear of loss, uncertainty and conflict resulted which made change even more difficult to introduce. Uncertainty could appear in a number of forms including the need for change, what to change and how to change it. Arrogance which acted as a barrier to imitate new competitors, was a function of past learning of superiority (and pride).

15.4 An International Industry Life cycle?

When dealing with only seven examples it is difficult to arrive at a definitive explanation. Nevertheless, in a pure and rigid form, an international life cycle does not appear to exist. Other forces are operating to undermine it, in particular, the movement from regional to global production and markets. Perhaps in the past, the shipping industry has been more influenced by regional environments than other industries due to the resulting death and losses that result if local environmental sensitivity is not highlighted. As

globalisation progressed and ships appeared that could handle a variety of markets, the life cycle appears to exist. Ironically, more recently, globalisation appears to threaten the cycle by reducing the impact of domestic environments

Acknowledgement must be meade of early indigenous developments, not based on imitation, that do not immediately lead to a position of advance/leadership. In this light, a better explanation for stage 1 would be 'capability building' which includes acombination of imitation and indigenous developments.

The stage of leadership was upheld in all cases, although in the case of Japan, it ouccrred after the time frame examined in this thesis. However, this finding should be of no surprise as the nations studied were chosen for the very reason that the literrature revealed that they would become leaders in this industry. To that extent, we have a bias of limited selection. An area of future research would focus more on the 'also-rans' and examine to what extent their pattern advance mirrors that explained in the life cycle. However, to study every nation that launched a shipping industry but failed to obtain global stature over the same time period of this thesis would involve a mammoth task so, should perhaps be limited to certain comparative epochs.

Table 15.2 Stages of the Life Cycle

	Imitation	Advance	Leadership	Entrapment
China	very little	Yes	Yes	Yes
Gujarat	already possessed	Yes	Yes	Yes
Iberian Peninsula	some	Yes	Yes	Yes
Netherlands	Yes	Yes	Yes	Yes
United Kingdom	Yes	Yes	Yes	Yes
United States	Yes	Yes	Yes	Yes
Japan	Yes	Yes	---	Yes

The cycle is also undermined by political and military forces which can not always be seen as exogenous. A stand-out example of this was the Dutch decline when loss of markets by military means occurred during Britain's period of catch up. Military and political maneuvering can reflect an alternative method for an economy to enhance its resource base and reflect the nation's value system. Despite this, the forces of imitation, catch up, advance and entrapment have occurred repeatedly throughout this thesis. To that extent, the model may have value as a descriptive tool once the affects of globalisation, luck, political and military forces are taken into account.

Another question that needs to be addressed is to what extent the model put forward is applicable only to the industry in question or the broader macro-economy. The question is relevant given that in each case shipping was declined by a general macro-economic decline and shipping's derived demand aspect. Clearly, given the industry's reliance on domestic capital, cargoes and knowledge capital, to some extent the model is driven by these broader forces, especially in the early phase in development when the industry is most directed towards the domestic environment. However, once the industry has become international competitive, these forces are reduced but buy no means irrelevant. Many of the industries in the economy

that rise and fall with shipping are based on similar techno-economic regimes or paradigms, consequently they shared the same fate on arrival of a new paradigm or market shift. In this light, it is worth recalling the American experience in the 1970's when the 'rust-belt' industries of America were ravaged by superior Japanese competition. Other parts of the American economy managed to survive and revitalize themselves, a reflection that as economies become more diverse, and a number of techno-economic paradigms co-exist. In this light, the macro-economic environment can experience forces of decline and capability building at the same time.

It would be useful to see what extent these forces have been at work in other industries. Other areas of future research could include other industries with such longevity. This could include ceramics, textiles and agriculture. In *Revolution in Time,* David Landes(1983) has performed an excellent examination of the account of the watch and clock industry which could be re-examined with an eye to an industrial cycle.

15.5 Can the past predict the future?

Margaret Hodgen's "Change and History: a study of dated distributions of technological innovations in England AD1000-1899 identified that the 'chief factor making for innovation in a community is prior innovation'(quoted in Lynn White Jr 1963:). We now live in a society that has become accustomed to a faster rate of innovation than any society before it. If Margaret Hodgen is correct, we could perhaps expect our acceptance of innovation to reduce the chances of entrapment. Certainly, the recent growth of the United States in the 1990's begs the question 'do we know no longer need to fear entrapment?' As mentioned above, the United States was ravaged in the rust-belt districts but, the economy has been reborn with new Internet and bio-technology production. Our economies are more diverse with a number of different growth paths being developed at any given time. Any one product may in itself combine a number of different technologies. While one part of the economy may be entrapped, another may have the vigour to advance regardless. At the same time, improvements in low cost transportation have reduced the chance of resource-based entrapment

Other factors that could reduce the chance of entrapment are our greater scientific knowledge which is generating advances at dramatic rates. We have reached the stage where innovation itself has been institutionalised with R&D staff becoming responsible for innovative advance. We have large companies with R&D budgets far in excess of anything imaginable in eighteenth century Netherlands or Ming China. However, we should not forget that some of the most innovative companies in the United States were among the first to succumb to the Japanese challenge. We need only think of RCA, a company that pioneered many of the innovations that ended up being mastered by the Japanese.

