



Faculty of Commerce

SUPPORTING LEAN MANUFACTURING INITIATIVES IN NEW ZEALAND

Final Report

Prepared for:
New Zealand Trade and Enterprise



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Appendix One: Tangible Benefits of Lean

2. Acknowledgements

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We acknowledge that the opinions expressed in this report are that of the authors and are expressed without undue constraint or liability.

“Go hard on behalf of New Zealand”
Managing Director,
Lean Exemplar Firm, October 2008

3. Executive Summary

New Zealand has lagged significantly in the OECD tables of labour productivity in recent years, and lies at the lower end of the OECD rankings in 22nd place out of 30 OECD countries in 2008 (New Zealand Treasury, April 2008). Labour productivity is a measure of how effective labour is being utilised as a factor of production, and is defined as the ratio of real goods and services produced per hour worked. The New Zealand Government has previously set policies with the specific aim of achieving a place in the top quartile of OECD productivity rankings (see the Growth and Innovation Framework, Ministry of Economic Development, June 2005). Despite these initiatives New Zealand is still lagging behind in labour productivity terms, especially so when compared with Australia (New Zealand Treasury, April 2008).

Another indication of the deteriorating economic environment is the recent release of the Bank of New Zealand’s Performance of Manufacturing Index (PMI). In October 2008 this index reached its lowest level since the survey began in 2002, and has been in decline for a record six consecutive months. BNZ chief economist Mark Walton recently stated that the manufacturing recession was widespread and entrenched (<http://nz.biz.yahoo.com/081113/3/p/96t4.html>).

Concerning this situation, it is imperative that the manufacturing sector lifts its productivity and competitiveness. Hence, this study is timely as the results demonstrate that Lean Manufacturing systems have the potential to be a significant vehicle for increasing New Zealand’s productivity, and could potentially be the basis of a new national strategy.

The findings of this study are based on the actual experiences of 22 companies who have undertaken a Lean manufacturing implementation. In addition, this study also examines Lean implementations from the consultants’ perspective, and we also review the state of Lean education in New Zealand’s eight major universities. We pay particular attention to the role of NZTE in initiating and supporting Lean manufacturing in New Zealand through various programmes. The following major conclusions are drawn from the results of the study.

The various Lean Manufacturing initiatives conducted by NZTE over the last three years have been assessed as very successful, in particular the Aichi programme. This programme was noted for its combination of co-funding, industry clusters, forums, reference site visits, its low barriers to entry

and its low administrative burden. It is noted that those firms on Aichi 1 (the first cohort) have achieved the most progress and are the closest to being self-supporting in terms of embedding a culture of Lean within their operations. This suggests that a three year time frame may be required for successful Lean implementations.

The resident level of knowledge and experience of Lean Manufacturing systems in New Zealand is minimal to non-existent at both managerial and operational levels. This has strong implications when considering implementations as education and the role of the external consultant then become more critical.

The progress and benefits accrued by active Lean firms in this study, and by default the New Zealand economy, have been impressive and continue. All firms report significant savings and performance improvements across a range of measures (see Appendix One for actual recorded benefits).

The form of NZTE interventions in terms of co-funding, organising clusters and Lean forums, and exemplar visits is seen as appropriate, but with some modifications noted in the recommendations below.

For the firms supported by NZTE, the co-funding played a critical role in the decision to adopt Lean. Two main reasons were given; firstly it 'de-risked' what is generally an unknown methodology, and secondly, it allowed good initial progress to be made that 'proved' the concept to the sceptics.

All firms found the input of external consultants a critical part of their Lean journey. Virtually all had positive experiences with those consultants. Many have reemployed their consultants at their own expense, but on a less intensive basis to help maintain momentum. Many now use their consultants for regular 'health checks' or auditing visits as a means of imposing self-discipline. All the firms doing this stressed the importance of on-going external support. Without this, they stated, they would 'soon lose their way'.

However, all firms insisted that 12 months (the period of co-funding) was insufficient to embed Lean within their organisations. Most saw a period of two or three years as appropriate, albeit at different levels of intensity with the first 12 months being the most important.

It was found that the initial fears of major staff resistance were not realised during the implementations. The 'buy-in' of staff has been a revelation to managers and business owners. Generally, staff morale, job satisfaction, retention and motivation have improved, whilst absenteeism has declined.

Unskilled and semi-skilled workers tend to adopt Lean more readily, whilst skilled workers and tradespeople tended to be more resistant, although not obstructive. The skill levels of staff are improving as they accept more responsibilities in their duties. Some firms noted the need for literacy training for staff and also general supervisory skills for team leaders in addition to Lean training.

The intangible benefits of Lean systems are just as valuable, although harder to quantify. Most firms stated that communication and labour relations between management and staff have improved considerably, with lower stress work places and a move away from 'blame cultures'.

All firms stated that they intend to continue on the Lean journey and were encouraging other firms in their supply chain to adopt Lean.

The use of clusters and forums as well as other industry associations has greatly increased the awareness of the benefits of Lean systems. Hence, there is a significant contagion effect that should help promote Lean beyond the pilot programme run by NZTE. Nationwide, this effect will be beneficial and should be encouraged as word-of-mouth references carry considerable weight.

Firms cited losing momentum and slipping into old habits as the biggest threats to the success of Lean in their firms.

The study suggested that NZTE could improve their services by providing regular health checks for Lean active firms, hosting speakers and experts at forums and conferences, and also maintaining a knowledge centre of contacts and resources for Lean firms.

The consultants highlighted three major barriers in the Lean adoption decision. Firstly, the lack of knowledge and understanding about Lean and what is required to make it work. Secondly, the lack of internal resources to fund an external consultant, and finally, the lack of skills amongst the work force at managerial and operational levels.

The consultants also argued for a coordinated government approach to promoting and supporting Lean as currently there are a number of different initiatives (at least six) run by different government agencies. This could lead to a duplication of effort and also confusion in industry as to where help is available.

Finally, a review of Lean education in the tertiary sector reveals that the depth and breadth of coverage varies considerably. At the low end of the scale this consists of a maximum of two weeks coverage in one course. At the upper end of this scale different tools and concepts are presented

in six or more courses spread across several elective topics. The general approach by tertiary institutions has been to incorporate Lean as just one of many modules taught throughout the term in various courses, but overall there is no particular focus on Lean education in New Zealand.

We recommend:

1. That Lean thinking and systems as a proven methodology be adopted as a national strategy for lifting productivity in New Zealand. This will best be achieved through a national centre of excellence.
2. That a New Zealand Centre of Excellence for Lean Thinking be established to coordinate the funding and implementation assistance contributed by central government, industry and other supporting organisations. This Centre could take the form of a 'virtual' centre of excellence resident across several institutions simultaneously, for example NZTE, and those Lean research active universities. The Centre may be controlled by an advisory board consisting of an even balance of industry leaders, government and practically focused academic personnel, with a rotating chair.
3. That this Centre maintains two principal aims. Firstly, to act as a clearing house for Lean resources available in New Zealand, such as maintaining a list of 'accredited' consultants¹, facilitating Lean exemplar visits (i.e. opening doors at a high level), clusters and Lean forums. The primary focus here is providing practical support for firms engaging with Lean. The second principal aim is to facilitate and promote Lean education and research in organisations and tertiary institutions through the promotion of Lean road shows, seminars, and conferences. The primary focus here is education and upskilling of the New Zealand work force at all levels.
4. In terms of practical implementations, we recommend that the Aichi format become the main vehicle for sponsored Lean implementations in the future. In our judgement, the elements that worked best were the co-funding for the first 12 months, the on-going interactions in forums and clusters, and the visits to the exemplar firms.
5. However, we recommend that the Aichi programme be improved through the following:
 - a. That Lean interventions should, where possible, concentrate on firms that are linked through supply chain relationships, thus creating '*Lean supply chains*'. The mutual

¹ Note, consultants need not be ranked, but information pertaining to focus, orientation, qualifications, experience and reference sites should be presented to help Lean interested firms deciding on a consultant to engage

- interest in improving performance and profitability encourages each firm in the supply chain to maintain momentum in Lean initiatives.
- b. That co-funding for consultants be extended for an addition 12 months beyond the first year, but on a periodic and on-call basis for the second 12 months.
 - c. That NZTE (or the Centre) conduct follow up visits or 'health checks' for those firms who require some form of external accountability during the third year or beyond until Lean is self sustaining within the firm. This will help protect the Governments' investment and allow ongoing assessment and revision.
 - d. That the most appropriate exit point for any external intervention is when a firms' Opportunity for Improvement (OFI) business processes are well established and functioning correctly within the firm. This then allows continuous improvement initiatives to be captured, evaluated and implemented on an on-going basis.
6. That further practical research be undertaken to help identify some key issues unique to Lean implementations to the New Zealand context. Firstly, given the relative youth of the Lean initiatives studied for this report, we recommend that this current sample of firms be revisited again in three years to measure the drivers of Lean over the medium to longer term. Secondly it is important to understanding the rationale and motives for business as to why some firms adopt Lean and others do not.

4. Project Overview

4.1 Introduction

This study was commissioned by New Zealand Trade and Enterprise (NZTE) to examine the effectiveness of their initiatives in promoting Lean manufacturing techniques in selected New Zealand business.

Lean manufacturing, or as NZTE have termed it 'Lean Thinking', is a way of doing business that has been derived from the Just-in-Time (JIT) philosophy pioneered by Toyota in the 1960s. It is known by different names in different companies, e.g. the Toyota Production System, Stockless Production (Hewlett Packard), Short Cycle Manufacturing (Motorola), and Lean Manufacturing (Boeing). Lean originated out of a need to produce a greater variety of products in smaller batches in a repetitive manner using the same production facilities. Its secondary objectives were to eliminate waste, inefficient activities, work-in-process (WIP) and finished goods inventory at every stage of the value chain. Over a period of time, the concepts of JIT and Total Quality Management (TQM) have evolved into the Lean manufacturing paradigm (Bhasin and Burcher, 2006). However, Lean still retains many of the techniques and methodologies of JIT and TQM.

