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Integrating Trust in Electronic Commerce with the Technology Acceptance Model: Model Development and Validation

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INTEGRATING TRUST IN ELECTRONIC COMMERCE WITH THE TECHNOLOGY ACCEPTANCE MODEL: MODEL DEVELOPMENT AND VALIDATION

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Abstract

This paper develops and empirically validates a model to predict intentions to transact by integrating trust in electronic commerce (EC) with the Technology Acceptance Model (TAM.). The impersonal nature of the online environment and the technological unpredictability of the Internet reduce consumer perceptions of control over their online transactions, making trust an inevitable component of EC. Since intentions to use a Web retailer's interface for transactions necessitate an element of trust, perceived risk is incorporated as a direct antecedent of intention to transact. In addition, trust in EC that arises mainly from favorable privacy and security perceptions is hypothesized to reduce perceived risk and indirectly to influence intentions to transact. In addition, following TAM, intentions to transact are also influenced by both perceived usefulness and also by perceived ease of use. The resulting research model is validated using data from 52 subjects and the results give substantial support for the proposed hypotheses, while explaining 76% of the variation for intention to transact in EC. This research validates TAM outside the workplace, suggesting that by including trust in EC, it could extend into consumer online behavior. The paper discusses several new insights of this study and concludes with their theoretical implications.

Introduction

The future of business-to-consumer electronic commerce (EC) depends both on consumer trust toward Web retailers and also toward Internet technology. The spatial and temporal separation between consumers and Web retailers imposed by the Internet infrastructure generates an implicit risk around online transactions (Brynjolfsson and Smith 2000). Online buyers must rely on electronic information without physically inspecting the focal product; hence, there is additional risk because of potentially incomplete information provided by Web retailers (Lee 1998). Moreover, the open nature of the Internet as a transaction medium and its unregulated global nature create additional risks for online consumers, making trust a crucial element of EC (Hoffman, Novak, and Peralta 1999). Given the uncertain nature of the online environment, Stewart, Pavlou, and Ward (2001) argue that perhaps the most important element of consumer-marketer relationships is the notion of trust. In addition, research and the government and trade press stress the importance of privacy and security (e.g. Culnan and Armstrong 1999, Federal Trade Commission 1998) for EC success. Consequently, perceptions of trust, risk, privacy, and security become fundamentally important for the future of EC.

As with most information systems, Internet technology adoption and use may be explained by the Technology Acceptance Model (TAM) (Davis 1989). While TAM has initially focused on system usage in the work environment, recent research has attempted to use TAM to understand website use (Moon and Kim 2001). Therefore, intentions to use the Internet for online transactions could take in account the major constructs of TAM, perceived usefulness and perceived ease of use. In addition, online transactions contain the notion of risk since monetary and private information are introduced. This research aims to predict intentions to transact in EC by integrating the trust literature with TAM.

Since intentions to use a website for transactions involves a certain degree of uncertainty, perceived risk is incorporated as a direct antecedent of intentions to transact. Following TAM, intentions to transact necessitate both perceptions of usefulness and ease of use. In addition, trust arising primarily from favorable privacy and security perceptions is hypothesized to reduce perceived

risk and indirectly influence intentions to transact. The resulting research model is tested and validated using data from an experiential study with 52 subjects. The paper discusses the results of the empirical study, suggests several new insights arising from this research, and concludes with their theoretical implications.

Conceptual Development

Figure 1 shows the proposed model. Integrating trust in EC and TAM, the proposed model incorporates additional theoretical constructs spanning trust, risk, and privacy and security perceptions.

