Attitude of Finnish Timber Buyers towards Implementation of a Forest Computer Visualisation

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Palander, T., Turunen, K. & Laukkanen, S. 2003. Attitude of Finnish timber buyers towards implementation of a forest computer visualisation. Silva Fennica 37(2): 269–281.

Timber buyers' opinions as regards forest computer visualisation are studied. The results indicated that timber buyers are still rather conventional in their computer use since they mainly use only the information system of their own company. The majority of the buyers perceived computer visualisation to be slightly useful for their work, or they had no opinion concerning the usefulness of it. One third of the buyers considered computer visualisation to be a quality factor for timber trade, and the majority were willing to use it if a program is going to adopt by their company. In analysis, different personal characteristics were found for three timber buyer groups: *qualified, neutral* and *reluctant*. Qualified buyers were the largest one, about half of the buyers belonging to this group. The greatest barriers to adopting a positive attitude to computer visualisation turned out to be weak computer skills and a general lack of interest in computer use. On the other side, it was found that organisational factors did not influence the buyers' computer skills or attitudes towards visualisation. The results of this study can be utilised by timber buying organisation in ensuring the successful adoption of a new computer system.

Keywords change resistance, competence, forest computer visualisation, timber trade
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Received 30 June 2000 **Accepted** 22 January 2003

1 Introduction

Recently there have been a large number of computer based technical changes in functioning of timber procurement of Finland. So far, however, timber buying has not been adjusted to them (Kärhä 1998). Timber procurement can be defined as a chain of operations involved in extracting timber from the forests and delivering it to the markets, which is being increasingly directed by computers. In the beginning of the chain, timber buying is the special procedure where buyers buy cutting stands mainly on a stump-price basis from small forest owners conventionally without computer support.

Forest ownership changes have caused struc-

tural changes in timber trade markets (Ripatti and Reunala 1989, Sikanen 1999). As a result of the division of inherited property, the number of forest holdings has grown. Furthermore, more and more forest owners are urban dwellers, and a forest holding is only a secondary source of income for many of them. Therefore, Leinonen (1998) reported that timber buyers doubt whether the growing proportion of city-dwelling forest owners will cause some problems for the timber trade. On the one hand, the forest owners have become less familiar with logging operations and their effects on landscape resources. On the other hand, awareness of and interest in environment have grown significantly. Since the behaviour of forest owners has been changing, they are frequently concerned about the visual effects of the logging operations planned for their holdings (Ripatti and Reunala 1989).

Managers of companies have started to pay more attention to the desires of the forest owners, and the timber trade is gradually becoming an all-inclusive service for timber sellers (Kärhä 1998). Because organisations further want to improve the service, forest computer visualisation might be developed for improving the environmental soundness of harvesting operations by assessing and optimising the visual quality of the layout of stands. If a forest owner feels he would get better service with the aid of a visualisation tool, then such a tool would be a 'quality factor' in the timber trade and, at its best, a crucial factor when forest owners decide whether to make a timber sale or not.

According to Uusitalo et al. (1997) visualisation of a forest stand means making the information depicting a stand, e.g. tree and terrain information, visible. When computers are used, visualisation requires a digital elevation model, stand information (stand boundary data) and tree characteristic data. So far, forest computer visualisation has not been a widely used method in forestry. However, some studies have already investigated aspects of it, e.g., the studies of Orland (1988, 1991, 1999), Cox (1990), Heasley and McNamara (1990), Nousiainen and Pukkala (1992), Bergen et al. (1995), Muinonen et al. (1995), Tahvanainen and Tyrväinen (1995, 1998), Kilvert and Griffith (1996), Tahvanainen et al. (1996), Thuresson et al. (1996) Nousiainen et al. (1998) and Pukkala (2000).