Lean is conceptualised differently within organisations. For example, it can be considered a philosophy, a work culture, a technique, a management concept, a value, a methodology or an ethos. Through all, a common thread exists, that of continuous and forced learning within and between organisations. Like any inter-organisational system it requires high levels of commitment, discipline, reliability and support from a firm's supply chain partners to make it successful (Harland, Caldwell, Powell and Zheng, 2007; Puschmann and Alt, 2005). Those organisations that implement Lean manufacturing do so in their own unique ways, which means no two Lean manufacturing systems are exactly the same. This is due to the unique set of variables and problems experienced in a firm's operations and supply chain. Indeed, Lean manufacturing has a chequered implementation success rate. For example, Bhasin and Burcher (2006) note that less than 10% of Lean implementations in the UK are considered successful. Kallage (2006) states that over 50% of Lean implementations have failed, primarily due to the lack of a properly developed business case, a lack of top management commitment, a misunderstanding of what Lean is, and a failure to communicate at all levels. They also argue that a lack of buy-in, the lack of general supervisory skills and an over-reliance on the Lean 'champion' or the external consultant as human sources of failures. Hence, Lean implementations are neither simple nor easy, yet as the contents

of this report verifies, the returns and payback from successes, even partial successes, are significant and worth pursuing.

4.2 NZTE Lean Initiatives

4.2.1 NZTE Sponsored Lean Initiatives

NZTE have been involved in promoting Lean Thinking for several years. Their focus to date has been to encourage 'high growth potential firms' to adopt Lean Thinking. These high growth potential firms have been medium sized businesses who are actively exporting high value added products with good growth prospects in their markets, or they are part of a value adding export supply chain. The NZTE programme has been operated on a pilot basis to test the uptake of Lean by New Zealand manufacturers and to consider appropriate options for government support of Lean implementation.

Once identified, the high growth companies were approached and invited to participate in the Lean programme. Generally, NZTE have used a three stage approach to encourage firms to adopt Lean and to support them along the journey, these are;

1. Engagement: This stage was to introduce Lean Thinking to the business owners and their senior management teams and demonstrate the benefits it offers. The commitment of management is critical to the success of the programme and it was a key requirement for participation in the NZTE programme. The original NZTE Lean programme included a trip to Japan for companies to visit exemplar Lean firms. The trips provided clear evidence of the need for full commitment and leadership by management.
2. Implementation: Here NZTE, in conjunction with the firm, co-fund a consultant for a period of 12 months to work intensively with the firm on implementing a Lean programme. The Consultant is selected and works directly with the firm concerned.
3. Sustainability: The final stage of the process is focused on how to maintain the momentum of Lean change within firms. This is supported by NZTE sponsorship of industry forums and the establishment of clusters that facilitate networking and sharing of experiences at both the executive and shop floor levels.

The major NZTE Lean initiative has been the 'Aichi' programme. Here, selected high growth potential firms were sponsored through a Lean implementation programme for a period of twelve

months. They were formed into cohorts or clusters to share experiences and learn from each other. There have been three Aichi streams to date with Aichi 1 starting just over three years ago in 2005, Aichi 2 starting in 2006, and Aichi 3 starting in 2007. In addition to the Aichi programme, NZTE have sponsored other firms on the Lean journey through other programmes such as its Growth Services Fund (GSF) and industry cluster initiatives. Other firms have joined the Lean programme on their own initiative or through more indirect routes. A breakdown of the Lean active firms interviewed ($n = 22$) and their supporting programme is listed in the following table.

Thus, NZTE have taken a focused approach to the selection of firms to engage in the Lean programmes. This has been a deliberate strategy as it is prudent to channel public funding only to those firms willing and able to commit to a Lean implementation and who show the greatest potential for payback. The period of NZTE co-funding support stopped after 12 months regardless of actual progress, but in all cases the companies have continued with Lean implementation.

Table 4-1: Various NZTE Supporting Programmes for Lean Implementations.

Aichi 1 Cohort	Aichi 2 Cohort	Aichi 3 Cohort	Growth Services Fund	Other Programme or Own Initiative
Clearlite Alto Packaging RPM Tool & Die Stainless Design	Old Fashion Foods Kitchen House	Kea Campers Hunza Productions Swages Engineering Akl Coachbuilders Selecon Filtercorp Int Ltd GDM Group Howard Wright	Salthouse Marine Tritec Wedgelock Equip Pacific Aerospace Windsor Engineering McDell Marine	Stainless Downunder Trevelyan's Pack House
4	2	8	6	2

In addition to the above Aichi programme, NZTE sponsors Lean through other initiatives such as follows.

4.2.1.1 Enterprise Training Programme

NZTE funds the Enterprise Training Programme which provides training courses, delivered through third party providers, covering a range of subjects aimed at improving the knowledge and skills of smaller SMEs. A number of regions have been running courses on Lean which have proved to be

popular. The courses normally run for two days and in some cases there is assistance for follow up with companies on an individual basis.

4.2.1.2 The Competitive Manufacturing Initiative

The Competitive Manufacturing Initiative (CMI) was launched by eight Industry Training Organisations (ITO's) in November 2006. The CMI has 'developed national qualifications that recognise the work processes and skills that are best practice for highly competitive organisations internationally'. Basically they have introduced NZQA approved qualifications covering aspects of Lean for levels 2-5 on the NZQA framework. These are workplace based courses where approved assessors go into the companies and assess worker progress against the unit standards. Obviously they need companies to be implementing Lean before the staff can apply or enrol for these qualifications. NZTE supports this initiative as it gives staff the opportunity to gain recognised qualifications in Lean and it helps to lift the Lean competency of the workforce.

Nevertheless, from the perspective of NZTE, there are several fundamental issues that remain ill-defined. In particular, how best to deliver and sustain Lean in the New Zealand economy over the longer term and how best to exit any intervention, hence the need for this study.

4.2.2 Future NZTE Lean Initiatives

At the time of writing this report, NZTE have just launched a new pilot programme titled "Lean Engagement". The different nomenclature addresses some of the concerns about the image problem of 'Lean Manufacturing' raised in this report. This new programme is a scaled down version of the Aichi programme and encompasses some of the major lessons learned so far. Essentially, Lean Engagement is built around the principals of gaining strong Senior Management Team (SMT) commitment, and formulating a sound implementation plan for their firms. It is organised along two major lines;

1. Lean Seminar. Owners and senior management of firms who are interested in Lean are sponsored on a two day seminar highlighting the principals and benefits of Lean. If companies then elect to continue with Lean, they are then supported by NZTE through the next phase.
2. Co-funding for Training and Implementation Planning. Here companies are co-funded on a 50/50 basis (up to \$10,000 from NZTE) with an external consultant who will provide the initial company training and assist the company in formulating a rigorous implementation plan with

at least an 18 to 24 month time horizon. To receive the co-funding, the companies must meet certain criteria set by NZTE.

Once, firms have completed these steps, they are then expected to source and fund their own consultants and implementations. Currently, NZTE are actively pursuing more funding in order to facilitate further Lean implementations.

When examining NZTE's new initiative in light of the previous programmes analysed in this report we would like to pass two comments. Firstly, NZTE have rightly recognised the critical importance of capturing and enthusing the business owners and the senior management group. Most studies highlight that fact the Lean will not succeed without the strong commitment of the senior management group, hence NZTE have correctly targeted this important facet of Lean implementations.

Secondly, we note that the funding only supports the two day seminar, and the implementation plan development with a consultant. It appears that no funding is available for the implementation itself or ongoing support. This report will go on to demonstrate that the current level of Lean knowledge and experience residing in the economy is inconsequential, and as such the major concern is how do firms access the 'practical know-how' for a live Lean implementation? It appears that the firms will have to fund the consultants from their own resources.

However, all respondents in this study unequivocally stated how critical the co-funded external consultant was to their on-going progress and success of Lean. They noted how the initial 12 month period of co-funding de-risked the adoption decision, and also the important role the consultant played in transferring the Lean culture and practices to the shop floor. This report actually recommends the extension of the co-funding arrangement for at least a second 12 month period, albeit on a less intensive basis.

It seems that the absence of the co-funding for the implementation phase (say at a minimum of 12 months) will be a significant barrier to future Lean adoption by New Zealand firms. This will ultimately reduce the number of project starts, and also place a greater burden on already resource constrained firms. These factors increase the risk of firms experiencing a Lean implementation failure and the associated negative outcomes.

4.3 Project Aim

The overall aim of this project was to obtain a cross sectional view of the experiences and state of Lean active firms, consultants, trainers and the state of Lean educational resources available in New Zealand at present.

In conjunction with NZTE we identified the following general research questions:

1. What activities has NZTE provided to initiate and support the adoption of Lean manufacturing in New Zealand?
2. What has been the impact of NZTE's initiatives on active Lean companies?
3. What is the best mix of activities to initiate and sustain Lean manufacturing in New Zealand?
4. What consultant and educational resources are available in New Zealand?
5. What is the optimal mix of resources and policy initiatives to drive interventions in the future?

Essentially, we asked questions along the themes of; what have we done, where are we now, what worked and what didn't, and where do we go from here?

4.4 Structure of this Report

Section five discusses the results of interviews with active Lean companies that have been assisted in their implementations by NZTE. This section constitutes the major findings for this report.

Section six discusses the findings of interviews with Lean consultants or trainers, only some of whom were involved in any of the NZTE Lean initiatives. Finally, section seven provides a brief overview of the current state of Lean education from private training organisations and tertiary providers in New Zealand.

5. Survey of Lean Manufacturing in New Zealand

This section of the report details the results of NZTE's interventions with various firms in New Zealand who have been encouraged to adopt Lean manufacturing principles. Firstly, a brief summary of the study method is given, then NZTE's support is evaluated from the perspective of active Lean companies. Next the implementation process is discussed including the benefits achieved. This section concludes with feedback on how NZTE might support Lean in the future.

