

An Empirical Investigation of Intelligent Agents for E-Business Customer Relationship Management: A Knowledge Management Perspective

Weiquan Wang

MIS Division, Faculty of Commerce and Business Admin.
University of British Columbia
2053 Main Mall, Vancouver, BC, V6T1Z2, Canada
Phone: (604)822-2822, Fax: (604)822-0045
Email: wwang@commerce.ubc.ca

Izak Benbasat

MIS Division, Faculty of Commerce and Business Admin.
University of British Columbia
2053 Main Mall, Vancouver, BC, V6T1Z2, Canada
Phone: (604)822-8396, Fax: (604)822-0045
Email: benbasat@commerce.ubc.ca

Abstract:

Using a knowledge management perspective, this paper investigates new and efficient ways of applying intelligent agents to e-business customer relationship management. Intelligent agents, as well as knowledge-based systems or expert systems, as a branch of applied artificial intelligence not only predate the recent surge of interest in knowledge management, but also stand out as a well-established means for implementing certain aspects of knowledge management. Intelligent agent technologies make it easier to codify, store, share, and transfer certain kinds of knowledge. Based on the IS literature on explanations and decisional guidance for knowledge-based systems, this paper argues that transferring appropriate knowledge from an organization's staff to its partners and customers can facilitate efficient customer relationship management (e.g., improving customer trust). It is suggested that three types of knowledge – "How Explanations", "Why Explanations", and "Decisional Guidance" – be embedded in intelligent agents, and transferred to the agent's users. A laboratory experiment is proposed to test if, in which aspects, and to what extent these types of knowledge will increase customer trust.

Keywords

Intelligent agents, knowledge-based systems, e-business, customer relationship management, trust, trusting beliefs, trusting intention, knowledge management, how explanations, why explanations, decisional guidance, knowledge

1. Introduction

The transformation of organizations in the increasingly digital economy coincides with the ongoing synthesis of the two phenomena currently known as Knowledge Management and E-Business (Malhotra 2000). The demands of e-business for rapid response and agile adaptation to the market-place necessitate the knowledge sharing among not only intra-organizational staff but also partners and customers in new and more efficient ways (Denning 2000). Customers are looking for commitment, trust, and a sense of ownership for the outcomes of their dealings with an organization. They want to learn with every transaction in order to be more knowledgeable and self-reliant (Saint-Onge 1998). However, with the explosion of knowledge and information available on the Internet, consumers face information overload problems (Nwan, Rosenschein, Sandholm, Sierra, Maes, & Guttman 1998). Fortunately, due to advances in Web-based technologies, there are plenty of opportunities for well-developed artificial intelligence technologies to codify, store, and share certain kinds of knowledge in easier and more cost-effective ways through the Internet (e.g., Mao & Benbasat 2001, Tsui, Garner, & Staab 2000).

This paper aims at applying intelligent agent technology to knowledge management in the new era of e-business. With relevant knowledge embedded in them, intelligent agents can help buyers and sellers cope with information overload and expedite the stages of the online buying process (Maes, Guttman, & Moukas 1999). Then, what types of knowledge should be stored in intelligent agents and transferred to customers? How can these types of knowledge improve customer relationship management (e.g., increasing user trust)? This paper investigates these two questions through a laboratory experiment.

2. Literature Review

The ability to explain knowledge and reasoning, referred to as the explanation facility, is considered to be one of the most powerful components of KBS (Hayes-Roth & Jacobstein 1994). In general, we can identify two streams of studies in this area (see figure 1). One stream (e.g., Dhaliwal & Benbasat 1996, Gregor & Benbasat 1999) investigates knowledge related to system actions to make them more transparent to the users. Another stream of studies (e.g., Silver 1991, Limayem & DeSanctis 2000) focuses on delivering appropriate knowledge to guide the user to use the system.

