The Relationships Between Computer Use and Canterbury Dairy Farmers' Goals, Personality Traits and Learning Styles

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The relationships between computer use and Canterbury dairy farmers' goals, personality traits and learning styles.

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Abstract

To help explain dairy farmers' use of software in managing farm information, farmers' goals, personality traits and Kolb's learning styles were included as independent variables in a model. The relationships were tested against on-farm computerised information system (CIS) use and other related variables. Relationships were in fact identified, using both direct and indirect correlation, between farmer's psychological characteristics and their computer related behaviour. Furthermore, cluster analysis was used to find a complex relationship indicating computerised information system use seems to be related to abstract conceptualisation, two psychological profiles, introspection and extroversion, and a preference to follow management principles. On the other hand, a high scoring in "concrete experience" may be related to a delay in CIS adoption. These findings will help in assisting farmers, especially those who want to improve their information systems, decide on their personal computer aptitude.

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1 Introduction

Besides the physical factors, such as farm size, the reasons for farmers information practices could well be based on personal factors. This paper contains an analysis of this possibility. In previous papers the following hypotheses were proposed to explain on-farm computerised information system use.

- The first is the knowledge gap between the software developer and user. This gap involves the knowledge and information that each farmer posses and uses for operating and managing her/his dairy farm relative to the software developers' concepts. A large gap may result in different viewpoints of the decision problem and its solution. If this knowledge gap is small, adoption will be facilitated, otherwise adoption will not occur. Often the developers' knowledge relies on scientific, economic and management research in contrast to practical considerations. Higher levels of acceptance may exist for applications developed by analysts who also have a farming background.
- The second factor is the extent of a farmer's perception of the economic benefits and ease of management derived from the adoption of an information innovation. A clearly perceived benefit will reinforce adoption behaviour, otherwise adoption will not occur. The first and second factors are related.
- The third factor concerns the skills needed to manage the information innovation. Adoption will be accelerated if farmers have the skills, otherwise adoption will be slowed down.

These hypotheses were discussed in Alvarez and Nuthall (2001d). The aim of this paper, therefore, is to expand the proposed model through the inclusion of new variables, such as farmers' goals, their personality traits and learning styles, and to test the relationships between these variables and on-farm computerised information system use and other related variables.

2 Data collection

Two sets of data were collected during the research process. Firstly, through a mail questionnaire, 290 valid responses were received from 537 Canterbury dairy farmers during July of 2000. Secondly, 39 interviews were carried out among randomly selected farmers who were using on-farm computerised information systems (25), and those who were not (14). Data about farmer's goals were collected in both survey procedures. The mail questionnaire included a question requiring a score on 7 suggested goals using a 1-5 scale (see appendix 1). Additionally, at the end of each interview, each interviewee was asked to complete three tests, one for goals, another for personality traits and a final one for learning styles. The forms used to collect this data are reported in appendices 2 to 4.

The following sections consider farmers' goals, personality traits and their learning styles, all in relation to information management.

3 Farmer goals

3.1 Mail survey data

Table 3.1 presents the percentage of farmers (from the 290 sample) giving each level of importance (rank) for each of the 7 goals suggested in the mail questionnaire.

The ranking has "enjoying farming" as the most important goal, with "achieving high profits" second, "to provide an income to raise the family" third, "farming in a sustainable way" fourth, "achieving high farm production" and "having a reasonable income and plenty of time to enjoy other interests" follow, with the lowest ranked goal being "to be a top farmer".

Table 3.1 Importance of farmer goals: percentage of farmers in each category

Goal\Goal ranking	Not important	A little important	Moderately important	Quite important	Very important	No response
To enjoy farming	0.69%	1.03%	4.14%	15.17%	75.52%	3.45%
To achieve high profits	1.38%	0.69%	6.55%	14.83%	72.41%	4.14%
To provide an income to raise my family	4.14%	1.38%	6.21%	14.48%	66.90%	6.90%
To have a reasonable income and plenty of time to enjoy other interests	1.72%	4.83%	12.41%	17.93%	57.24%	5.86%
To achieve high farm production	3.79%	1.72%	12.76%	22.41%	54.14%	5.17%
To farm in a sustainable way	1.72%	1.72%	11.03%	28.28%	52.07%	5.17%
To be a top dairy farmer	4.83%	4.14%	17.24%	25.86%	41.72%	6.21%

Source: Alvarez and Nuthall (2001a)

Factor analysis of 29 farmer characteristics, including the farmer's goals, recorded through the mail questionnaire, shows that the 7 goals can be summarised into two factors (see Alvarez and Nuthall, 2001b). These factors were called "production-economic orientation" and "other interests". The first factor included being a top farmer, achieving high farm production and high profits. The second factor was positively correlated with the remaining goals.

3.2 Interview survey data

Table 3.2 presents the percentage of each "ranking" assigned by the 39 interviewed farmers to the 29 objectives included in the Edinburgh farm objective scale.

Table 3.2 Edinburgh farm objective scale: percentage of farmers in each "ranking" category

Objective statement	Strongly agree	Moderately agree	Neither agree nor disagree	Moderately disagree	Strongly disagree	Non response
1. It is important to pass the farm to a member of family	7.7%	12.8%	35.9%	18.0%	25.6%	0.0%
2. It is important to stay in farming whatever happens	7.7%	2.6%	12.8%	33.3%	43.6%	0.0%
3. It is important to have the respect of other farmers in the community	18.0%	30.8%	35.9%	10.3%	5.1%	0.0%
4. It is important to enter and win in shows	5.1%	2.6%	7.7%	20.5%	64.1%	0.0%
5. In adopting new ideas it is important to lead rather than follow.	15.4%	28.2%	41.0%	7.7%	7.7%	0.0%
6. Making a comfortable living is all that is important.	7.7%	15.4%	28.2%	18.0%	30.8%	0.0%
7. Being fully productive is important.	38.5%	38.5%	20.5%	0.0%	2.6%	0.0%
8. It is important to plan for retirement.	46.2%	38.5%	15.4%	0.0%	0.0%	0.0%
9. It is important to keep debt as low as possible.	12.8%	12.8%	30.8%	28.2%	15.4%	0.0%
10. Having interests outside of farming is important.	66.7%	12.8%	18.0%	0.0%	2.6%	0.0%

Table 3.2 (cont.)						
11. There is too much emphasis put on preventing pollution.	7.7%	15.4%	25.6%	35.9%	15.4%	0.0%
12. It is important to use chemicals sparingly.	33.3%	38.5%	18.0%	7.7%	2.6%	0.0%
13. Having a successfully diversified farm is important.	5.1%	18.0%	35.9%	25.6%	15.4%	0.0%
14. Improving the quality of the farm generally is important.	59.0%	38.5%	2.6%	0.0%	0.0%	0.0%
15. Improving the quality of my life is important.	76.9%	18.0%	5.1%	0.0%	0.0%	0.0%
16. Improving the living standards of family life is important.	71.8%	25.6%	2.6%	0.0%	0.0%	0.0%
17. It is important just to operate on a day to day basis.	2.6%	0.0%	10.3%	30.8%	56.4%	0.0%
18. It is important to spend time with the family.	76.9%	12.8%	7.7%	0.0%	2.6%	0.0%
19. It is important to plan for holidays off the farm.	64.1%	25.6%	7.7%	0.0%	2.6%	0.0%
20. It is important to minimise risk in farming.	41.0%	41.0%	12.8%	5.1%	0.0%	0.0%
21. It is important not to overproduce, on the farm.	12.8%	18.0%	28.2%	20.5%	20.5%	0.0%
22. It is important to encourage wildlife on the farm.	12.8%	25.6%	35.9%	15.4%	10.3%	0.0%
23. It is important to leave the land in as good a state as one received it.	68.4%	23.7%	7.9%	0.0%	0.0%	2.6%
24. Having up-to-date machinery/equipment is important	12.8%	7.7%	41.0%	25.6%	12.8%	0.0%
25. It is important to have the best possible livestock/pasture.	53.9%	38.5%	7.7%	0.0%	0.0%	0.0%
26. It is important to make the largest possible profit.	38.5%	43.6%	10.3%	7.7%	0.0%	0.0%
27. It is important to fully utilise all your resources.	48.7%	33.3%	18.0%	0.0%	0.0%	0.0%

Table 3.2 (cont.)						
28. It is important to increase the size of the farm.	12.8%	30.8%	30.8%	15.4%	10.3%	0.0%
29. Financial commitment should be taken over a long term.	28.2%	33.3%	35.9%	2.6%	0.0%	0.0%

The analysis of each item can be enhanced by developing an index that scores "strong agreement" with 2, "moderate agreement" with 1, "neither agreement nor disagreement" with 0, "moderate disagreement" with –1, and "strong disagreement" with –2 and is summed across all the sample farmers. This data is presented in table 3.3.

Table 3.3 Edinburgh farm objective scale index

Objective statement	Index
1. It is important to pass the farm to a member of family	-41.03
2. It is important to stay in farming whatever happens	-102.56
3. It is important to have the respect of other farmers in the community	46.15
4. It is important to enter and win in shows	-135.90
5. In adopting new ideas it is important to lead rather than follow.	35.90
6. Making a comfortable living is all that is important.	-48.72
7. Being fully productive is important.	110.26
8. It is important to plan for retirement.	130.77
9. It is important to keep debt as low as possible.	-20.51
10. Having interests outside of farming is important.	141.03
11. There is too much emphasis put on preventing pollution.	-35.90
12. It is important to use chemicals sparingly.	92.31
13. Having a successfully diversified farm is important.	-28.21
14. Improving the quality of the farm generally is important.	156.41
15. Improving the quality of my life is important.	171.79
16. Improving the living standards of family life is important.	169.23
17. It is important just to operate on a day to day basis.	-138.46
18. It is important to spend time with the family.	161.54
19. It is important to plan for holidays off the farm.	148.72
20. It is important to minimise risk in farming.	117.95
21. It is important not to overproduce, on the farm.	-17.95
22. It is important to encourage wildlife on the farm.	15.38
23. It is important to leave the land in as good a state as one received it.	160.53
24. Having up-to-date machinery/equipment is important	-17.95
25. It is important to have the best possible livestock/pasture.	146.15
26. It is important to make the largest possible profit.	112.82
27. It is important to fully utilise all your resources.	130.77
28. It is important to increase the size of the farm.	20.51
29. Financial commitment should be taken over a long term.	87.18

As a group the farmers showed strong agreement (index value greater than 150) with statements 14, 15, 16, 18 and 23. The first four are related to quality of life and family enjoyment. The last is related to conservation awareness. With index values between 150 and 100 a second group reflects different ideas that can be associated with being successful in the business, such as statements 7, 20, 25,26 and 27. On this band of moderate agreement other statements reflect quality of life, such as statements 8,10 and 19. The next step, index values between 100 and 50 (little agreement), has two statements, 12 and 29. The first is related to sustainable practices and the second reflects a preference for long term financial commitments. Between 50 and –50, which means neither agreement nor disagreement, there is the larger group of statements, which can be grouped into four categories, farming status –statements 1 and 3, conservation awareness – statements 11, 21 and 22, successful farming – statements 9, 24 and 28, and other topics (statements 5, 6, and 13). Finally, on the band of moderate disagreement, there are two statements related to farming status –statements 2 and 4, and one related to the business –statement 17.