5.1 Study Method

The findings of this section of the report are based on in-depth interviews conducted with those companies who have undergone a Lean implemented assisted by NZTE. Firstly, it is important to note that all the firms interviewed were either selected to be part of NZTE's programmes or elected to join the programme voluntarily. Hence, there is an element of 'self selection' bias in the sample, and the results should be interpreted accordingly. That stated, this study did interview 22 of the companies targeted by NZTE into Lean and this represents approximately half of the total population. Therefore, the results can be considered strongly representative of the actual experiences of a live Lean implementation. Key informants were selected in conjunction with NZTE, and all respondents were either the business owners or senior executives of the firms. Where the principal owner or manager was not available, a senior executive was nominated by the firm. All respondents have been intimately involved in their respective Lean programmes and their responses should be considered authoritative and reliable.

A survey questionnaire protocol was constructed and approved by NZTE prior to the interviews. Face-to-face interviews were conducted with twenty firms based in Auckland, Hamilton, Tauranga and Wellington. Following this, two telephone interviews were conducted with firms based in Wanganui and New Plymouth. All face-to-face interviews were electronically recorded verbatim and extensive field notes were also taken. The data were analysed from these transcripts and field notes. The semi-structured in-depth interview was considered the best method for collecting rich data as it allowed issues of interest and clarifications to be pursued immediately. This method also produced a 100% response rate from those firms asked for an interview.

We consider that the data gathered is strongly representative of the actual experiences and opinions of these firms, and thus can be considered reliable.

5.1.1 Lean Company Characteristics

This section gives a brief overview of the demographic and other details of the firms involved in the survey. Twenty two firms were involved in this part of the analysis. Their characteristics are summarised in table 5-1.

Table 5-1: Characteristics of Lean Active Companies in the Sample

	<i>Average</i>	<i>Range</i>
Number of full-time employees (FTEs)	70.3	11 – 190
Years in Business	25.6 years	7 – 61 years
% Sales Domestic	57%	0 – 100%
% Sales Export	44%	0 – 100%

n = 22

Given that 96.3% of all New Zealand enterprises are classified as small or medium sized enterprises (SMEs) with fewer than 20 full time equivalent employees (Ministry of Economic Development, 2007), it is clear that the average number of FTEs in this sample is quite large at 70.3. This indicates that the majority of Lean implementations to date have been with medium or larger sized firms rather than SMEs. Only one firm in the sample was a true SME. As a consequence, the dynamics and resource implications of Lean implementations for SMEs (with less than 20 FTEs) is not covered in this report but would be a valuable future exercise given the predominance of SMEs in the economy.

While most firms described themselves as manufacturers, the range of activities and industries covered was extensive. For example, the sample included luxury yacht building, motor homes, CNC machining, timber kilns, FMCG food producers, plastics, horticulture, aviation, domestic kitchens, bathroom installations, industrial filter manufacturers, tool and die makers and earth moving attachments. This variety demonstrates the principle that Lean can be implemented in an array of industries utilising different production methods.

The length of engagement with Lean for each firm varied, and ranged from a maximum of six years to just 10 months. The average length of Lean programmes in the sample is just over 19 months. Clearly, this shows that most programmes are still in their infancy, and the responses are bound to reflect the experiences of firms who are still struggling with quite dramatic changes. Five of the firms have at least three years experience, whilst one firm has over six years. Thus, the conclusions drawn from this report are applicable to early stage Lean implementations only, and

they cannot be used to draw inference for mature Lean programmes. A follow-up research programme would be needed in the future to assess the impact of maturing Lean programmes.

Nevertheless, the firms reported that despite the very short timeframe so far, the progress made and the performance improvements achieved has been remarkable.

5.1.2 Limitations and Sample Bias

Individual findings from each respondent were aggregated together during the analysis. Thus, our findings report the general themes and patterns that were observed in the data. Hence, individual respondents may not agree with everything in this report, especially where their individual opinion ran counter to a strong theme. Where possible these outlying opinions were accommodated.

It is critical to read this report with the understanding that all the firms interviewed were specifically identified as suitable candidates for a Lean implementation by NZTE. As a result of this targeting strategy, it is noted that none of the firms interviewed had experienced a significant failure during the implementations. Since other studies show that the failure rate for Lean implementations is quite high (Bhasin and Burcher, 2006; Cua, McKone-Sweet and Schroeder, 2006), it is clear that the strategy of assessing and targeting suitable firms has been successful. Hence, the tone of this report may seem overly effusive in support of Lean and NZTE, and the tone of this report may appear skewed toward the positive.

5.2 Survey of Lean Active Companies

The following sections detail the results of the interviews with the active participants of the various Lean initiatives.

5.2.1 The Role of NZTE

It was obvious from the outset of fieldwork that the role of NZTE in encouraging the uptake of Lean manufacturing principles was critical. The respondents stated they thought that NZTE's initiatives were generally appropriate and pitched at the right level. As noted above, NZTE supported Lean initiatives through a variety of channels. However, when comparing the various entry methods, it is observed that those firms who were on the Aichi programme were generally more successful.

Thus, the Aichi format would seem to be appropriate for future interventions, with some modifications that will be commented on later. However, as noted in the method section, the data did not include firms who have experienced a Lean implementation failure as yet. Only time will tell

the true levels of performance of these programmes, but the short-term results are reported as being impressive.

5.2.1.1 Co-funding Support

The major and most obvious factor that made firms work with NZTE on Lean initiatives was the offer of co-funding for the consultants. This aspect had the most significant impact on the firm's decision to implement Lean, but in two different ways. Firstly, those firms that had no prior understanding of Lean saw the co-funding as an endorsement of Lean by NZTE, and as a way of mitigating the risks and reducing the uncertainties of the decision. Secondly, those firms that were keen to implement Lean anyway saw the co-funding as an essential kick-start to their programmes and has allowed them to achieve significantly more progress that would have otherwise been possible.

While the co-funding was much appreciated, it still required the firms to also invest. Most firms clearly stated that they would not have proceeded at all without the funding as their own resources were limited. About 30% of the respondents said that they would have started anyway regardless of the funding as they saw the benefits of Lean. Yet, the funding was a key factor in stimulating action, forcing a decision, and allowed progress beyond what a firm relying on its own resources would have achieved by itself. Most respondents thought that the 50/50 arrangement was fair, but few commented they could absorb much more funding, perhaps unreasonably so.

Some firms also noted that it was indeed their own responsibility to fund such initiatives, and over time to take ownership of their Lean programmes. The responses revealed that firms knew that at some point they were ultimately responsible for funding their own activities. Thus, they were generally realistic about how much support they could expect from NZTE.

Another intangible spin-off of the co-funding was that some firms felt a form of obligation or responsibility to NZTE to achieve or make progress in their Lean projects. This focused the senior management on maximising this opportunity, and provided an intrinsic motivation to succeed with Lean.

With any funding activity, a critical question is to determine the appropriate point at which the NZTE funding should stop. An answer to this question requires some detail, and it is addressed later in section 5.2.8 (NZTE Exit Strategies).

5.2.1.2 Working with NZTE - Other Contributing Factors

Apart from the material contributions from NZTE in the form of co-funding, the respondents noted other factors that prompted them to work with NZTE. These are:

- Word of mouth assurances from other firms involved with Lean programmes, such as previous cohorts of the Aichi programme.
- The sourcing and recommending of Lean consultants who appeared to be 'approved' by NZTE.
- The professionalism and approach of the NZTE Lean staff.
- The fact that NZTE sponsored forums for firms on the Lean journey.
- That NZTE were seriously committed to Lean and backed this up with resources.
- The single focus on Lean as the guiding philosophy.
- NZTE was proactive in sourcing and engaging firms in the sample. This is an artefact of the focused approach on high growth potential firms, but as (if) the programmes are extended in the future, this approach may be viewed as elitist or unfair on those firms not approached. This may have implications for determining the correct engagement strategies for any future increase in the scale of the initiatives.

5.2.1.3 NZTE – Opportunities for Improvement

The interviews did not reveal any significant areas of improvement for NZTE, and virtually all respondents indicated a high level of satisfaction with Lean and NZTE. However, a couple of firms expressed a preference for NZTE staff to have 'walked the talk' in their specialisations. These few firms had a high preference for individuals who not only have general business experience, but also experience in their particular industry. Whilst NZTE do indeed have a policy of recruiting experienced industry staff, this issue should be reconfirmed as important to the perceptions of at least some of the firms engaged by NZTE.

Also, the administrative burden of applying for and administering NZTE grants was seen as onerous by a number of firms. Yet in those instances where NZTE staff assisted in the preparation of the applications, this view changed somewhat. This was particularly true for the Growth Services Fund (GSF) where many were put off applying due to the excessive time requirements for the application forms and also the reporting requirements. In sharp contrast, those firms on the Aichi programme praised the notable lack of additional administration, and 'ease' with which the co-funding was

sought and approved. This was welcomed by the business owners or managers worried about the burden of compliance and sent a positive reinforcing signal to firms about the importance of Lean.

Some firms also saw the need for closer coordination between the NZTE area managers and the centrally coordinated Lean initiatives. It is understood that some NZTE Sector Managers (those not involved with the selection of suitable firms for the Lean programme) are not involved in the Lean initiatives due to the centrally controlled nature of the pilot programme. For a few firms this created an impression of an uncoordinated agency.

In addition due to the pilot nature of the Lean programme, the researchers also noted the absence of any NZTE sponsored Lean initiatives or clusters based in the South Island even though some Lean exemplars (such as Tait Electronics) exist. NZTE have indicated their desire to extending their Lean programme to other areas of New Zealand once the pilot programme is validated as a successful model.

5.2.1.4 Impressions of Intangible Support

All Lean active firms were grateful for the tangible support from NZTE. However, there were other intangible benefits reported by the respondents. The major intangible benefits identified were;

- The feeling that NZTE were 'partnering' with industry in an extremely useful way.
- Since NZTE was sponsoring Lean, the concept had been vetted and approved by a reputable body and thus Lean was viewed more favourably and was more readily accepted.
- In addition, the sponsorship meant that Lean was sold as a means of productivity improvement that would benefit the firms at no material gain for NZTE.
- The government agency approach did much to negate the suspicion that Lean was just another revenue generating fad promoted by individual consultants or commercial consulting houses for their own benefit.