2.1 Explanations in KBS

Adapted from Swartout and Smoliar (1987) and Chandrasekaran, Tanner, and Josephson (1989), four typical and frequently used kinds of explanations based on the contents of explanations are suggested by Gregor and Benbasat (1999): 1) line of reasoning, that explains why certain decisions were or were not made by reference to the data and rules used in a particular case; 2) justification, that justifies part of a reasoning process by linking it to the deep knowledge from which it was derived; 3) control or strategic, that explains the system's control behavior and problem solving strategy; and 4) terminological, that supplies definitional or terminological information.

To justify the use of explanations by KBS users several theoretical foundations have been suggested in the literature (e.g., Dhaliwal & Benbasat 1996, Gregor & Benbasat 1999). Results from empirical studies demonstrate that explanations, by virtue of transferring

knowledge to users that make systems more transparent, are influential in user acceptance of KBS and improving users' trust in the advice provided.

2.2 Decisional Guidance in KBS

Silver (1991) defined decisional guidance as "how a decision support system enlightens or sways its users as they structure and execute their decision-making processes – that is, as they choose among and use the system's functional capabilities." Results from several empirical studies (e.g. Limayem & DeSanctis 2000, Wilson & Zigurs 1999) provide supportive results to the consequences of decisional guidance.

Use of KBS needs the judgments and inputs from systems' users. Silver (1991) summarized different situations to apply decisional guidance. Among them, of our interest is the situation when providing relevant knowledge to facilitate users to decide what input values to use for a specific action.

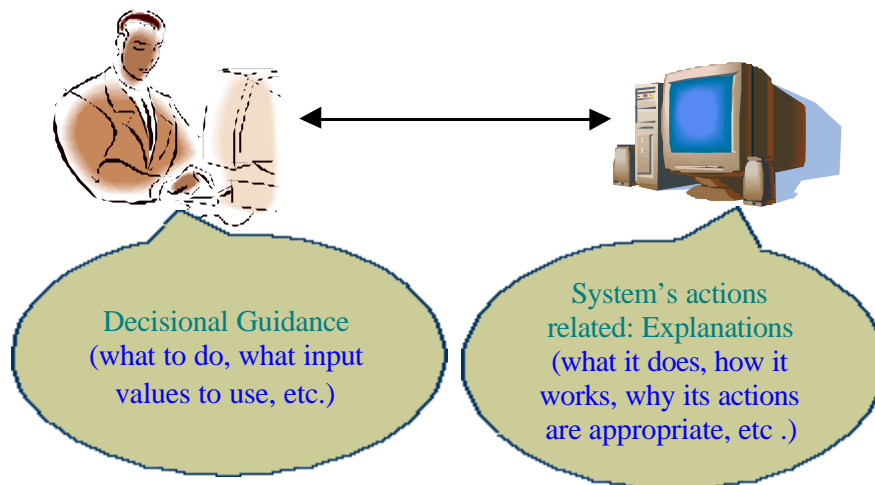


Figure 1 Explanations and Decisional Guidance in KBS

3. Knowledge Embedded in Intelligent Agents

Should same types of knowledge as those in traditional KBS be embedded in intelligent agents in e-business? This section discusses the uniqueness of intelligent agents for e-business. Then, three types of knowledge are identified.

3.1 Intelligent Agents for E-Business

Intelligent agents can be applied to e-business for various purposes. In this study, we focus on those agents that provide shopping advice based on users' needs and preferences elicited through an agent-user dialogue (an example is provided in figure 2).

Intelligent agents applied in e-business environments differ from traditional KBS in at least two aspects. First, there is an agency relationship between the agent and its users. An Internet-delivered agent application is not owned exclusively by one user or company. It is thus unclear if the way the agent operates benefits the user only, or if at the same time the agent provides recommendations that favor its provider (e.g., a particular merchant or

manufacturer). This agency relationship will lead to problems related to information asymmetry and opportunism (Bergen & Dutta 1992). Second, a high amount of discretion is granted to the agent by users. Users' inputs (i.e., their needs, uses, and preferences) are very flexible. They should be able to adjust their inputs during their interaction with the agent. This is different from traditional KBS, where the inputs (e.g., the financial data about a company) are normally fixed. These two issues direct our efforts in figuring out the types of knowledge that should be embedded in intelligent agents.

