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Echo Huang

National Kaohsiung First University of Science and Technology

Karen Hsu

National Kaohsiung First University of Science and Technology

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THE INVESTIGATION OF TAIWAN B2C FIRM WEB MINING ADOPTION

Echo Huang and Karen Hsu

Department of Information Management
National Kaohsiung First University of
Science and Technology

echoh@ccms.nkfust.edu.tw

karenhsu@ccms.nkfust.edu.tw

Abstract

Datamining has been widely used in retailing for several years. In previous theoretical work on information systems IS adoption, the question of whether classical diffusion variables determine the organizational adoption of IS with internal and external factors are still confused. Web mining adoption impose a high knowledge burden or high user interdependencies and the primary determinant of adoption is the organization's ability to adopt.

The basic proposition of this study is that this varying importance of factors may be related to the stage of adoption. The finding shows that internal factors, which are sufficient to explain the adoption of web mining. The perceived technological benefits associated with competitive pressure are important factors considered by managers and its effect is positive.

Keywords: B2C, electronic commerce, Web mining, organizational innovation

Introduction

The fade of Electronic Commerce is declined gradually, more and more B2C players left web without any notices. Obviously, B2C firms face two major challenges, as traditional industry does. The first challenge is to survive and prosper. Therefore, they become faster learner, more customer-oriented and conscious of cost than they have ever been before. Technology deployment has been one of the ways to increase business competitiveness, especially in information-intensive industry. Businesses are realizing that to stay competitive, they have to become more responsive to their customers, using IT to keep them satisfied and loyal. Companies are luring new customers and holding onto existing ones through a variety of IT endeavors, including E-business ventures and other Internet initiatives that provide more purchasing and customer service options, data warehouses and knowledge-management projects that form the historical base from which to draw and analyze information on customer preferences and activities, and customer-relationship management systems that provide analysis about what customers want and need. In the past 3 years, many firms have started using data mining to conduct the e-tailing markets' customer behaviors.

The second challenge to B2C business today is complexity. Markets and competitive structures have grown increasingly complicated and volatile. Companies had trouble dealing with these challenge because its data was fragmented. Data generated by different systems was stored in separate, difficult-to-access databases. It was thus difficult to retrieve data for analytical purposes, and it was even more difficult to obtain a logical view of the broader processes by which the company interacted with agents, customers, and service providers. This fragmentation had contributed to major business inefficiencies. In addition, the company's ability to detect and quantify problems, let alone respond to them, was minimal. Similarly, potential synergies between different product lines were not being exploited. In addition, the company operated in many different markets, each with its own regulatory environment that required extensive information for effective policy planning and management.

However, research has focused on application development (Jui & Jha, 2000; Changchien & Liu, 2001; Ha & Park, 1998) and there has been little or no attempt to relate datamining to strategic issues that affect the whole process of datamining deployment; this

is probably because datamining were new to industries. The adoption and diffusion of innovative technologies have remained critical concerns in information systems research. With the recent advent of data mining and electronic commerce, issues in IT deployment have become even more crucial.

A review of past IT technology literature indicates that past studies have focused mainly on large businesses. This is understandable, as IT has been the privilege of large businesses because of the huge investment involved in the past. SMEs are the backbone of the Taiwan economy, especially in B2C industry. Despite the fact that SMEs represent such an important sector of the economy, few studies have been done on IT adoption by SMEs. The proliferation of web mining has been so rapid that several practitioners have hailed this information technology as the next significant paradigm.

Past studies have revealed many reasons why an organization should adopt datamining including improved customer service Hue & Jha, 2000, built long-term customer relationship, reduced marketing cost, and increased sales. While there are substantive reasons why organizations should adopt datamining, they do not explain why some organizations adopt earlier than others, and why others may never adopt the innovation. Adopting research focuses on understanding the conditions under which an organization responds to changes in its environment in adopting or not adopting an innovation, even after a considerable period of time.

This study attempts to alleviate these concerns. This study views data mining technologies as innovations and examines the factors facilitating their initiation, adoption, and implementation. The two sets of contextual factors investigated in this study are internal and external; all provide the context for organizational adoption.