Due to the small number of farmers interviewed it was not possible to use principal component analysis to reduce the farmer goal data into a small number of underlying factors.

4 Farmers' personality traits

Many psychologists (see, for example, Matthews and Deary, 1998) believe a person's basic psyche is made up of two main factors –their intelligence level and their personality (though some believe motivation is also a basic trait). Thus, it is important to explore whether personality is related to information practices. It was not possible to include intelligence in this work.

Appendix 3 shows the form used to collect personality trait data. The scale was developed following a psychological framework that defines human personality based on five main traits: openness, conscientiousness, extroversion, agreeableness and neuroticism (see Matthews and Deary (1998) for their definition). Form the total 25 questions, there are five groups of five questions each one of which is theoretically associated with each trait. Appendix 5 shows these five groups of questions.

Factor analysis was used to test both the number of basic personality traits and whether the relationships between the questions occurred as expected. This technique required 5 or more observations (farmers) for each variable considered (25 questions) (Hair et al, 1998). The interviewee sample, which only has 55 observations (in some cases the personality test was answered by other family members, besides the farmer) did not provide enough observations to use factor analysis.

A national survey on managerial competency factors was run in 2001 by the Management Systems Research Unit of Lincoln University (Nuthall, 2001) using the same personality test. This survey collected 264 responses from New Zealand dairy farmers located across the country. This data was used to estimate farmers' personality traits to provide a check on whether the surveyed Canterbury dairy farmers were similar to this more extensive survey.

Table 4.1 Factor loadings of variables describing farmer's personality traits*

	F1	F2	F3	F4	F5	F6	F7
Q1	0.12	-0.01	0.06	0.13	-0.07	0.00	**0.64**
Q2	0.01	**0.43**	-0.13	**0.42**	-0.07	0.05	0.25
Q3	0.02	0.03	0.10	**0.75**	0.05	0.26	0.10
Q4	-0.01	0.01	0.35	**0.61**	0.06	-0.35	0.20
Q5	**0.70**	-0.04	0.11	0.12	-0.03	-0.25	0.07
Q7	0.20	-0.03	-0.06	**0.57**	0.06	0.12	**-0.46**
Q9	0.20	0.36	**0.53**	0.10	-0.05	0.13	**-0.46**
Q10	**0.79**	0.03	-0.07	0.05	-0.01	0.10	0.08
Q11	0.01	**0.71**	0.11	0.03	0.20	0.09	0.10
Q12	0.06	**0.44**	0.16	0.14	-0.10	**0.40**	0.30
Q13	**0.69**	-0.06	-0.08	0.08	-0.05	0.03	-0.11
Q15	-0.05	**0.56**	0.19	-0.11	0.35	0.06	-0.15
Q16	0.21	**-0.65**	0.08	-0.02	-0.05	0.10	0.20
Q17	0.15	-0.14	0.38	-0.07	0.13	0.31	0.21
Q18	0.05	0.04	0.07	0.05	**0.79**	0.06	-0.16
Q19	0.33	-0.39	0.25	-0.06	0.12	0.28	0.02
Q20	**0.54**	-0.21	0.11	-0.25	0.10	0.23	0.12
Q21	-0.17	-0.07	**0.74**	0.05	-0.03	-0.08	0.04
Q23	-0.06	0.21	-0.10	0.04	**0.83**	0.02	0.09
Q24	-0.02	0.05	0.08	0.16	0.09	**0.82**	-0.10
Q25	0.10	0.26	**0.58**	0.14	0.00	0.29	0.02

Note: * see appendix 11.3 for the question Q1-Q25.

Table 4.1 shows the seven factors obtained from the factor analysis of the 264 responses collected through the national survey. The method used was principal component analysis from the correlation matrix. Four questions were eliminated due to their low measures of sampling adequacy (Hair, 1998). These were questions 6, 8, 14 and 22. The criterion to determine the number of factors was to keep those with eigenvalues greater than one. Collectively, these seven factors explain 59% of the total variation, which is a significant amount. Loading values were obtained using a varimax rotation.

Factor 1 and factor 5 are closely aligned to two of the five theoretical personality traits. Factor 1 measures neuroticism with the high loadings of questions 5, 10 and 13, which were originally developed to measure this trait, and question 20, which can be rethought in this direction. Factor 5 measures extroversion due to the high loadings in questions 18 and 23. Factor 2 is mainly measuring openness

(questions 2, 11, and 16) combined with innovativeness (question 15) but with a methodical (question 12) approach.

The other four factors result from combinations of questions aimed at measuring conscientiousness, and openness. Three of the agreeableness questions (6, 14 and 22) were removed during the factoring process.

Factor 4 (questions 2,3,4, and 7) combines high loadings on questions that have in common an inter-human relationship theme, such as phoning strangers (2), seeking the views of many (3), discussing everything with family members (4), and sharing with neighbours (7). This trait may be measuring agreeableness but combined with a sense of precaution in decision making.

Factor 3 (questions 9,21, and 25) describes farmers who rely on experience (21), who admire financial logic (9), and like to plan ahead of time (25), these can be called "non improvisers" or farmers who "prefer to plan ahead".

Factor 6 relies mainly on question 24, which is related to following management principles, so this style can be called "theoretical or principled ".

Finally, factor 7 describes farmers who prefer to think carefully, but they may tend not to share, or involve others, in their decisions, so this style can be called "introspective".

Using the factor analysis results, seven new variables were developed, each one representing the above personality trait factors. Each variable receives the contributions of the 21 original question scores. The original questions that have higher loadings on each factor make the important contributions. The new variables have mean 0, and a variance equal to the squared multiple correlation between the estimated factor scores and the true factor values. The new variables may be correlated, even when the factors are orthogonal (SPSS 10.1, 1999).

5 Farmers' learning styles

Measurements of farmer's learning styles were carried out using the well recognised Kolb learning style inventory test (Kolb, 1984). The form used is shown in appendix 4. For each interviewed farmer four learning (modes) dimensions were elicited, concrete experience (ce), reflective observation (ro), abstract conceptualisation (ac), and active experimentation (ae). These modes were described by Kolb as:

Concrete experience: learning from specific experiences, relating to people, sensitivity to feelings and people.

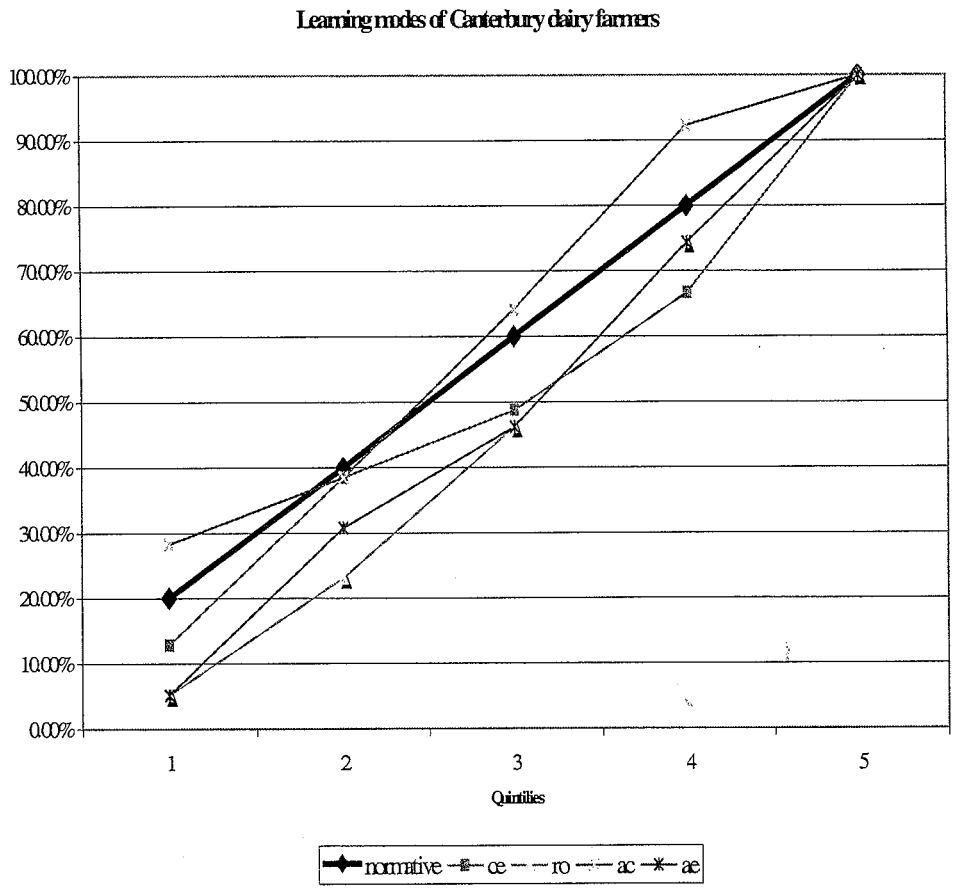
Reflective observation: careful observation before making judgements; viewing things from different perspectives, looking for the meaning of things.

Abstract conceptualisation: logical analysis of ideas, systematic planning, acting on an intellectual understanding of a situation.

Active experimentation: ability to get things done, risk taking, influencing people and events through acting.

These measurements are compared with standards provided by Kolb in figure 5.1.

Figure 5.1 Kolb's learning modes of Canterbury dairy farmers

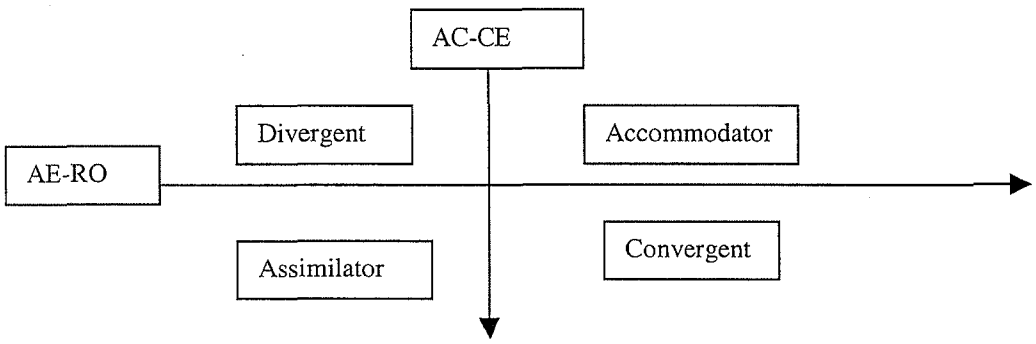


Note: see above explanation

The comparison with the norm (developed from 1933 adults ranging from 18 to 60 years of age, Kolb, (1984)) shows that large percentages of New Zealand farmers have higher values on three learning modes, concrete experience (ce), reflective observation (ro), and active experimentation (ae). Conversely, they show lower values on abstract conceptualisation (ac).