In an increasingly international age, it is now possible to buy ships in an international market, recruit sailors from the cheapest labour supply and, through modern communications, compete in any markets with little domestic ties. It seems the domestic market is no longer so important and this can free producers from the chance of entrapment. This is most blatant in the Flags of Convenience, in which ships can sail under flags

of nations such as Liberia and Panama with few rules and allow the exploitation of the lowest costs available. In theory, the flags of convenience are not linked to any domestic economic system. Consequently, it represents an age where the domestic economic system would seem of less importance. However, many of these FOC ships have ties with organisations, which serve the same function as their domestic economy. For example, oil tankers registered under a FOC are likely to be connected to a multinational that provides access to markets, cargoes and information channels. Secondly, if we look at Norway, a nation that appears to excel on the cross trades, we find Norwegian shipping draws strongly on its home based cluster which includes 20% of the world's ship insurance market, classification of 15% of the world's fleet, ship-gear producers, educational facilities and brokerage houses. It should also be noted that the domestic market is where the infant industry learns to walk. It is the early stages that the domestic environment is most important. The domestic economic system still appears to be playing a large role, albeit at a reduced level than that in the twelfth century.

Over time, there seems to be a reduced influence of religion as a force of entrapment, however, military influences still seem to be strong. Even today, as military technology becomes more specialised there is a fear their programs could distracts scientists and resources from productive technologies. On the other hand, military R&D has produced many spill-overs including computer technology and the Internet. Coming from outside the existing commercial pathway, this R&D has opened up pathways that might not otherwise exist.

Technologies have a potential to reduce entrapment. New technologies can improve information flows and the potential for flexibility in organisations but this force is in many ways negated by the increased size of companies. Technology allows larger flexible companies but, I suggest each technology has its own upper limits where the organisation problems pointed out by Greiner set in.

Entrapment may also be overcome by the advanced knowledge of 'change management', which has in itself become a major area of academic study. However, the literature on change management has revealed that serious barriers to successful change still exist. Even with the latest knowledge of psychological, social and organisational processes, the introduction of change is not free of pitfalls. For example, David Collins (1998) identifies the difficulties managers have in imposing their ideas for change on others when those ideas conflict with deeply embedded social processes. Many beliefs and attitudes have been imprinted on society through a process of cultural reinforcement. Behavior that has been learned and reinforced over the years can be very hard to change, especially when those behaviors have helped to create strong cohesive groups. Influences such as childhood learning and home life will not give way overnight to the desires of management.

Management of change is embedded with issues of politics, conflict and control. Protagonists for change will be pitted against opponents in scenes of repeated struggles and shifting alliances. Underlying this landscape lurks uncertainty and distrust. Uncertainty can refer to whether environmental shifts leading to

the change will be enduring, whether a new solution is needed and what solution is appropriate. Information flows during the change process will be riddled with rumors and tidbits that shape and distort expectations. Distrust is riddled with the fear that one party will gain from the change at the expense of others.

Even with the appropriate changes in place, resource constraints and continued use of old knowledge, and old, now mis-aligned, incentive systems can undermine the success of a change program. Finally, after change has been introduced, it can take years for results to flow after change has been introduced. The economy has to embark on a new process of learning and gaining of experience. It is a period of relative loss in which the old ways and glory days beckon a return to the past.

In a 1995 *Harvard Business Review* article, John Kotter of the Harvard Business School noted that of the more than 100 US companies that he had observed trying to remake themselves, only a few had been successful. Undermining the high failure rate was the difficulty of managing a change program. The problems he identified included not creating a powerful enough guiding coalition, not removing obstacles to the new vision, declaring a victory too soon and lacking a vision. At the end of the twentieth century, implementing change in a company is still embedded with difficulties despite our greater knowledge.