Using data from a national-wide survey, the impact of EC internal and external characteristics on the initiation and adoption of web mining were examined. This empirical study of 68 EC firms in various stages of adoption. A research model is proposed and tested. The theory behind the model is discussed in the following section. Much of this is based on innovation literature. The model and variables are then discussed, followed by sections describing methodology and results.

Research Model and Hypotheses

Organizational Innovation

An innovation is any idea, practice or object that is perceived as new by the adopter. The innovation adoption/diffusion literature examines the various factors that influence the adoption of innovation, the characteristics of the adopters, the process of adoption decision-making and the diffusion of innovation in the population. Rogers (1995) argued that the diffusion process usually starts out slowly, but takes off rapidly after an initial period. Zmud (1984) provided a demand pull theory to explain how the innovation can be used to overcome the existing performance deficiencies or exploit new opportunities.

Attewell (1992) categorized adoption/diffusion researches in IS areas into two styles: adopter studies and macro diffusion studies. The former primarily addresses understanding differences in adopter innovativeness, while the latter deals with characterizing the rate and pattern of adoptions of a technology across a group of potential adopters. Subramanina & Nilakanta 1996 in their review of innovation adoption research identified two major categories: innovation process and innovation variance. The former is concerned with

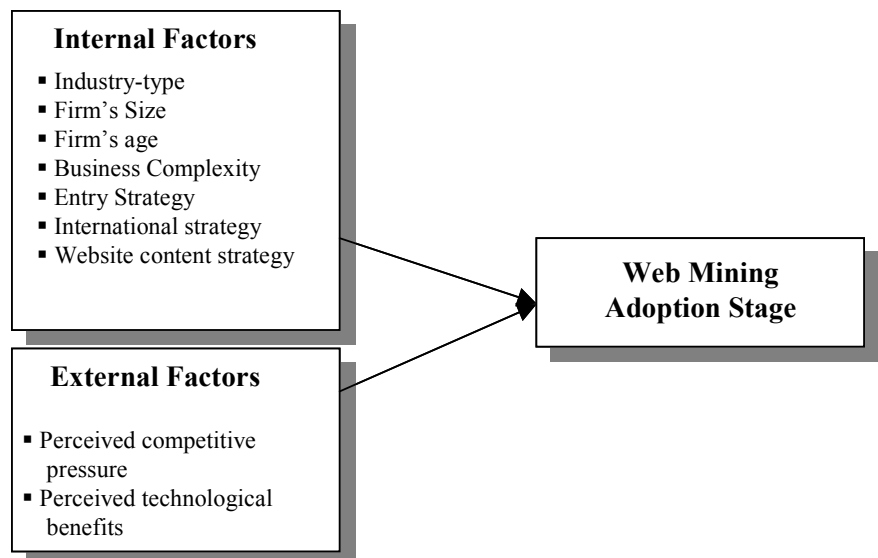


Figure 1. Research Model

examining the process of adoption of an innovation, while the latter deals with the association between innovativeness, their external environment, and their organizational performance.

Fichman 1992 proposed that IS innovation are of two types. Type I innovations impose a low knowledge burden and/or few new user interdependencies and the primary determinant of adoption is the organization's willingness to adopt. Type II innovations impose a high knowledge burden or high user interdependencies and the primary determinant of adoption is the organization's ability to adopt. Swanson 1994 classified IS innovation in an organization into three types: innovations affected mainly the organization's IS processes, innovations affected the business and IS processes in the organization, and innovations additionally affected the actual products made by the organization, as well as integration with other businesses. Web mining adoption is similar to Fichman Type II model and Swanson Type II and Type III.

Based on previous research, there appears to be a growing consensus among researchers that IS innovations in an organization are different from other innovations Fichman, 1992; Swanson, 1994. Modified the previous studies, we propose a research model illustrated in Fig. 1. This study investigates which factors occupy the decision models of senior managers when considering new technology, market pressure, and whether there is a pattern across organizations with different size, age, business, strategies of these factors. It describes the impact of two sets of antecedent factors on the adoption of web mining in Taiwan B2C firms. The external characteristics considered are perceived competitive pressure and perceive technological benefits; the organizational characteristics are industry type, size, age, degree of business complexity, internet entry strategy, international strategy, and website content strategy.