The four learning modes were combined into two scores that resulted from combining concrete experience and abstract conceptualisation (ac-ce), and combining reflective observation and active experimentation (ae-ro). Parameter (ac-ce) measures to what extent a person emphasises abstractness over concreteness while parameter (ae-ro) measures the relative "action over reflection" emphasis. By combining both parameters, a two-dimension space is developed, and four learning styles are defined, (a) convergent, which emphasises abstract conceptualisation and active experimentation; (b) divergent, which emphasises concrete experience and reflective observation; (c) assimilation, which emphasises abstract conceptualisation and reflective observation; and (d) accommodative, which emphasises concrete experience and active experimentation.

This situation can be protrayed through the following diagram:



The 39 interviewed farmers were categorised into their corresponding learning styles as shown in Table 5.1. The percentage distribution did not differ from standard norm (chi-square test).

Table 5.1 Interviewed farmers' learning styles

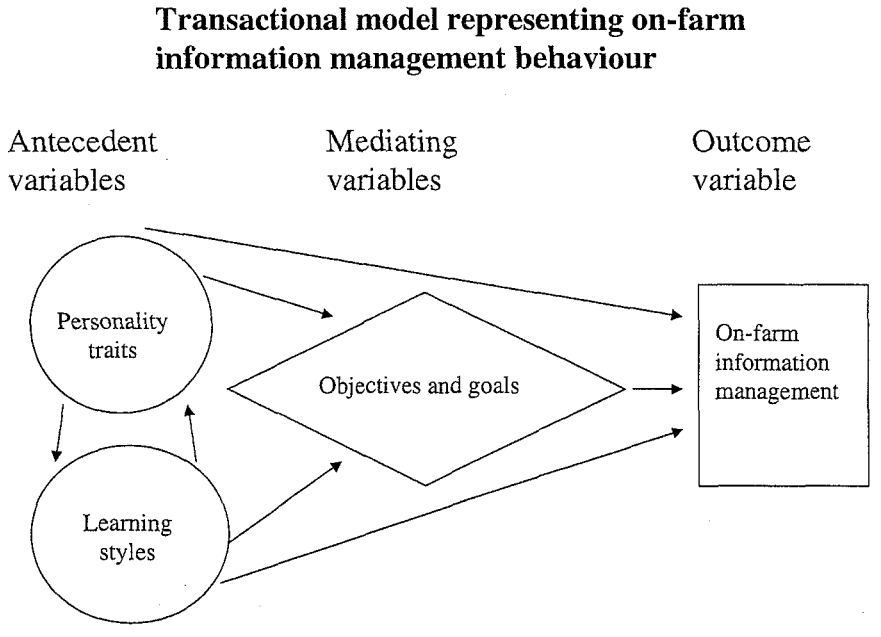
Learning style	Interviewed farmers
Accommodator	23.01%
Assimilator	20.05%
Convergent	23.01%
Divergent	30.77%
Divergent-assimilator	3.16%

6 Computerised information system use-goals, personality traits and learning styles relationships

Behavioural modelling using mediating variables was used to assess the relationships. This approach produces a transactional model of behaviour (Willock et al, 1999), which includes three types of variables. The first group includes antecedent variables, such as personality traits, the second includes mediating variables, such as coping styles, appraisals, objectives, and goals. The last group includes outcome variables such as behaviours, for example, the use of on-farm computerised information systems.

A transactional model allows considering both direct and indirect relationships between antecedent variables –farmer's personality traits and learning styles, and information management behaviour.

Figure 6.1 Transactional model



Three situations were represented through transactional modelling. Firstly, the farmers who were using at least one on-farm computerised system for information management (involved 61% percent of farmers (64% in the interview sample)) formed the first group or situation. Secondly, farmers who were using computerised systems to manage information associated with feed and pasture management formed another group representing 17% of the farmers (21% in the interview sample). The last group involved non computerised farms, and compares farmers who are considering the use of a computer relative to farmers

who were not. These groups represent 21% and 15% of the interviewed farmers respectively.

For each of these three situations, farmer behaviour was represented as a binary variable with "1" meaning that the farmer exhibits the particular behaviour, and "0" meaning that s/he does not (CIS-users against non-users; Feed-CIS-users against CIS-users who were using CIS in other areas; and non-users who were thinking of using relative to non-users who were not considering this possibility). Pearson correlation coefficients were used to show whether the behavioural variables were correlated with the farmer's objectives and goals, personality traits and learning styles. The same statistic was used to find relationships among mediating and antecedent variables.

6.1 Users of on-farm computerised systems

Table 6.1 presents mediating and antecedent variables that show statistically significant correlations (less than 10% probability) with the on-farm computerised system use binary variable (1= using one or more computerised systems, 0= not using).

Table 6.1 Variables related to the use of computerised information systems

Variable	Pearson correlation coefficient	Probability level of statistical significance
Objectives (mail questionnaire)(1)		
3-To achieve high profits.	0.32	5%
5-To provide an income to raise my family.	0.40	1%
Goals (Edinburgh scale) (2)		
3-It is important to have the respect of other farmers in the community.	-0.33	4%
8-It is important to plan for retirement.	-0.32	5%
15-Improving the quality of my life is important.	-0.49	<1%
18-It is important to spend time with the family.	-0.30	7%
19-It is important to plan for holidays off the farm.	-0.31	6%
Personality traits* (3)		
Factor 5 (extroversion)	-0.35	3%
Learning modes** (4)		
Concrete experience	-0.36	2%

Notes: * see section 4 for description of the personality trait factors, ** see section 5 for description of the learning modes. (1) a positive correlation means that farmers with the expected behaviour considered that objective more important. (2) a negative correlation means that farmers with the expected behaviour considered that goal more important. (3) a negative correlation means that farmers with the expected behaviour strongly showed the personality trait describes by the factor. (4) a negative correlation means that farmers with the expected behaviour have a lower score in that learning mode.

Because of the binary nature of the behavioural variable, for each positive or negative correlation between any variable and "using one or more computerised systems", the same correlation exists, with the inverse sign, with the "not using a computerised system" variable.

Farmers who were using one or more computerised systems ranked " to achieve high profits" and "to provide an income to raise their families" highly, they also showed agreement with having the respect of other colleagues, and gave high consideration to the quality of their personal and family life. They were also more extrovert, and showed less emphasis on concrete experience as a learning mode and problem solving approach than farmers who were not using computerised systems.

Table 6.2 Relationships between CIS-use related variables and personality factors

Variable	Personality trait factors*				
	Neuro-ticism (1)	Planning (3)	Agree-able (4)	Extro-version (5)	Intros-pection (7)
Objectives (mail questionnaire)(1)					
3-To achieve high profits.		-0.37 (2.7%)	-0.35 (3.9%)		-0.42 (1.2%)
5-To provide an income to raise my family.		-0.31 (6.9%)	-0.42 (1.1%)		
Goals (Edinburgh scale) (2)					
3-It is important to have the respect of other farmers in the community.	0.31 (7.0%)		-0.28 (9.2%)		
8-It is important to plan for retirement.		0.46 (0.4%)		0.32 (5.4%)	
15-Improving the quality of my life is important.				0.33 (4.7%)	0.33 (4.3%)
18-It is important to spend time with the family.				0.37 (2.4%)	
19-It is important to plan for holidays off the farm.				0.38 (2.0%)	
Personality traits*					
Factor 5 (Neuroticism)			0.31 (6.5%)	1	

Notes: * see section 4 for description of the personality trait factors, ** see section 5 for description of the learning modes. (1) a negative correlation means that farmers who scored the objective highly showed the personality trait described by the factor, (2) a positive correlation means that farmers who scored the goals lower (showing agreement) showed the personality trait described by the factor. The figures in brackets show the statistical significance level for each Pearson correlation coefficient (percentage of accepting the null hypothesis "r = 0").

The next step was to investigate the relationship between mediating and antecedent variables relevant to explaining the studied behaviour. Table 6.2 shows the statistically significant correlations among mediating and antecedent variables. There are 5 personality trait factors that appear relevant to explain

CIS-use behaviour. Besides factor 5, which has also showed a direct relationship with CIS-use, the correlation analysis showed indirect relationships with factors 1, 3, 4, and 7.

Factor 5, which measures extroversion, showed a positive correlation with goals 8, 15, 18 and 19 and with factor 3. Extrovert farmers showed a preference for the quality of their personal and family life. On the other hand, extrovert farmers expect to enjoy interpersonal relationships (factor 4).

A correlation between goal 3 ("It is important to have the respect of other farmers in the community") and factor 1 (neuroticism) was expected since one of the personality questions that had a high loading on this factor was question 13 ("You tend to worry about what others think of your methods"). Although the higher level of neuroticism in users does not have statistical significance (see table 6.3), the more neurotic farmers may think that by using a computerised system (new technology) they will have more respect from others within the farming community.

Factor 3 showed a positive correlation with objectives 3 and 5, and with goal 8[1]. Farmers who showed aversion to improvising, (and relied on experience, financial logic and planning) were more economics oriented, and wanted to plan their retirement. Similarly, factor 7 showed a positive correlation with objective 3 and goal 15, showing the relationship between this management style (introspection) and a preference for economic and quality of life aims.

The negative relationship between factor 4 and goal 3 seems contradictory and difficult to explain. On the other hand, farmers who showed a preference for interpersonal relationships and are precautionary in making decisions, aimed for high profits, and in providing an income to raise their families.

Table 6.3 shows personality factor values for users and non-users. As expected, the only factor that shows a statistically significant difference is factor 5 -this is the extroversion factor.

[1] To avoid confusion, aims contained in the mail questionnaire are called "objectives", while those which belong to the Edinburgh scale are called "goals".

Table 6.3 Personality factors of users and non-users

	Average	Users of computerised systems	Non-users of computerised systems	Probability of similarity
Factor 1	-0.3412	-0.3383	-0.3465	98.0%
Factor 2	-0.4733	-0.4356	-0.5429	71.3%
Factor 3	-0.2651	-0.3570	-0.0953	40.1%
Factor 4	-0.1809	-0.2322	-0.0861	56.2%
Factor 5	-0.1631	-0.3953a	0.2655	3.2%
Factor 6	0.1535	0.2169	0.0366	37.1%
Factor 7	-0.2326	-0.3376	-0.0387	33.7%

Notes: a: t-test shows a statistically significant difference between users and non-users in factor 5, t=2.231, p=3.2%.

Table 6.4 presents the learning mode scores for users and non-users. Again, as expected, the only learning mode that shows a statistically significant difference is concrete experience. Non-users rely on this learning mode more than users.