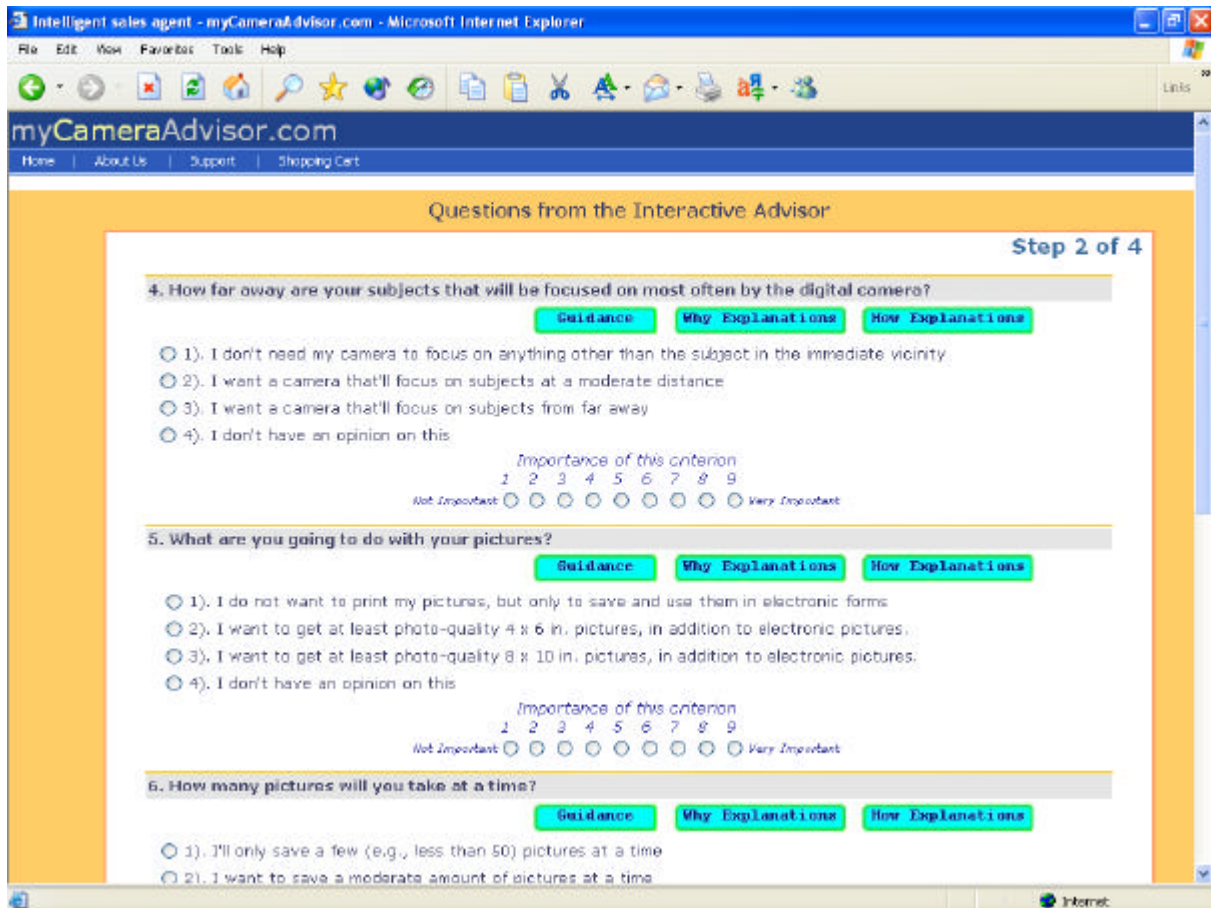


Figure 2 A Screen Shot of the Agent-User Dialogue from our Experimental Intelligent Agent

