

Risk Management in Real Estate Electronic Transactions

Lawrence Chin* and Jiafeng Liu**

Abstract

In the recent past, both consumers and real estate service providers have increasingly used the Internet to improve trading effectiveness and efficiency in the real estate market. Although Internet usage has reached phenomenal levels, the pure real estate electronic transaction, where the process is totally completed through the Internet, is still very much in its infancy. This indicates that significant barriers and risks remain in applying this kind of technology. This paper develops a model to optimize the risk management of real estate electronic transactions and suggests methods to control the risks inherent in these transactions.

Introduction

The number of both consumers and real estate service providers using the Internet is growing significantly. According to the National Association of REALTORS® (NAR, 1999), the number of buyers in the United States using the Internet to search for homes rose from just 2% in 1995 to 23% in 1999, and to more than 55% in 2001 (Muhanna, 2000; and Brice, 2001). In addition, the real estate industry has embraced the Internet as a very attractive medium to conduct business. In January 1995, there were approximately 100 real estate websites that offered properties for sale. By the end of that year, the figure rose to over 4,000 sites and up to approximately 8,000 sites by the end of 1996 (Heller and Krukoff, 1997).

Even though the Internet is widely predicted to revolutionize commerce over the next few years, the full potential of electronic commerce (e-commerce) will only be realized if both buyers and sellers have sufficient confidence to trade electronically (Skevington, 1998). The results from a survey of e-commerce in the real estate brokerage industry (Muhanna, 2000) found that buyers' searching was the most impacted by the Internet, followed by property listing and property evaluating, while respondents believed that the impact on the negotiating and executing steps was limited. This indicates that there exist some barriers and risks in real estate electronic transactions. However, when these risks are carefully managed, electronic transactions provide potential benefits in terms of transaction costs, accessibility to market and speed of transaction (Westland, 2002).

To date, relatively few studies have focused on the risk aspects of electronic transactions in real estate applications. This paper examines the risk of real estate electronic transactions and develops techniques to mitigate its adverse effects.

*National University of Singapore, Singapore 119260 or rstekh@nus.edu.sg.

**National University of Singapore, Singapore 119260 or sdep1246@nus.edu.sg.

Literature Review

The Internet and Real Estate

Past studies concerning the relationship between the Internet and real estate can be classified into a few dominating themes. One direction is how the Internet has become and continues to be a very important tool for marketing real estate and related services. Rodriquez, Lipscomb and Yancey (1996) identified four different types of real estate-related sites, including those that offered both real estate for sale and real estate services, and provided an extensive list of these sites. Bond, Seiler, Seiler and Blake (2000) examined the explosive growth of real estate-related websites and determined the reasons why Ohio real estate brokerage firms did or did not use websites in their businesses, the information contained in their sites and the technical requirements that were necessary for maintaining them. Similarly, Muhanna (2000) examined how real estate firms adapted to the use of the Internet and assessed their perceptions regarding its potential.

A growing body of literature looks at the effect of the Internet on retail sales, property and service (e.g., Mander, 1996; Wheaton, 1996; Schwarz, 1997; Borsuk, 1999; Hemel and Schmidt, 1999; Baen, 2000; and Miller, 2000). For example, Baen and Guttery (1997) examined how the Internet threatened the traditional relationship among licensees, real estate buyers and sellers, and how these developments would create savings for real estate consumers. Similarly, Thrall (1998) discussed the emerging trends and changes in the Internet for other real estate service providers, including lenders, appraisers and commercial brokers. Baen (2000) examined the impact of e-commerce on traditional retail sales, as well as its potential impact on commercial property values and percentage rents. Tse and Webb (2002) studied the impact of information technology on real estate brokerage in Hong Kong, using regression models to investigate how page "views" on the Internet affect real estate transactions and commissions. Finally, Lucas (2001) believes that since information technology facilitated the design of new types of organizations, institutions and partnering arrangements, its implementation would have second-order effects on demand for physical space of manufacturing, retailing and offices in the industrialized world.