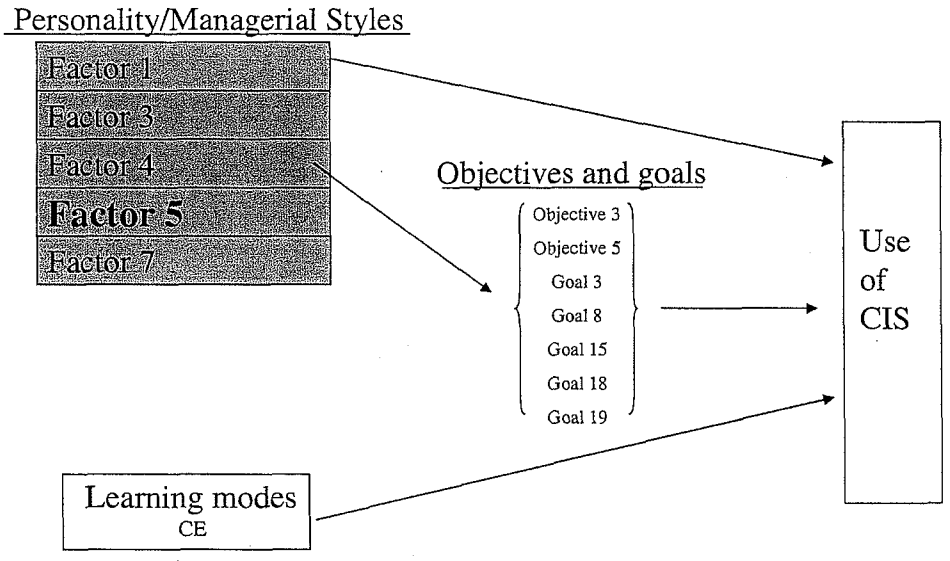
Table 6.4 Kolb's learning modes of users and non-users

	Average	Users of computerised systems	Non-users of computerised systems	Probability of similarity
Concrete experience	15.18	14.32a	16.71	2.5%
Reflective observation	14.61	14.80	14.29	58.1%
Abstract conceptualisation	16.56	16.68	16.36	76.2%
Active experimentation	16.94	16.76	17.29	59.6%

Notes: a: t-test shows a statistically significant difference between users and none-users in concrete experience, t=2.34, p=2.5%.

Given the analysis presented the following composite transactional model is proposed.

Figure 6.2 Transactional model for CIS-use



6.2 Users of computerised feed and pasture information systems

Farmers who were using computerised systems to manage their feed and pasture information represent 17 % of the mail survey respondents. These, on average, are more educated and manage bigger farms and herds than other users of farm software (Alvarez and Nuthall, 2001b).

A new variable, called "Feed-CIS-use", was developed, involving only those farmers who were using computerised information systems. From these 25 farmers, 9 were managing feed and pasture information through computers. These farmers were given a "1" for this variable, while the other 16 farmers, who were using software in other information areas, were classified as "0".

None of the farmer's objective, goal, personality trait factors and learning mode variables showed a statistically significant correlation with "Feed-CIS-use" variable. However, the differences may have been significant given a greater sample size as the averages were quite different in some cases.

Table 6.5 Personality factors of Feed-CIS-users and non-Feed-CIS-users

	Average	Users of computerised systems	Users of feed computerised systems	Non-users of computerised feed systems, but users of other CIS	Probability of similarity
Factor 1	-0.3412	-0.3383	-0.1817	-0.4322	53.0%
Factor 2	-0.4733	-0.4356	-0.4493	-0.4273	94.5%
Factor 3	-0.2651	-0.3570	-0.3200	-0.3792	88.6%
Factor 4	-0.1809	-0.2322	-0.0889	-0.3182	46.5%
Factor 5	-0.1631	-0.3953	-0.6082	-0.2676	32.9%
Factor 6	0.1535	0.2169	0.0362	0.3252	21.7%
Factor 7	-0.2326	-0.3376	-0.4804	-0.2520	54.9%

Comparisons between factor average values of these two groups of users and the average of all users show that computerised feed system users tend to exhibit traits described by factors 5 and 6 and less on factor 4 (see appendix 11.6). Thus, farmers using computerised systems to manage feed and pasture information seem to be more extrovert[2], and use a management style based on following principles, and are less "agreeable" relative to the other farmers.

6. 3 Non-users who were considering using computerised systems

These farmers represent 21% of the interviewed farmers. Table 6.6 presents mediating and antecedent variables that show a statistically significant correlation (less than 10% probability of being the same) with farmers who were still not using CIS, but they were thinking of doing so soon (represented as a binary variable (1= non-users who were considering, 0= non-users who were not considering)).

Farmers considering using computerised systems were less concerned about farming in a sustainable way and in using chemicals sparingly; they also put less importance in leading the adoption of new ideas, improving the quality of their family life, but were more concerned about day-to-day management; further they tended to think introspectively before acting; and, finally they showed less emphasis on abstract conceptualisation than farmers who where not considering the use of CIS.

[2] In addition, these farmers are more educated and have larger business than non-computer users.

Table 6.6 Characteristics of farmers considering the use of computerised information systems

Characteristic	Pearson correlation coefficient	Probability level of statistical significance
Objectives (mail questionnaire)(1)		
6- To farm in a sustainable way.	-0.58	4.9%
Goals (Edinburgh scale) (2)		
5- In adopting new ideas it is important to lead rather than follow.	0.57	3.2%
12- It is important to use chemicals sparingly.	0.66	1%
16- Improving the living standards of family life is important.	0.65	1.3%
17- It is important just to operate on a day to day basis.	-0.58	2.9%
Personality traits * (3)		
Factor 7 (Introspection)	0.64	2.8%
Learning modes ** (4)		
Abstract conceptualisation	-0.66	1%

Notes: * see section 4 for description of the personality trait factors, ** see section 5 for description of the learning modes. (1) a negative correlation means that farmers with the expected behaviour considered the objective as being less important. (2) a positive correlation means that farmers with the expected behaviour considered that goal less important, a negative correlation means that farmers with the expected behaviour considered that goal more important. (3) a positive correlation means that farmers with the expected behaviour showed the personality trait described by the factor less strongly. (4) a negative correlation means that farmers with the expected behaviour have a lower score in that learning mode.

Table 6.7 shows the second level of relationships between objectives, goals and learning modes relevant to the behaviour under consideration and personality trait factors. There are 4 personality trait factors that appear relevant in explaining "non-use considering using" behaviour (willingness). Besides factor 7, which showed a direct relationship with CIS-use, factors 1, 2, 3, and 6 showed indirect relationships.

Factor 7, which measures the introspective characteristic, shows a positive correlation with goal 12. Less introspective farmers tend to give less importance to the environment.

While the positive correlation between factor 1 and goal 5 means that less neurotic farmers are less concerned about leading the adoption of new ideas, the positive correlation between factor 2 and goal 16 means that less open farmers are less concerned with improving family welfare. Similarly, the positive correlation between factor 3 and goal 12 shows that farmers with less interest in not improvising, (i.e. they are happy to compromise) are less concerned about the environment.

Table 6.7 The relationships between the characteristics of farmers considering using CIS and their personality factors – Pearson correlations

	Personality trait factors*				
	Neuro-ticism (1)	Open-Ness (2)	Planning (3)	Principled (6)	Intros-pection (7)
Objectives (mail questionnaire)					
6- "To farm in a sustainable way".					
Goals (Edinburgh scale) (1)					
5- "In adopting new ideas it is important to lead rather than follow".	0.28 (9.5%)				
12- "It is important to use chemicals sparingly".			0.41 (1.3%)		0.36 (3.1%)
16- "Improving the living standards of family life is important".		0.42 (1.1%)			
17- "It is important just to operate on a day to day basis".					
Personality traits*					
Factor 7 (Introspection)				-0.28 (9.1%)	1

Notes: * see section 4 for description of the personality trait factors, ** see section 5 for description of the learning modes. (1) a positive correlation means that farmers who scored the goals highly (showing disagreement) exhibited less strongly the personality trait describes by the factor. The figures in brackets show the statistical significance level for each Pearson correlation coefficient (percentage of accepting the null hypothesis "r = 0").

Finally, there is a negative correlation between factor 7 and factor 6. Introspective and principled management styles showed an inverse relationship.

Table 6.8 shows personality factor values for these two groups of non-users. As expected, the only factor that shows a statistically significant difference is factor 7 (related to introspection). Farmers who are not thinking of using CIS show an emphasis on factor 2, and seem to be more open than farmers thinking of using CIS (see appendix 11.6).

Table 6.8 Personality factors of non-users considering computer use relative to farmers not considering use

	Average	Non-users of computerised systems	Non-users thinking of using	Non-users not thinking of using	Probability of similarity
Factor 1	-0.3412	-0.3465	-0.3031	-0.3971	87.0%
Factor 2	-0.4733	-0.5429	-0.2323	-0.9052	25.1%
Factor 3	-0.2651	-0.0953	0.0595	-0.2759	46.5%
Factor 4	-0.1809	-0.0861	-0.0945	-0.0762	96.6%
Factor 5	-0.1631	0.2655	0.1556	0.3937	63.8%
Factor 6	0.1535	0.0366	-0.1373	0.2395	30.4%
Factor 7	-0.2326	-0.0387	0.4556a	-0.6154	2.8%

Notes: a: t-test shows a statistically significant difference between the two groups of non-users in factor 7, t=-2.523, p=2.8%.

Table 6.9 Kolb's learning modes-scores for non-users considering computer use relative to farmers not considering use

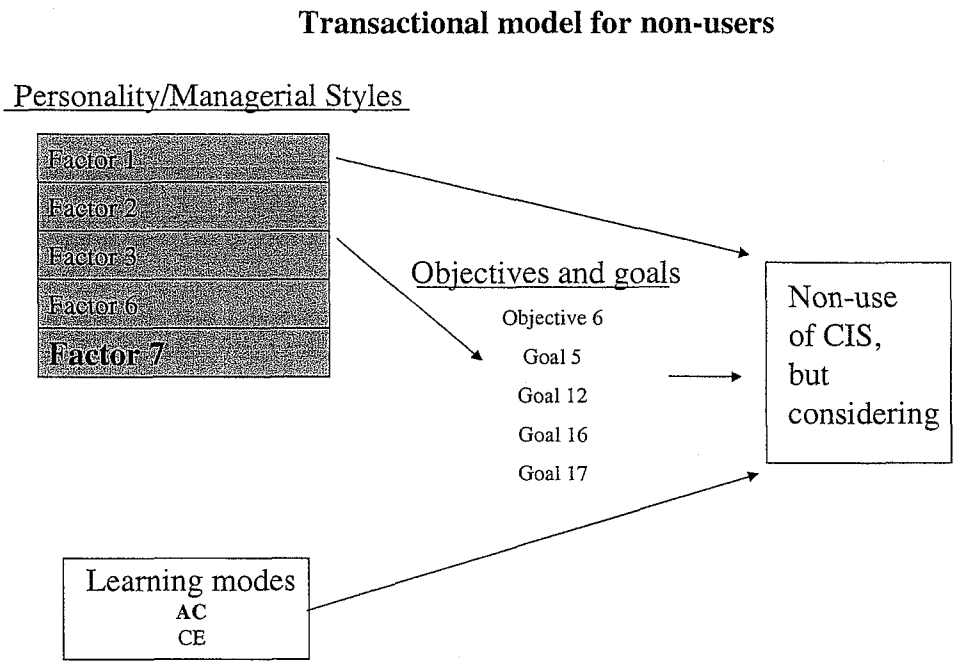
	Average score	Non-users of computerised systems	Non-users considering use	Non-users not considering use	Probability of similarity
Concrete experience	15.18	16.71	17.88a	15.17	12.0%
Reflective observation	14.61	14.29	14.75	13.67	58.9%
Abstract conceptualisation	16.56	16.36	14.88b	18.33	1.0%
Active experimentation	16.94	17.29	16.75	18.00	50.1%

Notes: a: t-test shows a statistically significant difference between users and non-users in concrete experience, t=-1.674, p=12%. b: t-test shows a statistically significant difference between users and non-users in abstract conceptualisation, t=3.070, p=1%

Table 6.9 shows that, relative to each group, non-users considering using computerised systems tend to learn through concrete experiences, non-users not considering CIS use tend towards the abstract conceptualisation approach.