Perceptions of environmental quality are primarily visual, and forest operations may have a significant impact on a visual amenity (Schauman 1988, Kilvert and Griffith 1996). The practices followed by the timber trade decision include the planning of boundaries and other landscape characteristics of a marked stand. A visualisation tool could help forest owners to evaluate different logging operations by viewing the projected changes to the landscape immediately after the operations, as well as in the future. In addition to viewing the landscape, there are also other grounds for using a visualisation tool. It might be used before decision-making during planning a marked stand for a timber sale. According to Karjalainen and Tyrväinen (1998), decision-making can be easier when the impacts of different operations in the landscape are presented in the form of pictures. Furthermore, Johnson et al. (1994), Pukkala et al. (1995), Nalli et al. (1996) and Uusitalo et al. (1997) have stated that, when solving forest management problems, it could be useful to use traditional decision-support systems in addition to e.g. forest visualisation.

So far, it is not known how timber buyers perceive the usefulness of visualisation software and what factors influence adopting an attitude to it. Furthermore, this human factor may be the critical component of such a new system; particularly since it has already been shown that personnel of the wood procurement organisation adopt different attitudes to new information and communication technology (Palander et al. 2001, Toivonen et al. 2001). For studying the human factor the background theory is reasonable to base on human resource management obtained from the studies of Cushway (1994), Ruohotie and Grimmet (1994) and Otala (1996) (Fig. 1).

When the object of interest is an attitude towards a new working method – in this case use of forest computer visualisation – the personal characteristics behind behaviour have to be clarified. In addition to personal characteristics, organisations are faced with a considerable challenge in ensuring the success of the new computer system and preventing resistance to change (Cushway 1994, Reponen 1994, Ruohotie and Grimmet 1994, Vepsäläinen 1994, Aulanko et al. 1996, Mehandijev and Bottaci 1996, Otala

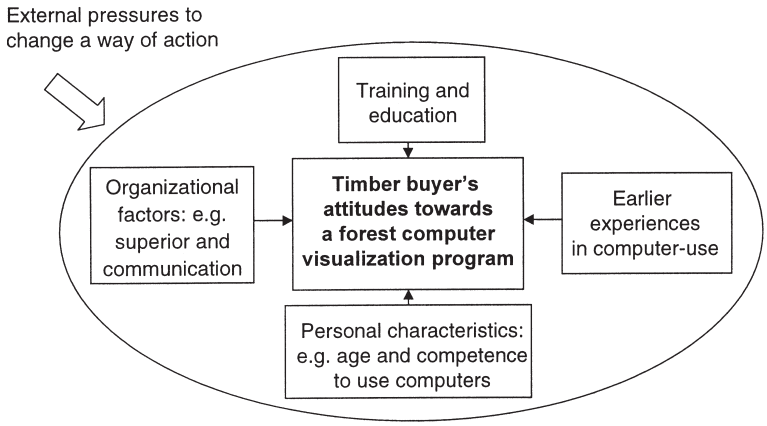

Fig. 1. The framework for studying human factors that influence adopting an attitude to visualisation software.

1996, Strebel 1996). There may also be many difficulties in the implementation of the system, if earlier experiences in computer-use are lacking. Also users' overall competence to use the program has to be taken into careful consideration. A competence is an extensive concept which includes personal characteristics, organisational factors (employee's superior, work team), as well as training and communication, they all making their own contribution (Otala 1996, Hackett 1997).

The goals of the study are: i) to analyse the timber buyers' opinions of the usefulness of a forest computer visualisation for timber trade transactions, ii) to understand the interaction of their perceptions with personal characteristics, experience in computer use, training, education and organisational framework, as well as iii) to discuss how timber buyers' competence influence their attitudes towards forest computer visualisation, and the degree to which training can help in meeting demands set by implementation.

2 Material and Methods

2.1 Material

A survey study was used gathering the data by interviews and questionnaires during the autumn of 1999. Since forest computer visualisation was a rather unfamiliar and new theme for the timber buyers, a personal interview was selected as the main research method. This was also necessary because visualisation was implemented by means of computer graphics. In the data, 40 buyers represented two large forest companies in North Karelia, Ostrobothnia and Southern Finland. Only few of the buyers who were asked for an interview refused and any previous information about their personalities were not available.

