

# To What Extent Does the Tacit Knowledge Embodied in a Technology Product Limit Its Electronic Commerce Potential?

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## Abstract

*This paper examines the question of whether the tacit knowledge embodied in technology products limits its electronic commerce potential. The paper describes the knowledge embodied in a technology product, and the transfer of that knowledge to the customer. In particular, the relationships between Internet users/customers and Internet applications are explored. Two related small-scale case studies about the purchase of a product over the Internet are presented. In the first case study the product is a computer operator's chair (assumed to incorporate tacit knowledge) and, in the second, a portable microcomputer (assumed to incorporate mostly explicit knowledge). Finally, a comparison is made between these cases. The comparison gives evidence that tacit knowledge limits commerce taking place over the Internet.*

**Keywords:** Buying activity, E-commerce, Explicit knowledge, Internet, Tacit knowledge, Technology product

**BRT Keywords:** GB, GC

## Introduction

One of the biggest challenges facing commercial activities over the coming years will be the development of web-enabled technologies. It is being claimed that as a new channel for commercial transactions, the use of electronic commerce (E-commerce) will open new sources of revenue and opportunities for organisations and individuals.

The US market for E-commerce was \$26 billion in 1996/7 and is expected to be \$330 billion by 2002, and \$1000 billion by 2005. It is also estimated that by the year 2005 about 15 percent of retail sales in the US will be conducted by E-commerce. This compares with a figure of 0.5 percent in 1996/7 (OECD, 1998).

But can E-commerce replace the traditional ways of doing business? Would it be possible some day to purchase most of our products via the Internet?

This paper explores human behaviour when a customer is buying technology products over the Internet. Basing our arguments on a literature study and two small-scale case studies, we will suggest that the knowledge embodied in technology products (quality and quantity) affects the extent to which the Internet can be used in technology product commerce.

## **Theoretical Framework**

### **Technological Knowledge**

Technology is specific knowledge needed to produce a product for a market (c.f. Waxlax, 1995, Vincenti, 1993). Vincenti (1993) divides technological knowledge into three categories: 1) descriptive, 2) prescriptive, and 3) tacit. Both descriptive and prescriptive knowledge are *explicit knowledge*. Descriptive knowledge describes things as they are in reality, whereas *prescriptive knowledge* prescribes what is to be done in order to reach a desired result. *Tacit knowledge* is implicit in human activity.

### **Descriptive Knowledge**

Descriptive knowledge implies factual statements about such matters as material properties, technical information, and tool characteristics. Descriptive knowledge is in close proximity to explicit knowledge since it describes things as they are; it can be in the form of rules, abstract concepts and general principles, and it often has a consistent and generalizable structure. (c.f. Vincenti, 1993, Nonaka et al., 1995, Herschbach, 1995)

### **Prescriptive Knowledge**

Prescriptive knowledge is based on efforts to gain a greater effectiveness, such as improved operations (c.f. Vincenti, 1993). The basis of prescriptive knowledge is often the experience obtained through trial and error. Because the basis of prescriptive knowledge consists of less scientific principles, and because it is an outgrowth of specific application, it is not easily codified in a general form. "The easier a knowledge is codified, the easier it can be transmitted," observes Perrin (1990, p. 6).

## **Tacit Knowledge**

Tacit knowledge is implicit, and it is largely the outcome of individual judgement, skill and practice, and it is possessed only by an individual (c.f. Polanyi, 1966, Johnson-Laird, 1987, Winter, 1987, Nonaka et al., 1995). Tacit knowledge cannot easily be expressed formally. Descriptions, diagrams, and metaphors help to explain tacit knowledge. Tacit knowledge results largely from an individual's experiences. Tacit knowledge often constitutes the "tricks of the trade," and it is also often protected or restricted knowledge (Vincenti, 1993). Specialists simply do not, and often cannot, reveal all they know. Tacit knowledge and prescriptive knowledge are closely related in practice since both deal with procedures.

Tacit knowledge is embedded in technological activity to a greater extent than is normally recognised (Herschbach, 1995). In addition, tacit knowledge has not disappeared with the use of more sophisticated ways of manufacturing based on the application of science and descriptive knowledge. "On the contrary, new forms of know-how have appeared and all these non-codified techniques play an important role both in industrial production and in technical and technological innovation" (Perrin, 1990, p. 6). Polanyi (1966) has demonstrated that all human action involves some form of tacit knowledge (c.f. Nonaka et al., 1995).

The distinction between tacit knowledge and explicit knowledge is not, however, clear but problematic. Polanyi (1969, p. 144) has pointed out that "these two are not sharply divided. While tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood and applied. Hence all knowledge is either tacit or rooted in tacit knowledge."