These relationships give rise to the transactional model portrayed in figure 6.3.

Figure 6.3 Transactional model for non-users



7 Discussion

The results presented show that part of a farmer's computerised system use behaviour can be explained using psychological type variables. Farmer's behaviour showed direct and indirect relationships with both personality trait factors and Kolb's learning modes. On the other hand, the use of computerised systems in the feed and pasture information area shows few relationships with these variables. Table 7.1 summarises the main findings.

The direct relationships suggest that users are more extrovert and rely less on concrete experimentation as a learning mode than non-users. Indirect relationships suggest that these farmers, relative to non-users are more neurotic, planners, agreeable and deeper thinkers (introspective) than non-users. Note that the term "neurotic" reflects a person tendency towards what is more commonly referred to as "worrying". Thus, psychologists use the term quite differently to its use in general conversation.

Those farmers who were using computerised systems for the management of feed and pasture information are more concerned about following management principles and show also a tendency to exhibit extroversion and less "agreeableness" characteristics.

Non-user farmers who were considering the use of computerised systems show less affinity to "think before acting" and consequently do not exhibit abstract

conceptualisation as a learning mode relative to non-users who were not considering the use of computerised systems. Additionally, indirect relationships suggest that these farmers are also less neurotic, open (innovative), and are planners relative to non-users not considering computer use. Farmers who have expressed their willingness to use software have the opposite psychological characteristics relative to users. Conversely, those who expressed their intentions of avoiding using software show psychological characters more compatible with this behaviour.

Table 7.1 The personality factors and Kolb's learning modes that are related to CIS-behaviour

		Computerised system use	Computerised system use in the feed and pasture area	Considering use of computerised systems
Personality trait Factors	1	Positive relationship with neuroticism		Negative relationship with neuroticism
	2			Negative relationship with openness
	3	Positive relationship with planning		Negative relationship with planning
	4	Positive relationship with agreeableness	Negative relationship with agreeableness	
	5	**Positive relationship with extroversion**	Positive relationship with extroversion	
	6		Positive relationship with following principles	Positive relationship with following principles
	7	Positive relationship with introspection		**Negative Relationship with introspection**
Learning modes	CE	**Negative relationship with concrete experimentation**		Positive relationship with concrete experimentation
	RO			
	AC			**Negative relationship with abstract conceptualisation**
	AE			

Note: bold reflects direct relationships.

If a farmer considering purchasing a computer believes "s/he is not sure of what system to use to manage information", in contrast to a positive thought directed at adopting software, the behaviour becomes explainable in psychological terms. Some farmers who show a high level of openness, planning, introspection and preference for abstract conceptualisation have decided to keep their former non-computerised systems. These farmers are satisfied with their existing systems and do not think they are going to obtain a significant advantage from using software (see Alvarez and Nuthall, 2001c). Other farmers, also showing a high level of openness, planning, introspection and preference for abstract conceptualisation, have decided to change and start using computerised systems. Finally, a third group, with less emphasis on these personal characteristics may include both farmers who have changed and those who are considering this possibility. This third group of farmers may not have definite feelings about which kind of system to use for information management so chance events may have been important in their decisions (for example, a neighbour using a computer).

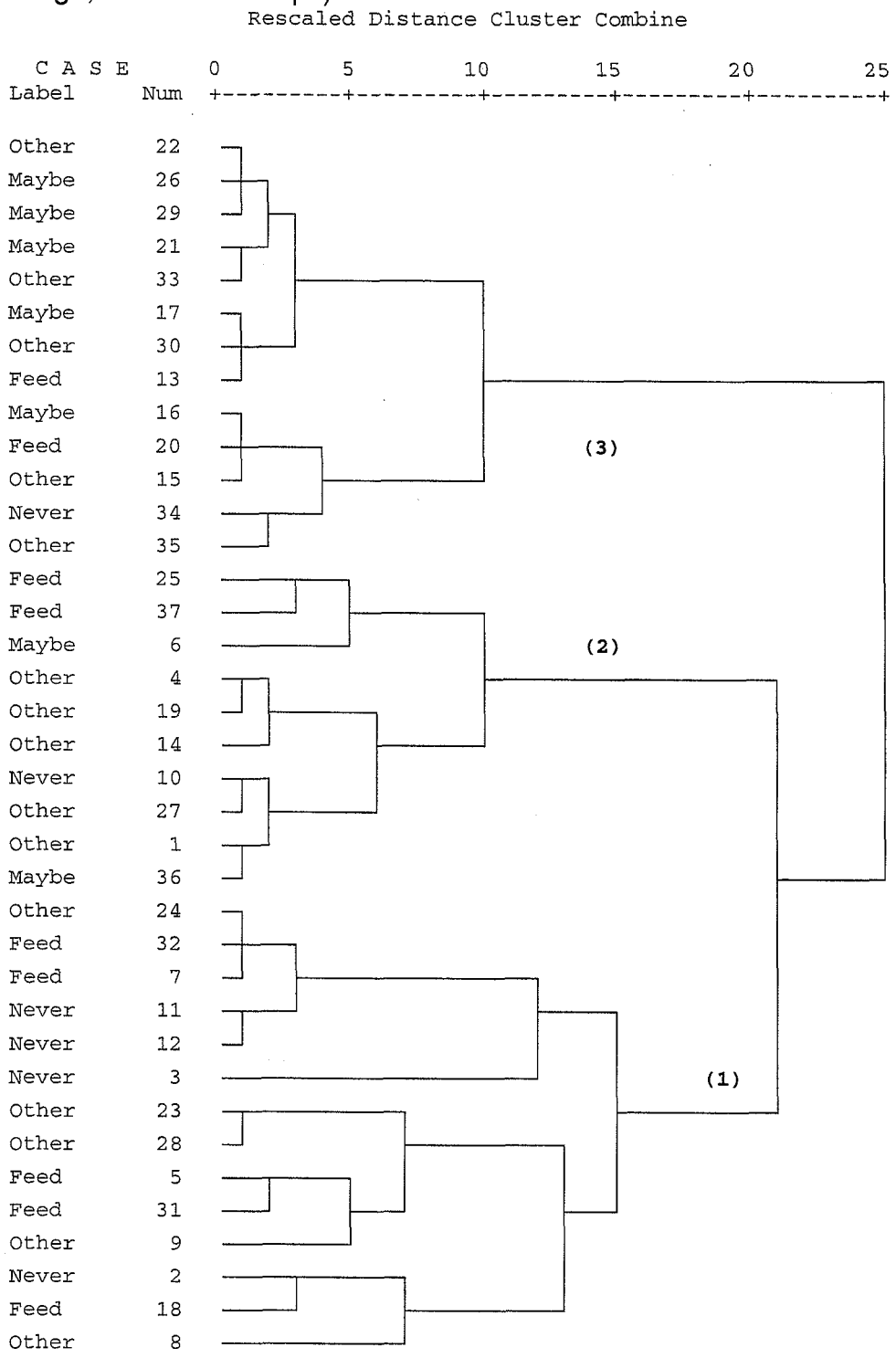
A cluster analysis was carried out to verify the above interpretation. Variables that showed a direct relationship with the behaviours studied (Factors 5 and 7, Concrete experimentation and Abstract conceptualisation learning modes) were selected as classification variables. The cluster analysis was performed using the hierarchical agglomerate method. Distance was measured using the Pearson correlation ratio. Variables were z-standardised. The resulting dendrogram is presented in figure 7.1.

Table 7.2 shows the farmers' psychological nature, learning and computer related behaviour, when three clusters are selected.

Cluster 1 includes both users and non-users, having a CIS-user percentage similar to the average. However, within the user group, there are more farmers using software to manage feed and pasture information; and within the non-user group, all farmers belong to the "not considering computer use" subgroup. These farmers show medium learning strengths in concrete experience and high learning strengths in abstract conceptualisation, belonging to Kolb's assimilator and converger learning types (see table 7.3). They are also more agreeable than farmers belonging to Cluster 3, and more introspective and extrovert than farmers belonging to both Cluster 2 and 3.

Cluster 2 involves the same proportion of users and non-users as the first cluster. Within the user group there are less farmers using software to manage feed and pasture information; and within the non-user group, more of them belong to the "considering computer use" subgroup. These farmers show learning strengths in abstract conceptualisation and poor skills in concrete experience. They also are less extrovert and introspective than both farmers belonging to Cluster 2 and 3. Conversely, they show a greater preference to follow management principles.

Figure 7.1 Dendrogram based on Factors 5 and 7, and the Concrete experimentation and Abstract conceptualisation learning modes (Average Linkage, Between Groups)



Notes: "Feed" means a farmer using software to manage feed and pasture information, "Never" a farmer not considering use of computerised systems, "Maybe" a farmer considering, and "Other" a farmer using software to manage information in other farm areas than feed and pasture management.

Cluster 3 involves more non-users than the other two clusters. Within the user group there are less farmers using software to manage feed and pasture information; and within the non-user group, more of them belong to the "considering computer using" subgroup. These farmers show learning strengths in concrete experience, and a weakness on abstract conceptualisation belonging to Kolb's accommodator and diverger learning types (see table 7.3). They are also less agreeable and less extrovert than farmers belonging to cluster 1, and more introspective and worry less about following management principles than farmers belonging to cluster 2.