About 40 forest visualisation pictures were shown to the timber buyers on a laptop computer at the start of the interviews. The pictures were made using two programs: MONSU and Smart Forest II. Smart Forest II is an object-based, partly three-dimensional forest stand visualisation program, originally developed at the University of Illinois (Uusitalo et al. 1997). MONSU is a forest management-planning program, which produces landscapes by means of line graphics. The program has been developed at the University of Joensuu (Pukkala 1995). The original visualisations were transferred to the Power Point program. It was used to explain what forest computer visualisation means, especially, what kind of forest landscape pictures can be constructed using current programs. The pictures were selected to show different logging operation (clear-cutting, thinning, clear-cutting with groups of trees or tree belts) and different forest site types.

Table 1. Data definitions of the study.

Criteria	Variable	Scale
Experience with computers	Computer skills	4…10
	Computer use	hours/day
	Computer programs a timber buyer uses	number
	Proportion of program's use	percent
	Laptop computer use	yes/no
	Initial phases of new programs	free
	Initial phases of visualisation software	free
Usefulness of visualisation software	Usefulness for timber buyers	1…5
	Usefulness for forest owners	1…5
	Willingness to use a visualisation program	1…5
	Proportion of forest owners met personally	percent
	Would a forest visualisation program be a quality factor in a timber sale?	1…3
Timber buyers' personal characteristics	Self estimated computer skills	1…6
	Computer programs a timber buyer uses	1…6
	'I have sufficient knowledge and ability to utilise computers'	1…6
	'I can become a good computer user'	1…6
	'I dare to try all the new possibilities provided information technology'	1…6
	'Training concerning information technology is important'	1…6
	'Training assurance to work in the face of continuous innovations and development.'	1…6
	'Computers help me a lot in my work, and I would like to work with one'	1…6
	'I would like to have a better understanding of the computer systems and programs which I use in my work'	1…6
	'I want to improve myself and my working skills'	1…6
	'I might ask other people for help when I try to solve some problems concerning computers'	1…6
	'There will be many interesting innovations and method development in my work'	1…6
	'I have a possibility for advancement in my career'	1…6
	'I am satisfied with my present work'	1…6
	'My work is of considerable importance in our organisation'	1…6
Timber buyer profiles	Age	1…5
	Amount of timber bought	m^3/year
	Attitude towards changes in general	1…3
	Length of computer training	weeks
	Would a forest visualisation program be a quality factor in a timber sale?	1…3
	Have you time to use a visualisation program?	1…3
	Are you interested in using computers?	1…3
	Willingness to learn computer skills	1…3
	Willingness to use a visualisation program	1…5
	Employees are taken into consideration in decisions concerning computer technology	1…6
	My superior trusts my ability to use computers	1…6

The interview had features of different interviewing techniques; there were pre-structured questions, with alternative answers or not, as well as 'free' discussion about research topics. On the whole, the interview was called a theme interview. The interview dealt with the following topics concerning 1) experiences of buyers, 2) forest computer visualisation, 3) personal characteristics of buyers and 4) organisational factors. With respect to the forest computer visualisation, interest was directed at opinions concerning the usefulness of it in buyers' work. Current use of computers and experiences in it were also subjects of interest. With respect to the personal characteristics, those influencing the use of computers and the development of skills needed in computer work were important. Special interest was directed at knowledge of using computers, and the willingness to improve buyers' own competence. Organisational factors affecting computer use were studied in order to obtain a broad understanding of a framework in which buyers use computers. Special interest was directed at communication with superiors.

The timber buyers were also given a questionnaire during the interview. In the questionnaire they were asked to express their opinions about 33 different statements. These statements were designed to provide further clarification about the research topics. The buyers expressed their opinions to the statements by assigning ranking from 1 to 6; 1 meant total agreement and 6 total disagreements. The information concerning data definitions are given in Table 1.