Factors Affecting the Web Mining Adoption

In planning for IT change, managers consider external and internal forces. Kwon and Zmud 1987 proposed five factors influencing adoption, which are innovation, organizational, environmental, task and individual characteristics. Tornatzky and Klein 1982 concluded four innovation characteristics influence adoption, which are relative advantage, compatibility and complexity. Yang 1999 proposed four external variables influence CASE tools adoption in Taiwan, which are personal, organizational, IS department, and system development variables. We consider nine contextual factors that may affect web mining adoption.

Internal Factors

Large companies can more easily absorb the risks and costs of implementing web-mining Chengalur-Smith & Duchesi, 1999. Research in IT adoption identifies many organizational factors that influence the adoption Premkumar & Roberts, 1999. They are top management support, size, and IT expertise. Thong & Yap(1995) found that the use of IT in small business was influenced by the size of business and CEO characteristics. Hence, it is positively associated with adoption Lind et al., 1989; Thong and Yap, 1995.

H1b: The size of a company influences the adoption for web mining.

Koberg, et al.(1996) proposed life-cycle stage is an important facilitators of organizational innovation. Thus, we state the hypotheses as following:

H1c: The age of a company influences the a option for web mining.

Complexity is the degree of difficulty associated with management and maintenance of a B2C business. The complexity of the business products/locations creates greater dependence for successful implementation and therefore increase the preference in the adoption decision. Tornatzky and Klein 1982 argued only three factors compatibility, relative advantage, and complexity were found to be significantly correlated with adoption across studies. Hence, it is positively associated with adoption Dos Santos and Pfeffers, 1995.

H1e: The complexity of a company influences the adoption for web mining.

Kwon and Zmud 1987 identified five categories of factors that would influence the adoption and diffusion of IS. The categories are individual factors, organizational structure factors, technology factors, task factors, and environment factors. Thus, we state the hypotheses as following:

H1a: The industry type of a company influences the adoption for web mining.

H1f: The Internet entry strategy influences the adoption for web mining.

External Factors

Innovation adoptions are organizational responses to external environmental changes. In order to be successful an organization must adapt to the changing environmental conditions by altering its organizational characteristics such as its structure or its process (Lawence & Lorsch, 1967). Competition characteristics affect the initiation and adoption process. A company's desire to ahead of the competition is a major factor in adopting IT Kunnathur, et.al., 1996. Companies that are dominant in a particular market tend to leaders; either they are responsible for IT innovations or are very quick to adopt them as the yare introduced by competitors Leonard-Barton, 1991. Technological issues are important during initiation and adoption as companies evaluate the fit between the new technology and their existing systems. An application's technical complexity may hinder implementation success Tornatzsky, 1982. Premkumar & Roberts (1999) argued that the primary motivation for business to adopt new technologies is the anticipated benefits these technologies would bring to the company. Kuan & Chau 2001 investigated small businesses EDI adoption found that adopter firms perceived benefits more than non-adopter firms. Also, adopter firms perceive higher government pressure but lower industry pressure than non-adopter firms do. Hence these hypotheses follow:

Competition in the adopter's industry is generally perceived to positively influence the adoption of innovation Roberson, 1989. This would be even more evident if the innovation directly affects the competition. Prior research on IT adoption has shown that it has become a strategic necessity to have these technologies to compete in the marketplace.

H2a: Adopter firms perceive higher level of competitive pressure than non-adopter firms do.

The benefits of the new technology has been shown by several studies to impact the adoption. Rogers 1985 defined relative advantage of an innovation as the degree to which the innovation is perceived as better than the idea it supersedes. Studies have found it to be a significant variable, positively related to the adoption of innovation.

Premkumar(1999) argued that a rational adoption decision in an organization would involve evaluating the advantages of the new technology. Web mining technologies provide many benefits to the adopters in terms of better customer service, timely information availability for decision making, immediately online interaction, and more customer-oriented marketing campaign information. In a competitive marketplace these benefits create significant motivations for adoption.

H2b: Adopter firms perceive higher level of technological benefits than non-adopter firms do.