Table 7.2 Farmers' characteristics for a three cluster solution

		Cluster 1	Cluster 2	Cluster 3	Average
CIS use (%)		71%	70%	54%	65%
Feed-CIS use (%)*		50%	29%	29%	37.5%
Non-users considering using (%)**		0%	67%	83%	53.85%
CIS-use starting year		1996	1997	1998	1997
Learning modes	CE	14.3ab	12.4a	18	15.1
	RO	13.8	15.3	14.5	14.5
	AC	18.9b	18.0a	13.3	16.7
	AE	17.4	16.2	16.8	16.9
Personality trait Factors	1	-0.2942	-0.0478	-0.6174	-0.3412
	2	-0.3859	-0.6929	-0.3985	-0.4733
	3	-0.4367	0.1134	-0.3714	-0.2651
	4	-0.4333b	-0.0465	-0.0123	-0.1809
	5	-0.7421ab	0.3039	0.1010	-0.1631
	6	0.2130	-0.1053a	0.2886	0.1535
	7	-0.7784ab	0.2319a	-0.0209	-0.2326

Notes: * percentage within CIS-users, ** percentage within non-users
Cluster 2:
CE (a): statistically significant difference (SSD) with cluster 2: t-test=-1.785, p=8.8%, (b): SSD with cluster 3:t-test=-4.183, p<0.1%;
AC (b): SSD with cluster 3:t-test=7.334, p<0.1%;
Factor 4 (b): SSD with cluster 3: t-test=-1.801, p=8.4%;
Factor 5 (a): SSD with cluster 2: t-test=3.176, p=0.4%, (b) SSD with cluster 3: t-test=-2.570, p=1.7%;
Factor 7 (a) SSD with cluster 2: t-test=3.266, p=0.4%, (b) SSD with cluster 3: t-test=-2.369, p=2.6%.
Cluster 1,
CE (a): SSD with cluster 3: t-test=-5.515, p<0.1%;
AC (a): SSD with cluster 3: t-test=4.902, p<0.1%;
Factor 6 (a): SSD with cluster 3: t-test=-1.725, p=9.9%;

Table 7.3 Kolb's learning styles for a three cluster solution –average scores*

	Cluster 1	Cluster 2	Cluster 3	Total
Accommodator	2	0	6	8
Assimilator	5	3	0	8
Converger	6	3	0	9
Diverger	1	3	7	11
Diverger-Assimilator		1		1
Total	14	10	13	37

Note: Chi-square=23.468, p=0.3%; *see section 5 for a description.

The fact that none of the clusters had isolated only users or non-users may mean that psychological variables just create conditions that promote or delay CIS use.

Summarising the results, cluster 3, which has the largest percentage of non-users, represents farmers who combine low abstract conceptualisation, and high concrete experimentation. Cluster 2, which has a similar user percentage than the whole sample, includes farmers with low concrete experience, high abstract conceptualisation, and high preference to follow management principles. Finally, Cluster 1, which also has similar user percentage relative to the whole sample, represent farmers with high abstract conceptualisation, high introspection and extroversion.

Computerised information system use, then, seems to be related to high scoring in abstract conceptualisation, which is combined with two psychological profiles, high introspection and extroversion (cluster 1), and high preference to follow management principles (cluster 2). On the other hand, a high scoring in concrete experience may be related to a lack of CIS adoption.

8 Conclusion

An attempt to explain on-farm software use through psychological variables has been partially successful. Using two sets of psychological variables, one belonging to Kolb's learning style inventory, and other developed to identify personality traits, some relationships have been identified, through direct and indirect correlation, between farmer's psychological characteristics and their computer related behaviour.

The contrast between users and non-users of on-farm computerised information systems has shown that computer use is related to extroversion, neuroticism, agreeableness, preference to plan and introspection. Users showed higher levels of these personality traits than non-users. On the other hand, non-users showed strength in concrete experimentation as their learning dimension for problem solving.

Within users, the contrast between overall users and those using feed and pasture software shows that this behaviour is related to extroversion, agreeableness and a preference to follow management principles.

Within non-users, the contrast between those considering software use and those who were not has shown that this decision is related to introspection, neuroticism, openness, a preference to plan and preference to follow management principles. On the other hand, non-users "not considering computer use" show strength in abstract conceptualisation as their learning dimension for problem solving.

Results from these pair-contrasts suggest non-linear relationships among psychological variables and computer related behaviour. Cluster analysis allowed finding a more complex relationship pattern. Using four psychological variables, Factor 7 (introspection), Factor 5 (extroversion), concrete experimentation and abstract conceptualisation learning modes, three groups were identified, each of them combining a different proportion of non-users with users.

Cluster analysis results suggest that computerised information system use seems to be promoted by high scoring in abstract conceptualisation which can be combined with two psychological profiles, high introspection and extroversion (cluster 1), and high preference to follow management principles (cluster2). On the other hand, high scoring in concrete experience may be related to a lack of CIS adoption.

These findings will help farmers, especially those who want to improve their information systems. By measuring related learning skills (Kolb's learning modes or new scales) it is possible to find out whether a potential user has the required characteristics. If not, a search among family members (or staff) for someone with the needed skills to manage the computer would be useful. Secondly, even if personality traits are partially intrinsic (difficult to change) personal characteristics, they are still environmentally affected. By selecting an appropriate teaching method (environment) relative to the personal characteristics, the chances of success in changing and successfully using an on-farm information system should be increased. Furthermore, for people supporting farm computing, the knowledge of the personal factors associated with successful farm computing will help them advise farmers, as clearly, personality and learning styles are important components of successful use. These influencing factors are in addition to farm size and education levels. Clearly, the dictates of a large farm impose a need that would impact on profitability if it was not met.

9 References

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10 Appendices

10.1 Mail questionnaire-farmer's goal questions

For each of the following objectives, please rate its importance on a 1 to 5 scale (1=not important through to 5=very important).

a) To be a top dairy farmer..... ☐
b) To achieve high farm production..... ☐
c) To achieve high profits..... ☐
d) To enjoy farming..... ☐
e) To provide an income to raise my family..... ☐
f) To farm in a sustainable way..... ☐
g) To have a reasonable income and plenty of time to enjoy other interests ☐
h) Other (please specify) _____ ☐
i) Other (please specify) _____ ☐

10.2 Goal test-Edinburgh Farming objective scale

The following are some goals and objectives voiced by farmers. Please indicate to what extent these objectives are important to you by circling the appropriate number. Please answer all of the questions.

Statement	**Strongly agree**				**Strongly disagree**
1. It is important to pass the farm to a member of family	1	2	3	4	5
2. It is important to stay in farming whatever happens	1	2	3	4	5
3. It is important to have the respect of other farmers in the community	1	2	3	4	5
4. It is important to enter and win in shows	1	2	3	4	5
5. In adopting new ideas it is important to lead rather than follow.	1	2	3	4	5
6. Making a comfortable living is all that is important.	1	2	3	4	5
7. Being fully productive is important.	1	2	3	4	5
8. It is important to plan for retirement.	1	2	3	4	5
9. It is important to keep debt as low as possible.	1	2	3	4	5
10. Having interests outside of farming is important.	1	2	3	4	5
11. There is too much emphasis put on preventing pollution.	1	2	3	4	5
12. It is important to use chemicals sparingly.	1	2	3	4	5
13. Having a successfully diversified farm is important.	1	2	3	4	5
14. Improving the quality of the farm generally is important.	1	2	3	4	5
15. Improving the quality of my life is important.	1	2	3	4	5
16. Improving the living standards of family life is important.	1	2	3	4	5
17. It is important just to operate on a day to day basis.	1	2	3	4	5
18. It is important to spend time with the family.	1	2	3	4	5
19. It is important to plan for holidays off the farm.	1	2	3	4	5

Statement	Strongly agree				Strongly disagree
20. It is important to minimise risk in farming.	1	2	3	4	5
21. It is important not to overproduce, on the farm.	1	2	3	4	5
22. It is important to encourage wildlife on the farm.	1	2	3	4	5
23. It is important to leave the land in as good a state as one received it.	1	2	3	4	5
24. Having up-to-date machinery/equipment is important	1	2	3	4	5
25. It is important to have the best possible livestock/pasture.	1	2	3	4	5
26. It is important to make the largest possible profit.	1	2	3	4	5
27. It is important to fully utilise all your resources.	1	2	3	4	5
28. It is important to increase the size of the farm.	1	2	3	4	5
29. Financial commitment should be taken over a long term.	1	2	3	4	5

10.3 Nuthall's Managerial Style Record- Personality Traits Test

For each of the following statements please indicate how true they are with respect to your management style. Each question has five boxes beside it – tick only the ONE that best records the degree of truth in the statement.

1 You tend to mull over decisions before acting.

TRUE [] [] [] [] [] NOT TRUE

2 You find it easy to ring up strangers to find out technical information.

TRUE [] [] [] [] [] NOT TRUE

3 For most things you seek the views of many people before making changes to your farming system.

TRUE [] [] [] [] [] NOT TRUE

4 You usually find discussing everything with members of your family very helpful.

TRUE [] [] [] [] [] NOT TRUE

5 Where there are too many jobs for the time available you sometimes become quite anxious.

TRUE [] [] [] [] [] NOT TRUE

6 You tend to tolerate mistakes and accidents that occur with employees and/or contractors.

TRUE [] [] [] [] [] NOT TRUE

7 You share your successes and failures with neighbours.

TRUE [] [] [] [] [] NOT TRUE

8 Keeping records on just about everything is very important.

TRUE [] [] [] [] [] NOT TRUE

9 You admire farming colleagues that are financially logical and don't let emotions colour their decisions.

TRUE [] [] [] [] [] NOT TRUE

10 You sometimes don't sleep at night worrying about decisions made.

TRUE [] [] [] [] [] NOT TRUE

11 You find investigating new farming methods exhilerating and challenging.

TRUE [] [] [] [] [] NOT TRUE

12 You tend to write down options and calculate monetary consequences before deciding.

TRUE [] [] [] [] [] NOT TRUE

13 You tend to worry about what others think of your methods.

TRUE [] [] [] [] [] NOT TRUE

14 You are happy to make do with what materials you have to hand.

TRUE [] [] [] [] [] NOT TRUE

15 You find talking to others about farming ideas stimulates and excites you as well as increasing your enthusiasm for new ideas.

TRUE [] [] [] [] [] NOT TRUE

16 Having to make changes to well established management systems and rules is a real pain.

TRUE [] [] [] [] [] NOT TRUE

17 You normally don't rest until the job is fully completed.

TRUE [] [] [] [] [] NOT TRUE

18 You normally enjoy being involved in farmer organisations.

TRUE [] [] [] [] [] NOT TRUE

19 You sometimes believe you are too much of a stickler for checking and double checking that everything has been carried out satisfactorily.

TRUE [] [] [] [] [] NOT TRUE

20 When the pressure is on you sometimes become cross and short with others.

TRUE [] [] [] [] [] NOT TRUE

21 You generally choose conclusions from experience rather than from hunches when they are in conflict.

TRUE [] [] [] [] [] NOT TRUE

22 You are inclined to let employees/contractors do it their way.

TRUE [] [] [] [] [] NOT TRUE

23 You not only speak your mind and ask questions at farmer meetings, but also enjoy the involvement.

TRUE [] [] [] [] [] NOT TRUE

24 It is very important to stick to management principles no matter what the pressure to do otherwise.

TRUE [] [] [] [] [] NOT TRUE

25 You are much happier if everything is well planned ahead of time.

TRUE [] [] [] [] [] NOT TRUE

10.4 Learning styles-Kolb's Learning Style Inventory

Instructions

There are nine sets of four descriptions listed in this inventory. Mark the words in each set that are most like you, second most like you, third most like you, and least like you. Put a four (4) next to the description that is most like you, a three (3) next to the description that is second most like you, a two (2) next to the description that is third most like you, and a one (1) next to the description that is least like you (4 = most like you; 1 = least like you). Be sure to assign a different rank number to each of the four words in each set; do not make ties.