2.2 Methods

Timber buyers' experience with computers was statistically analysed with percentage shares and mean values. Some supporting statements from recorded interviews were also used in interpretations. Same methods were also applied when data about usefulness of visualisation software were analysed.

Principal component analysis was used to search for the dimensions of timber buyers' personal characteristics. In the analysis, the original variables are transformed into a smaller number of linear combinations that explain most of the variation among the original variables (Anderson 1958). The aim is to explain as much as possible of the original variance using a minimum number of principal components. The prerequisite is that correlation exists between the variables used in the analysis. The Quick-and-Dirty rule was applied, in which components having an eigenvalue of over 1.0 are included (Johnson and Wichern 1982). Interpretation of components was simplified by using a Varimax rotation each component loadings being either low or high (Morrison 1976). Moreover, Kruskal-Wallis (K-W) one-way ANOVA test was applied (Hollander and Wolfe 1973). It was used to test the hypothesis that components actually come from the same population. If the test statistic is high, the hypothesis should be rejected.

Cluster analysis was used to group different types of timber buyers as computer users with an inclination to develop their competence. In K-means clustering, the variables are grouped so that the group is homogeneous, but the groups are as heterogeneous as possible in comparison to each other. Statistically, the purpose of the cluster analysis is data reduction: classifying observations into a manageable number of groups (Afifi and Clark 1990, Hair et al. 1995). Because variables were also reduced, principal component analysis was used before cluster analysis. Hair et al. (1995) have recommended using principal component scores (as independent variables) representing original variables, because component scores include the loading of all the variables in each principal component. Based on clustering descriptive buyer profiles were made.

In order to obtain knowledge that would help in designing an effective and user-friendly adoption process for a visualisation program, factors of the personal and organisational qualities influencing timber buyers' attitude towards the forest computer visualisation were analysed. In the beginning of the analysis Spearman's correlations was used. Spearman's correlation is the commonly used nonparametric measure of correlation between two ordinal variables. Then, suggested differences in factors between positively and negatively reacting timber buyer groups were compared using the Kolmogorov-Smirnov (K-S) -test (Hollander and Wolfe 1973). For that a combination was made by calculating the mean of the sum of three variables

of visualisation. The value (1…5) of this combination were coded to two new variables (positive attitude, negative attitude). Values of 2 and under were assigned as 0 and values of over 2 as 1.

3 Results

3.1 Timber Buyers' Experiences with Computers

Many timber buyers admitted that computers and information technology are playing an increasing role in their work. On the average, the buyers assessed their computer skills to be equivalent to 8.2 (on the scale from 4 to 10) when they compared their computer skills to the demands set by their work. On the daily basis they used computers for 2 hours 30 minutes. The computer program used the most was naturally the company's own information system, followed by a word processor (38%) and e-mail (35%) (in parentheses the proportion of buyers who mentioned a program). Only 18% of the buyers used laptop computers in their work. However, the majority would like to have a laptop computer, or at least had a positive attitude towards using them.

When the timber buyers were asked about the initial phases in using a new computer program, the major problem appeared to be a lack of time to start learning and using a new program; 43% mentioned that this is a problem. Nearly as many stated that it is often hard to realise the advantages of a new program. 15% of the buyers assessed that, in new situations, shortcomings in their own abilities also cause problems. When they were asked about adopting a forest visualisation program, the buyers thought that the most important convenience quality of the program would be user-friendliness. Other frequently mentioned convenience qualities were the trouble-free working of a program, and the availability of computers efficient enough to use such a program.

3.2 Usefulness of Pictured Forest Computer Visualisation Program

The first impression of imagined use of forest computer visualisation in timber buying work was asked from the timber buyers. In Fig. 2, usefulness of computer visualisation to forest owners has been presented. The buyers were also asked how willing they would be to start using the visualisation program.