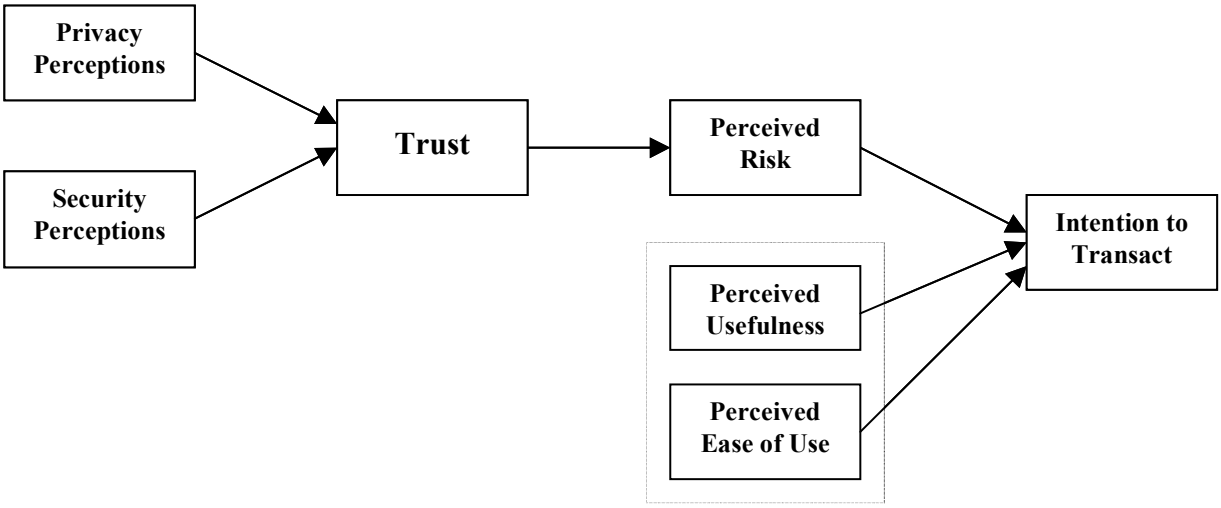

Figure 1. The Proposed Conceptual Model

Intention to Transact and Perceived Risk

Intention to transact in EC is defined as the consumers' intent to engage in any exchange of value with Web retailers. EC has some unique dimensions not explicitly covered by TAM, such as the implicit uncertainty of using Internet technologies. Uncertainty increases fears of seller opportunism, which is difficult to control in an online environment. Two types of uncertainty are present in EC and increase consumer perceived risk. Behavioral uncertainty arises because Web retailers may behave in an opportunistic manner by taking advantage of the impersonal nature of EC (among others), while environmental uncertainty occurs because of the unpredictable nature of the Internet technology that is beyond the control of the consumer (and perhaps of the retailer). The theory of planned behavior (Ajzen 1991) predicts that consumers would be willing to transact if their risk perceptions were low. Jarvenpaa, Tractinsky, and Vitale (2000) suggested that reduced risk associated with buying from an Internet store would likely increase the likeliness a consumer purchases from that store. Given the uncertain environment of EC, it is expected that perceived risk would lower consumers' intentions to use Internet sites for transactions.

> **H1: The intention to transact with a Web retailer is negatively related to the perceived transaction-specific risk.**

Trust in Electronic Commerce

All transactions require an element of trust, especially those conducted in the uncertain environment of EC (Lee 1998). Following Stewart et al. (2001), trust in electronic transactions is defined as the subjective probability with which consumers believe that an online transaction with a Web retailer will occur in a manner consistent with their expectations. This definition captures two distinct facets of trust in EC. First, it involves the traditional view of trust in a specific entity; second, it encompasses trust towards the reliability of the Internet infrastructure. This means that consumers consider both the Web retailer's characteristics (behavioral uncertainty) and also the characteristics of the technological infrastructure (environmental uncertainty). Trust has been associated with favorable perceptions including increased satisfaction, long-term orientation, and reduced risk (Ganesan 1994). Jarvenpaa et al. (2000) showed that trust in an Internet store reduces risks from buying from that store. Trust toward transactions with a Web

retailer would be a function of the degree of uncertainty involved in the situation. In general, trust has been shown to reduce risk from being taken advantage from sellers (Anderson and Weitz 1989). Therefore, I argue that trust toward transactions with a Web retailer should reduce perceived risk related to being mistreated by the retailer.

H2: Trust toward an online transaction with a Web retailer is negatively associated with the perceived transaction-specific risk.

Privacy and Security Perceptions

Online transactions are associated with (a) possibility for a loss of privacy and (b) risk for monetary loss. First, privacy perceptions are defined as the subjective probability with which consumers believe that the collection and subsequent access, use, and disclosure of their private information by Web retailers is consistent with their expectations. This definition denotes that perceived privacy is not an objective reality but a subjective anticipation. Second, the open nature of the Internet has heightened concerns about information security. Security perceptions are defined as the subjective probability with which consumers believe that their private information will not be viewed, stored, and manipulated during transit and storage by inappropriate parties in a manner consistent with their confident expectations. This definition denotes that security perceptions are also personal anticipations that deal with the consumers' subjective beliefs regarding data authentication, authorization, and non-repudiation. It is important to note that privacy and security perceptions are subject both to the Web retailers' actions (behavioral uncertainty) to respect consumers' privacy and protect their security, and also subject to the Internet infrastructure (environmental uncertainty) to facilitate secure transmission and storage of consumer information.

