

C-Commerce Virtuality - Will it Work in the Internet?

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Abstract

During the Spring of 2000, students with a bachelor's degree in engineering participated in an experiment which was intended to investigate the possibilities to manage a virtual furniture company by means of c-commerce. The test subjects developed a virtual furniture company operating on the Internet with suppliers available on the Internet. The test subjects' satisfaction and perception of the experiment were solicited. The task was complex, but taking into consideration the test subjects' background, their bachelor's degree in engineering, as well as several years of industrial experience, these students if any should have the capabilities to manage the task given and thus provide us with some valuable information about the possibilities of c-commerce virtuality in the Internet.

Key words: c-commerce, virtuality, management, hyperknowledge, utility, usability

1. Introduction

Companies' business environment has changed dramatically: the variety of products has increased, the products' life cycles have shortened, repeat orders have decreased, and batch sizes have become smaller (Iacocca Institute report 1991, Kidd 1995). This all means that companies have been forced to create a new concept which reacts and responds to demand fluctuations, such as flexibility, quality, highly customized products, and future changes in the market (Booth 1996, Kidd 1995). The new construct which covers all the concepts is agility manufacturing. It consists of three basic elements: organization, people, and technology (Kidd 1995). The above mentioned trend has led to a new situation, where different companies are collected together to form virtual enterprises or extended enterprises (cf. Cristopher 1998). The main requirement when forming a virtual enterprise, is that each company has the needed core competence, which supports the virtual enterprise holistically (Cox 1996, Kidd 1995). Moreover, every company has to have the needed organization, people, and especially technology for the virtual enterprise. Thus, different companies' organizations are first forced to adapt the virtual enterprise's organization and then the different companies' personnel have to be capable of working in teams crossing the companies' boundaries with new technology. The nature of the participation and the contribution of the members of the supply and the value chain becomes in this way very important. From this follows, that it is essential for companies to evaluate all their value chain activities and also to evaluate their human resources; how do they understand the new modern Internet based supply chain and how do they behave when they meet this new virtuality? In this research we have created a new virtual working environment with the existing Internet based application and used the hyperknowledge environment with its definitions as a background framework.

In our study the decision-makers are working through several www addresses in order to create a virtual furniture company. Many of the found www addresses are clicked away, while others are brought up for a more thorough inspection. Our main interest is to find out if c-commerce (here collaborative) and virtuality is possible on the Internet. The main research question can be divided into the following sub questions:

1. Is it possible to find necessary suppliers on the Internet?
2. Is it possible to evaluate different suppliers on the Internet?
3. Is it possible to create a virtual enterprise on the Internet?
4. Does the Internet environment give enough support for the decision-maker?

We assume that the fourth question forms an essential part of the other three questions, as the decision maker needs support for his/her decision making process.

By using the hyperknowledge platform, we assume that we can deal with structuring and processing of decision problems, which involve creating the virtual enterprise. We start from the idea that our virtual furniture enterprise is an object, which has to be formed in the knowledge base. Thus the decision maker needs support for his/her decision making process, through which s/he forms the virtual enterprise and affects the contracts between the decision maker / the virtual company and the supplier. The decision maker has to evaluate the ability to make the contracts solely by using the information which s/he gets from the computer screen.

We address the usability and the utility of e-commerce in the Internet. Usability and utility are two equally important factors in the evaluation process. Newell et al. (1972) define utility as “the question of whether the functionality of the system in principle can do what is needed”. Usability, in turn, is usually described in terms of criteria like learnability, efficiency of use, memorability, a small number of errors, and subjective satisfaction (Nielsen 1990). The result of previously executed validity and utility tests on hyperknowledge applications (Vanharanta et al. 1995), constitutes the point of departure for our study.

The present study focuses on the two most critical components of the hyperknowledge environment: the user and the contents of the Internet applications. We try to find out if the Internet applications used are a plausible system for evaluating the decision support activities of business contracts, and what are the advantages and disadvantages of Internet applications from the user’s point of view. The validation methods are partially the same that which have been used in expert systems (O’Keefe et al. 1987 and O’Leary 1988) and in the hyperknowledge system evaluations (Vanharanta et al. 1995), i.e. a form of performance validation combined with a questionnaire.