About 70% of the buyers were at least slightly willing to use a visualisation program, if it would be adopted by their organisations. Their willingness to use a program was higher than the esti-

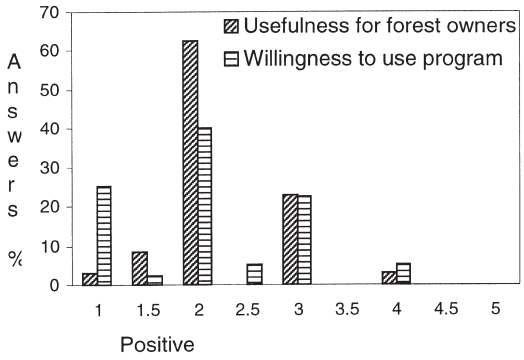

Fig. 2. Timber buyers' estimates of the usefulness of computer visualisation to forest owners and timber buyers' willingness to use a program (scale 1… 5, 1 = very useful/willing, 5 = not at all useful/willing).

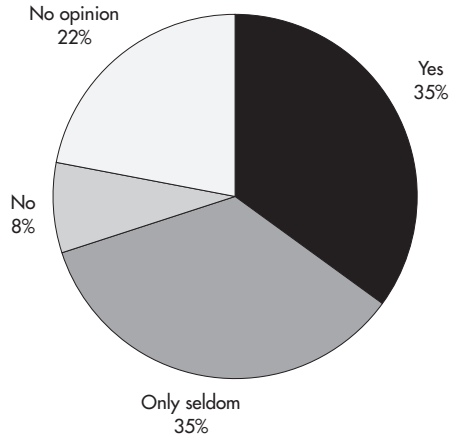

Fig. 3. 'Would a forest visualisation program be a competitive, or at least a quality factor in a timber sale?'

mates concerning the usefulness of the computer visualisation to them. When they assessed the usefulness of computer visualisation, nearly as many thought it to be slightly useful as those who had no opinion concerning its usefulness, and thus gave an average value for usefulness.

In the interviews, the buyers stated that it would be possible to show forest visualisations to forest owners, because they personally meet about 70% of all the forest owners with whom they have contact. Further, many buyers admitted that it is a great challenge to get a forest owner to agree to a timber sale, and that they have to provide forest owners with information about forestry matters. In the questionnaire, 35% of the buyers estimated a visualisation program to be a competitive, or at least a quality factor when negotiating with a forest owner about a timber sale (Fig. 3).

Those who felt visualisation to be useful considered it a good supporting tool when negotiating about a timber sale, because it could visualise the effect of different logging operations and future situations. However, statements of how much visualisation would help in such negotiations varied. There were also doubts that only a small number of forest owners would be interested in seeing visualisations. Practical reasons like a lack of time to use a program and difficulties in obtaining the information needed in creating visualisation were stated.

3.3 Personal Characteristics and Profiles Concerning Computer Visualisation

Four principal components were formed about timber buyers' perceptions concerning variables of personal characteristics (Table 2). The test statistics of 220.34 is significant at $p=<0.01$, which indicates that the components differs sig-

Table 2. Principal component solution with four principal components for the variables reflecting timber buyers' computer use and the development of skills needed in such work.

Variable	Principal component loading			
	PC1	PC2	PC3	PC4
Self-estimated computer skills	**0.835**	0.015	0.173	–0.167
'I have sufficient knowledge and ability to utilise computers.'	**0.835**	0.082	0.180	0.108
'I can become a good computer user.'	**0.706**	0.045	0.240	–0.231
The number of computer programs a timber buyer uses	**0.655**	0.178	–0.362	–0.125
'I dare to try all the new possibilities provided information technology.'	**0.641**	0.027	0.130	0.241
'Training concerning information technology is important.'	–0.056	**0.852**	0.258	0.173
'Training assurance to work in the face of continuous innovations and development.'	0.193	**0.846**	0.030	–0.022
'Computers help me a lot in my work, and I would like to work with one.'	0.162	**0.749**	0.020	0.111
'I would like to have a better understanding of the computer systems and programs which I use in my work.'	–0.352	**0.643**	0.014	–0.266
'I want to improve myself and my working skills.'	0.355	**0.599**	0.360	0.206
'I might ask other people for help when I try to solve some problems concerning computers.'	–0.123	–0.211	**–0.710**	0.398
'There will be many interesting innovations and method development in my work.'	0.069	0.257	**0.700**	0.239
'I have a possibility for advancement in my career.'	0.267	–0.025	**0.679**	0.320
'I am satisfied with my present work.'	–0.148	0.109	0.021	**0.794**
'My work is of considerable importance in our organisation.'	0.095	0.028	0.180	**0.610**
Eigenvalue	4.121	2.577	1.755	1.237
Variance explained (cum.%)	27.47	44.65	56.35	64.60
KMO of sampling adequacy; result of K-W -test	0.660; $\chi^2=220.34$, df = 105, $p<0.01$			