The competence and calculative trust-building processes indicate the theoretical importance of privacy and security perceptions as antecedents of consumer trust in online transactions (Doney and Cannon 1997). First, for consumers to build trust toward a particular transaction with a Web retailer, they employ a competence process to assure that the retailer and the associated infrastructure are capable of fulfilling the transaction. Second, consumers may involve a calculative process to assess that the benefits to Web retailer from protecting their private information are higher than the benefits from not doing so. In sum, consumers engender trust towards a transaction when they believe that the Web retailer and the associated infrastructure are able to protect their personal information during transmission and storage, and also when they believe the Web retailer has higher benefits than costs from respecting their information privacy and security. Therefore, perceptions of privacy and security are likely to positively influence consumer trust towards a transaction with a Web retailer.

H3: Privacy perceptions are positively related to trust toward transactions with a Web retailer.

H4: Security perceptions are positively related to trust toward transactions with a Web retailer.

Perceived Usefulness and Perceived Ease of Use

Intentions to transact necessitate that the consumer first uses a retailer's website and then completes a transaction. Even if usage and transaction may be theoretically distinct processes, they are practically indistinguishable in online transactions since consumers use Web retailers' sites with intentions to transact. Therefore, it is justifiable to use TAM as the baseline model to predict intentions to use a website for online transactions. Following TAM, it is hypothesized that perceived usefulness and perceived ease of use have a positive influence on intentions to transact.

H5: Perceived usefulness is positively related to the intention to transact with a Web retailer.

H6: Perceived ease of use is positively related to the intention to transact with a Web retailer.

Research Methodology

An experiential survey was conducted to validate the proposed research model (Figure 1). Fifty-two undergraduate students in a supervised lab were asked to spend 10 minutes visiting Amazon.com and then complete a questionnaire related to this specific Web retailer. Given class bonus for their participation, 52 students completed the questionnaire; their average age was 20.8, 55% of them were males, and they had an average of 2.8 years of work experience. The choice of a popular retailer such as Amazon was performed to assure that the respondents were familiar with the target Web retailer to avoid uninformed responses. Also, the

respondents were encouraged to visit Amazon's website and perform transaction-related activities before completing the questionnaire in order to ensure knowledgeable responses. In the Amazon study, 90% of the respondents actually visited the site before the study, and 54% actually purchased a product before the day of the survey. These numbers support the thesis that the respondents were sufficiently knowledgeable about the specific Web retailer.

Measure Development and Validation

The principal constructs were developed based on existing measures where possible, or they were generated based on similar scales. Measures for perceived usefulness (USEF) and perceived ease of use (EOU) were adapted from existing studies on TAM (Venkatesh and Davis 2000, Heidjen 2001). Measures for trust (TRUST), risk perceptions (RISK), and reputation (REP) were adapted from Jarvenpaa et al. (2000). The scales for privacy (PRIV) and security (SEC) perceptions were based on Cheung and Lee (2000). The construct for intentions to transact (TRANS) was captured with three items. Two items were based on TAM and measured intentions to use (Venkatesh and Davis), and one item captured likeliness to transact. The reason for using items spanning intentions to use and likeliness to transact jointly is to empirically validate the convergence validity of this construct. A preliminary version of the instrument was generated, which was reviewed by faculty and doctoral students for comprehensiveness and clearness. Subsequently, the instrument was pretested by personally administering it to several consumers to verify its appropriateness; these phases revealed no major problems. The final measures for all ten constructs of this research and their internal consistency results (Cronbach's alpha) are shown in the Appendix.

All items were submitted to an exploratory factor analysis, and based on factor loadings and a priori theoretical expectations; indicators for the hypothesized principal constructs were identified. To address the issue of construct and discriminant validity, the items corresponding to each of the theorized constructs was subjected to item-to-total examination. The inter-item correlation matrix of the principal constructs was analyzed, and all items tapping the same construct had high correlations, whereas items tapping different constructs had significantly lower correlations. In addition, all eigenvalues associated with the factors were set to greater than unity, and the items were reduced to their principal constructs using confirmatory factor analysis with Varimax rotation. The overall factor solution has an excellent loading pattern and explains 78% of the variation. All items loaded on their hypothesized factors, and the estimates were positive and significant. Therefore, convergent and discriminant validity for all measures is strongly supported. It is worth mentioning that the three items spanning intentions to transact converged into a single factor explaining 95% of the variation. Measure validation was also examined for reliability analysis by computing Cronbach's alpha coefficient as shown in the Appendix. Descriptive statistics and the correlation matrix for the study's resulting 10 principal constructs are shown in Table 1.

