

# Web Personalization to Build Trust in E-Commerce: A Design Science Approach

Choon Ling Sia, Yani Shi, Jiaqi Yan, Huaping Chen

**Abstract**—With the development of the Internet, E-commerce is growing at an exponential rate, and lots of online stores are built up to sell their goods online. A major factor influencing the successful adoption of E-commerce is consumer's trust. For new or unknown Internet business, consumers' lack of trust has been cited as a major barrier to its proliferation. As web sites provide key interface for consumer use of E-Commerce, we investigate the design of web site to build trust in E-Commerce from a design science approach. A conceptual model is proposed in this paper to describe the ontology of online transaction and human-computer interaction. Based on this conceptual model, we provide a personalized webpage design approach using Bayesian networks learning method. Experimental evaluation are designed to show the effectiveness of web personalization in improving consumer's trust in new or unknown online store.

**Keywords**—Trust, Web site design, Human-Computer Interaction, E-Commerce, Design science, Bayesian network.

## I. INTRODUCTION

WITH the development of the Internet, E-Commerce is growing at an exponential rate, which offers great opportunities for businesses to significantly improve the way they interact with their customers. Increasingly, more and more online stores are built to sell products or services online.

Trust is an important element for the successful adoption of E-Commerce [1]. Because of a deep-seated human need to understand the social surroundings, online stores, especially new or unknown online stores, are perceived to contain an element of risk, which is a major barrier to be trusted. Studies have provided evidence that trust in an online store is built through a belief that the vendor is unlikely to engage in cheating, a belief that there are safety mechanisms built into the website, and by having a typical interface [2].

The website provides the key interface for consumers' use of E-Commerce. Previous empirical researches have revealed that

different website design strategies have different levels of effectiveness to build trust [3, 4]. In this paper, we investigate the design of website to build trust in E-Commerce from a design science approach [5]. We propose a web personalization approach using Bayesian networks learning method. Via web personalization, the web pages which consumers are browsing will be personalized to the specific consumer from the analysis of the user's navigational behavior in correlation with other information collected in the Web context, namely, structure, content, and user profile data. Empirical experiment will be carried out to evaluate this web personalization approach in improving consumer's trust in E-commerce.

The rest of this paper is arranged as follows. Section 2 introduces the theoretical background of trust building in E-Commerce. The investigation of personalized website design will be introduced in Section 3, within a design science framework. In Section 4, we propose a conceptual model to describe the ontology, based on which a personalized webpage design approach is proposed. The design of experimental evaluation is given in Section 5. We conclude with contributions in the last section.

## II. TRUST BUILDING IN E-COMMERCE

Trust refers to a consumer's perception that an Internet store can be relied upon and will deliver the promised products/services, despite the exposure to loss during an Internet shopping transaction [6] [7] [8]. Trust in Internet shopping is a fundamental theme in both academic research and practitioner activities [4] [8]. Factors that may influence online shopping behaviors have been identified based on Theory of Reasoned Action, Technology Acceptance Model, etc [6] [8] [9]. Practitioners have also been exploring web strategies to build consumers' trust in websites, such as third-party seals of approval, website endorsement by third parties such as portals, satisfied peer customer endorsements, among others (Cheskin Research and Studio Archetype/Sapient, 1999).

For a new/unknown online store, trust can be built through reputation categorization (e.g., associating with a reputation brand), unit grouping (e.g., extent of common characteristics shared between trustor and trustee), and institutional assurances (guarantees, rules and legal resources) [9]. Online stores that employ these three strategies are likely to increase the potential consumers' initial trust [4] [7] [9].

While much of previous literature on Internet trust assumes that trust is built uniformly, researchers have begun to question

C. L. Sia is with the Department of Information Systems, City University of Hong Kong, Kowloon, Hong Kong (e-mail: iscl@cityu.edu.hk).

Y. Shi is with the School of Management, University of Science and Technology of China, Hefei, China. She is also with the Department of Information Systems, City University of Hong Kong, Kowloon, Hong Kong (e-mail: ynshi@mail.ustc.edu.cn).