Example

0	**Happy**	**4**	**Fast**	**3**	**Angry**	**1**	**Careful**	**2**

(Some people find it easiest to decide first which word best describes them (4 - Happy) and then to decide the word that is least like them (1- Angry). Then you can give a 3 to that word in the remaining pair that is most like you (3- Fast) and a 2 to the word that is left over (2- Careful).

1	**Discriminating**		**Tentative**		**Involved**		**Practical**	
2	**Receptive**		**Relevant**		**Analytical**		**Impartial**	
3	**Feeling**		**Watching**		**Thinking**		**Doing**	
4	**Accepting**		**Risk taker**		**Evaluative**		**Aware**	
5	**Intuitive**		**Productive**		**Logical**		**Questioning**	
6	**Abstract**		**Observing**		**Concrete**		**Active**	
7	**Present-oriented**		**Reflecting**		**Future-oriented**		**Pragmatic**	
8	**Experience**		**Observation**		**Conceptualisation**		**Experimentation**	
9	**Intense**		**Reserved**		**Rational**		**Responsible**	

10.5 Questions that were theoretically related to five basic personality traits

Table A.1 Questions that were theoretically related to five basic personality traits

Personality trait	Question number (from appendix 3)
Openness	1, 9, 11, 16, and 21
Conscientiousness	3, 8, 12, 17, and 24
Extroversion	2, 7, 15, 18, and 23
Agreeableness	4, 6, 14, 20, and 22
Neuroticism	5, 10, 13, 19, and 25

10.6 Confidence interval (95%) for average user's and non-users personality factor values

Table A.2 Confidence interval (95%) for average user's factor values

	Average (users of computerised systems)	Lower bound	Upper bound
Factor 1	-0.3383	-0.7265	0.0499
Factor 2	-0.4356	-0.7450	-0.1262
Factor 3	-0.3570	-0.7572	0.0431
Factor 4	-0.2322	-0.5382	0.0738
Factor 5	-0.3953	-0.7735	-0.0172
Factor 6	0.2169	-0.0138	0.4475
Factor 7	-0.3376	-0.7085	0.0333

Table A.3 Confidence interval (95%) for average non-user's factor values

	Average (non-users of computerised systems)	Lower bound	Upper bound
Factor 1	-0.3465	-0.9307	0.2377
Factor 2	-0.5429	-1.1516	0.0719
Factor 3	-0.0953	-0.5683	0.3776
Factor 4	-0.0861	-0.5248	0.3526
Factor 5	0.2655	-0.2104	0.7414
Factor 6	0.0366	-0.3452	0.4184
Factor 7	-0.0387	-0.5934	0.5160

11.7 Relationships between farmer's goals, personality trait factors and computerised information system use in the National Survey on Managerial Factors (Nuthall, 2001)

Data collected during the National Survey on Managerial Factors was used to estimate personality trait factors. This survey also included a section asking for farmer's goals and aims, and it also asked information about computer use. The goals and aims section included 19 questions. From these, 8 were equal to the objective mail questionnaire or the Edinburgh scale (appendex 11. 2) used in the Canterbury dairy farmer survey, 5 were similar and 6 were different. Table A.4 presents the questions.

Table A.4 Goals asked in the National Survey on Managerial Factors

1	It is very important to pass on the property to family members.
2	It is important to earn the respect of farmers/growers in the local community.
3	Making a comfortable living is important.
4	It is very necessary to keep debt as low as possible.
5	It is essential to plan for reasonable holidays and plenty of leisure time.
6	Attending field days and farmer/growers meeting is vital.
7	It is very important to reduce risk by using techniques like diversification, farming conservatively, keeping cash reserves...
8	Developing facilities and systems that give good working conditions is crucial.
9	It is very important to ensure employees enjoy their jobs.
10	Doing jobs that I enjoy is a very important part of the operation.
11	Minimising pollution is very important.
12	I enjoy experimenting with new products and production systems.
13	Proper retirement planning is a major consideration.
14	You must always be striving to increase the total value of assets.
15	Constantly expanding the size of the business is absolutely necessary.
16	Aiming for maximum sustainable net cash returns is very important.
17	Maintaining a presence in local community activities is important.
18	It is very important to improve the condition of the property (fertility, facilities...).
19	Giving assets to the children so they can pay for education and/or set up businesses is very important.

Source: Nuthall, 2001.

From 737 letters sent to a random sample of New Zealand dairy farmers, there were 264 usable responses. These were used to estimate personality trait factors (see section 4). From these 264 responses, 231 correspond to the North Island and 33 to the South Island, with 9 belonging to the Canterbury region.

10.7.1 Users of on-farm computerised systems.

Table A.5 presents percentages of computer ownership and farm related software use in two farmer surveys, one carried out among Canterbury dairy farmers during 2000 and another carried out among all New Zealand farmers during 2001. Both Canterbury and South Island farmers show higher percentages of software use than their North Island colleagues.

Table A.5 Percentages of farmers in each category

	Canterbury (2000)a	New Zealand (2001)b	North Island (2001)b	South Island (2001)b
Number of farmers surveyed*	290	264	231	33
Computer ownership	73.8%	56.8%	54.5%	72.7%
On-farm computerised system use	60.7%	48.1%	45.5%	66.7%
On-farm financial software use	54.5%	45.1%	42.4%	63.6%
On-farm livestock software use	35.2%	31.1%	28.6%	48.5%
On-farm feed and pasture software use	16.9%	17.8%	16.5%	27.3%

Notes: *usable responses; a: Alvarez and Nuthall, 2001a; b: Nuthall, 2001.

Pearson's correlation coefficients were estimated between a binary variable (1= using one or more computerised systems, 0= not using), goal scores (table A.4) and personality trait factor scores (see section 4) for North Island and South Island dairy farmers.

According to the results (table A.6), North Island users did not believe in keeping debt as slow as possible, reducing risk, minimising pollution and improving their properties. On the other hand, they believed in attending field days and increasing the total value of assets. There is also a positive correlation between using computerised systems and farmer's openness (Factor 2).

Indirect relationships (table A.7) involve the complete set of personality traits. Farmers who disagree with keeping debt low are more open (relationship between goal 4 and factor 2). Farmers who attend field days are more open, emphasise planning ahead and are more extrovert (relationship between goal 6 and factor 2, 3 and 5 respectively). Farmers who worry less about reducing risk are less neurotic and less agreeable (relationship between goal 7 and factor 1 and 4 respectively).

Table A.6 Variables related to the use of computerised information systems for North Island dairy farmers

Variable	Pearson correlation coefficient	Probability level of statistical significance
Goals (National Survey on Managerial Factors scale) (1)		
4- It is very necessary to keep debt as low as possible.	0.398	<0.1%
6- Attending field days and farmer/growers meetings is vital.	-0.131	5%
7- It is very important to reduce risk by using techniques like diversification, farming conservatively, keeping cash reserves...	0.327	<0.1%
11- Minimising pollution is very important.	0.16	1.5%
14- You must always be striving to increase the total value of assets.	-0.175	0.8%
18- It is very important to improve the condition of the property (fertility, facilities...).	0.137	3.9%
Personality traits (2)*		
Factor 2 (Openness)	-0.275	<0.1%

Notes: * see section 4 for description of the personality trait factors. (1) a positive correlation means that farmers with the expected behaviour considered less important that goal; a negative correlation means that farmers with the expected behaviour considered more important that goal. (2) a negative correlation means that farmers with the expected behaviour showed more strongly the personality trait describes by the factor.

Farmers who are striving to increase the total value of assets show more emphasis on openness, extroversion and following farm management principles (relationships between goal 14 and factors 2, 5 and 6 respectively). Finally, those who disagree with the need to improve farm conditions are more introspective (relationship between goal 18 and factor 7).

Table A.8 shows personality trait factor values for both users and non-users. Only two factors show statistically significant differences, factor 2 and 3. The second contrast shows that non-users are in fact more emphatic in planning ahead.

Summarising direct and indirect relationships, users may be characterised as being less neurotic, more open, more agreeable, more extrovert, and more theorist than non-users. Figure A.1 provides the resulting transactional model.

Table A.7 Relationships between CIS-use related variables and personality factors for North Island dairy farmers

Variable	Personality trait factors*						
	Neuro-ticism (1)	Open-ness (2)	Plann-ing (3)	Agree-able (4)	Extro-versio n (5)	Principl-ed (6)	Intros-pection (7)
Goals (National Survey on Managerial Factors scale) (1)							
4- It is very necessary to keep debt as low as possible.		-0.31 (0.1%)					
6- Attending field days and farmer/grower meetings is vital.		0.43 (0.1%)	0.14 (4.3%)		0.33 (0.1%)		
7- It is very important to reduce risk by using techniques like diversification, farming conservatively, keeping cash reserves...	0.21 (0.3%)			0.17 (1.3%)			
11- Minimising pollution is very important.							
14- You must always be striving to increase the total value of assets.		0.14 (4.5%)			0.19 (0.7%)	0.25 (0.1%)	
18- It is very important to improve the condition of the property (fertility, facilities...).							-0.18 (1%)
Personality traits *							
Factor 2		1					

Notes: see section 4 for description of the personality trait factors. (1) a negative correlation means that farmers who scored a goal highly showed less strongly the personality trait describes by the factor ; a positive correlation means that farmers who scored the goals lower (showing agreement) showed the personality trait described by the factor. The figures in brackets show the statistical significance level for each Pearson correlation coefficient (percentage of accepting the null hypothesis "r = 0").

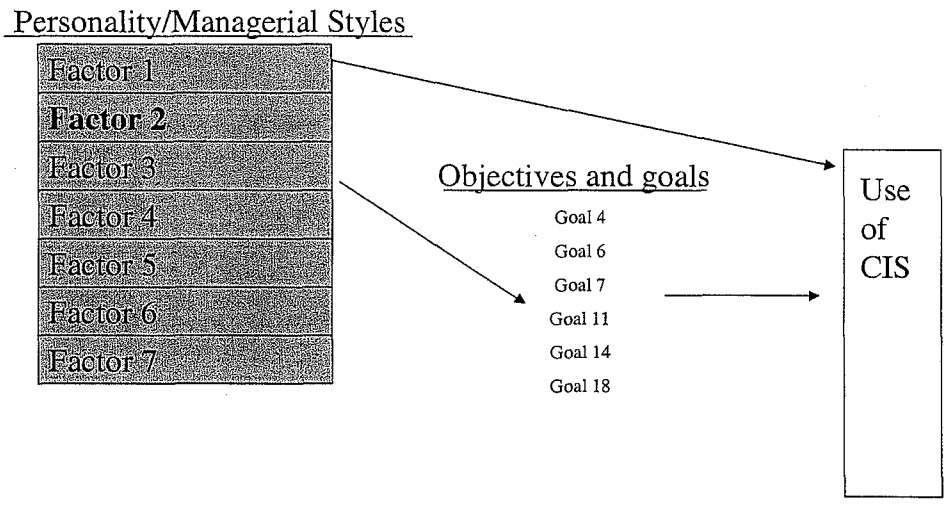
Table A.8 Personality factors of users and non-users for North Island dairy farmers

	Average	Users of computerised systems	Non-users of computerised systems	Probability of similarity
Factor 1	-0.0120	0.0546	-0.0659	39.4%
Factor 2	0.0121	-0.2913a	0.2573	<0.1%
Factor 3	-0.0090	0.1323b	-0.1232	6.3%
Factor 4	-0.0001	0.0273	-0.0238	71.3%
Factor 5	-0.0277	-0.1107	0.0394	28.6%
Factor 6	-0.0087	-0.1285	0.0882	12.7%
Factor 7	-0.0201	-0.0001	-0.0358	79.1%

Notes: a: t-test shows a statistically significant difference (SSD) between users and none-users in factor 2, t=4.186, p<0.1%; b: t-test shows SSD between users and none-users in factor 3, t=-1.870, p=6.3%.