2. Theoretical framework

2.1 Hyperknowledge

Hyperknowledge is strongly related to the technologies of hypertext and hypermedia (Bush 1945, Engelbart 1963), and to the architecture of the hypertext systems (Nelson 1987, Nielsen 1990). Hypertext consists of pieces of text or other information, which can be interlinked. The user can read this interlinked text network in a nonsequential manner, as it is possible to do in the Internet. This technology gives the user different options from which to choose. The user determines what to read, in other words, s/he determines what kind of information to pick and read. Hypertext is part of hypermedia. Hypermedia in turn means a free combination of information using media such as text, data, pictures, voice and video (Woodhead 1991).

The concept of hyperknowledge is wider than those of hypertext or hypermedia, although it follows the same general principles. Hyperknowledge is an ideal working and learning environment that holds knowledge and, at the same time, defines the nature of hypertext and hypermedia. The user can navigate freely in this environment (as on the Internet), and widen his/her own knowledge. (Chang et al. 1989, 1993, 1994). The basic goal of this framework is to serve active decision support that enables the decision maker to participate actively throughout the decision process. The framework takes into account that the decision maker cognitively possesses and processes many diverse and interrelated pieces of knowledge e.g. procedural knowledge, descriptive knowledge, reasoning knowledge, etc. The user (i.e. the user's mind) is able to freely deal with and control these different pieces of knowledge, thus the decision support systems (DSS) (cf. Dos Santos et al. 1989) should be a natural extension of the decision maker's internal activities (Chang et al. 1989, 1993, 1994).

2.2. Decision Support System

A decision support system (DSS) (See Dos Santos et al. 1989, p. 3), in turn, consists of three main components: *The Language and the Presentation System* mediate messages to and from the decision support system. The language System (LS) on the Internet is controlled by using a hypertext transfer protocol (http).

The user activates a www page and a www address by using a mouse and keyboard. The presentation System (PS) on the Internet application is everything presented in www page/screen format and which can be printed in paper form. *The Problem Processing System (PPS)* handles all the user requests or responses to and from the various knowledge sources in the system. On the Internet this all means search functions and processes by the Internet application.

The Knowledge System (KS) contains all the decision support system's knowledge and it stores, in groups, concepts that are related to each other by definition and/or by association. On the Internet applications this means that all available contract information, knowledge and procedures in www addresses, sites, and pages are placed in this system.

The environment makes it possible for the user to navigate logically in the hyperknowledge environment. In the ideal hyperknowledge environment the pieces of knowledge (i.e. concepts) and the user are united. The user receives an impression or several impressions as the system presents an image or images (visualization) on a graphical user interface (GUI), i.e. computer screen (c.f. Chang et al. 1989, Vanharanta et al. 1995)

2.3. Supply chain management and e-commerce in the Internet

The empirical part of our study belongs to modern supply chain management. In practise this involves the adoption of electronic linkages between two businesses that are related as suppliers and customers within a singly industry channel or supply chain. According to Westland and Clark the new supply chain management innovations are mainly in the process of changing the nature of purchasing, manufacturing, distribution and retailing in Europe, Japan, and Australia as well as throughout Asia. The reduction in inventories, stock outs, and overall costs are the main outputs of the new innovative supply chain management approaches using information technology (IT).

When channel bargaining power occurs simultaneously over partners, it can result in virtual channel alliance, with long-term relationships based on mutual trust replacing market-based short term contracts (cf. Sinha). The power of shared and transparent information within a channel in reducing costs and improving efficiency can be dramatic (cf. Carlsson and Fuller). Many companies have invested substantial resources in IT and process innovations designed to improve chain efficiency and effectiveness (cf. Westland and Clark, Sinha).

In the exploratory study the test subjects, i.e. the decision-makers were using the Internet in order to create a virtual furniture company. The decision makers investigated the possibilities to manage a virtual furniture company by means of e-commerce. In our case e means collaborative and has been defined as follows: *“The ability of two or more people or groups to transfer data and information with the capability of on-line interaction. The distinguishing feature is the ability for many-to-many interactions and information sharing, unlike e-mail where the interaction is one-to-one or one-to-many”* (<http://www.collaborate.com>).

Ideal e-commerce means that it is possible to create a virtual enterprise by using the Internet. This, in turn, means that a company has the ability to form a network, which consists of suitable suppliers and distributors. The members' core competences support the company's core competence. The virtual enterprise, based on collaborative contracts on the Internet, can then control and evaluate all the needed transactions.