J. Yan is with the School of Management, University of Science and Technology of China, Hefei, China. He is also with the Department of Information Systems, City University of Hong Kong, Kowloon, Hong Kong (e-mail: jqyan@ustc.edu).

H. Chen is with the School of Management, University of Science and Technology of China, Hefei, China. (e-mail: hpchen@cityu.edu.hk)

its appropriateness by arguing that trust could be formed differently in different cultures [3] [10]. One pioneering study on Internet-based trust building across cultures has reported that different web strategies have different levels of effectiveness to build trust in people of different cultures [3]. In collectivistic cultures like Hong Kong, in-group members involving peers are more effective than out-group members [3]. In their follow-up study, local peers (in-group) were also more effective than firm affiliation. It is suggested that one-design-fit-all strategy in designing websites to build trust is not necessarily the most cost-effective for organizations. Specific web strategies should depend on the extent that they appeal to the specific cultural traits.

Rooted in social identity theory [11], In-group versus out-group categorizations explains why people identify with members of their social groups, share their attitudes, and behave more favorably towards members of the group, compared to people not in the social group. Trust can be more effectively built through unit grouping by presenting common characteristics shared between trustor and trustee [3]. Such ingrouping strategies could alter people's perceptions of others from out-group members to in-group members by appealing to social identity and ties of the individual [11].

### III. RESEARCH FRAMEWORK OF WEB PERSONALIZATION

Web personalization is the process of semi-automatically customizing a Web site to the needs of a specific user, taking advantage of the knowledge acquired from the analysis of the user's navigational behavior (usage data) in correlation with other information collected in the Web context, namely, structure, content, and user profile data [12]. As a means of "mass customization", vendors can personalize their online store for individual customers on a massive scale [13]. In this section, we propose a research framework of web personalization for trust building in E-Commerce via the design science approach.

Design science approach addresses research through the building and evaluation of artifacts designed to meet the identified business need [5]. Design science has its roots in engineering and the sciences of the artifact, the key concept of which is the IT artifact. As in this research, the IT artifact is a Bayesian network supported approach of web personalization. As shown in Fig.1, the research framework is composed by a build-and-evaluate loop. Bayesian Network Supported Web Personalization (BNSWP) approach is built to address the trust building needs in E-Commerce which is composed of consumer, vendor, and online store. The BNSWP is evaluated with respect to the utility provided in improving the trust in E-Commerce. Theoretical background of trust building and web design strategies provide guidance on how to design the website to improve trust via web site design, while experimental design methodology provide guidelines in evaluating the utility of the approach.

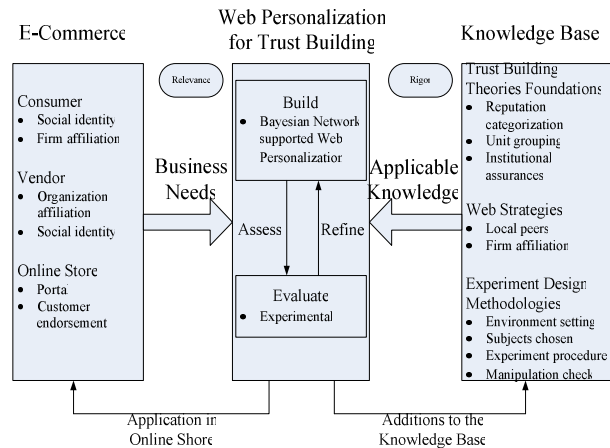


Fig. 1 Research framework

As we can see from the Fig.1, the research is composed by a build-and-evaluate loop. The build process is a sequence of activities that produce the web site design approaches, while the evaluation process provides feedback information and a better understanding of the problem in order to improve both the quality of the product and the design process. The build-and-evaluate loop is typically iterating a number of times before the final design artifact is generated. In the next sections, we will introduce the build and evaluate process respectively.