Table 3. Final cluster centres in the K-means cluster analysis and the three timber buyer groups formed on the basis of the four principal components and group size.

Timber buyer cluster (group)	Principal component				n
	Computer skills	Willingness to develop competence	Belief in advancing one's career	Work satisfaction	
Qualified	–0.750	–0.173	0.249	0.041	21
Neutral	0.812	–0.411	–0.540	0.143	13
Reluctant	0.867	1.498	0.300	–0.167	6

Table 4. Mean values of variables in three timber buyer groups (if the original scale is mentioned, small values mean a positive and large a negative assessment). Statistically significant differences (Kolmogorov-Smirnov -test) are given with p-values.

Variable of profile	Original scale	Qualified	Neutral	Reluctant	K-S -test
Age	1…5	3.29	3.62	3.83	
Amount of timber bought	m^3/year	45 900	42 900	55 000	
Attitude towards changes in general	1…3	1.61	1.92	2.33	
Length of computer training	weeks	8.38	3.23	1.83	
Would a forest visualisation program be a quality factor in a timber sale?	1…3	1.95	2.23	2.83	
Have you time to use a visualisation program?	1…3	1.25	1.00	2.33	$p<0.01$
Are you interested in using computers?	1…3	1.57	1.85	2.50	$p<0.05$
Willingness to learn computer skills	1…3	1.19	1.54	2.33	$p<0.01$
Willingness to use a visualisation program	1…5	1.76	2.16	2.83	$p<0.05$
Employees are taken into consideration in decisions concerning computer technology	1…6	4.35	3.15	3.20	$p<0.05$
My superior trusts my ability to use computers	1…6	1.45	2.31	3.20	$p<0.01$

nificantly between the timber buyers. Loadings of over 0.5 were taken into account when naming the principal components. In the first principal component (PC1), the variables with the greatest loadings were those that measured computer skills and the buyers' belief in their own skills. This component was therefore called *Computer skills*. Other components were also named according to the highest component loadings: *Willingness to develop competence* (PC2), *Belief in advancing one's career* (PC3), and *Work satisfaction* (PC4). These components explained about 64% of the total variation of the original variables.

K-means clustering grouped the timber buyers into three groups, who adopted a different attitude to a new computer system (Table 3). Three groups were distinguished according to the interpretation of the principal component scores and a reasonable group size. The groups were named according to the values of the principal component scores in the final cluster centres. When interpreting the cluster centre scores, it should be remembered that negative values indicate positive inclination to computer use, because the original variables were ranked on a scale from 1 to 6, where 1 indicated positive and 6 negative attitude or skills. The timber buyer groups were called: 1) *qualified*, 2) *neutral* and 3) *reluctant*.

When the values of interesting variables concerning forest computer visualisation behind the different groups were examined, more specific timber buyer profiles were formed. The components of the profiles are presented in numerical form in Table 4. There were statistically significant differences as regards both personal characteristics and organisational factors underlying the three groups.

Table 5. Spearman's correlation for selected personal and organisational variables and variables related to forest computer visualisation.