3. The Empirical Study

3.1 The Virtual Furniture Experiment

In the spring of 2000 we conducted an exploratory study on M. Sc. (Eng.) students' capabilities to create a virtual furniture company on the Internet.

The task given to the test subjects was twofold; (i) to create a virtual furniture company on the Internet and (ii) to report on their experiences and perceptions, especially the problems they faced during encountered during the task.

The test subjects represented the knowledge managers and all the contracts were to be made between the knowledge manager and the different suppliers. When choosing the suppliers a requirement was that the transportation costs should be reasonable when taking the geographical distances into account. To make the task easier we defined the virtual company as a sofa manufacturer. We provided the test subjects with a preliminary flowchart describing the different materials needed for the manufacturing as well as the proper English concepts for the materials in order to avoid possible language problems. The flowchart represented also included a possible virtual company organization diagram. The test subjects were asked to construct the virtual company organization, i.e. construct a flowchart of different suppliers with their www addresses. This flowchart was to be designed in a logical way and delivered as a report at the end of the experiment. No e-mail contacts were allowed during the experiment between the test subjects and the suppliers.

3.2 Test situation and questionnaire

The experiment was conducted in one of the PC-classes at Tampere University of Technology in Pori. The experiment started at 8 a.m. and the test subjects were given 4 hours to complete the given task. Early morning hours were chosen in order to avoid too much traffic on the net. The instructors were present during the experiment and could both control as well as help the test subjects in case of problems. After completing the task we administered a questionnaire to the test subjects. All the test subjects completed the questionnaire.

3.3 Demographic Data

Altogether 18 M.Sc.(eng.) students with a bachelor's degree in engineering participated in the experiment. All of the students have industrial engineering as their academic major. The gender distribution shows that four were female students, the rest male students. The mean age of the participants was 35 years and the participants had on average 9.2 years of industrial experience (cf table 1 and 2).

We were interested in knowing if the test subjects had participated in an Internet project before the present experiment and how proficient they were with the Internet. Finns are among the most frequent users of the Internet, and they show the highest proportion of users in relation to population (<http://www.nw.com>). According to a recent 1999 report Finns are surfing the net daily (<http://www.telmo.fi>). This gave us the perception that the Finnish students are experienced with the Internet.

The majority of the test subjects visit the Internet daily 11 (61%), 5 (28%) several times per week and 2 (11%) once a week. It turned out that on the average the test subjects had participated twice in an Internet project before the present experiment. We were surprised to find out that 4 (22%) test subjects considered themselves as not at all or only somewhat proficient with the Internet, 6 (34%) as proficient or very proficient, and the majority 8 (44 %) being somewhere in between. (cf. Table 3)

4 Results

4.1. Result categories

Our utility analysis focuses on research constructs, which are based on the hyperknowledge framework, and the validity and utility model for the hyperknowledge environment as implemented in Vanharanta's benchmarking application (c.f. Vanharanta 1995). In this model the knowledge of the system has been divided into five different types of knowledge: linguistic knowledge e.g. computer explanations, descriptive knowledge e.g. fact data etc., procedural knowledge, reasoning knowledge and presentation knowledge (these areas form a flexible user interface e.g. audio and visual systems) (c.f. Chang et al. 1994). Our research paper is concerned with descriptive knowledge only, thus we examine how the information which is transmitted via the www pages, supports the user's evaluation of business under his/her decision making. We also refer to the statistical results calculated from the questionnaires.

In this paper the above mentioned research constructs used were divided into three different categories:

- The first category describes traits and feelings perceived by the test subjects themselves during and after the tests. In our study these constructs are “lost in space”, and “cognitive overhead”. (cf. Conklin 1987)
- The second category describes perceived outcomes for the test subjects interacting with the Internet application, e.g. what was the contribution of the virtual environment for the user. In our study these constructions are: “learning”, the “creation of comprehensive understanding”, “understanding the Internet and its applications”, “usefulness in acquisition”, and the “utility of the Internet”.
- The third category (satisfaction) describes user satisfaction.