## **A Technology Product Embodied with Tacit Knowledge**

The design and manufacturing processes of a technology product often require the use of tacit knowledge, which prevents a company's competitors from copying the design and manufacturing methods of the product in question. For example, the surface treatment of a tap manufactured by a Finnish company is performed using skills that competitors are unable to discover precisely, for example, by means of re-engineering, and thus to describe it explicitly. There may also be tacit knowledge used in the manufacturing processes which is "hidden" in the product characteristics.

Furthermore, although no tacit knowledge may have been used in the designing and manufacturing a product, that product does, nevertheless, have characteristics based on tacit understanding. An example of this is visible in the research results by Heikkilä et al. (cf. Heikkilä et al. 1998). According to these results, the buyer of a book often wants to touch the book before buying it, and is therefore unable to come to a decision about the purchase solely on the basis of the descriptive knowledge obtainable via the Internet application. In this kind of situation it is the customer who seems to apply tacit knowledge in making the buying decision.

However, in this paper we define such products in the production of which there has been applied a decisive degree of tacit knowledge as "products embodying tacit knowledge."

*Proposition 1. A technology product, which embodies tacit knowledge, cannot be fully described by means of explicit (i.e. descriptive) knowledge. The result of this is that one cannot (always) make a decision to buy a product solely on the basis of knowledge obtainable via the Internet.*

## **Transfer of Technological Knowledge**

Literature dealing with strategic leadership considers the transfer of knowledge, in terms of media richness, as a determinant of the extent to which technological knowledge is successfully transferred. The richness of the media can be analysed in terms of two underlying dimensions: the variety of cues that the medium can convey and the rapidity of feedback that the medium can provide (Daft, et al., 1987, Trevino, 1987, Berger et al., 1966). Media have varying capacities for resolving ambiguity, meeting interpretation needs, and transferring knowledge, and they can be placed along a five-step continuum: 1) face-to-face, 2) telephone, 3) written personal, 4) written formal, and 5) numeric formal (Daft, et al., 1984). Because most of the Internet applications available on the market today are capable of conveying mainly explicit knowledge, they are therefore located in points 3), 4), and 5) of the continuum. However, future applications are likely to fulfil the requirements also of points 1) and 2) of the continuum.

## **The User and the Internet**

The relationship between a person (the decision-maker or the active computer user) and the computer based environment (the Internet) can be described by a philosophical model: the Holistic Concept of Man (HCM) (c.f. Vanharanta et. al., 1997; Rauhala, 1995).

HCM has three basic dimensions which describe the human actor: the body, the mind and the situation. These three dimensions define three modes of existence: 1) corporeality, or existence as an organism with an organic process (the body), 2) consciousness, or existence as a physic-mental phenomenon, as experiencing (the mind) and 3) situationality, or existence in relation to reality, i.e. the world or the environment (the situation).

The objective of applying the HCM model in this study is to cover the whole situation between the user and the computer application. The model takes into account, among other things, a person's professional skills, product know-how as well as the knowledge that an individual receives from and handles by the computer application.

The organic process of man (the body), partly influences how an individual handles and reacts to the knowledge. The brain, for example, as a part of the body, converts the knowledge that the individual sees on the web pages. By so doing, the body reacts to the knowledge on a "physical" level.

In this process of interaction between user and Internet application, also the consciousness is needed. The consciousness is "a mental tool", which connects the user to the Internet application. It is not possible for a person to perceive, understand and react to the knowledge on a computer display without that person's consciousness. The consciousness controls, selects and "makes" decisions about the things that the user sees

and watches on the display. Thus the consciousness plays a decisive role as and when a person reacts to the knowledge seen on the display. As and when a person looks at the things s/he perceives, the contents of the consciousness vary constantly (Baars, 1997).

Situationality means all of the relationships between the user (the body and the consciousness) and the objects in the user's situation, or in the "environment." It can be said that the body and the consciousness are the internal factors of the person and situationality the external. An example of the objects in the user's situationality is the "place" in which the user exists physically. In addition it contains all of the people and other objects and "things" with which the user has a relationship. An Internet application is a part of the user's situationality and it affects both the consciousness and the body, and therefore also the ways in which a person uses the Internet application.

*Proposition 2. The situation in which a person considers buying a product affects his decision to buy that product. The result of this is that the product characteristics (based also on tacit knowledge) do not always affect the buying decision of all the users in the same way.*

## **Absorptive Capacity of the User**

Badaracco (1991) claims that a human being cannot take advantage of new information unless he or she has earlier "social software" connected to that information. Also Cohen and Levinthal (1990), who have introduced the "absorptive capacity" concept, claim that man's capability for utilising new information in the solution of a problem depends largely on his earlier knowledge. In terms of the Holistic Concept of man, this earlier knowledge is called the "world-view," where all the previous understanding or knowledge is accumulated.