	A	B	C	D	E	F	G	H	I	J
B	0.410**									
C	–0.532**	–0.299								
D	0.318*	0.447**	–0.327*							
E	–0.001	0.148	–0.316	0.309						
F	0.311*	0.817**	–0.377*	0.424**	0.250					
G	–0.138	0.107	–0.213	0.075	0.155	0.187				
H	0.214	0.421*	–0.234	0.286	0.049	0.251	0.251			
I	0.243	0.426*	–0.116	0.453**	0.333*	0.312*	0.389	0.227		
J	–0.245	–0.405*	0.075	–0.320*	0.097	–0.427*	–0.029	–0.101	–0.332*	
K	–0.028	0.265	–0.221	0.449**	0.542**	0.331*	0.321	0.153	0.439**	0.358*

* $p<0.05$, ** $p<0.01$. Underlined figures indicate partial correlation where $p<0.05$.

A=Age; B=Computer skills; C=Length of computer training; D=Interest in computer use; E=Computers have helped in their work; F=Personal cluster; G=Usefulness of visualisation to the timber buyer; H=Usefulness of visualisation to the timber seller; I=Willingness to use visualisation program; J=Employees can participate in decision-making concerning computer technology; K=Attitude towards changes in general.

3.4 Factors Influencing the Attitude towards Forest Computer Visualisation

The differences between timber buyer groups *(F=personal cluster)* were also found from the correlation between variables related personal characteristics and organisational factors (Table 5). When interpreting the correlation, it should be borne in mind that the measurement scale in the variables other than age and length of training was such that small values indicated a positive quality.

As regards personal qualities, good computer skills promoted the opinion that the computer visualisation is useful for forest owners. Good skills also increased timber buyer's willingness to use the visualisation, and the more willing the buyers were to use the visualisation, the more interested they were in using computers. It was no wonder that the timber buyer cluster also correlated with a willingness to use the visualisation. Thus, the buyers belonging to the *qualified* group also had an inclination to use it.

Resistance to change, i.e. the phenomenon in which some people have a negative attitude towards almost anything new was found. Although, these timber buyers were not willing to use the computer visualisation, they participated in decision-making concerning computer technology.

Because age correlated strongly with computer skills, which further correlated with many other interesting variables, age was set as a controlling variable. As a result there were the correlations between variables which related forest computer visualisation. Thereafter, three different visualisation variables – two variables concerning the usefulness of visualisation (usefulness to a buyer and a seller) and one variable concerning the willingness to use visualisation – were combined in order to divide the buyers into those with a positive attitude towards visualisation, and those with a negative attitude. The groups of positively or negatively reacting buyers did not differ with respect to organisational factors, but computer skills was significantly different between the two groups (K-S -test; $Z=1.729$; $p=0.005$). The group of buyers with a positive attitude towards visualisation had better computer skills than the group of negatively reacting buyers.

4 Discussion

A reason for need for the computer visualisation is supposed to be an increasing share of forest owners called 'recreationists' or 'environmentalists'. This suggestion was derived from the earlier conclusion that recreationists differ from the other

forest owner groups in their greater concern for the protection of landscape values, which are related to outdoor activities (Karppinen 2000). In this study, the majority of the timber buyers assessed the computer visualisation would be at least slightly useful in a timber purchase situation with forest owners. The willingness to use it was at an even more positive level. Every third buyer also assessed it would be a quality factor in timber trade negotiations. These can be regarded as rather good results.

However, there was also significant resistance to the computer visualisation. Some buyers even thought that forest owners would not like the idea that a buyer was using this kind of software. This resistance to change may be seen as a normal psychological reaction, because new, unknown things arouse uncertainty in the buyers. This is fundamental, because people do not know what a change will mean for them and whether they can cope with new tasks (Rubenowitz 1985, Robbins 1986). In general discussion, the advantage of the computer visualisation is supposed to come from providing a better service to the forest owners and thus supporting a timber purchase. Even if only 8% of the buyers definitely denied usefulness of the computer visualisation, the positive relationship between abundant use of computers and work dissatisfaction seems to indicate that buyers experience computer use as useless or at least unprofitable work. Therefore, it is clear that the computer visualisation is not yet an indispensable and urgently needed support for most of the buyers.