### IV. PERSONALIZED WEB SITE DESIGN

As stated above, the build process is in the context of E-Commerce environment, stimulated by needs for trust building, and guided by trust building theory foundation. In this section, we will first analyze the ontology of E-Commerce environment, and present the guidelines derived from trust building theories. The BNSWP will then be presented to resolve the business needs.

#### A. Ontology

Ontology refers to the shared understanding of some domain of interest which can be used as a unifying framework to represent selected phenomena [14]. The ontology of E-Commerce is proposed to analyze the E-Commerce environment.

Fig.2 is a conceptual model that partially represents the ontology, including the entities and their relationships in E-Commerce. As shown in the picture, the online store has several components, such as portal, reviews, comments, and news. The product is presented in the online store with its detailed information. Customer navigates the online store website, buys products and makes comments.

This ontology provides the instrument to analyze the component of an online store and its relationship with other entities, which is a foundation for web personalization to build trust.

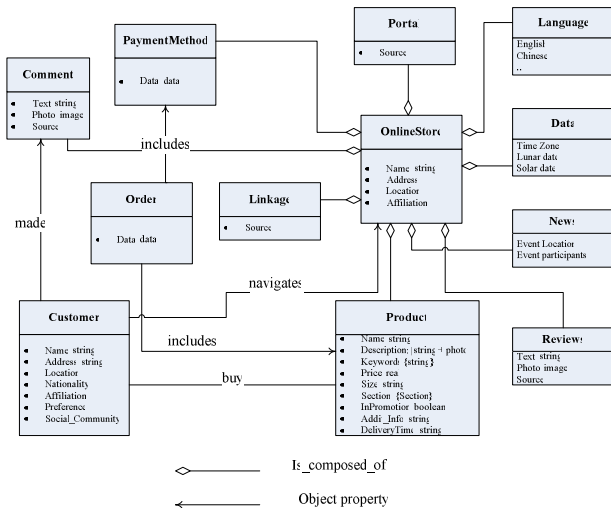


Fig. 2. Conceptual model of E-Commerce

### B. Design Guidelines

Our design process is guided by the theoretical foundation of trust building and web design strategy.

When facing a new online store, consumers would perceive it as an out-group firm rather than an in-group firm. An in-group refers to a social group that an individual perceives to be a member of, and which the individual feels more close to, compared to members of the out-group. In-groups could be classified into specific in-groups and generalized in-groups. Specific in-groups have the feature of common-bond, such as family, relatives, and friends while generalized in-groups share common identity, such as large group memberships [15].

To build trust for such out-group firm, in-grouping strategies should be employed. According to Social Identity Theory, the effectiveness of in-grouping strategies to build trust is contingent upon the psychological distance felt and the extent of social similarity between the potential consumer and the trustee [11]. As a result, common-bond in-group members are likely to be psychologically closest to consumers followed by common-identity members, followed by local firms or icon/elements.

Guideline 1: Linking out-group firm with local firms (collaboration with local companies and local institutional assurances, etc.).

Guideline 2: Linking out-group firm with local elements/icons (local information, news, etc.).

Guideline 3: Linking out-group firm with local common-identity peers (use social network fans recommendations, bloggers' discussion).

Guideline 4: Linking out-group firm with local common-bond peers (friends' recommendations and discussion about the firm).

Guideline 5: Linking out-group peer with local common-identity peers (peers with local experience).

Guideline 6: Linking out-group peer with local common-bond peers (peers recommended by friends, or common friends' on the social network site).

### C. Bayesian Network Supported Web Personalization

To customize the content and structure of online store website to the specific consumer, a series of steps should be included: (a) the collection of Web data and user data, (b) the modeling and categorization of these data, (c) the analysis of the collected data, and (d) the determination of the web site content to the specific user.

Fig.3 shows the module of web personalization, which reflects the above steps. We use the ontology of E-Commerce to categorize the user data and Web data. The user data are collected via web usage mining from the specific user's information, including his/her browsing history, usage logs, IP address, operation system version, and his/her user profiles. From the ontology based categories, the specific consumer can be categorized from culture, nationality, preferred language, location, affiliation, social network community, and preference.