5.2.1.5 Summary

All respondents felt that the NZTE Lean initiatives to date were pitched appropriately, in particular the Aichi programme. What they noted was the cumulative effect of a multi-pronged approach to engaging firms and supporting them through the crucial first years of an implementation. Thus, the major tenets of NZTE's approach, that of co-funding, visits to exemplar firms both here and in Japan, and participation in Lean forums and clusters was influential in the decision to adopt Lean.

This '*funding, flying and forums*' approach sends a consistent message and was the key factor in convincing the respondent firms to adopt Lean.

In an effort to determine overall respondent satisfaction with NZTE, all firms were asked the following question; "how satisfied were they with NZTE's current level of support". Responses were recorded on a scale of one to five (1 = very dissatisfied, 5 = very satisfied). The mean of the responses was 4.0 (range 3 – 5) indicating that the firms were generally quite satisfied with NZTE's support for Lean. However, this also shows that there is room for improvement, and these aspects were discussed in section 5.2.1.3 above.

5.2.2 The Lean Decision

5.2.2.1 Prior Knowledge and Experience

Generally, the level of prior knowledge of Lean systems of the executives interviewed was negligible. Only a small number had formal business or operational management qualifications that incorporated some aspects of Lean techniques. Yet, most had at least done some reading and had a basic idea of what Lean meant. Hence, while the 'entry-level' knowledge varied, it was generally very low.

In addition, the firms described the prior experience their staff at all levels as inconsequential or non-existent.

Concerning experience, only those executives that had prior overseas experience (such as Firm 3 and Firm 10), or had come from industries that have used Lean in the past (for example Firm 17) had any inkling of how to manage or implement a Lean project. Others described their experience as 'academic' or 'interested' only (such as Firm 21). Most had never heard of Lean Manufacturing. As a consequence of this lack of knowledge at the senior level, Lean initiatives were reported as being problematic and more dependant on external help to overcome issues.

This lack of experience and knowledge with Lean manufacturing techniques within the New Zealand economy is quite profound and perhaps needs to be addressed as part of a national strategy. This issue also has significant implications for recruitment strategies, immigration policies, national education policies, and is discussed further in the third section of this report. Nevertheless, this lack of knowledge is a major barrier to Lean implementations, and would thus necessitate NZTE (or some other body) adopting the role as a form of knowledge centre. It also increases the

firm's reliance on the specialist consultants and thus makes their selection and 'fit' more important than ever.

5.2.2.2 Perceptual Barriers to Lean Implementations

The respondents were asked what their understanding of Lean was. The resulting data did not show any consensus, and when questioned further, it seemed that Lean represented many different things to many different people. Yet, while there were a wide variety of differing opinions of what lean actually stands for, in general all seemed to agree on the major tenets of the approach, that of reducing waste and continuous improvement. However, this is quite a narrow definition of Lean, and it appears that one of the barriers to Lean adoption is a clear understanding what Lean actually constitutes. Hence, Lean suffers from a definitional problem.

Initially, most firms were concerned that Lean was only applicable to continuous production line processes (for example automotive production lines), and they stressed that their production processes more resembled 'job shops' with variable demand and small lot size runs. They had difficulty in visualising the application of Lean to their own production systems.

In addition, most had difficulty in visualising how Lean would fit their businesses overall and stated that their firm was somehow different to others or unique. They could not see how Lean could apply to the way they currently do business. This was especially true for functions apart from production such as administration, procurement, and finance where many simply could not see how Lean principals could apply. This was one of the key perceptual barriers to Lean.

Engaging consultants was another perceptual barrier as the respondents were generally sceptical of 'management fads' and saw consultants as only self-interested and not working for the interests of the firm. Again, NZTE's promotion of selected consultants helped to eliminating this uncertainty.

Selling Lean as a philosophy was difficult for those who did not know about it. Hence, respondents reported some intellectual barriers that had to be overcome. Again the support of the concept by NZTE and use of reference sites as exemplars was very useful in demonstrating the potential of Lean.

Many cited the possibility of losing staff during the implementation as a potential negative which might produce resistance from staff. However, the experience of respondents showed that this problem did not really eventuate as most staff quickly brought into the programme. Those few 'holdouts' were eventually convinced by their experiences or were encouraged to acquiesce through peer pressure. Some firms did indeed lose a small number of staff as a result of the Lean

implementation. The respondents noted that a characteristic of those employees lost seemed to be that they had other performance or labour relation issues other than resistance to Lean. As an illustration, one firm who lost two 'hold outs' eventually reemployed them after their experiences of a non-Lean environment with their new employer convinced them that Lean was the right way to go. Indeed, in a relatively short period a number of firms in the sample actually needed to take on more staff as the result of becoming more competitive and winning more orders.

The term "Lean" was also a perceptual barrier to staff as it conjured negative images of downsizing and redundancies. Some firms overcame this by re-naming their initiatives, such as the 'GDM World Class' programme and the 'PACE' or Pacific Aerospace Competitive Edge. This was found to be helpful as such titles could encompass future performance improvement initiatives in addition to Lean.

Clearly 'Lean Manufacturing' has an image problem, and it is argued that titles such as 'Lean principles' or 'Lean systems' would be more appropriate. However, it is also argued that the word Lean be retained as it refers to a specific way of doing business despite its negative connotations.

5.2.2.3 Perceptions of Owners Verses Managers

An emerging theme during the interviews was that professional executives (i.e. those without an equity stake) were more easily convinced to implement Lean. They saw Lean as a natural progression and a way forward in their efforts to manage and improve the business. Many stated that Lean provided an overarching framework in which to order their efforts. The professional managers' goals were generally focused on business improvement, whereas convincing the owners was more problematic.

Business owners had to decide whether they were personally motivated enough to attempt the rigors of a Lean implementation.. Some adopted Lean virtually straight away with little persuasion (e.g. Firm 20), while other owners stressed the need for a deep and careful evaluation of their motivations (e.g. Firm 8). Thus, owners are advised to undertake a self assessment and goal setting exercise prior to Lean to determine if they were willing to accept the rigors of implementing an ongoing Lean business philosophy. Some owners may see the effort as too onerous as their expectations are only built around a current standard of living (such as the 'Auckland 3 B's' – 'The Batch, Boat and BMW'). In some cases business owners implemented Lean for their own as well as other intrinsic motivations, such as a heightened sense of social responsibility and community economic goals like providing livelihoods for their staff and families (e.g. Firm 22). In terms of

adopting Lean, this area of perceptual motivation is very important, and would benefit from a closer study.

The implication for NZTE is that they should advise business owners to conduct this self evaluation exercise either prior or concurrently with any evaluation of Lean.

5.2.2.4 *Appealing Aspects of Lean*

The survey noted the following aspects of Lean that appealed and encouraged them to adopt;

- Managers found that the Lean approach allowed them to group a whole lot of other performance improvement efforts (such as the Theory of Constraints) into an overarching framework for action. It allowed them to present all these disparate efforts in one coherent package that was more easily understood by the staff.
- Most firms were generally dissatisfied with their performance figures prior to Lean, and were actively searching for the next initiative. For many, the Lean proposal came at 'just the right time' as they were searching for new ways to increase productivity and profits. Some noted that prior to Lean there was nothing else on the horizon for them.
- Lean was attractive as it was seen as a tangible way of becoming more competitive to fight off growing competition (e.g. Chinese imports).
- For business owners, Lean was seen as a means of setting in place a business continuance programme and facilitating exit strategies for owners and share holders. Many saw Lean principals as an opportunity for leaving a 'legacy' and embedding an operating system that could survive the retirement or exit of the main owner (i.e. Firm 19). It allowed the professionalisation of management systems and a devolving the decision making routines away from the owner toward the lower levels in the organisation.
- Lean was also seen as a means of involving staff, gaining buy-in and improving management and employee communications. Interestingly, most respondents mentioned the potential benefits for their staff first, showing a genuine concern for employee welfare.
- Respondents were also attracted to the proposition that they would be joining a cohort of others firms on a similar journey, for example the Aichi programme.

5.2.3 Lean Implementations – Lessons Learned

The following sections outline the major lessons learned during the Lean implementations.

5.2.3.1 *The Role of the External Consultant*

The role of the external consultant in the Lean initiatives was a critical enabler of success. All the firm's experiences with their consultants were generally positive. However most firms insisted that they be allowed to choose a consultant that they felt had the right 'fit' with their organisation.

Thus, firms saw the benefits of consultants in different lights, but the main benefits were;

- Access to the necessary knowledge and experience of Lean.
- The co-funding of consultant support.
- Knowledge transfer from the consultant or trainer to the organisation.
- Many respondents stated that they felt somewhat personally accountability to the consultant for the progress of their Lean initiatives. They knew that they had to report regularly to the consultant whom they did not want to disappoint, or at least fail to keep their own milestones. This gave a sense of accountability for progress and they saw the intermittent visits by the consultants as forms of 'health checks'. A number of firms noted this phenomenon.
- Management saw the consultants as sounding boards and a confidant.
- Management saw the opportunity for the knowledge transfer of general business ideas for areas other than Lean.

A key factor in the acceptance of the consultants was their interpersonal skills and their passion and enthusiasm for Lean. The respondents found that this passion was a major motivational factor for the senior management group.

Virtually all firms acknowledged the need for an external consultant to implement Lean. As noted in previous sections, the knowledge and experience for a self start simple does not reside within the organisations interviewed. Only one firm initiated their own Lean programme without a consultant (Firm 14), yet this was the smallest firm in the sample and their programme really consisted of only the 5S's (the initial steps of cleaning and organising: sort, set in order, shine, standardise and sustain). By their own admission, they needed external help to implement some of the more complex Lean steps such as the Opportunity for Improvement (OFI) systems that are so critical for long-term Lean sustainability.