Risks in E-commerce

An expansive list of studies examines the risks in e-commerce transactions (e.g., Jung, Han and Suh 1999; Hsiung, Scheurich and Ferrante, 2001; and Chan, 2001). One focus is on how to develop technological methods to deal with these risks. For example, Skevington (1998) outlined some of the technologies that were developed to address security concerns and to apply them to facilitate trust in electronic trading. Atif (2002) described a proposal for a trust web model based on a distributed search algorithm and a network of trusted intermediaries that can establish a trusted channel through which terminal transacting parties deal virtually directly and risk-free with each other. However, the traditional models of trust between vendors and buyers fall short of the requirements for an electronic marketplace, where anonymous transactions cross territorial and legal boundaries, as well as traditional value-chain structures.

To overcome this problem, Manchala (2000) introduced a notion of quantifiable trust to evaluate the transaction risk in such an environment.

Another direction of the literature focuses on the managerial perspective of the transaction risks of e-commerce. Using case studies, Lee and Clark (1997) presented suggestions on the analysis, design and implementation of electronic market systems by market-making firms. Brice (2001) discussed some of the risks and considerations involved in the use of electronic signatures. Westland (2002) developed a model for evaluating and managing transaction risk in e-commerce in the migration from broker-mediated to electronic markets.

Real Estate Transaction Stages

Real estate agents and firms are essentially market intermediaries, connecting buyers and sellers and facilitating the real estate transaction process. Traditionally, real estate sales can be divided into five stages: property listing, buyer search, property evaluation, negotiation and execution/closing. With the development and popularity of information technology, each stage of this process has been affected profoundly.

Stage 1: Property listing. In the past, real estate agents listed houses and entered them into a Multiple Listing Service (MLS) database. The MLS is today an online network of properties listed for sale and supported by the NAR. In effect, the MLS created a cartel-like role in managing information and virtually ensures that the agent will have a pivotal role in the real estate transaction. However, this situation has since changed with the introduction of websites in the market that provide property listings. A survey by Muhanna (2000) found that about 23% of real estate agents actually list their properties on their own websites. In addition, Fletcher (1997) found that their owners were listing many homes for sale on websites. For example, on Microsoft's network system, Home Advisor (www.homeadvisor.msn.com), and national selling services, such as Abele Owners Network, any seller's listing can be posted for a nominal fee (Guttery, Baen and Benjamin, 2000; and Bond, Seiler, Seiler and Blake, 2000).

Stage 2: Buyer search. Although potential buyers can search for homes on their own through browsing newspaper advertisements or call owners directly, most prospective buyers generally seek homes through agents that have access to MLS listings. Nevertheless, buyers can now perform their own searches on the Internet easily. Many MLS listings can now be reached directly (Aalberts and Townsend, 2002), such as the NAR's website (www.realtor.com) with more than a million listings. Established real estate players, such as Coldwell Banker (www.coldwellbanker.com) and Prudential (www.realbid.com) also have their own listings. Moreover, there are also upstarts doing the same, including the For-Sale-By-Owner (FSBO) listing and Microsoft's Homeadvisor. Finally, some local newspapers provide their own websites for real estate listings. For example, the Classified Federation, a subsidiary of the Newspaper Association of America, created www.realfind.com, which is a free service through which potential buyers may request a copy of the weekend real estate section of newspapers in major markets and can link directly with the newspaper classifieds via the Internet.

Stage 3: Property evaluation. Traditionally, after buyers find a property of interest, an agent often arranges for a walk-through showing or has access to a house through a lock-box. Now, it is possible to conduct a “virtual” walk-through online. Since electronic pictures can be downloaded into a computer’s hard drive, electronic cameras allow the use of pictures to include landscaping, interior views and neighborhood scenes. In addition, electronic versions of property photographs and information can be recorded in VCR tapes and shipped overnight to prospective buyers around the globe. Furthermore, websites can provide prospective buyers the option to examine the surrounding neighborhood and environment, including shops, schools, parks, entertainment, transportation, weather conditions and even crime statistics. As a result, the number of properties that need to be physically inspected by a buyer can be substantially reduced. In reality though, no current real estate website can make most buyers confident enough to decide to buy without any actual physical inspection.