3.2 Three Types of Knowledge

An intelligent agent will transfer or convey its knowledge and expertise using its explanation facilities. In line with the explanation literature, we suggest that three kinds of knowledge be embedded in intelligent agents – How Explanations, Why Explanations, and Decisional Guidance. How explanations reveal the line of reasoning used by the agent based on users' needs and preferences, and detail the logical process to reach the final recommendations. Why explanations: i) justify the importance and purpose of an agent's questions to users to gather their inputs, and, ii) provide justifications for the recommendations, after the consultation is complete. Decisional guidance refers to the knowledge about the potential constraints brought by different choices for a question (e.g., about product features), and about how to adjust a user's needs and preferences accordingly.

3.3 Explanations and Knowledge Management

Referring to figure 1, explanations and decisional guidance serve two goals of knowledge management. First, “why” and “how” explanations facilitate the flow of knowledge from the intelligent agent to its users. This knowledge improves users’ understanding of the agent, and hopefully trust; furthermore, it improves users’ knowledge of the particular domain in which the agent is an expert in, e.g., digital cameras. Second, the flow of knowledge in the form of decisional guidance from the agent to users improves the way that users convey their needs and preferences (a form of knowledge) to the agent; as a consequence the recommendations and advice that users receive from the agent (a form of knowledge) fits the particular needs and goals of users much better.

4. Research Framework

4.1 Dependent Variables

We choose trust as our dependent variable for two reasons. First, many researchers have noted that the most significant barrier to realizing the potential of e-business is the lack of customer trust (Urban, Sultan, & Qualls 2000). Second, previous studies (e.g., Dhaliwal & Benbasat 1996) used some surrogate variables for trust since no valid and reliable measurement instruments for trust were available at that time.

As a complex and multidimensional concept (Ganesan 1994), trust has received a great deal of attention over the years (Gefen & Straub 1999). McKnight, Cummings, and Chervany (1998) proposed that the concept of trust fits the definition of homonymy, which means that one label encompasses more than one concept (Smith 1990). They defined trust to mean that one believes in, and is willing to depend on, another party. This high level trust concept can be broken into two constructs: (1) trusting intention, meaning that one is willing to depend on another party in a given situation, and (2) trusting beliefs, meaning that one believes the trusting object is benevolent, competent, honest, or predictable. Regarding trusting beliefs, Mayer and Davis (1995) proposed three main components: ability/competence, benevolence, and integrity.

4.2 Hypotheses Development

Similar to the KBS, since users are to remain responsible for the decision made, they will not accept advice and recommendations from the intelligent agent based on the reasoning they do not understand (Hollnagel 1987). Essentially, the how explanations are bridging what buyers know, namely their needs, intended use, preferences and so forth, and what they need to know, namely the product attributes that fits their needs, uses, and preferences. They demonstrate the set of knowledge (skills, competencies, and expertise) that enable the agent to make recommendations. Therefore, we hypothesize that

H1: Use of how explanations will improve users’ competence belief in an intelligent agent.

“Why” explanations indicate the agent’s goodwill towards users in its motivation. Due to the agency relationship, users of the agent may have concerns on whether the agent works for users or works for the provider - the online store, and whether the agent put the users’ interest first or only have egocentric interests. “Why” explanations can release users from these

concerns by showing their purposes of meeting the needs of users and satisfying user's interests and preferences. Therefore, we hypothesize that

H2: Use of why explanations will improve users' benevolence belief in an intelligent agent.

Given the high discretion in deciding their inputs and the very large volume of information on the Internet, users may have difficulties in adjusting and explaining their needs since they may not have corresponding knowledge. Decisional guidance provides objective knowledge regarding the potential constraints brought by different choices for a question. Using the decisional guidance, users will not only feel the usefulness of products, but also be exposed to the potential costs of a choice. The objectivity and honesty of the agent can be signaled out through the decisional guidance. Therefore, we hypothesize that

H3: Use of decisional guidance will improve users' integrity belief in an intelligent agent.