Table 1. Descriptive Statistics and Correlation Matrix of Principal Constructs

Construct	Mean	STD	TRANS	RISK	USEF	EOU	TRUST	PRIV	SEC	REP
TRANS	5.44	1.15	1.0	**-.767**	**.809**	**.503**	**.470**	**.582**	**.467**	**.768**
RISK	5.18	1.06		1.0	**-.750**	**-.510**	**-.477**	**-.479**	**-.409**	**-.679**
USEF	5.82	1.02			1.0	**.586**	**.561**	**.605**	**.580**	**.710**
EOU	5.92	0.96				1.0	**.479**	**.431**	**.366**	**.466**
TRUST	5.86	1.03					1.0	**.528**	**.507**	**.469**
PRIV	4.85	1.56						1.0	**.629**	**.552**
SEC	4.79	1.22							1.0	**.354**
REP	5.75	1.25								1.0

Results

Support for the six proposed hypotheses was provided by testing three multiple regression equations:

(a) $TRANS = \alpha_0 + b_1\ RISK + b_2\ USEF + b_3\ EOU + b_4\ REP + b_5\ TRUST$

(b) $RISK = \alpha_1 + b_6\ TRUST + b_7\ REP + b_8\ PRIV + b_9\ SEC$

(c) $TRUST = \alpha_2 + b_{10}\ PRIV + b_{11}\ SEC + b_{12}\ REP$

Table 2. Regression Analysis Results for Intention to Transact

Variables	Construct	Intention to Transact (Standardized beta)	t-value	p-value
Independent	**Perceived Risk**	-0.253	-2.13	**0.039**
	Perceived Usefulness	0.415	3.19	**0.003**
	Perceived Ease of Use	-0.001	0.01	0.992
Control	Reputation	0.312	2.80	**0.007**
	Trust	-0.291	-0.31	0.750
	R-squared	**0.76**	**0.73 (adjusted)**	
	F ratio	**$F_{5,46}$ = 28.23 (p<0.000)**		

As shown in Table 2, perceived risk (b_1=-.253, p<.039) is negatively associated with intentions to transact, rendering significant support for H1. In addition, perceived usefulness (b=.415, p<.003) was also significantly related to intentions to transact, rendering support for H5 and also validating TAM. However, perceived ease of use (b_2=-.001) has a non-significant effect on intentions to transact, refuting H6. However, as Davis (1989) argued, ease-of-use may act on intentions to use indirectly through usefulness. Indeed, perceived ease of use has a strong correlation with usefulness (r=.59, p<.001) suggesting that ease-of-use increases the website's usefulness. Moreover, reputation was a significant antecedent of intention to transact (b=.312, p<.007), while trust was non-significant. The non-significant effect of trust on the dependent variable may suggest that trust acts indirectly on intentions to transact through perceived risk. Whereas many of the independent variables were significantly correlated, multicollinearity was not a serious concern for this regression equation. Finally, the variance explained by this regression was particularly high (R^2=.76), well above values found by TAM researchers on intention to use. Therefore, the addition of perceived risk and reputation significantly add to the explanatory value of TAM.

Table 3. Regression Analysis Results for Perceived Risk

Variables	Construct	Perceived Risk (Standardized beta)	t-value	p-value
Independent	**Trust**	-0.42	-2.82	**0.007**
Control	Reputation	-0.29	-2.63	**0.012**
	Privacy	-0.10	-0.57	0.318
	Security	-0.15	-1.01	0.573
	R-squared	**0.39**	**0.34 (adjusted)**	
	F ratio	**$F_{4,47}$ = 7.62 (p<0.000)**		

Table 3 shows the results of the regression analysis with perceived risk as the dependent variable (R^2=39, F=7.62, p<.000). The impact of trust on risk is significant (b=-.42) validating H2. It is interesting to note that privacy and security perceptions are non-significant predictors of risk, suggesting that they may act on perceived risk indirectly through trust. Finally, as shown in Table 4, perceived security (b=.28, p<.049) is a significant trust antecedent validating H3. Perceived privacy (b=.27, p<.194) shows a directional, yet non-significant support for H4. The regression coefficients (R^2=.34, F=9.52, p<.000) suggest that a substantial amount of trust is explained by privacy and security perceptions and by reputation.