When people attempt to solve their problems, they are guided by the knowledge they have gained from earlier similar problems (Schultz, 1970). The fact that knowledge and know-how based on experience can be utilised in the purchasing of technology products is also supported by findings of cognitive psychology research (for example Ross, 1989). The results of these studies provide evidence for the important role of specific, previously experienced situations in the purchase of such products.

*Proposition 3. The user's absorptive capacity determines the possibilities and difficulties in making buying decisions related to products embodying tacit knowledge. The result of this is that the more a person has experience of products embodying tacit knowledge, the better that person is able to buy these products via the Internet.*

## **Research Context and Research Methodology**

### **Research Context**

Today there is an increasing tendency to buy and sell technology products utilising web-enabled technologies. During this study, trial purchases via the Internet were made of

two products that are assumed to embody quite different degrees of tacit knowledge (quality and quantity).

## **Research Methodology**

On the basis of the theoretical framework, the purchase of a technology product via the Internet can be seen as a knowledge intensive task, which can be approached in terms of the quality and quantity of the knowledge.

In the empirical part of the research, the case study method was used for gathering information with the objective of verifying and validating the three propositions stated above.

## **Case Studies and Comparison of Their Results**

In the case studies, students on the 1997 Industrial Management course at the Pori School of Technology and Economics made two trial purchases by means of Internet applications. In the first acquisition the object was a computer operator's chair which is assumed to embody much tacit knowledge that is difficult to transfer via Internet applications. The object of the second purchase was a portable microcomputer which is assumed to embody mainly explicit knowledge that can easily be transferred via Internet applications.

The case studies were limited to the technological knowledge embodied in both the product and the user. Thus, the studies did not extend to prices, delivery times, and other similar factors of the products. The buyers were individuals who were familiar with the use of Internet applications.

The purchases were primary acquisitions, i.e. the buyers had not bought corresponding products before. However, the products purchased were of the kind of which all the buyers had relatively much pre-understanding.

The buyers were given questionnaires on which they answered the following questions:

- 1) Did you receive sufficient information via of the Internet to make a purchase decision?
- 2) Did you easily understand the information that you received?
- 3) Would you buy the product by way of the Internet in an actual purchase situation?

The buyers returned the questionnaires either in an envelope or by e-mail. The forms were given to 23 buyers. Answers were received from 21, giving a return rate of 91 percent.

## Research Results

*Computer operator's chair (Table 1):* When the purchasers were asked if they had received sufficient information by way of the Internet to make a purchase decision regarding the chair, a clear majority (81%) said that they did not. All the information they needed was however explicit in nature, in other words information that could potentially be transferred from the seller to the buyer via the Internet.

When the buyers were asked if they understood the information that they had received by the Internet, the vast majority (90%) answered that they did. Those who did not understand said that the reason was a lack of preliminary knowledge about the product. The answers to this question tend to support proposition 3, according to which the “absorptive capacity” of the buyer effects (in this case limits) purchasing decisions.

When the buyers were asked if they would buy the chair via the Internet in a *real* purchase situation, a clear majority (90%) said that they would not. We suggest that the reason for this is the tacit knowledge embodied in the product. The buyers wanted to either sit in the chair or at least to see the chair “live” before making a purchase decision. The result suggests evidence for Proposition 1.

The situation in Proposition 2, according to which situationality or the purchase environment effects the decision, was not tested, largely due to lack of time for the study. One respondent did answer that s/he would not buy a chair via the Internet if required to use his/her own money. On the other hand if s/he were using company funds, s/he would buy the chair through the Internet. This is an example of the impact of the situationality of the user on his/her buying decision.

Table 1. The Results for Computer Operator's Chair.

<b>Sufficiency of Information</b>	<b>n</b>	<b>%</b>
Buyer received enough information from the Internet application	4	19
Buyer did not receive enough information from the Internet application	17	81
<b>Additional Information Wanted</b>	<b>n</b>	<b>%</b>
Technical details such as: materials, structure, cleaning, warranties, country of origin etc	27	96
The possibility of comparison with other chairs was lacking	1	4
<b>Understandability of Information Received</b>	<b>n</b>	<b>%</b>
The buyer easily understood the information	19	90
The buyer did not understand the information	2	10
<b>Problems in understanding caused by</b>	<b>n</b>	<b>%</b>
Insufficient pre-understanding on the buyer's part	21	100
<b>In a real situation, would you buy a chair via the Internet application?</b>	<b>n</b>	<b>%</b>
Yes	2	10
No	19	90
<b>Reasons for a negative decision</b>		
A chair needs to be sat on before purchase		83 %
A chair needs to be seen “live” before purchase		17 %

*Portable microcomputer (Table 2):* When the buyers were asked whether they received enough information via the Internet application to make a purchase decision, just over half (52%) said they did not. Additional information was wanted regarding technical specifications and warranties, as well as information on support and maintenance. All of this information is explicit in character and can potentially be delivered via the Internet application.