B2C Datamining Adoption

Amazon have caused a favor when it revealed it has been keeping track of consumer's book-buying behaviors and had composed best-seller lists by ZIP codes, workplaces, and colleges Streitfeld, 1999. Meanwhile, Real Networks was found to be monitoring and reporting the listening behaviors of individuals using its popular software Robinson, 1999. Yahoo! Carefully analyze which advertisements and products have the most appeal so it may alter its price and sales strategies Koch & Cebula, 2002. Net firms utilize the massive experience data they collect on the Net in a variety of ways. They tailor products to specific customers, we may be offered a lower price if we haven't purchased something recently, or we maybe offered a higher price if our characteristics suggest to them our demand for a particular good or service is less price elastic.

Research Method

Measurement

Seven single items were used to collect the respondents characteristics. The items were measured using a nominal scale. To determine the adoption stage, used: unknown, no adoption, initiation, adoption, implementation. To determine the industry type, used: IT firms and non-IT firms. To measure a company size, used the number of employees and total sales. Two groups were created for high/low degree of complexity of business. Again, two groups were created for transaction-oriented and information-oriented Internet approach. Similarly, two groups are separated based on each variable of international strategy and website content.

The variables identified in the research model were measured using multi-item indicators that aimed to capture the underlying theoretical domain of the construct. Most of the items were measured using a seven point Likert-type scale ranging from strongly disagree to strongly agree.

The construct were tested for two psychometric properties, validity and reliability, to ensure that the measurement was accurate. Validity was assessed through content, convergent and discriminant validity. Content validity assesses if the measurement covers the complete domain of the construct; convergent validity evaluates if all the items measuring the construct cluster together to form a single construct; and discriminant validity measures the degree to which a concept differs from other concepts and is indicated by a measure not correlating very highly with other measures from which it should theoretically differ Churchill, 1979. The reliability of the constructs was assessed using Cronbach's α . The results indicate that all the constructs have adequate alpha value >0.65 . These values are well within the thresholds suggested by Nunnally 1967.

Perceived competitive pressure was measured base on items adapted from previous studies. The items assess the perceived pressure of electronic commerce to the firm. To reduce the number of competitive pressure, a factor analysis was run. Bartlett test for sphericity was highly significant (Barlett =1187.64, $p<0.00$), suggesting significant correlations among at least some of the pressures. The measure of sampling adequacy for each item was acceptable and the overall measure of sampling adequacy was 0.77, well within the acceptable range Hair, 1995. We used the principal components extraction method with oblimin rotation $\delta=0$. We determined the number of factors on the basis of the minimum eigenvalue (greater than one) and the scree plot. The factor analysis revealed four underlying dimensions, which collectively explain 67.5% of the total variance in adoption.

The first factor, advertisement issue, represents a company perceived the versatility of Internet advertisement arrangement; while the second factor, transaction issue, depicts a company technical limitation of process order s speed, response to inquiries, and the security mechanism. The third factor, integrated planning issue, represents a company long term planning to achieve a more flexible and dynamic website. The forth factor, comprehensive information needs, represents customer needs to access ordering, processing, shipping, returning, maintenance information on line. The last factor, global marketing, portrays a company desire to develop a global-wide market strategy.

Perceived technological benefit was measured based on items adapted from previous studies. The items assessed the perceived benefits of web mining technology to the firm. Again, to reduce the number of incentives, a factor analysis was run. The result revealed one underlying dimensions, which collectively explain 78% of the total variance in initiation and adoption. The factor, perceived benefits, represents a company degree of awareness of web mining technology.

Table 1. Sample Characteristics

	Number of firms	Percentage		Number of firms	Percentage
<i>Industry</i>			<i>Annual Sales Revenue NT\$</i>		
e-Tailing	5	7.4	Under 1000m	12	17.6
Airline	2	2.9	1001m -3000m	11	16.2
Traveling	1	1.5	3001m – 1 billion	20	29.4
Insurance	2	2.9	1-10 billion	14	20.6
Banking	5	7.4	Over 10 billion	11	16.2
Information	32	47.1			
Entertainment	7	10.3	<i>Employee</i>		
Others	14	20.6	Under 10	18	26.5
			11-50	17	25.0
<i>History</i>			51-100	11	16.2
1-3 yrs	34	50	101-150	1	1.5
4-7 yrs	16	23.5	Over 151	21	30.9
8-10 yrs	3	4.4			
11-15 yrs	6	8.8			
Over 15 yrs	9	13.2			