5.2.3.2 Pre-Implementation Phase

In terms of pre-implementation practices, the following issues were identified in the data for future best practice for Lean implementations:

- As noted above in Section 5.2.2.3 business owners must have a clear vision and specific goals of what they want to achieve prior to Lean.
- The next step is to gaining buy-in from key members off the senior management team (SMT), or at least the key functional area managers, in particular the senior manager with executive power (this may not be the owner). Without this support and drive from the top, any Lean initiative will fail as the employees will mimic this lack of commitment from the SMT in their own efforts. It is not necessary for the entire SMT to be ardent followers of Lean, as long as the doubters are not obstructive. Some firms started with only one or two committed managers and found that the immediate results of Lean proved their case and the other sceptics quickly followed.
- In conjunction with gaining the SMT commitment, it is also wise to identifying and empower a 'Lean Champion' within the firm. The position and hierarchical level of this Champion varied amongst the firms. Some were the owners themselves, whilst others were functional managers, but generally the Champion was above supervisory level. It was found that the appointment of a Lean Champion did not contradict the Lean philosophy of universal responsibility for continuous improvement. Rather, the Lean Champion was critical in maintaining the momentum for change.
- One of the more tangible aspects of demonstrating the SMT commitment was the allocation of finance, time, and resources to Lean projects identified by management and the employees. The SMT must ensure that there is a 'will' to commit finance and resources for Lean projects, especially where there are competing priorities.
- Virtually all firms reported that they developed their implementation plans in conjunction with the external consultant. Many did not develop actual formalised plans, but instead relied on the Lean programme introduced by the consultant. The advantage of this approach was that action was initiated virtually straight away.
- Most firms advised others to select their consultants carefully. They looked for Lean and wider general business experience, knowledge, passion, fit with management, rapport with operational staff, and the committed to transfer knowledge to the organisation.

- Don't delay the start of the implementation, most Lean projects started virtually straight away.

5.2.3.3 Lean Training

Most firms stated that the training they received was difficult to comprehend at first due to the complexity and breadth of subjects contained in Lean. However, they also acknowledged that the SMT must understand Lean on a deeper philosophical level first.

In contrast, the training for operational staff must be pitched at a level appropriate to their level of education. Firms agreed that classroom sessions and seminars for operational staff were generally unhelpful as the environment was unfamiliar to them and did not suit their style of learning (a more kinaesthetic approach is usually needed).

The best form of training noted by the firms was a hands on approach by the trainer or consultant working directly with individuals in an On-Job-Training (OJT) format on a project that was directly applicable to the individuals job role. This allowed immediate recognition of the relevance of the change and this aspect was key for the buy-in of staff.

Higher-level training on the strategic aspects of Lean was appropriate for the executives, owners and other members of the SMT.

Much of the Lean training was conducted in groups that consisted of members drawn from all hierarchical levels and across functions. This intermingling did much to break down perceptual barriers and old prejudices and facilitated the transfer of knowledge, intent, and improved communication. Hence, group training with all levels learning the same things was cited as a major reason for eliminating much of the staff resistance to Lean.

Some firms noted that many of their operational employees lacked even basic literacy skills. To facilitate Lean training they were compelled to conduct literacy training in conjunction with Lean. Similarly, other firms noted the need for additional general supervisory skills for their first line supervisors.

5.2.3.4 The Implementation Phase

Virtually all Lean programmes started with training from a consultant for the SMT. However, they also set about working with staff immediately on work place improvement programmes. This facilitated immediate buy-in from the staff.

An important concurrent activity in the implementation is the Opportunities for Improvement (OFI) business processes that allow that capture of staff suggestions for continuous improvement. A number of firms identified the OFI processes as one of the more critical aspects of the implementation phase. They noted that the OFI process is the mechanism that captures any bottom-up suggestions for improvement and hence these processes are critical for embedding Lean over the longer term.

Most firms reported that they needed to customise the external Lean programmes to suit their unique situations. One example was the need to 'Kiwise' the *20 Keys* programme that was utilised by the majority of firms on the Aichi programme. Generally, this was facilitated by the consultants.

They also started with quite modest goals, and warned against trying to achieve too much too early. The firms were unanimous in advising against starting a wide range of initiatives from the outset. However, they noted that it did not really matter which goals (such as selecting one or two of the 20 Keys) one started with. A key finding here is that it is not necessary for Lean implementations to follow any fixed or prescribed agenda. An attractive feature of Lean is the flexibility firms have in selecting their own starting point. This allows firms to select goals that address problems of immediate concern to them.

Those firms that achieved some easy wins, such as utilising the 5S's (sort, set in order, shine, standardise and sustain) to rearrange the factory floor and introduce visual cues had greater initial buy-in from staff. This effort also assisted in demonstrating to staff that management were serious about change. In support of this buy-in process, a number of firms noted the need to train their first line management staff or team leaders in general supervisory skills in addition to Lean education. Others also noted that a number of their operational staff needed training in general literacy skills in order to cope with the learning process.

Concerning the delivery of Lean training, most firms clearly emphasised the need to ensure that the operational staff training remains highly practical, real and relevant to their work areas, and not overly academic.

Generally, it was found that trade and skilled staff were more resistant to Lean initiatives than semi-skilled or unskilled staff. This was an interesting finding, but respondents explained this by stating that skilled staff were trained in particular techniques and were used to doing things their own way. Hence having to modify their practices, often as a result of a suggestion from an unskilled employee, was an affront to their professional pride. On the positive side, the skilled staff were more easy to train and could more readily absorb higher level Lean concepts.

5.2.4 Lean Implementations in a Recession

All firms saw Lean not just as a competitive weapon, but also as an essential tool for survival. All firms described the various economic difficulties they were currently facing. In particular, the high exchange rate and import competition from low labour cost countries was frequently cited.

One firm (Firm 9) has currently suspended their Lean programme due to severe economic hardship (a recent sudden reduction in domestic sales of 40%). Yet, they saw Lean as an essential survival tool and a key to their long-term recovery. While Lean initiatives have ceased, they have every intention of recommencing when the current crisis has subsided.

Another firm (Firm 13) who has also undergone three years of severe exchange rate pressure has continued their Lean programme and now states that Lean was the key to their survival. Now that the exchange rate has eased, they argue that they are much more competitive than ever before and their quote-to-order conversion rate is much higher.

Most firms stated that Lean could be implemented at any stage in the economic cycle, and it is argued this it is even more essential in recessionary times. Firms concluded that the productivity and competitiveness gains far outweigh the investments required and therefore, Lean should be even more necessary in a recession. Firms should not stop investing in these types of initiatives. Some firms were adamant that Lean has been their key to survival.

5.2.5 Quantifying the Benefits of Lean

One Managing Director stated that “every dollar spent by NZTE on Lean funding would be recouped many times by the increased productivity, higher wages and hence increased taxes and revenue for the Government”. This sentiment was echoed by the majority of other respondents. Other benefits can be quantified as either tangible or intangible benefits.

5.2.5.1 *The Tangible Benefits*

Specifically, the following are some examples of the benefits achieved by firms to date from their Lean activities. The full list of benefits achieved for each firm in the sample is attached at Appendix One. These numbers illustrate some of the dramatic improvements that have been achieved, and have been quoted directly from the respondents.

Firm 4:

- Better production planning and more in control of own firm.
- Productivity improved by 50% over the period.
- Job shop efficiency improved from 43% to 65%.

Firm 7:

- Inventory holdings reduced from five to six weeks to two weeks or less.
- Productivity increased by 60%.
- Work in progress (WIP) reduced by 70%.
- Finished goods inventory reduced by 70%.
- Same output, but 25% less staff for one key process (excess staff being redeployed).

Firm 10

- Lead times for orders reduced from 12 – 17 weeks to four weeks.
- Projects that used to take four months, now take five weeks.
- Inventory reduced by \$1.2m out of a total of \$6.3m, a 19% improvement.
- Productivity improved by 110% over a four year period.
- Design and production efficiencies improved by 50%.

Firm 14

- Lead times for customer orders reduced from 12 – 16 weeks to five to six weeks, approximately a 40% improvement.
- Sales up 10%.
- Profitability up 20%.

Firm 19

- Grown 30% over the last four years.
- Increased staff levels by 30%.
- Creating a more skilled work force allowing greater competencies with new technology.

These figures testify to the effectiveness of Lean initiatives so far.

5.2.5.2 The Intangible Benefits

The following are some of the intangible benefits accrued by the firms in the sample:

- Allows the SMT to 'know' their business better as the performance measures become much more accurate and comprehensive.
- Allows SMT to step back from the daily operations for a while and take a longer-term view.
- Mostly the staff buy-in to the changes and feel like they are part of the change process. This is a major positive for the Lean approach.
- Relaxed staff atmosphere, less stress in the work place for staff and management. Because the firm is more organised there is no 'panic' when deadlines approach.
- Exposure of the firm to other business and networks through the involvement in forums and clusters.
- The physical landscape of the work place becomes much more organised, clean and aesthetically pleasing. This instils confidence to customers and others who visit the premises. Also, the staff find it a much more attractive place to work.
- Succession planning for business owners. The Lean framework allows a form of 'franchising' of the operations (Firm 23).
- Allows the 'corporatisation' of owner-manager type firms. Adds to the level of professionalism and accountability of management.
- Improvement in attitude and work culture toward cleanliness and Safety and Health. For example, Firm 7 had 20 lost time injuries (LTI's) in 2005, by 2007 they had achieved Level Two accreditation with ACC.
- Improved moral, job satisfaction, and staff retention. Lean has the ability to turn a "completely septic" (Firm 20) company culture into a cooperative and contented workplace.
- More open communication between management and staff, improved labour relations and the removal of functional silos within the firm.
- Tribal factions removed, blame cultures eliminated.
- Helped group all the disparate performance efforts into an overarching framework that allows better control, visibility and understanding of the business processes.

- The more consultative leadership style required by Lean is more appreciated by the staff and team members. Develops team leaders and supervisors in other management skills.

Despite the normal reserve applied to studies such as this, and given the short timeframe of all these initiatives (an average of just 19 months), it is fair to say that the overall improvements seen in the sample are no less than remarkable. Indeed, these changes are not just incremental rather they are step changes that have had a profound impact on the performances of all the firms. This success has been achieved even despite the vagaries of implementation process and the volatile economy. The tangible and intangible benefits recorded here are a testament to the applicability of Lean to the New Zealand economy.

5.2.6 Lean and Supply Chain Management

Some firms noted the need to extend Lean practices into their inbound and outbound supply chain partners. As such most Lean active firms become much more demanding from their suppliers and distributors. Lean allows greater visibility of supplier performance and this is usually feedback to suppliers in order to gain better service.