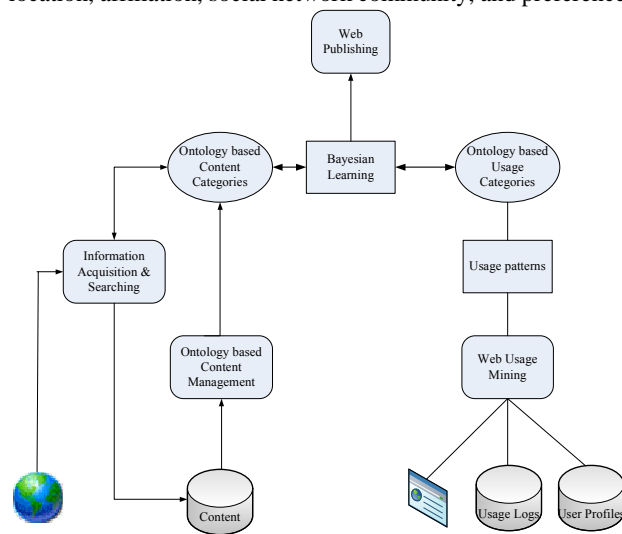


Fig. 3 Module of Web personalization

Bayesian network learning approach is used to analyze the relation between usage data and content data, and determine the published content. The Bayesian network approach is adopted from [16], which sets up a linkage between the relational databases and probabilistic reasoning models. As shown in Fig.4, the Bayesian network analyses the usage data to infer the social group information such as interest, location, ethnicity, social group, according to which the web publishing contents will be published. From this approach, the online store information will be represented as a form of in-group with the specific consumer.

Taking advantage of BNSWP, the website content of online store will automatically be customized to the specific consumer browsing it. BNSWP is expected to improve the consumer's trust in E-Commerce, because of its in-group information display on the website. We will introduce the evaluation method for BNSWP in the next section.



Fig. 4 Bayesian network structure

## V. EVALUATION DESIGN

In order to realize a website in support of personalized trust-building, an appropriate evaluation method should be employed to address the effectiveness of web personalization in building trust. In this section, a laboratory experiment will be designed to investigate the performance of the proposed personalized website and its impact on trust building in Internet shopping. The performance of two websites will be compared, one online store with personalized features and another without personalized features in trust building.

### A. Propositions

Based on the theoretical background of this research, we expect that the personalized website would promote higher effectiveness in trust building than the un-personalized one:

Proposition: Subjects browsing the personalized website will have a higher trusting belief toward the online store than subjects browsing the un-personalized website.

### B. Experimental Design

In the experiment, subjects will be asked to buy a book from an online bookstore that is unfamiliar to them. Technology support will be manipulated (personalized website versus un-personalized website). Dependent variable is trusting beliefs, attitude towards the bookstore and intention to buy. Items measuring trusting beliefs, attitude, and buying intention will be adapted to the context of this bookstore from previous research. Controlled variables include participant characteristics (through randomization), and time available for the task.

### C. Experimental Procedures

The experiment will be held in a computer laboratory and each experiment setting will have 20 subjects. It will comprise 5 minutes for briefing, 20 minutes for experiment, and 10 minutes for answering a questionnaire involving manipulation check, control questions and probing questions.

### D. Manipulation Check and Control check

Questions for manipulation check are used to determine the success of the technology support (personalized or not). Control check questions of demographic details include the extent of Internet usage, Internet experience, Internet shopping experience and gender. Probing questions are used to assess the underlying factors influencing trust building in the subjects.