4.2 Visited web-sites

The task was completed by all the test subjects, however with varying results. Due to network and other problems not all the tasks were satisfactorily done. The number of suppliers needed for a virtual furniture company was on average 12, the maximum number being 20 and the minimum being 6. The number of visited web sites also varied. On an average the test subjects worked through 9 out of 12 sites when creating the virtual company, the maximum being 13 and the minimum being 5 sites.

4.3 Selected partners

The majority of the suppliers chosen by the test subjects and included in the virtual furniture company were local companies. Very few foreign suppliers were considered and/or included in the virtual company. One of the virtual company solutions included only American suppliers and seven only Finnish suppliers. The rest had a mixed composition of suppliers, mainly Finnish suppliers with a couple of foreign suppliers, either Swedish (the second biggest group), American, British, Danish, German or Dutch companies. A plausible explanation for the majority on Finnish suppliers might be the language barrier.

4.4 Statistical results

In order to investigate the problems encountered when completing the task, the participants were asked to fill in a questionnaire. The questions covered the potential problem areas mentioned in the previous chapters as well as some questions of the nature of the task and the test subjects’ satisfaction with their performance.

The test subjects’ assessments of their own performance was measured on (i) the overall satisfaction rate, (ii) attitudes towards the task and (iii) how experienced they were with the Internet.

The attitudes towards Internet as a source for creating a virtual furniture company were measured with the following factors, (i) finding relevant suppliers, (ii) making comparisons between the suppliers, (iii) choosing the suppliers, and (iv) the usability of the suppliers’ web sites. One factor that could have been a hindrance was the test subjects’ (v) knowledge of the furniture industry which was also measured.

The responses were mainly measured using the Likert attitude scales (5-point scales ranging from “strongly agree” (5) to “strongly disagree” (1)). The statistical analysis included computations of descriptive statistics.

4.5 Difficult elements when creating the virtual furniture company

The task given was rather complex. The test subjects faced several problems, one of these being the university network going down. Fortunately, by then the majority of the students had already accomplished the virtual furniture company.

Finding relevant suppliers on the Internet might be a difficult task. In a hypertext environment it is rather easy to get lost in space and to get lost in space feeling (cf. Vanharanta).

On the Internet there are, however, rather good search engines but the suppliers' web sites are not necessarily easy to find.

4.6 Performance validity and utility assessment

4.6.1 Limited knowledge of the furniture industry

The level of existing knowledge in purchasing issues is mapped using questions concerning the background of each test subject. The test subjects are not experts in purchasing management but all are quite well grounded in the theories of purchasing management and they understand several concepts of contracts (cf. User knowledge in a hyperknowledge environment).

The participants did not consider their limited knowledge of the furniture industry as a drawback for creating the virtual furniture company. Maybe this is due to their industry experience which has taken them to several challenging tasks in their career (cf. table 10).

4.6.2 Finding the suppliers on the Internet

According to Vanharanta et al. (1995) one of the problems in hypertext and hypermedia applications is the feeling of being "lost in space". This means that the users lose their "coordinates". In Internet applications, especially www sites, this means that the user is unable to find "the right page" and s/he is not sure, where s/he exactly lays and what the context of the www page is. This means, that the user does not have any familiar framework. (cf. Lost in space in a hyperknowledge environment).

In the questionnaire we asked for the subject's opinion by evaluating his/her ability to find "the best supplier" among all the suppliers. On an average the test subjects did not consider finding the suppliers on the Internet as too difficult, the mean value being 2.9 (cf. table 10).

On an average the test subjects thought that the number of needed suppliers for the virtual furniture company would be 9 and on an average they found 12 suppliers on the Internet.

4.6.3 Choosing the "best" supplier

In this construct the user feels that there is too much information available and that s/he cannot digest it all, e.g. the user does not have the time to try and check all the available addresses. Moreover, the user's cognitive capacity is not large enough to handle vast amounts of information and the user is therefore reluctant to use it or cannot complete the assignment (c.f. Vanharanta et al. 1995). Cognitive overhead is normally tested by asking how challenging and demanding the experiment is and the need of time (cf. Cognitive overhead in a hyperknowledge environment).

Based on the information on the suppliers' web sites, it is not an easy task to choose the best supplier among the suppliers. The trend of growing complexity is obvious but the found differences are not significant in our experiment cf. table 10).