Subjects

The subjects in this study consisted of senior managers of information department or electronic commerce department of top 500 companies listed in the 2000 issue of Digital Week. This particular audience is preferred because the firms are generally leaders

in information technology application, and the managers are knowledgeable of the firm managerial-related applications. A four-page questionnaire was sent to the subjects. Six week later, 64 usable questionnaires were received. The repeated callbacks to non-responds were executed twice. After six more weeks, the data collection process was concluded. Four usable questionnaires were received from the second wave of mailing, giving a total of 68 respondents and 13.6% response rate. Such a low response rate may be due to that the subjects may be unwilling to respond to unsolicited survey, and that many more companies set a policy of rejecting survey questionnaires.

Table 2. B2C Technology Adoption

Stage	Number of firms	Percentages
Unknown	6	8.8
No adoption	5	7.4
Initiation	24	35.3
Adoption	5	7.4
Implementation	28	41.2

Table 1 show the sample profile. More than seven industry sectors were included in the sample. Information sector is the largest category followed by entertainment sector. The sample included firms of varies sizes and histories. Table 2 shows the status of web mining currently being used by the samples. The largest number of category is implementation 41.2% followed by initiation stage 35.3%. The smallest number of category is no adoption 7.4%.

Table 3. Stepwise Linear Regression Results

Dependent variable	R ²	F-value (p-value)	Independent variables	T-value	p-value	Beta
Adoption	.666	8.129 (<.000)	Industry type	.099	.921	.046
			Firm age	.531	.597	.114
			Firm size	1.032	.307	.096
			Complexity	-3.355	.001*	.262
			Entry strategy	5.049	.000*	.293
			Distribution	2.224	.030*	.274
			Content information	-.706	.483	.265
			Technological benefit	-.147	.883	.196
			Advertisement	-.653	.516	.114
			Transaction	-.844	.403	.199
			Planning	-1.655	.104	.110
			Information	-.536	.594	.101
			Globalization	2.178	.034*	.151

Results and Discussion

Analysis and Results

After established that item loaded appropriately on their expected constructs, the hypotheses were examined using linear regression. The linear regression results shows in Table 3 support three hypotheses supporting H1d, H1e, and H1f, respectively. Linear regression results show that complexity, entry strategy, and distribution strategy affected web mining adoption. Table 4 shows the comparison of mean on benefits and competitive pressure support the last two hypotheses. Adopter firms perceived significantly higher degree of technological benefits than non-adopter firms supporting H2a. Similarly, adopter firms perceived significantly higher degree of competitive pressure than non-adopter firms supporting H2b. Table 5 summarizes the findings.

Table 4. Compare Mean of External Factors

Stage		Benefits	Pressure1	Pressure2	Pressure3	Pressure4	Pressure5
Unknown	Mean	4.5833	5.0000	5.7500	5.6667	5.2783	3.8889
	S.D.	.8424	.5477	.7583	.7601	1.2198	1.6689
No adoption	Mean	2.9180	5.1000	4.7500	4.4000	5.4000	2.0833
	S.D.	1.0510	2.2749	1.1040	1.5528	1.9494	1.3159
Initiation	Mean	5.7371	5.5208	5.8854	5.0972	5.1675	4.8611
	S.D.	1.0194	1.4557	.9890	1.3708	1.3965	.9111
Adoption	Mean	4.5180	5.4000	5.5000	5.0667	4.2000	4.2667
	S.D.	.9936	.7416	.7706	1.2996	1.0438	1.8166
Implementation	Mean	5.3061	5.8036	5.7679	5.5833	4.8911	5.2262
	S.D.	1.0443	.7244	.6802	1.2091	1.3181	1.3640
F value		9.117	.859	1.979	1.291	.725	.0196
P value		.000*	.494	.108	.253	.578	.000*