These age-old problems are afflicting the most modern of industries. In *Only the Paranoid Survive*, Andrew Grove, the CEO of Intel gives an interesting account of changes that hit the computer industry. Intel had been a highly successful company making memories for computers. However, new Japanese competition was seriously threatening Intel. In the book, Grove describes many of the forces that acted to inhibit change. We can recognise many of the repeated patterns of entrapment. He described how CEO's are at the centre of fortified palaces 'and news from the outside has to percolate through layers of people from the periphery where the action is' (1999:22). Consequently, the CEO is often the last person to know when change occurs. He also spoke of devoting more time to charity during the period of crisis, an obvious example of cognitive dissonance as it meant he avoided being confronted with the crisis. Grove also spoke of the rationalities and belief systems that pervaded Intel:

> The company had a couple of beliefs that were as strong as religious dogmas. Both of them had to do with the importance of memories as the backbone of our manufacturing and sales activities. One was that memories were our "technology drivers". What this meant was that we always developed and refined our technologies on our memory products first because they were easier to test.... The other belief was the full Product line dogma. According to this, our salesman needed a full product line to do a good job in front of our customers (1999:91).

These beliefs were based on strong rational thinking. They had been keys to past success. They determined the company's priorities in allocating resources and making decisions. 'Our priorities were formed by our identity; after all, memories *were* us.' But, eventually when there was a substantial shift in the competitive environment the rules changed, and the CEO experienced a business crisis that took him through all the forces of uncertainty that have faced decision makers in previous centuries:

> It's a very personal experience. I learned how small and helpless you feel when facing a force that's "10X" larger than what you are accustomed to. I experienced the confusion that engulfs you when something fundamental changes in the business, and I felt the frustration that comes when the things that worked for you in the past no longer do any good (1999:94).

Fortunately for Intel, one part of their business was growing rapidly. This was microprocessors. Having divested themselves of memories, Intel became the leader in the microprocessor market. It opens the question what would have happened to Intel if this option had not been available? Perhaps they were fortunate that a new growth had opened up for them.

15.6 Implications for Government Policy

(1) Social and Education Policy Much entrapment occurred as a consequence of social stratification. This had important implications as key change agents had two characteristics (i) they had sufficient resources and educational ability to adopt and diffuse leading technologies and (ii) they had an incentive to improve their status. We see this again and again through the English yeoman, poorer Samurai, and religious minorities. Clearly there is a danger of class divisions that deny the most 'hungry' members of society from resources that they could use to expand the economy. In particular there is a need to ensure education is widely disseminated; a potential problem for the United States in the future as the cost of tertiary education rises.

(2) Competition Policy In many cases, monopolies and national champions proved themselves to be effective in advancing technology and opening up new growth paths. The monopoly served to reduce risk and could mobilise greater levels of resources. It was only once the necessary capabilities had been acquired and the biggest barriers overcome, that monopolies failed to serve their purpose. We saw this with the Dutch East India Company and noted when the country failed to remove the monopoly, competent Dutchmen fled to other countries where they set up in competition. The implication is that Competition Policy should be dynamic in its application, recognising the age of an industry and the circumstances in which it operates.

(3) Infant Industry Support There is clearly a role for infant industry support. In all cases examined, governments provided support in the attainment of capabilities, although in the case of Gujarat it was restricted to cargoes. When a nation has first mover advantage and is secure in its competitive strength, an imitating nation is hard pressed to compete without this support.

It is interesting to compare, the examples of the United Kingdom with Japan. In the English example, the Navigation Acts provided a huge area where shippers were protected from the Dutch but individual shippers still operated in a highly competitive environment with other English shippers which must have helped to raise standards. By contrast, the Japanese had a monopoly structure in the early years but all government assistance was pegged to the expansion of capabilities. Both strategies worked.

By contrast, during the nineteenth century, US shipping had no protection but was reliant on protected inefficient industries (ie: steel, iron and ship building). Clearly any protective policy must take into account the downstream effects on other industries. England in the seventeenth century also protected its shipbuilders, therefore saddling its shippers with high costs but, it compensated this by protecting its' shippers as well.

(4) **Governments should think beyond processes**. There exists the possibility for a government to influence society's value systems in a manner that is more consistent with prevalent growth paths. This can occur not only through education but, also being aware of policies in which it continues to endorse the old regime. Japan showed remarkable success in redefining values and the leading social class in line with new development paths. Of course, the nineteenth Japanese were highly submissive and modern techniques need to be more sophisticated.

(5) **Agent for Systematic Change.** Recognising the path-like nature of an economies development and the barriers to change resulting from market-based specialisation, governments need to be more sensitive to the potential of low growth due to market rigidities. The experience of the highly efficient and flexible Indian and Chinese market systems is a reminder that flexibility is limited by past investments.

In conclusion, processes of imitation, catch up advance and entrapment have shown to be at work in the shipping industry. But we must also acknowledge the effect of military and political forces that may not be exogenous, the trend from regionalism to globalisation, and early indigenous developments that are not based on imitation that do not immediately lead to a position of advanced leadership. In this light, a better description of the first stage would be capability building.

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