4.6.4 Making comparisons between the suppliers

We tested learning by asking the test subjects to estimate the ability to make contracts with suppliers. So the test subjects had to evaluate suppliers by using the information which was available on the suppliers' www sites. (cf. Learning and creation of comprehensive understanding in a hyperknowledge environment).

Once you find the suppliers you need to make comparisons between them. Due to the experimental settings no direct contacts, such as sending e-mails, were to be made with the suppliers. The comparisons were to be based solely on the information available on the Internet. Intuitively this phase would be more difficult than finding the suppliers on the Internet. The results give some evidence for this but the difference is not significant. The small sample size as well as the missing values makes the numerical calculations not very

relevant. We can, however, find without exception that the average values for making comparisons are higher than for finding suppliers on the Internet (mean 3.3) (cf. table 10).

4.6.5 The usability and utility of the suppliers' web sites.

This group of questions handled the Internet like a hyperknowledge construct. Our purpose was to indicate how well the user can handle the knowledge which the Internet contains, how aware s/he is of that knowledge, and how close the Internet can be to the ideal hyperknowledge environment. We tested the utility of the Internet by asking about the usability of the suppliers' websites.

On an average the test subjects did not see the usability of the suppliers' web sites as too problematic when creating the virtual furniture company, mean value 3.1. We did not elaborate on the usability in detail which would have given us more information. However, we asked the test subjects to address the three most important factors missing when creating the virtual furniture company. It turned out that besides the technical problems with the university net the most frequently mentioned factors were the shortcomings with the suppliers' web sites. Among these were the quality of the web sites, the relevant information not provided on the site, such as price and delivery terms, no interactive sites, missing company information which does not give a very reliable picture of the suppliers, just to mention a few. (cf. Understanding the Internet and its applications, usefulness in acquisition, utility of the internet in a hyperknowledge environment).

4.6.6 Satisfaction and Expectations

On an average the participants did not consider the experiment as very realistic in comparison to things that individuals and organisations do in a typical or common business situation, the mean value being 2.3 (cf. table 4). The idea of managing a virtual company was new to the test subjects and thus they lacked the needed experience of such an enterprise.

The majority of the test subjects 10 (56%) were dissatisfied or extremely dissatisfied with their performance to create a virtual furniture company. It turned out that only 4 (22%) were satisfied or extremely satisfied with their performance, and 4 (22%) being neither-nor. On an average the students were not very happy with their performance, the mean value being 2.6 (cf. chart 1). The participants thought that given more time they would have performed significantly better (cf. table 6).

However, when asked about it, the majority of the participants 11 (61%) thought that it is possible to manage a virtual furniture company, 5 (28%) being not sure and two being negative to the idea (cf. table 5). The majority of the students thought, based on their experience from creating the virtual furniture company, that it would be possible to agree on co-operation in general and on contracts on either a permanent or a temporary basis (cf. table 7 and 8). Considering partnership the opinions were divided (cf. table 8).

In general the test subjects did not find the effort as too demanding, mean value 2.4. The level of interest as well as the challenge of the task were rather low, both scoring 3.05 on average (cf. table 4). All the participants, with the exception of two with serious net problems, succeeded in creating a virtual furniture company.

5 Conclusions

The study conducted is an exploratory study on the possibilities to create a virtual furniture company on the Internet, i.e. to manage a company by means of c-commerce. Students with a bachelor's degree in engineering and several years of industrial experience participated in the experiment. Each participant developed a virtual furniture company with suppliers available on the Internet. The results varied among the participants. Our main interest was to find out if c-commerce is possible on the Internet. Our main research question was divided into four sub questions:

Is it possible to find necessary suppliers on the Internet?
Is it possible to evaluate different suppliers on the Internet?
Is it possible to create a virtual enterprise on the Internet?
Does the Internet environment give enough support for the decision-maker?

We can state, that there were no problems in finding the necessary suppliers on the Internet. The problems start with the evaluation of the suppliers, i.e. comparing and choosing the suppliers. The fact that the participants were not allowed to send e-mails to the suppliers made the task difficult. If the necessary information was not available or not found on the suppliers' web sites then the participants had to live with that and make the comparisons as well as choosing the best suppliers without proper information. According to our findings we can see a slight trend of growing complexity from finding to comparing and to choosing the best suppliers. The differences are, however, not significant.

