Evaluating Collaboration and Core Competence in a Virtual Enterprise

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ABSTRACT

During the Spring of 2000 and Autumn 2000 and 2001 students with a bachelor's degree in engineering participated in an estimation which was intended to investigate the possibilities to manage a virtual company by means of collaboration. The test subjects developed a virtual company operating on the Internet with suppliers available on the Internet. The test subjects' satisfaction and perception of the estimation were solicited. The task was complex, but taking into consideration the test subjects' background, their degree in engineering, as well as their 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 collaboration and virtuality in the Internet.

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1. Introduction

In our study the decision-makers are working through several www addresses in order to create a virtual company. Many of the found www addresses are discarded, while others are brought up for a more thorough inspection. Our main interest is to find out whether 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 provide sufficient 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.

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By using the hyperknowledge platform (Chang et al., 1989, 1993, 1994; Vanharanta et al., 1995), we assume that we can deal with the structuring and processing of decision problems, which involve creating the virtual enterprise. We start from the idea that our virtual enterprise is an object, which has to be formed on 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. Thus we address the usability and the utility of the Internet in the context of collaboration by utilizing the hyperknowledge platform. 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 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 whether 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 as those 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 and Decision Support System

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 deal freely with and control these different pieces of knowledge. (Chang et al. 1989, 1993, 1994)

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. With the Internet applications this means that all available contract information, knowledge and procedures in www addresses, sites, and pages are placed in this system. Thus the decision support systems (DSS) should be a natural extension of the decision maker's internal activities.

2.2 Collaboration in the Internet

In our case collaborative 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 collaboration in the virtual context means that it is possible to create a virtual enterprise by using the Internet. The virtual enterprise, based on collaborative contracts on the Internet, can then control and evaluate all the needed transactions. This, in turn, means that a company has the ability to form a network, which consists of suitable suppliers and distributors and the members' core competences support the company's core competence. In this context, the abilities of collaboration were estimated by taking the first step on the path of collaboration. In the

laboratory tests the companies' abilities and capabilities to collaborate were estimated with the help of the information on the www page.

3. Empirical Study

We made three separated tests, where we conducted an exploratory study on M.Sc. (Eng.) students' capabilities to create a virtual company on the Internet. The first estimation made in the spring of 2000 (marked with S00), the second in the autumn of 2000 (marked with A00), and the third in the autumn of 2001(marked with A01). Altogether (18 (S00); 30 (A00); 25 (A01) M.Sc. (eng.) students with a bachelor's degree in engineering participated in the estimation. All of the students have industrial engineering as their academic major. The mean age of the participants was (35 (S00), 28 (A00), 29 (A01)) years and the participants had on average (9.2 (S00), 3.6 (A00), 6 (A01)) years of industrial experience. The majority of the test subjects (i.e. 93 %) visit the Internet daily or several times per week. 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). In every test case the test subjects had already planned their own "case company" and the products which were needed via the Internet. The task given to the test subjects was twofold; (i) to create a virtual company on the Internet and (ii) to report on their experiences, and perceptions 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. 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 estimation. No e-mail contacts were allowed during the estimation between the test subjects and the suppliers. The estimation was conducted in one of the PC-classes at Tampere University of Technology in Pori. The estimation started at 8 a.m. and the test subjects were given 8 hours to complete the given task.

4. Results

Our utility analysis focuses on research constructs, which are based on the hyperknowledge framework, and the validity and utility model for the hyperknowledge environment.(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 (c.f. Chang et al. 1994). Our research paper is only concerned with descriptive knowledge, 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. 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 the 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. The responses were mainly measured using the Likert attitude scales (5-point scales ranging from "strongly agree" (5) to "strongly disagree" (1)).

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". 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. (cf. Conklin 1987; Vanharanta et al. 1995)

The task was completed by all the test subjects, however with varying results. The number of suppliers needed for a virtual 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.

4.1 Performance Validity and Utility Assessment

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 loose 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 regard finding the suppliers on the Internet as too difficult, when the mean values were (2.9 (S00); 2.7 (A00); 2.8(A01)), the std. deviation values being (0.97 (A00); 0.91 (A01)). The lowest limits for the t-distribution were (2.35 (A00); 2.43 (A01)), the upper limits being (3.08 (A00); 3.18 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar.

Making comparisons between the suppliers. We tested learning by asking the test subjects to estimate their 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 test subjects find the suppliers they need to make comparisons between them. 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 provide some evidence for this but the difference is not significant. We did, however, find without exception that the average values for making comparisons are in some cases higher than those for locating finding suppliers on the Internet (means 3.3 (S00); 2.6 (A00); 2.9 (A01)), the std. deviation values being (0.76 (A00); 0,59 (A01)). The lowest limits for the t-distribution were (2,33 (A00); 2,67 (A01)), the upper limits being (2,90 (A00); 3,16 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar.