The computer skills greatly influenced attitudes of timber buyers. In this respect, the most qualified buyers evidently adopted the most positive attitude to the computer visualisation. In fact, the users who have the best experience and knowledge of information technology are also best able to realise its advantages as, e.g., Reponen et al. (1987a,b), Galletta and Lederer (1989) and Lee et al. (1995) have also concluded. About one half of the buyers belonged to the group of *qualified* buyers. The result appears promising for implementation of the computer visualisation. However, it should be borne in mind that the buyers assessed their computer skills themselves, and compared their skills with the demands set by buyers' work. Otherwise, clustering of the buyers was similar to the expected result. Same kind of groups as reacting to new systems – *qualified, neutral* and *reluctant* – has also been found in earlier studies (Rogers 1995).

Cluster analysis is a highly empirical statistical method and the results have to be interpreted carefully (Afifi and Clark 1990). Previously, Palander et al. (2001) and Toivonen et al. (2001) have used the same method in the same target group. They sent the questionnaires to the whole company and 262 responses returned for quantitative analysis. Because the data of this study was collected during interviews, 40 respondents can be regarded as sufficient. During interviews we made observations about timber buyers' answering to presented statements and questions. To make clear our purpose of the study we helped them in confusing situations. This support increased validation of data. Therefore, the collection of the data was stopped when so called 'a saturation point' was reached. According to Strauss (1990), after saturation point additional data will no longer reveal any new ideas concerning the research problem. It is also worth noticing that in this study age classes were different. Most of the buyers in the data were aged between 45 to 54 years (45%), followed by 35 to 44 years (35%). The buyers had been working in timber buying for an average of 14 years, and the average amount of timber bought was 46 300 m^3/yr. The data is slightly emphasised by study material of elder age classes compared with the description of personnel made by Palander et al. (2001) and Toivonen et al. (2001). Otherwise, the chosen buyers were good representatives of the companies.

Organisational factors proved to have no significant interaction with the computer skills and attitudes. In spite of this fact, one reason for the correlation between participation opportunities and skills – those having weak skills and a negative attitude towards visualisation have had the possibility to participate in decisions concerning technical development – could be that *qualified* buyers want to participate in decision-making even more than those with weak skills. Thus, the *qualified* buyers felt that they have been neglected in participation processes concerning computer technology. On the other hand, it may also be that the *reluctant* buyers – those who are the oldest ones – are included in technology development

groups, because they have more authority in such decisions. This seems to mean that the selection of buyers for development groups has been made on the basis of properties other than computer skills. If the latter is true, then the adoption of new computer systems could be promoted by selecting *qualified* buyers for development groups.

The prevailing atmosphere in organisations is not very favourable for the adoption of a new computer system because buyers have also had to get used to computer work with relatively little training and guidance from their organisations. Ups to now, some problems have also been in the capacity and functioning of the computers as well as in data transfer. Thus, both technical and human qualifications of personnel have to be strengthened before the computer visualisation can be successfully adopted for timber procurement.

It seems improving the competence of buyers belonging to the group of *neutral and reluctant* represent a considerable challenge to an organisation. *Reluctant* buyers are so-called job-oriented persons, who feel that their job is to buy timber, nothing else. It would appear that technical development and the possibilities it provides do not arouse any interest in these buyers. In order to be able to reduce this problem, the *reluctant* persons should first be able to move to the group of *neutrals.* This would create conditions promoting successful adoption and use of the computer visualisation, because the greatest shortcoming of *neutral* buyers was insufficient computer skills, but they were still very willing to improve their skills and also rather willing to use the computer visualisation.

Acknowledgements

We would like to thank all those persons who have participated in this study, especially the timber buyers for their collaboration, as well as Professor Hans R. Heinimann for his valuable comments as referee of this paper. We also extend our thanks to the Academy of Finland for funding the research projects. This study was carried under the project 'Group decision support in wood procurement' led by Professor Pertti Harstela.

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