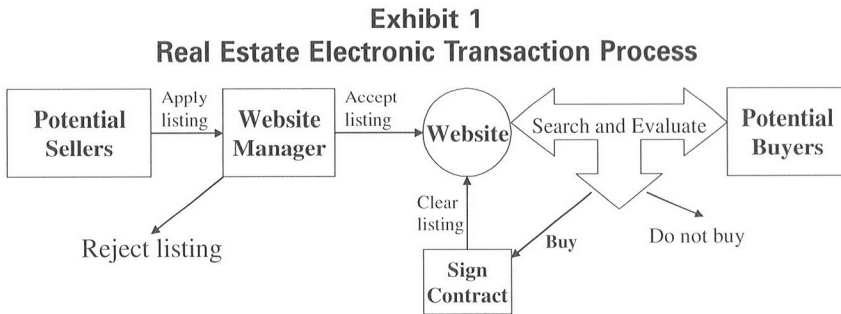
Stage 4: Negotiation and agreement. Negotiating the purchase agreement successfully can be considered as the most challenging task for a real estate agent. It involves advice regarding price, offers and counteroffers, and contract contingencies. It also requires dealings with other real estate professionals, such as lenders, appraisers, title companies and attorneys. Nevertheless, this stage has also been changed significantly by information technology. Now a buyer can identify their own appraisers, lenders, title companies and attorneys, and negotiate with these parties directly through the Internet (Aalberts and Townsend, 2002). In addition to the use of email, software is also available that can support multi-party meetings on the Internet, such as Netmeeting. Capabilities like that offered by Netmeeting allow for virtual negotiation instead of relying on the physical presence of the different parties.

Stage 5: Execution/closing. The customary role of the escrow agent or attorney in directing the closing is also changing. The Electronic Signatures in Global and National Commerce Act or E-Sign legislation passed on October 1, 2000, significantly removed impediments for business and government transactions to be conducted electronically. It was predicted that E-signature would allow real estate transactions, which are traditionally slowed down by endless paper trails, to take place online (Brice, 2001). Although the dream of “paperless transactions” is not yet reality, there have been a few notable “paperless transactions” involving residential real estate. Last year, for example, Orlando, Florida-based Attorney’s Title Insurance Fund participated in two closings that met the strict definition of this highly automated process (Southerland, 2002).

Risk Analysis

Modeling

Drawing upon the above discussion, the process of real estate electronic transaction can be depicted by Exhibit 1. The electronic transaction process can be broken down into two main parts according to their risks: (1) Potential sellers or sales agents can apply to the website manager to list the property on the website. The website manager would check the information and then decide whether or not to accept the application



for the listing; 2) Potential buyers search the website for the property that conforms to their taste and budgetary requirements. Results of the real estate search are then presented to the prospective buyers for their evaluation. If a decision is made to make an offer to purchase a listing, then buyer and seller can negotiate and sign a contract. Buyers can post their loan requirements on the Internet, allowing lenders to bid their mortgage rates, closing costs and discount points. Once the buyer has selected the mortgage lender, virtually all of the origination process can be performed electronically (Guttery, Baen and Benjamin, 2000). Finally, the website removes the listing from the active listings database, but might retain the sale documentation in another database for future comparable information.

The website manager controls the risk through procedures that allow “good” lists to be differentiated from “bad” or “risky” lists. Good lists are those that truly and appropriately reflect the actual conditions of posted properties and the seller’s asking price is not significantly different than the true market price. Bad lists, on the other hand, hide important negative characteristics of the property, or have a price offer much less than the true market value of the property. Bad listings should be rejected by the website manager. However, it is possible that good or bad lists can either be accepted or rejected by the website manager. Exhibit 2 shows a 2×2 matrix of such outcomes.

In this case, the risk from the viewpoint of the website manager is denoted by the α -risk and β -risk:

$$\alpha_1 = \text{Pr}(\text{type I error}) = \text{Pr}(\text{good lists are turned away by the website manager})$$

$$\beta_1 = \text{Pr}(\text{type II error}) = \text{Pr}(\text{bad lists are accepted by the website manager})$$

Before deciding whether to buy, potential buyers manage their risk through evaluation procedures that allow “good” real estate listings to be differentiated from “bad” listings. From the perspective of the prospective buyer, a “good” real estate listing satisfies their requirements and expectations. “Bad” real estate listings neither satisfy their requirements nor their expectations. For example, if a buyer misunderstands the real estate listing, or pays much more than the true market value of the property, then that buyer would be dissatisfied with the real estate purchase; hence it would be