Table 4. Regression Analysis Results for Trust

Variables	Construct	Trust (Standardized beta)	t-value	p-value
Independent	**Privacy Perceptions**	0.27	1.29	0.194
	Security Perceptions	0.28	1.96	**0.049**
Control	Reputation	0.25	1.82	0.074
	R-squared	**0.37**	**0.34 (adjusted)**	
	F ratio	**$F_{3,48}$ = 9.52 (p<0.000)**		

Discussion

The primary contribution of this paper is the integration of trust in EC with TAM to develop and empirically validate a set of interrelationships related to consumer intentions to use the Internet for online transactions with Web retailers. Several new insights are engendered regarding the importance of trust and risk and their role in EC. First, perceived risk is shown to be a direct negative antecedent of intention to transact, while trust was an indirect antecedent acting through risk perceptions. Second, intentions to use and transact were shown to behave as a single construct, suggesting that TAM could also extend into consumer online behavior. Third, perceived usefulness and perceived ease of use influence online usage intentions, validating TAM outside the workplace. Finally, privacy and security perceptions influenced trust, rendering support for two important antecedents of trust in EC that indirectly reduce perceived risk and influence intentions to transact. Given the high variance explained for intentions to transact, trust and TAM are likely to become essential components of EC.

Two important limitations of this study should be mentioned. First, the issue of external validity has not been fully addressed in these studies using student populations. For example, the non-significant effect of perceived ease-of-use might have been caused by the respondents' high expertise in using the Internet. Second, the constructs capturing the antecedents and consequences of trust in this model are not exhaustive; similarly, only the most basic constructs related to TAM have been examined. Therefore, future research could incorporate other constructs to better predict intentions to transact in EC.

Not only the integration of trust with TAM is theoretically appealing, it is also empirically significant since it explains 76% of the variation for intention to transact in EC. This finding also suggests that TAM could be useful in explaining purchase intentions where a technological infrastructure is present, since perceived usefulness is a significant predictor of intentions to transact. Therefore, TAM variables could be employed to predict consumer behavior in EC. The explanatory power of the proposed model also arises from the fact that trust and perceived risk act as key mediating variables. For instance, while trust is highly correlated with intentions to transact, it only acts indirectly on intentions to transact when risk is controlled for. Similarly, whereas privacy and security perceptions are significantly correlated to risk, their effect becomes only indirect when trust is controlled for. These findings suggest that the proposed model has a sufficient explanatory and predictive power. Future research could attempt to verify the robustness of the model in different contexts, and extend the proposed set of interrelationships with the incorporation of other variables.

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Appendix A. Measurement Scales and Reliabilities for Principal Constructs

Scale and Items	Cronbach's alpha
Intention to Transact	
Given the chance, I intend to use this retailer's Website.	0.96
Given the chance, I predict that I would use this retailer's Website in the future.	
It is likely that I transact with this Web retailer in the near future.	
Perceived Risk	
How would you characterize the decision to whether transact with this Web retailer? (Significant/Insignificant risk)	0.85
How would you characterize the decision of whether to transact with this Web retailer? (Very Negative/ Positive Situation/)	
How would you characterize the decision to buy a product from this Web retailer? (High Potential For Loss/ Gain)	
Perceived Usefulness	
Overall, I find this retailer's Website useful.	0.92
I think this retailer's Website creates value to me.	
The content on this retailer's Website is useful to me.	
This retailer's Website is functional.	
Perceived Ease of Use	
My interaction with this retailer's Website is clear and understandable.	0.95
Interacting with this retailer's Website does not require a lot of mental effort.	
I find this retailer's Website easy to use.	
I find it easy to locate the information that I need in this retailer's website.	
Trust	
This Web retailer is trustworthy.	0.88
This Web retailer is known as one that keeps promises and commitments.	
I trust this Web retailer keeps my best interests in mind.	
Privacy Perceptions	
I am confident that this Web retailer does not disclose consumer private information to unauthorized parties.	0.86
I believe this Web retailer will not share my private information without my consent in the future.	
I have control over how the private information I provide will be subsequently used by this Web retailer.	
Overall, I feel confident that my privacy will not be compromised during a transaction with this Web retailer.	
Security Perceptions	
am confident that the information I provide during my transaction will not reach inappropriate parties during storage in this retailer's databases.	0.89
I believe inappropriate parties cannot deliberately observe the information I provide during my transaction with this Web retailer during transmission.	
In my opinion, inappropriate parties will not collect and store the information I provide during my transaction with this Web retailer.	
Overall, I have confidence in the security of my transaction with this Web retailer.	
Web Retailer Reputation	
This Web retailer is known to be dependable.	0.83
his Web retailer has a poor reputation in the market (reverse scale)	