Those partner firms who are also implementing Lean demonstrate much higher levels of quality, delivery reliability and communication. As such, firms can now start sharing information for example production schedules in advance with each other. This allows for much tighter coordination of the supply chain and reduces costs.

Some firms see Lean as a value proposition to sell to their customers. It becomes part of the marketing mix and also branding. Many stated that their customers had noticed an improvement in various measures especially reduced lead times and delivery reliability.

There is a notable contagion effect of Lean implementations within a supply chain as partner firms either; see the benefits for themselves, or are forced to adopt Lean to maintain the current trading relationship. For example, Firm one had a supplier ask them for a presentation on Lean due to what they had seen within the firm. This is a fascinating side effect of Lean implementations, and could be of great value in promoting Lean in New Zealand. This suggests that once Lean reaches a critical mass in New Zealand industry, it should become self-sustaining.

However, most of the respondents acknowledged that their efforts to integrate Lean into their supply chain are in their infancy and are currently a low priority. This is because most of their efforts and resources are focused on embedding Lean internally first. This internal focus is a

characteristic of this sample as most are still in the early phases of Lean implementation. Yet, most respondents stated that as Lean matures internally, they will soon be seeking greater efficiencies from their supply chain partners.

5.2.7 Lean Clusters and Forums

All firms found the association with other likeminded firms in management and owner forums beneficial. However, they differed in their preferred format. Some respondents only found them helpful when Lean was the sole topic, whilst others found discussion on Lean and other general business topics as useful. The opinions were evenly divided, but all agreed that the forums were essential.

It was suggested that forums were also useful as means for education, such as Lean terminology and language and also to discuss aspects of Lean, such as the 20 Keys programme.

One member of the Aichi 2 group found that their forum did not work as well as it should due to the disparate nature of the industry groupings it contained. It was noted that the firms were interested in the experience of others within their own industry first and foremost, and the wider Lean experiences of others second. This suggests that where possible, clusters and groupings should belong to the same or similar industries, even better, to the same supply chain where feasible. However, some firms will inevitably be competitors and this has the potential to restrict the openness of the sharing. Thus, forum members and groups should be carefully selected. However, it is important that the forum groupings must not be forced, they must remain voluntary.

Many respondents also thought the idea of forums for team leaders and supervisors as useful. This would allow the cross pollination of ideas and experiences at an operational level and would provide intrinsic recognition for staff at this level.

Some firms suggested that NZTE could play a role in organising and hosting guest speakers and other notables in these forums. Others saw these forums as opportunities for managerial training in addition to sharing experiences. A suggested frequency was quarterly, as long as they did not devolve into “drinking clubs” or “time wasters”.

All firms did indeed recognise the benefits and networking opportunities associated with these forums.

5.2.8 NZTE Exit Strategy

Clearly there comes a time when external funding and support should cease. Determining this exit point is critical, as too early an exit would not give enough time for the Lean culture and philosophy to be embedded internally, whereas delaying the exit could potentially create an unhealthy dependency on external help.

Firms were asked at what point did they consider themselves to be mature enough to advance Lean on their own? Many did not know or had not reached that point, but those that did have an opinion were quite adamant.

It is clear that a firm progressing on the Lean journey will not be able to reach self sustaining levels until their internal OFI processes are robust and embedded in the company culture. The OFI processes are the tools that capture and reward suggestions and improvement initiatives from the shop floor. These OFI processes must be working for continuous improvement to be achieved, and this is essential for maintaining long term productivity growth. It is only at this point that Lean becomes self sustaining within the firm and external support can stop. It is noted that this point differs with each firm. Thus, setting an arbitrary time limit (such as 12 months) whilst good for planning and budgetary purposes, may not be optimal for Lean implementations.

Most firms were clear that they needed the support of the consultant for a period of longer than 12 months. Many firms had reengaged their consultant on a periodic basis, but others could not afford this. Those that did were materially making greater progress than those that didn't. The conclusion to be drawn is that NZTE should maintain their funding support until the OFI processes are embedded. However, the scale of the funding could be reduced in the second 12 months to period visits or on-call by the consultant.

5.2.9 Active Lean Companies - Summary

All the firms in this study have achieved significant benefits along a number of performance measurements as a result of their Lean initiatives. The only exception is a single firm where a severe market downturn has stopped any progress, but they intend to continue when things improve.

All firms found the input of external consultants as a critical part of the Lean journey and their experiences with those consultants have been very positive. Many have reemployed their consultants at their own expense, but on a less intensive basis to help maintain momentum. Many now use their consultants for regular 'health checks' or auditing visits as a means of imposing self

discipline. All the firms doing this stressed the importance of on-going external support. Without this, that stated, they would 'soon loose their way'.

The majority of the firms are relatively new to the Lean journey, thus long-term sustainability issues and problems have yet to arise. Virtually all were concerned about how to maintain the momentum they have already built and were worried about slipping back into old habits. Indeed, many were already experiencing atrophy in their initiatives.

The greatest risk to a Lean manufacturing programme is inertia and slipping into the old ways of doing things. Generally, this occurs as the result of the knowledge and a culture of continuous improvement (such as the OFI processes) not being properly transferred or embedded in the firm at all levels.

5.2.10 Sustaining Lean and the Way Forward

The following section discusses what is needed to support Lean initiatives in New Zealand in the future.

5.2.10.1 Sustaining Lean

Several themes emerged from the interviews concerning how to sustain Lean within firms. However, what cannot be avoided is the conclusion that the primary driver of Lean uptake was the offer of co-funding from NZTE. All firms agreed that the co-funding was a necessary antecedent for firms to start on the Lean journey. Yet to sustain Lean once started, most agreed that while funding was still desired it would be on a much more limited scale for things as external 'health checks' as an example.

Virtually all agreed that inertia and being swamped with day-to-day operational issues was the biggest threat to maintaining Lean in the future. Thus, efforts to sustain Lean should be focused on setting in place periodic external checks, not to dictate compliance through any punitive measures, but rather to encourage compliance through accountability for progress.

Another major theme was that 'Lean supply chains' was observed as the best model for embedding Lean in the New Zealand economy. The study showed that those firms doing the best were linked through trading relationships with other firms in their supply chain. For example, Selecon and Hunza are both supplied by Swages Engineering, and all are involved in the Aichi 3 cluster. 'Lean supply chains' incorporates the best of all of the NZTE initiatives so far in that;

1. The trading relationships economically link the firms and thus provides a profit incentive to succeed in Lean.
2. The Lean forums provide another channel to discuss relationship specific issues and operational problems between firms.
3. Higher levels of supply chain inter-firm cooperation, such as sharing production and material requirements forecasts, can be pursued confidently as trust develops.
4. Communication and market knowledge is improved between firms.
5. The cluster is mutually interested (albeit self-interested) in its own survival.

Those firms who are attempting Lean by themselves tended to suffer the most in terms of the lack of knowledge, encouragement, support and motivation. Comments showed that it is much harder to implement Lean in isolation. Thus, the synergies of a Lean supply chain are greater than the individual membership of a forum or a cluster (geographical only) of disparate industries. It is however acknowledged that this model may not be achieved in every circumstance, yet it is strongly recommended as a model for future Lean implementations. There is a common saying that firms no longer compete against firms, rather supply chains compete against supply chains (Defee and Stank, 2005). Lean is clearly a paradigm that can integrate a supply chain into an effective whole.

5.2.10.2 Expectations from NZTE

The clarion cry from the majority of the firms is for NZTE to not cut the funding short. Many indicated that the funding was the primary driver for the initial start-ups. The initial 12 month period was too short and left some firms with only partial implementations.

There was also a strong expectation that NZTE take the lead nationally in rolling Lean out in the economy. This will also need to be coordinated with other branches of government who are also involved or interested in establishing Lean in the country.

That NZTE maintain regular contact with Lean active firms (a suggested frequency was once a quarter).

Some suggested that NZTE could take a coordinating role in hosting guest speakers, experts and even national Lean conferences. There was a desire from the respondents for some form of centralised knowledge or data centre concerning Lean resources.

Also, another suggestion was that NZTE establish a recognition programme that annually celebrates those Lean firms who are judged the best on a range of measures. This could promote some healthy competition between Lean active firms.

More coordination was required between NZTE Lean and their sector managers as some are not involved in the Lean programme yet.

Many of the firms did not know what other services NZTE had to offer.

5.2.10.3 Policies to Support Lean Implementations in New Zealand

Those firms that were on the Aichi programme were noted as being further along in their implementations than those on the other programmes. It is clear that the combination of elements used by NZTE to support the Aichi programme is quite effective. In particular, the initial engagement of the owners and SMT in Lean principals, the co-funding for consultants, the formation of forums and clusters and the visits to overseas exemplar firms all worked in synergistic way to establish Lean successfully in the sample firms.

Hence, it is clear that the Aichi programme is the most suitable for future interventions. If one element is to be singled out as the most important, it is co-funding. However, no Lean implementations would be possible without the engagement and commitment of the owners and SMT. Additionally, the identification and development of a Lean Champion is a critical enabler.

From NZTE's perspective, a possible outline policy for future Lean interventions might feature the following major steps:

1. Pre-intervention:
 - SMT goal setting and vision casting exercise ('do we really want to do this?').
 - Gaining owner and SMT team support. This is essential.
 - Working up an implementation plan.
 - The process of finding and selecting a suitable consultant.
 - Establishment of forums and clusters.
2. Year One:
 - Co-funding of external consultant.
 - Project start up, training and workshops for staff at all levels.
 - Target 'low hanging fruit' to quickly establish the benefits of Lean.
 - Intensive consultant input.

- Networking of forums and clusters
3. Year Two:
- Continued co-funding for consultant for regular, less intensive visits (say one per month)
 - As required on-call support to restart stalled initiatives if needed.
 - The OFI processes becoming embedded and effective with firms.
 - Networking of forums and clusters.
4. Year Three:
- Confirmation of OFI effectiveness.
 - Firms require regular 'health checks' from either NZTE staff or consultants to give a sense of accountability.
 - This phase should be self funded.
 - Lean becomes self sustaining and continuous improvement becoming a matter of routine.