The usability and utility of the suppliers' web sites. 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 find the usability of the suppliers' web sites too problematic when creating the virtual furniture company, mean values 3.1(S00); 2.8 (A00); 3.0 (A01), and the std. deviation values being (0.95 (A00); 0.46 (A01)). The lowest limits for the t-distribution were (2.46 (A00); 2.76 (A01)), the upper limits being (3.17 (A00); 3.14 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar. This means that 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.

  Satisfaction and expectations. On an average the participants considered the estimation to be realistic in comparison to things that individuals and organisations do in a typical or common business situation, the mean values being (2.3 (S00); 3.3 (A00); 3.3 (A01)), and the std. deviation values being (1.17 (A00); 0.79 (A01)). The lowest limits for the t-distribution were (2.09 (A00); 2.95 (A01)), the upper limits being (4.47 (A00); 3.61 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar. On an average the students were not very happy with their performance, the mean values being (2.6 (S00); 3.0 (A00); 2.7 (A01)), and the std. deviation values being (0.96 (A00); 1.10 (A01)). The lowest limits for the t-distribution were (2.45 (A00); 2.14 (A01)), the upper limits being (3.55 (A00); 3.27 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar. When asked about it, the majority of the participants 61% (S00); 64% (A00); 56% (A01) thought that it is possible to manage a virtual furniture company, 28% (S00); 28% (A00); 32% (A01) being not sure of the idea. The majority of the students thought, based on their experience from creating the virtual company that it would be possible to agree on co-operation in general and on contracts on either a permanent or a temporary basis. Considering partnership the opinions were divided. In general the test subjects did not find the effort to be too demanding, mean values (2.4 (S00); 2.8 A00); 3.1 (A01)), and the std. deviation values being (0.71 (A00); 0.58 (A01)). The lowest limits for the t-distribution were (2.23 (A00); 2.84 (A01)), the upper limits being (3.37 (A00); 3.33 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar. The level of interest as

well as the challenge of the task were quite good, both scoring (3.05 (S00); 4 (A00); 3.5 (A01)) on average)), and the std. deviation values being (0.91 (A00); 1.12 (A01)). The lowest limits for the t-distribution were (3.62 (A00); 3.06 (A01)), the upper limits being (4.38 (A00); 3.98 (A01)). The std. deviation and t-distribution values in the (S00) case were not calculated, but we suppose that these values are similar.

5. Conclusions

We can conclude, 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 six, 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 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. According to the user satisfaction results we can conclude that users seem to need more relevant and supporting information for their decision- making.

The paper illustrates the theory connection between hyperknowledge and the Internet in the context of collaboration in the virtual environment. We can conclude that utilizing the constructs of "lost in space", "learning", "creation of comprehensive understanding", and "utility of the Internet" supported the estimation of the Internet as an implement of collaboration in the virtual working environment.

The results and experiences suggest that tests should be extended into real companies and business situations. Moreover, in the framework of the theories used, it will be fruitful to examine how different forms of information on the www page support decision-making in the context of collaboration.

6. References

Chang, A-L. Holsapple, C.W. Whinston, A.B. (1989) A Decision Support System Theory. *Working paper University of Aritzona* Tucson, USA, 53p.

Chang, A-L. Holsapple, C.W. Whinston, A.B. (1993) Model Management Issues and Directions Decision Support System 9(1) pp.19-37

Chang, A-L. Holsapple, C.W. Whinston, A.B. (1994) A Hyperknowledge Framework of Decision Support Systems. *Information Processing & Management*, 30 (4) pp. 473-498

Conklin, J. (1987) Hypertext: An Introduction and Survey*. IEEE Computer* 20(9) pp. 17-41

Dos Santos, B.L. Holsapple, C.W. (1989) A Framework for Designing Adaptive DSS Interfaces *Decision Support Systems*, 5 pp. 1-11. http://www.collaborate.com

Newel, A. Simon, H. (1972) Human Problem Solving Prentice Hall, Enlewood Cliffs, New Jersey

Nielsen, J. (1990) Hypertext and Hypermedia Academic Press Inc., San Diego

O'Keefe, R. Balci, O. Smith, E. (1987) Validating Expert System Performance. *IEEE Expert* 2(4) pp. 81-89

O'Leary, D. (1988) Methods of Validating Expert Systems. *Interfaces* 18(6) pp. 72-79

Vanharanta, H. Käkölä, T. Back, B. (1995) Validity and Utility of Hyperknowledge – Based Financial Bechmarking System. *Proceedings of the 28th Annual Hawaii International Conference on System Sciences*, pp. 221-230.