When the buyers were asked whether they understood the information easily, 52% reported that they did not. 55% of those who had difficulties in understanding said that the reason was lack of sufficient pre-understanding. One respondent said the problem was due to the fact that information was presented in English. The response to this question suggests support for Proposition 3 that the buyer's "absorptive capacity" effects (in this case strongly negatively) the making of a purchase decision.

Table 2. The Results for Portable Microcomputer

<b>Sufficiency of Information</b>	<b>n</b>	<b>%</b>
Buyer received enough information via the Internet application	10	48
Buyer did not receive enough information via the Internet application	11	52
<b>Additional Information Wanted</b>	<b>n</b>	<b>%</b>
Technical details, such as: Characteristics of the product, warranties, service and after-sales support	19	82
Salesperson's own opinion and guidance	2	18
<b>Understandability of Information Received</b>	<b>n</b>	<b>%</b>
Buyer easily understood the information	10	48
Buyer did not understand the information	11	52
<b>Problems in understanding caused by</b>	<b>n</b>	<b>%</b>
Insufficient pre-understanding of the product by the buyer	6	55
Lack of specific product information	2	18
Information presented unclear	2	18
Foreign language	1	9
<b>In a real situation, would you buy a computer via the Internet application?</b>	<b>n</b>	<b>%</b>
Yes	6	29
No	15	71
<b>Reasons for a negative decision</b>		<b>%</b>
Lack of pre-understanding about the product, therefore:		87
- Buyer wants an expert present at time of purchase	4%	
- Buyer wants to speak with a salesperson before purchase	29%	
- Buyer wants to hear the opinions of others before purchase	4%	
- Buyer wants to try out the machine before purchase	11%	
- Buyer wants more technical and market information before purchase	52%	
Buyer feels uneasy (no more specific clarification available)		10
Buyer opposed in principle to making purchase via the Internet application		3

When the buyers were asked whether they would *really* buy a computer via the Internet application, 71% of the respondents said that they would not. The majority of those who answered negatively (87%) gave as a reason that they did not have sufficient understanding of the specific product. A large proportion (37%) of the group in question



said that they would want to speak personally with a salesperson, have an “expert” along when the purchase decision was made, or desired to hear the opinions of others regarding the machine before they could make a decision to buy. 52% of the negative group separately mentioned an additional reason that they were not able to get enough technical specifics through the Internet application.

The case study of the microcomputer purchase tends to support Proposition 3, in other words the absorptive capacity of the buyer affects purchase decisions. 11% of the respondents who said that they would not buy a computer via the Internet application, gave as an additional reason that they wanted to try out the machine, particularly the keyboard, before buying. This result seems to indicate that a microcomputer also contains tacit knowledge that can not, not even potentially, be conveyed by the Internet applications.

### **Comparison Between the Case Studies**

On the basis of this study it may be assumed that the computer operator’s chair contains more tacit knowledge than does the microcomputer. This knowledge cannot be conveyed via the Internet. Another suggestion of the case study results is that the microcomputer contains much more explicit knowledge than does the chair.

The difficulty of conveying specific details is evident for both products. Regarding the chair, the purchase decision was difficult to make since almost every buyer wanted to at least sit in the chair before buying it. Regarding the microcomputer the purchase decision was made difficult because the buyers often felt that they did not have sufficient information about the product’s characteristics and therefore wanted to speak with an expert (often a salesperson) before coming to a decision.

### **Conclusions**

Tacit knowledge is a vague concept. Therefore, its significance in E-commerce can only be evaluated as far as its main features are concerned. The research results provide clear support for the proposition that electronic commerce can not displace the traditional ways of doing business. Products that contain tacit knowledge of factors such as comfort, ease of use etc. are difficult to sell via the Internet application. The tacit knowledge contained in technology products may significantly limit their Internet sales potential.

The Internet is an important extra source and channel of information in business. Its significance in business transactions as a source of added value comes, for example, in the selling of simple, standardised products as well as in situations where a buyer is seeking pre-purchase information.

### **Future Research**

Since electronic commerce is growing rapidly, research in the area is also prolific. However, the majority of this research is focused exclusively on technology and

software. Research focused on consumers and their relationship to electronic commerce is relatively sparse. There should be increased emphasis on research that deals with the information conveyed through the Internet and the interpretation of that information by consumers.

Since tacit knowledge is relatively new as a topic, and still quite nebulous an area of study, in the near future it will be necessary to increase our understanding of the notion of tacit knowledge. In the opinion of the authors of this study, another topic that concerns electronic commerce directly is the relationship of the user or the decision maker to the Internet since it is the *receiver* of information, not its sender that gives the information the relevant meaning.

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