5.2.11 Section Conclusions

One of the distinguishing features of this study has been the success of the application of the principles of Lean at all levels within the companies interviewed. It is clear that the consultants and trainers have been focusing on imbuing not just the operational tools of Lean, but also changing work cultures and establishing management structures to support Lean.

Historically, one of the primary causes of Lean failures has been the practice of implementing the tools of Lean in isolation without the supporting culture of Lean (Hines, Holwe and Rich, 2004). It is clear that the operational level tools of the Toyota Production System cannot be exported successfully apart from the culture of Lean. Yet the combination of operational level 'Lean tools' as well as the strategic level 'Lean principals' can be implemented with a much greater chance of success. Hence, this study found that those Lean implementations that focused on the identification of customer value, the mapping and control of the value stream, the use on 'pull' systems to control material flow through production, and the unrelenting pursuit of perfection through the reduction to zero of the seven types of waste have been the most successful so far. Fortunately, this has been the approach of the consultants to date, but 'Lean principals' will need to be the guiding framework for all future implementations as well.

Finally, firms were asked in a scale of one to five (1 = very dissatisfied, 5 = very satisfied) how satisfied they were with Lean as a production concept? The mean of the responses was 4.8 (range

4 – 5) indicating that the firms were very satisfied with Lean. This shows that the concept has been accepted and has produced material benefits in the sample.

Firms were also asked how satisfied were they with their progress along the Lean journey? The mean of the responses was 3.4 (range 2 – 5) or approximately halfway between satisfied and neutral. Related comments showed that most firms were very pleased with their progress to date, but they realised that the Lean concept is a never-ending journey of continual effort and improvement. Hence, their responses were tempered somewhat.

Lean has much to offer New Zealand. A common sentiment was that Lean was the most practicable or even the only way to increase productivity in our economy. One respondent stated that “there is no question about it, New Zealand must do Lean to remain competitive” (Firm 8). Another comment was “there is no other way apart from Lean” (Firm 10). Others stated that Lean will raise the training and skill levels of the workforce. Most saw that Lean was the only way to compete with low labour cost countries. It was also observed that Lean systems are applicable for all types of industries and organisations.

All firms realized that what they had achieved to date was only the beginning of a much longer journey, one that many said would not end. For Lean to become embedded in the New Zealand culture and economy this is an important mindset to possess. It means that New Zealand should never become complacent with where we are, and must strive to achieve world class. This is the essence of Lean.

5.3 Survey of Lean Consultants and Trainers

5.3.1 Study Method

This section outlines the method used and the characteristics of the sample of consultants and trainers interviewed. All interviews were conducted by telephone utilising the interview protocol developed in conjunction with NZTE.

We had some difficulty in contacting many of the consultants, and many messages were not returned. In the end a total of six consultants consented to an in-depth telephone interview. Included in the sample were the two consultants (CBI and Yeats Consulting) used most often by the firms surveyed in the previous section. The opinions expressed below are derived from an analysis of the data and again take an aggregated form.

5.3.2 Successful implementation of Lean within New Zealand businesses – Key Issues

There were two significant findings in this area. The first was the degree of demonstrated commitment to the project by owners or top management. This is not surprising as most research into organizational change has identified this element as key to a successful implementation. This commitment needs to be reflected by the active involvement of the top level management in planning and implementation activities.

The second finding related to the knowledge the top leadership possessed with respect to Lean systems. The better top management's understanding of the philosophies of Lean systems, the more likely the project was to succeed. This knowledge and understand needs to extend beyond any set of basic tools and must encompass the systems approach to a Lean organization.

5.3.3 Enablers of Lean implementation

The most commonly cited enabler of a Lean implementation is the enthusiastic support and guidance of a local champion. Often this was the chief executive, but senior leadership from specific functional areas have also been successful. These champions have two major influences on the organization. The first is to keep the organization focussed on the program and the second is to be able to remove barriers to implementation.

5.3.4 Barriers to Lean implementation

There were three major barriers identified that could impede a successful Lean implementation. The first of these was lack of knowledge and understanding about Lean, what it means to an organization, and what is required to make Lean work. The consensus opinion was that New Zealand managers are less aware of the true nature of Lean than managers in other countries. This led to an occasional corollary barrier, that of reluctance and defensiveness on the part of mid-level management. Lacking a proper understanding of Lean, they perceived the concept as a threat to their competence.

The second barrier was strictly financial. As most businesses in New Zealand are quite small, developing internal funding for consultants and the development and implementation of a Lean program can be a significant barrier.

The third barrier was the lack of skills amongst the workforce. This barrier is slightly more complex as there are two different skills sets in question. The first of these relates to the management skills

at all levels of the organization. Implementing Lean may require a significantly different and more sophisticated set of management and leadership skills than the current management and supervisory workforce exhibits. The second set of skills pertains to the literacy of the actual workforce. These both were common problems across many organizations in many industries.

5.3.5 How Successful was the NZTE Lean Project?

The consultants contacted unanimously praised the NZTE Lean program and believed it was a major success. The provision of financial support, the educational programs, and the access to exemplars (notably the Japan trip) were all deemed highly important and significant contributions. There was also considerable and strong support for the role NZTE clusters played in the Lean program. These clusters are perceived as highly variable in their effectiveness, but when they worked well, they were seen as extremely useful in deploying the Lean concepts and programs. The general consensus was that the NZTE program has been very successful in facilitating companies making the first steps towards Lean.

5.3.6 How to Promote Lean in the Future

There were several clear consensus opinions on this question. The first of these was that there is a real need for a coordinated government approach to promoting and supporting Lean in New Zealand. There are, by the estimates of the consultants, at least six different Lean initiatives from different government departments and agencies including NZTE, the Department of Labour, TEC, and Skills. This creates problems on two fronts. The first is that it makes it very difficult for an organization to access all of the support which might be available. The second is that there will inevitably be a duplication and overlap between these various programs, a concept that is inconsistent with the Lean approach.

The second strong consensus was that the support program needs to extend beyond the first year. All of the consultants believe that one year is simply not enough time for an organization to become truly self-sufficient in terms of Lean. All felt at least a second year was needed with some suggesting three to five years was more like the real time frame for complete integration. However, all consultants agreed that the level of support should decrease over time as the organizations became more self-sufficient.

The third consensus is that education and awareness are key to starting the Lean process. The consultants had clearly identified lack of knowledge and understanding as a barrier to successful implementation and felt that further, more widespread education, awareness, and exposure was a

key element in broader Lean programs. While the current approach was viewed favourably, there was some suggestion that a two-part initial training program, perhaps a month apart, might be more effective. This would allow attendees to integrate a base set of knowledge prior to getting into more detailed applications and concepts.

The final consensus point was that more and better exemplar organizations are needed both domestically and internationally to help illustrate the benefits of Lean and promote understanding of the process and outcomes. This was deemed an especially useful aspect of the current program that needs real expansion in the future. The need for international exemplar organizations was seen as an especially important component of an expanded program, largely due to the significantly greater scope and experience available overseas. However, it was pointed out that the help and support of high-level government officials (ministerial-level) could play an important role in developing such contacts.

5.3.7 The Role of NZTE in Future Lean Programs

In general, the consultants thought NZTE is uniquely placed in the overall scheme of things to be the lead agency in driving Lean program in New Zealand. This is largely due to the intense practical nature of the NZTE mission and their contacts domestically and internationally. This also reflects the training and education focus of the organization as this was seen as a key element in future program.

In many ways, this role is just more of the same. Future programs, according to the consultants, should contain more education, more forums, the development of new clusters around the country, more trips to exemplar organizations, and funding over a longer period of time as outlined above.

However, one key aspect represents a major new role for NZTE, that of the anchor agency for Lean in New Zealand. The need for this function was the most strongly expressed opinion of the consultants and they were uniform in their belief that NZTE was the best choice for such a role.

Part of the role of such an anchor agency would be to establish the vision, strategy, and structure for Lean uptake and implementation for the country. This needs to include the setting of specific objectives for organizations, clusters, and consultants as well as reporting and evaluation structures. While the journey is the important part, there must be measurable results during the process to assess improvement, focus efforts, establish appropriate benefits, and increase motivation and involvement.

While perhaps a parochial concern, the consultants generally felt NZTE should act as a clearing house for training and consulting resources around Lean. Setting aside for the moment the obvious self-interest in the creation of a “shopping mall” business can use to find a Lean consultant, part of this concept also included the up skilling and “qualification” of the consultants NZTE included in the program. Several consultants were concerned that not all practitioners of their trade had the necessary skill set, knowledge, or experience to properly present Lean in the New Zealand context. Beyond the current baseline standard, Lean is an evolving concept and the training and continued education of consultants was seen as an important component of building Lean in New Zealand.

Not surprisingly, every consultant contact was keen to be involved in such an effort.

5.3.8 Supplementary Points

The following points were made by at least one of the consultants interviewed. Others may have expressed related opinions that contributed to the summary comments below.

The focus of Lean programs should be on the organization, not just on the shop floor. Few organizations saw how Lean could be applied to areas off the shop floor.

Organizations tended to be impatient seeking quick results. Proper Lean implementation requires a long-term focus, perhaps three to five years.

Organizations often felt they were “different” and Lean wouldn’t really work for them. Part of this was accepting the realization that the current approach, no matter how successful it had been in the past, was not good enough. It was suggested the owner/manager/entrepreneur scenario commonly reflected in small New Zealand business aggravated this problem.

Related to this was a dismissal of the “one size fits all” mentality. While Lean is applicable in most if not all organizations, it needs to be structured in a way that makes sense for each individual organization. This comment is related to the need for ‘up-skilling’ consultants mentioned above. There was some concern that consultants with limited skill sets, a focus on one tool or structure, and lack of holistic experience could present significant problems to a Lean initiative for the country.

The opportunities in the public sector and health care are significant. The Lean initiative should be extended to address these areas as well.

The trip to Japan (or possibly other countries) should come after the organizations have spent some time becoming knowledgeable about Lean – perhaps three or four months into the program. It may also be advisable to limit the trip to top level management only.