Table 5. Overall Results of Hypothesis Testing

	Hypothesis	Supported ?
H1a	The industry type of a company influences the adoption for web mining.	No
H1b	The age of a company influences the adoption for web mining.	No
H1c	The size of a company influences the adoption for web mining.	No
H1d	The complexity of a company influences the adoption for web mining.	Yes
H1e	The Internet entry strategy of a company influences the adoption for web mining.	Yes
H1f	The distribution strategy of a company influences the adoption for web mining.	Yes
H1g	The content of website of a company influences the adoption for web mining.	No
H2a	Adopter firms perceive higher level of technological benefits than non-adopter firms do.	Yes
H2b	Adopter firms perceive higher level of competitive pressure than non-adopter firms do.	Partially supported

Internal Factors

The characteristics of adopters are shown in Table 6. They indicate that IT firms and non-IT firms didn't show significant difference on web mining adoption. Similarly, the size of a company didn't show the preference of web mining adoption. The degree of a company's business complexity influences the adoption preference. The transaction-oriented companies prefer to implement data mining for their websites. The most of information-oriented companies tend to initiate the new technology. The industry-specific factor shows that information and computer companies tend to be adopters in compare with other industries. For those companies established shorter than five years, tend to adopt new technology, which may be explained of the lower degree of system conversion. Companies engage mail-order business show high preference of web mining adoption. The transaction-oriented firms represent the significant adopting rate. The global strategies show the significant effect on web mining adoption.

External Factors

The ANOVA test for external factors are shown in Table 4. They indicate that firms didn't show significant difference on degree of pressure of creating leading product or service. Similarly, pressure of a company to pursue a market-oriented strategy didn't show significant difference. The degree of a company's globalization didn't show the adoption preference. The pressure of creating

comprehensive website information shows a significant difference on web mining adoption. Again, the pressure of creating low culture divide website shows a significant difference on web mining adoption. The perceived technological benefits show the significant influence on adoption.

Table 6. The Characteristics of Web Mining Adopter

Characteristics	Unknown	No adoption	Initiation	Adoption	Implementation
<i>Industry</i>					
Non-IT	4	5	9	3	14
IT	2	0	15	1	14
<i>History</i>					
1-3 yrs	3	3	14	2	12
4-7 yrs	0	1	4	0	11
8-10 yrs	0	0	0	3	0
11-15 yrs	0	0	4	0	2
Over 15 yrs	3	1	2	0	3
<i>Annual sales revenue</i>					
Under 1000m	2	1	7	0	2
1001m -3000m	0	2	0	2	7
3001m 1 billion	1	0	7	0	12
1-10 billion	2	1	6	1	4
Over 10 billion	1	1	4	2	3
<i>Business complexity</i>					
<i>Direct marketing</i>					
Yes	1	0	10	1	15
No	5	5	14	4	13
<i>Mail Order</i>					
Yes	2	1	12	3	28
No	4	4	11	2	0
<i>Logistics</i>					
Yes	1	0	6	1	13
No	5	5	18	4	15
<i>Entry Mode</i>					
Information	5	4	17	5	7
Transaction	1	1	7	0	21

Summary and Conclusions

Based on a sample of 68 managers, we examined differences in adoption, as measured by our seven factors, to understand which internal and external characteristics significantly affect them. For instance, we found a significant relationship between adoption and the Internet entry strategy, but do firms with online transaction mechanism result in new technology preference?

Complexity was found to be a critical variable even within the B2C firms. This is consistent with prior studies that have found complexity to be a critical factor in IT adoption and use. Concerning entry strategy, transaction-oriented firms focus more on new technology adoption than information-oriented firms. We find that companies with online transaction applications give more attention to technological benefits and competitive, operational, and efficiency pressure.

The overall validity of the research model developed using the organizational innovation concepts as a basis was generally supported in this study. Although the study hypotheses were not all supported, based on the statistics measuring the model fit, the research model was statistically valid.

The result show that the organizational factor has a more significant influence on the decision mode than the external factor in terms of partial contribution to the total variance of the model. This seems to indicate that when an organization has to decide whether or not to adopt web mining, business operation needs may be the most important consideration.

Of the three factors found to be significant in affecting the adoption decision, may be considered to be similar to organizational slack and or size in Roger framework. The Internet entry strategy may be considered to be similar to complexity in Roger framework. The competitive pressure in Roger framework is still valid in this study.

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