All the students, with the exception of two, managed in principle to create a virtual company. Whether these companies would in practice be manageable was not tested. The participants were rather positive to the idea of managing a virtual furniture company. Their opinions were divided regarding partnerships but the majority thought that it is possible to agree on co-operation in general and on contracts on either a permanent or a temporary basis.

The last sub question was only partially answered. According to the user satisfaction results we can conclude that users seem to need more relevant and supporting information for their decision making. The available technology is strongly pushing companies towards this kind of new, more hyperknowledge based, virtuality.

This experiment was the first tentative step in our attempt to acquire knowledge about the possibilities to create a virtual enterprise on the Internet. In the fall at 2000 we will investigate the possibilities in more detail. The research design will differ. The participants will be working in groups, during a period of three months and each group will have a real company considering going virtual.

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WWW addresses:

<http://www.collaborate.com>

(<http://www.nw.com>

<http://www.telmo.fi>

Appendix:

Table 1: Demographic data

	N	Minimum	Maximum	Mean
AGE, years	18	25.00	49.00	35.0000
Participation in Internet projects	15	1.00	4.00	2.0000
Proficient with the Internet	18	1.00	5.00	3.1111
Years of experience	18	2.00	25.00	9.2778
Valid N (listwise)	15			

Table 2: Gender

	Valid		
	male	female	Total
Frequency	14	4	18
Percent	77.8	22.2	100.0

Table 3: How often do you visit the Internet?

	Frequency	Percent
every day	11	61.1
several times a week	5	27.8
once a week	2	11.1
Total	18	100.0

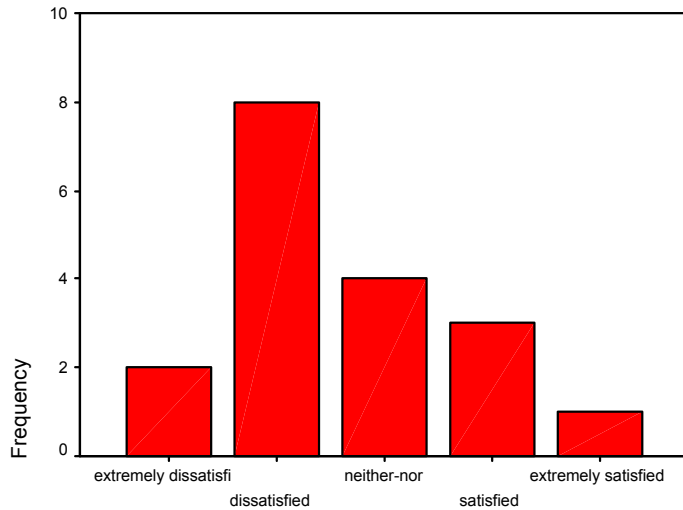


Chart 1 : Satisfied with own performance (mean value 2.6)

Table 4: Overall evaluation of the experiment (1=low, 5=high)

	N	Mean
Realistic experiment	18	2.2778
Effort	18	2.3889
Interest level	18	3.0556
Challenging	18	3.0556
Valid N (listwise)	18	

Table 5: Is it possible to manage a virtual company?

	Frequency	Percent
Valid not sure	5	27.8
no	2	11.1
yes	11	61.1
Total	18	100.0

Table 6: Given more time, better results in the experiment

		Frequency	Percent
Valid	the same	2	11.1
	somewhat better	7	38.9
	much better	9	50.0
Total		18	100.0

Table 7: Is it possible to agree on cooperation in general?

		Frequency	Percent
Valid	no	3	16.7
	yes	15	83.3
Total		18	100.0

Table 8: Is it possible to agree on contracts on either permanent or temporary basis?

		Frequency	Percent
Valid	no	4	22.2
	yes	13	72.2
	Total	17	94.4
Missing		1	5.6

Table 9: Is it possible to To agree on partnerships?

		Frequency	Percent
Valid	no	8	44.4
	yes	9	50.0
	Total	17	94.4
Missing		1	5.6

Table 10: Difficulties when creating the virtual company (1=little, 5=a lot)

	N	Mean
Finding the suppliers on the Internet	12	2.9000
Making comparisons between the suppliers	11	3.2363
Choosing the "best" supplier	10	3.4100
The usability of the suppliers' websites	18	3.1111
Limited knowledge of the furniture industry	18	3.1667
Valid N (listwise)	10	