## VI. CONCLUSION

Trust is critical for the success of Internet shopping and different trust-building strategies have different effectiveness. In this paper, we propose a web personalization approach to build trust in E-Commerce from a design science perspective. Based on trust building related theories and by using Bayesian networks learning method, the web page that a consumer browse will be personalized according to the analysis of specific consumer's profile data, navigational behavior, etc. An experiment will be conducted to evaluate the effectiveness of the proposed approach in building trust of Internet shopping. This study would not only contribute to the literature of trust building and web personalization, but also provide guidelines for E-Commerce practitioners.

## ACKNOWLEDGEMENT

The work described in this paper was partially supported by a grant from the City University of Hong Kong Strategic Research Grant [Project No. CityU 7002345].

## REFERENCES

- [1] F. F. Reichheld and P. Scheffer "E-loyalty: Your secret weapon on the Web," *Harvard Business Review* (78:4), 2000, pp. 105-113.
- [2] D. Gefen, E. Karahanna, and D. W. Straub, "Trust and TAM in online shopping: An integrated model," *MIS Quarterly*, Mar 2003, vol.27, issue 1, p51-90.
- [3] C. L. Sia, K. H. Lim, K. Leung, M. K. O. Lee, W. W. Huang, I. Benbasat "Web Strategies to promote internet shopping: Is cultural-customization needed?" *MIS Quarterly*, 2009, vol. 33, no.3, pp. 491-512.
- [4] K. H. Lim, C. L. Sia, M. K. O. Lee, and I. Benbasat. "Do I trust you online, and if so, will I buy? An empirical study of two trust-building strategies." *Journal of Management Information Systems*, 2006, vol. 23, no.2, pp. 233-266.
- [5] A. R. Hevner, S. T. March, J. Park, S. Ram. "Design science in information systems research," *MIS Quarterly*, 2004, vol. 28, no.1, pp. 75-105
- [6] D. Gefen "E-commerce: the role of familiarity and trust." *Omega*, 2000, vol.28, no.6, pp. 725-737.
- [7] D. H. McKnight, L. Cummings, N. L. Chervany, "Developing and validating trust measures for e-commerce: An integrative typology." *Information Systems Research*, 2002, vol. 13, no.3, pp. 334-359.
- [8] D. Gefen, E. Karahanna, D. W. Straub "Trust and TAM in online shopping: An integrated model." *MIS Quarterly*, 2003, vol. 27, no.1, pp. 51-90.

- [9] D. H. McKnight, L. L. Cumming, and N. L. Chervany "Initial trust formation in new organizational relationships," *Academy of Management Review*, 1998, vol.23, no.3, pp.473-490
- [10] D. Gefen and T. Heart "On the need to include national culture as a central issue in e-commerce trust beliefs," *Journal of global information management*, 2006, vol.14, no.4, pp. 1-30.
- [11] H. Tajfel and J. C. Turner "An integrative theory of intergroup conflict" In W. G. Austin & S. Worchel (Eds.), *The Social Psychology of Intergroup Relations*. Monterey, CA: Brooks-Cole, 1979.
- [12] M. Eirinaki and M. Vazirgiannis, "Web mining for web personalization", *ACM Transactions on Internet Technology*, vol.3, no.1, pp.1-27, 2003
- [13] B. Mobasher, R. Cooley and J. Srivastava, "Automatic personalization based on web usage mining," *Communication of ACM*, August 2000, vol.43, no.8, pp.142-151.
- [14] M. Uschold and M. Gruninger, "Ontologies: Principles, methods and applications" *Knowledge Engineering Review*, 1996. Vol.11, no.2, p. 93-136.
- [15] D. A. Prentice, D. T. Miller, and J. R. Lightdale, J. R. "Asymmetries in attachments to groups and to their members: Distinguishing between common-bond and common-interest groups," *Personality and Social Psychology Bulletin*, vol.20, pp. 484-493
- [16] S. S. Liao, H. Q. Wang, Q. D. Li, and W. Y. Liu, "A Functional-Dependencies-Based Bayesian Networks Learning Method and its Application in a Mobile Commerce System," *IEEE Transactions on Systems, Man, and Cybernetics – Part B: Cybernetics*, vol.36, no.3, June 2006, pp. 660-671.