Figure A.1 Transactional model for North Island CIS-use

Transactional model for computerised system use



When the same exercise is carried out with South Island dairy farmers, direct relationships only appear between CIS-use and goal 7 (r=0.36, p=4.3%) and indirect relationships between this goal and factor 3 (r=0.34 , p=6.3%). This means that like North Island farmers, South Island users disagree with reducing risk, and those farmers who disagree with reducing risk put less emphasis on planning ahead. However, none of the differences in personality factors between Southern users and non-users are statistically significant (see table A.9).

Table A.9 Personality factors of users and non-users for South Island dairy farmers

	Average	Users of computerised systems	Non-users of computerised systems	Probability of similarity
Factor 1	0.0832	-0.0359	0.3612	29.4%
Factor 2	-0.0835	-0.1322	0.0302	70.4%
Factor 3	0.0624	0.1852	-0.2242	36.4%
Factor 4	0.0063	0.1958	-0.4360	13.6%
Factor 5	0.1923	0.1492	0.2923	70.9%
Factor 6	0.0601	0.1082	-0.0523	55.1%
Factor 7	0.1395	-0.0104	0.4894	30.5%

11.7.2 Users of computerised feed and pasture information systems

Table A.10 presents the direct relationship (statistically significant correlations) between goals and the use of software to manage feed and pasture information in North Island dairy farmers. This group of farmers prefer planning time for holidays and leisure, assisting with field days, developing good working conditions and maximising profits. This behaviour does not show direct relationship with personality trait factors. Through indirect relationships, these links can be investigated. Table A.11 presents the indirect relationships. The relationships among behaviour related goals and personality trait factors suggest that feed-CIS-users are more open, have a preference to plan ahead, are more agreeable and extrovert. Contrasts between subgroups (table A.12) confirm that feed-CIS-users tend to exhibit personality trait factors 2, 3 and 5.

Table A.10 Variables related to the use of computerised systems to manage information related to feed and pasture for North Island dairy farmers

Variable	Pearson correlation coefficient	Probability level of statistical significance
Goals (National Survey on Managerial Factors scale) (1)		
5- It is essential to plan for reasonable holidays and plenty of leisure time.	-0.328	0.1%
6- Attending field days and farmer/grower meetings is vital.	-0.384	<0.1%
8- Developing facilities and systems that give good working conditions is crucial.	-0.238	1.5%
16- Aiming for maximum sustainable net cash returns is very important.	-0.325	0.1%

Notes: (1) a negative correlation means that farmers with the expected behaviour considered that goal more important.

Table A.11 Relationships between Feed-CIS-use related variables and personality factors for North Island dairy farmers –Pearson correlation coefficients

Variable	Personality trait factors*			
	Open-ness (2)	Planning (3)	Agree-able (4)	Extro-version (5)
Goals (National Survey on Managerial Factors scale) (1)				
5- It is essential to plan for reasonable holidays and plenty of leisure time.	0.25 (0.1%)		0.25 (0.1%)	
6- Attending field days and farmer/growers meeting is vital.	0.43 (0.1%)	0.14 (4.3%)		0.33 (0.1%)
8- Developing facilities and systems that give good working conditions is crucial.	0.33 (0.1%)	0.22 (0.1%)		
16- Aiming for maximum sustainable net cash returns is very important.		0.18 (1.2%)	0.16 (1.9%)	

Notes: see section 4 for description of the personality trait factors.(1) a positive correlation means that farmers who scored the goals lower (showing agreement) showed the personality trait described by the factor. The figures in brackets show the statistical significance level for each Pearson correlation coefficient (percentage of accepting the null hypothesis "r = 0").

Table A.12 Personality factors of Feed-CIS users and non-users for North Island dairy farmers

	Average	Users of computerised systems	Users of feed and pasture software	Non-users of feed and pasture software	Probability of similarity
Factor 1	-0.0120	0.0546	0.0088	0.0823	69.3%
Factor 2	0.0121	-0.2913a	-0.5010c	-0.1648	6.5%
Factor 3	-0.0090	0.1323b	-0.1065d	0.2763	3.9%
Factor 4	-0.0001	0.0273	-0.1343	0.1249	20.9%
Factor 5	-0.0277	-0.1107	-0.3393e	0.0272	8.4%
Factor 6	-0.0087	-0.1285	-0.1611	-0.1088	76.9%
Factor 7	-0.0201	-0.0001	0.0351	-0.0224	75.2%

Notes: a: t-test shows a statistically significant difference (SSD) between CIS-users and CIS-non-users in factor 2, t=4.186, p<0.1%; b: t-test shows SSD between CIS-users and CIS-non-users in factor 3, t=-1.870, p=6.3%; d: t-test shows SSD between FeedCIS-users and FeedCIS-non-users in factor 2, t=1.864, p=6.5%; d: t-test shows SSD between FeedCIS-users and FeedCIS-non-users in factor 3, t=2.099, p=3.9%; e: t-test shows SSD between FeedCIS-users and FeedCIS-non-users in factor 5, t=1.745, p=8.4%;

There are no statistically significant correlations among the South Island dairy farmer variables. This may be due to small numbers in the sample.

11.7.3 Cluster analysis with North Island dairy farmers

Using the results from the previous sections, a cluster analysis was preformed using personality trait factors 2, 3 and 5 as classification variables. Table A.13 shows the results.

Table A.13 North Island dairy farmers' characteristics for a three cluster solution

		Cluster 1	Cluster 2	Cluster 3	Average
CIS use (%)		37%	43%	55%	45%
Feed-CIS use (%)*		32%	33%	45%	38%
Personality trait Factors	1	0.1014	-0.0501	-0.0466	-0.0120
	2	0.6297ab	-0.0836a	-0.3779	0.0121
	3	-0.2636b	-0.4050a	0.9372	-0.0090
	4	-0.0599	0.0935	-0.1173	-0.0001
	5	-0.8599ab	0.7066a	-0.5943	-0.0277
	6	-0.1141	-0.0388	0.1418	-0.0087
	7	0.0001	0.0019	-0.0784	-0.0201

Notes: * percentage within CIS-users
Cluster 1,
Factor 2 (a): statistically significant difference (SSD) with cluster 2: t-test=-4.114, p<0.1%, (b): statistically significant difference (SSD) with cluster 3: t-test=6.606, p<0.1%;
Factor 3 (b): SSD with cluster 3: t-test=-7.719, p<0.1%;
Factor 5 (a) SSD with cluster 2: t-test=12.879, p<0.1%; (b) SSD with cluster 3: t-test=-2.046, p=4.3%.
Cluster 2,
Factor 2 (b): SSD with cluster 3: t-test=2.160, p=3.2%;
Factor 3 (b): SSD with cluster 3: t-test=-9.936, p<0.1%;
Factor 5 (b): SSD with cluster 3: t-test=10.733, p<0.1%.

Cluster 1 represents CIS-non-users. These farmers are less open and more extrovert than remaining groups. Cluster 2 has similar percentages of CIS-use and Feed-CIS-use to the whole sample. This cluster represents farmers who are less extrovert and show a preference to plan ahead. Finally, cluster 3 represents Feed-CIS-users. This last group is more open, and they show less of a preference to plan ahead. Summarising these results, computerised system use seems to be related to the openness trait.

11.8 Personality trait measurement

For this study, personality traits have been defined and measured using data collected by the National Survey on Managerial Factors (Nuthall, 2001). The National Survey collected 264 usable responses, from a nation wide random sample during 2001, using the form shown in appendix 11.3. This form was also used to collect personality data in the Canterbury study in 2000. Although the collection time was different, you would expect to find similar personality trait

measures for the average farmer in each sample, since both groups belong the same population.

Table A.14 shows the contrast between the two samples. The Canterbury average farmer seems to be more neurotic and more open than the National average farmer. Are these differences real, or they are related to the experimental procedures?

Within the National Survey there are 33 responses that correspond to South Island dairy farmers, and 9 of them are from Canterbury. Table A.15 presents average values for Northern, Southern and Canterbury dairy farmers personality traits. Two statistical tests (t-test) were carried out, Northern against Southern and Canterbury against the remaining farmers. Neither show statistically significant differences.

Table A.14 Average personality measures in the Canterbury Study (Alvarez and Nuthall, 2001) related to the National Survey on Managerial Factor (Nuthall, 2001) Studies

	Average Canterbury farmer (2000)	Average farmer National Survey farmer for Managerial Factors (2001)	Probability of similarity
Number of observations	39	264	
Factor 1	-0.3412a	0.0000*	5.2%
Factor 2	-0.4733b	0.0000	0.7%
Factor 3	-0.2651	0.0000	12.9%
Factor 4	-0.1809	0.0000	29.1%
Factor 5	-0.1631	0.0000	35.1%
Factor 6	0.1535	0.0000	18.5%
Factor 7	-0.2326	0.0000	18.3%

Notes:* average values for the National survey are zero because of factor score procedure used to estimated personality measures (SPSS, 1999); a: t-test shows a statistically significant difference (SSD) between studies in factor 1, t=1.950, p=5.2%; b: t-test shows SSD between different studies in factor 2, t=2.734, p=0.7%.

Table A.15 Average personality measures for North Island, South Island and Canterbury dairy farmers

	Average North farmer	Average South farmer	Average Canterbury farmer (National Survey)	Probability of non statistical difference-North against South Island	Probability of non statistical difference-Canterbury against rest
Number of observations	231	33	9		
Factor 1	-0.0120	0.0832	0.4932	62.7%	13.2%
Factor 2	0.0121	-0.0835	-0.1644	62.6%	61.6%
Factor 3	-0.0090	0.0624	0.0562	71.6%	86.4%
Factor 4	-0.0001	0.0063	0.2561	97.1%	43.5%
Factor 5	-0.0277	0.1923	0.4952	26.1%	13.0%
Factor 6	-0.0087	0.0601	0.0396	62.7%	85.2%
Factor 7	-0.0201	0.1395	-0.5330	41.5%	10.3%

These results suggest that Canterbury Study personality measures may be biased due to differences in the data collection procedure. In the Canterbury Study, personality data was collected using a one and a half-hour interview. In the National Study, personality data was collected through a mail questionnaire, which was sent back by the respondent. These collection methods may explain the difference in the transactional models developed for Canterbury CIS-users and North Island CIS-users.