5.4 Survey of Tertiary (University) Providers

5.4.1 Study Method

This section outlines the methods used in the sample of tertiary providers. All eight of New Zealand's universities were surveyed. These are; The University of Auckland, Auckland University of Technology, Waikato, Massey, Victoria, Canterbury, Lincoln and Otago. Most of the information was able to be retrieved via desk research as the websites and other information available in the public domain was extensive. Where needed, interviews were conducted by telephone utilising the interview protocol developed in conjunction with NZTE. The opinions expressed below are derived from an analysis of the data, again taking an aggregated form.

5.4.2 Current Lean Programmes Offered

The current offerings in this area fall roughly into two categories; commerce based and engineering based programmes. Commerce based offerings follow a common pattern though the breadth and depth of coverage varies considerably. In each case the approach is to incorporate Lean tools and concepts into relatively traditional survey courses in Operations Management, Quality, and Strategy. At the low end of the scale (Victoria), this would consist of a maximum of two weeks coverage in one course. At the upper end of this scale (Lincoln), different tools and concepts are presented in six or more courses spread across several elective topics. But even in this extended coverage, Lean is just one of many modules throughout the term in each course.

The one school (Massey) that addresses Lean in their engineering program has a slightly different perspective. Their program is based on sustainable business improvement and Lean tools and concepts play an important part in many courses. However, like the commerce based approach, Lean is not viewed as a stand alone topic but rather as an element of other courses and it was not generally possible to clearly identify Lean in course outlines. Lean could not be identified in engineering programs at other universities.

No universities in New Zealand offer a specific degree program in Lean. Thus there are no NZQA accredited programmes at higher levels.

The vast majority of courses that address Lean in any form are at the undergraduate level. Occasional reference was made to Lean tools such as process mapping in graduate business courses, but this was sporadic and only addressed a few tools and did not present a Lean philosophy.

It should be noted that the University of Auckland Graduate School of Enterprise, through the presence of Bryan Travers, offers a series of 2-day short courses, several of which address Lean issues. They are targeted at the CEO/Executive level and are not part of a degree programme.

5.4.3 Graduate Profiles that Address Lean

No institutions indicated the Lean appeared in any graduate profile for any course currently on offer.

5.4.4 Demand for Lean Education

Across all universities there is essentially no expressed demand by students for stand alone Lean studies at the undergraduate level. The commonly expressed opinion is that students at this level either don't see the value or they don't believe the claims.

Massey reports that student interest raises somewhat after their students complete field trips if they have seen Lean in operation. They gain some understanding of the potential benefits and become interested in learning more. Massey also reports interest from local business people seeking educational resources.

At the graduate level, Massey, Waikato, and AUT report some student interest in doing thesis or dissertation research in topics related to Lean. This is frequently based on prior work experience and is generally limited to specific industries or companies.

5.4.5 Tertiary Awareness of NZTE Lean Initiatives

Massey, AUT, and Lincoln were generally well aware of the NZTE initiatives and were participating to some degree. Otago was vaguely aware of NZTE initiatives but only knew that NZTE had decided against offering programs in Dunedin/Southland. The other schools seemed generally unaware of NZTE initiatives and could not point to any direct involvement.

5.4.6 Qualifications and Experience of University Staff with Lean

All institutions had staff with basic academic knowledge in Lean. Most had staff with some research interest or activity in Lean, though the degree of activity varied. Massey, Lincoln, AUT, and Otago had staff with work experience in Lean-style implementations.

There are no proper advanced qualifications in Lean.

5.4.7 NZTE Support for the Tertiary Sector

As most knew little about NZTE programs, most had no real opinion of how this could be expanded or improved. Those schools who were involved were generally positive about the current approach. AUT would like to see more direct research funding for Lean studies and the establishment of a Lean Institute to provide structure and organization for research in Lean. For schools involved with Lean research or education, NZTE was seen as a valuable conduit into the business community for the development of research and teaching materials and resources. Most would like to see this role expanded.

Otago suggested Lean audits would be a valuable activity that NZTE could support.

5.4.8 Potential Contributions of Tertiary Institutions to NZTE Lean Programs

Responses in this area varied from “little or nothing” to expanding current programs to larger geographic areas, more industries, or broader scope. At the high end of the involvement scale, Massey and AUT wanted to grow and expand their existing relationships with NZTE. At a slightly different level, Lincoln is investigating restructuring several current course offerings around an explicitly Lean perspective. This would be directly reflected in graduate profiles and learning outcomes. These courses could be models for future NZTE educational initiatives.

At the low end of the involvement scale, the rest of schools indicated they might be able to develop some specialized courses on a contract basis but did not show evidence of any real enthusiasm.

5.4.9 Other Lean Research Initiatives

Coincidentally with our study, Lisa Blanchard at the University of Alabama in Huntsville is conducting a study of the integration of Lean concepts and principles into the curriculum of engineering and business schools in the USA sponsored by the Lean Educator Academic Network.

The study is in its early days so only very preliminary results are available. Briefly, Dr. Blanchard reports that

“Institutions approach Lean integration in a variety of ways, but integration into the curriculum seems to edge out stand alone courses. We also found OM to be a typical course, as well as Lean manufacturing/production on the Engineering side.”

She has also found that some institutions are looking at lean from a broader perspective and presenting it at an enterprise-level. Curriculums are structured around Lean (systems) thinking and lean supply chains without expressly calling the coursework “Lean.”

Thus, her findings closely parallel our findings here in New Zealand where integrating Lean into existing coursework is more common than stand-alone courses. Some institutions seem to be adopting Lean (or similar philosophies) at a more conceptual level in designing broader curriculums. It will be interesting to see the final analysis of the USA data to compare that to the balance between these approaches here.

Finally, the Ohio State University has started a new Master of Business Operational Excellence targeted at the executive/upper management level student. This programme is based on core Lean and Six Sigma principles and leading Lean academics and practitioners from around the USA will participate in delivering the programme. While the particular structure of this programme is probably not suitable to the New Zealand environment, it does provide one model of how such programmes can be structured. Further, the first cohort is fully subscribed (at a cost of US\$39,000!) indicating that the business community sees a real need for such an advanced programme.

End of Report

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Appendix One: Tangible Benefits of Lean

The following is the full list of the tangible benefits of Lean as experienced by the sampled firms.

<p>Firm Four:</p> <ul style="list-style-type: none"> • Better production planning and more in control of own firm. • Job shop efficiency improved from 43% to 65%. • Productivity improved by 50% over the period.
<p>Firm Five:</p> <ul style="list-style-type: none"> • Each vehicle used to take 13 days to complete, now takes just 5.8 days. • Processes reduced from 230 hours to 158 hours, saving 72 hours or a 31% improvement. • Clean and tidy work place, more organised.
<p>Firm Six:</p> <ul style="list-style-type: none"> • Reduced lead time for each yacht by 1.5 months, from 13 months to just over 12 months, as saving of 12% in production time. • \$50k worth of supplier overcharges per boat identified and claimed back. • Allowed new team leaders to be trained and become productive much sooner due to the standardised and documented SOP's.
<p>Firm Seven:</p> <ul style="list-style-type: none"> • Inventory holdings reduced from 5-6 weeks to 2 weeks or less. • Productivity increased by 60%. • Work in progress (WIP) reduced by 70%. • Finished goods inventory reduced by 70%. • Same output, but 25% less staff for one key process (excess staff being redeployed).
<p>Firm Eight:</p> <ul style="list-style-type: none"> • Hours build per boat reduced from 15,000 hours to below 10,000 hours, a savings of 33%. • Previous all plywood cuttings were measured and cut by hand, now a CNC cutting machine produces better quality, more accurate cuts and has significantly reduced waste.
<p>Firm 10:</p> <ul style="list-style-type: none"> • Lead times for orders reduced from 12 – 17 weeks to 4 weeks. • Projects that used to take 4 months, now take 5 weeks. • Inventory reduced by \$1.2m out of a total of \$6.3m, a 19% improvement. • Productivity improved by 110% over a four year period. • Design and production efficiencies improved by 50%.
<p>Firm 11:</p> <ul style="list-style-type: none"> • DIFOT (delivery in full, on time) measurers significantly improved. • Reduced absenteeism rates, significantly reduced overtime costs.

<p>Firm 12:</p> <ul style="list-style-type: none"> Helped maintain profit margins when market preferences changed. Eliminated overtime altogether, previously was 10% of labour hours. Reduced WIP and finished goods inventory, moved to consignment stock from suppliers, this has improved cash flows. Growth of sales per employee up by 110% over five years.
<p>Firm 13:</p> <ul style="list-style-type: none"> Quote conversion rate was 63%, now improved to 88%. DIFOT (delivery in full, on time) improved from 62% to 89%.
<p>Firm 14:</p> <ul style="list-style-type: none"> Lead times for customer orders reduced from 12 – 16 weeks to 5 – 6 weeks, approximately a 40% improvement. Sales up 10%. Profitability up 20%.
<p>Firm 15:</p> <ul style="list-style-type: none"> Production through put up by 10% Damage due to storage and handling of delicate horticulture product reduced. This improves the total amount of fruit that can be classified as export quality.
<p>Firm 17:</p> <ul style="list-style-type: none"> Production time per piece reduced from 13 minutes to 6 minutes, a 46% improvement. Daily output increased from 176 units to over 300 unites, a 58% increase. WIP and raw material inventory reduced. Improved quality, material handling and less damage during processing. Make to order processes have saved between \$150k to \$200k in savings each year. Engineering changes introduced more quickly reducing rework costs of WIP by 60%.
<p>Firm 18:</p> <ul style="list-style-type: none"> DIFOT improving from 65% to a target of 95%. Productivity improved (no figurers given)
<p>Firm 19:</p> <ul style="list-style-type: none"> Grown 30% over the last four years. Increased staff levels by 30%. Creating a more skilled work force allowing greater competencies with new technology.
<p>Firm 20:</p> <ul style="list-style-type: none"> Reduced the production time for the wings from 1,200 hours to 900 hours, a 25% reduction, and also for the fuselage from 1,000 hours to 670 hours, a 23% reduction. Aircraft production was less than one per month, now nearly 2 per month.

Firm 21:

- Productivity improved by 29% in 12 months.

Firm 22:

- DIFOT was 64%, now 95% on time (neither early nor late).