Trust literature and empirical studies (e.g., Lee & Turban 2001) show that these trusting beliefs are antecedents of trusting intention. Therefore, we hypothesize that

H4 (a, b, c): Users' ability (a), benevolence (b), and integrity (c) belief of an intelligent agent will positively affect their trusting intention.

Based on the above analyses and hypotheses, figure 3 shows our research model.

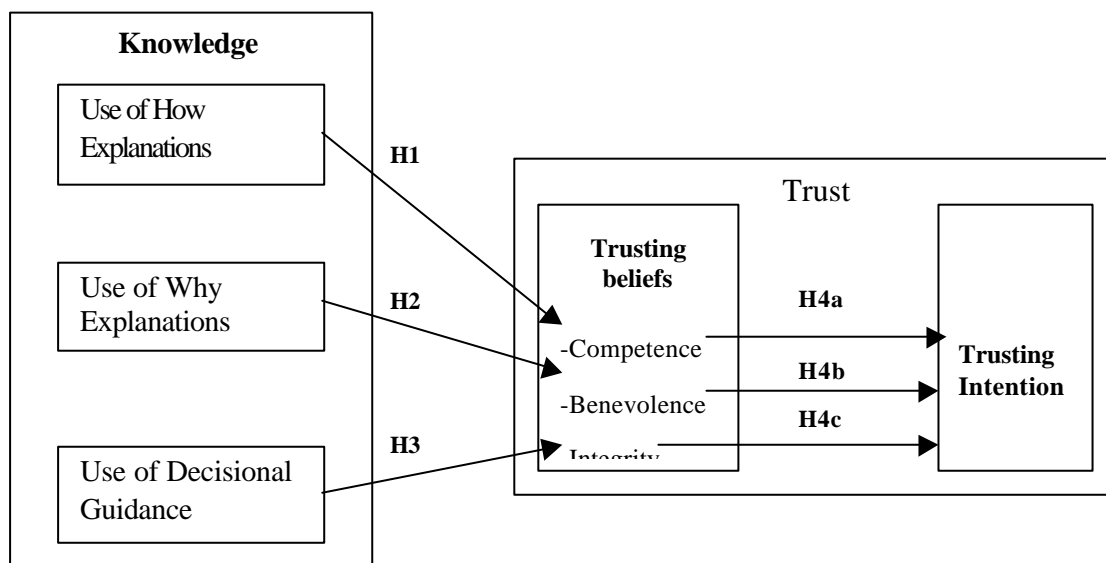


Figure 3 Research Model

5. Methodology, Preliminary Results, and Current Status

A laboratory experiment with a 2 (Decisional Guidance: with or without) X 2 (How Explanations: with or without) X 2 (Why Explanations: with or without) full factorial design will be conducted to test the hypotheses. The experiment utilizes a Web site with an intelligent agent created specifically for this research. Subjects are asked to get recommendations for two hypothetical tasks. A questionnaire is delivered to the subjects to capture their trusting beliefs and trusting intentions when both tasks are finished. Instruments

are drawn from and validated by Xiao and Benbasat (2002). Data will be analyzed using Partial Least Squares (PLS) and ANOVA to test our hypotheses and model.

To date, we have developed the research web site as the experimental platform. Validation has been carried out to test our explanations and decisional guidance to ensure their definitional accuracy. Pilot test have been completed and preliminary data analysis provided some support for our hypotheses. Use of “how”, “why” explanations, and decisional guidance increases users’ competence, benevolence, and integrity beliefs in the agent, respectively. Surprisingly, we also found that use of how explanations increases the benevolence belief significantly. The main experiment will be conducted in winter 2002 and the full set of results will be reported at ECIS 2003.

6. Conclusions

Applying intelligent agent technologies to knowledge management may provide competitive advantages for companies in the knowledge era. From a practical standpoint, the results of this study will help shed light on the way that companies may attempt to deliver appropriate knowledge to their customers for effective customer relationship management. From an academic point of view, this study will contribute to the literature on trust building processes in intelligent agent by examining how different types of knowledge influence different components of user trust.

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