Exhibit 2
Decision Outcomes in Determining Good and Bad Lists

List Type	List Accepted	List Rejected
The list is actually "good"	<i>Correct decision</i>	<i>Type I error</i>
The list is actually "bad"	<i>Type II error</i>	<i>Correct decision</i>

viewed as "bad" real estate. It is also possible that "bad" real estate is rejected and "good" real estate purchased by prospective buyers, thereby identifying all possibilities of the 2×2 matrix of possible outcomes as shown in Exhibit 3.

In this case, the risk from the viewpoint of buyers is denoted by the α_2 - and β_2 -risks:

$$\alpha_2 = \text{Pr}(\text{type I error}) = \text{Pr}(\text{good real estate is rejected by the buyer})$$

$$\beta_2 = \text{Pr}(\text{type II error}) = \text{Pr}(\text{bad real estate is bought by the buyer})$$

If α_1 or α_2 of a website is perceived as being too large, potential sellers would be expected to switch to alternative websites, thereby reducing the quantity of real estate listings on the website. Likewise, if β_1 or β_2 of a website is too large, prospective buyers may switch to other websites, thereby reducing the demand on the website.

However, website managers can reduce α_1 - or β_1 -risks attributable to misleading information, and misleading representation of the real estate listing. The increased active participation of the website manager can be referred to as *management* $\theta \in [\theta_1, \theta_2]$. Thus, the risk of (α_1, β_1) is then a function of *management* θ , and can be denoted by:

$$(\alpha_1, \beta_1) = f_1(\theta). \quad (1)$$

Likewise, given (α_1, β_1) , potential buyers can lower the α_2 - or β_2 -risks by increasing the level of *management* $\gamma \in [\gamma_1, \gamma_2]$. Since the management of α_1 - and β_1 -risks affects the level of α_2 - and β_2 -risks, the risk of (α_2, β_2) can be expressed as:

Exhibit 3
Decision Outcomes in Buying Good and Bad Real Estate

List Type	Bought	Rejected
The real estate is actually "good"	<i>Correct decision</i>	<i>Type I error</i>
The real estate is actually "bad"	<i>Type II error</i>	<i>Correct decision</i>

$$(\alpha_2, \beta_2) = f_2(\gamma|\alpha_1, \beta_1) = f_2(\gamma|\theta). \quad (2)$$

The functions of $f_1(\theta)$ and $f_2(\gamma|\theta)$ in Equations (1) and (2) can be estimated through the Bayesian approach, *i.e.*, (α_1, β_2) can be obtained based on statistical sampling and then tested at different levels of *management* $\theta \in [\theta_1, \theta_2]$, so as to estimate the function of $f_1(\theta)$. Similarly, given θ , (α_2, β_2) can be derived based on statistical sampling and then tested at different levels of *management* $\gamma \in [\gamma_1, \gamma_2]$, in order to estimate the function of $f_2(\gamma|\theta)$.

Risk Management

To better understand the risks involved in Internet and related electronic transactions, it is first important to analyze the relationships of different types of risks.

Relationship between α -risk and β -risk. When compared with α -risk, β -risk of falsely accepting “bad” real estate listings is found to be a more critical risk for optimal risk management, because high β -risk directly decreases buyers’ participation in the market (Westland, 2002). Since exposures of β -risk usually cause a loss of buyers, this loss is usually more expensive than that of rejecting good real estate listings (α_1 -risk). Since real estate is a commodity of high value, real estate websites typically cannot support bad listings that render high β_1 -risk. Furthermore, at a certain level of accepting bad listings (β_1 -risk), two additional effects decrease buyer-seller participation in markets: reputation effects and reduced network externalities. Poor reputation tends to reinforce itself and would drive some risk-averse participants away. This would reduce the total participation. Finally, it would lead to a reduction in the network externalities as participants leave the market. On the other hand, if a website rejects too many good lists (*i.e.*, α_1 -risk is too large), this may cause a large loss of supply in the website, and the potential sellers may turn to other websites to post their lists.

Moreover, α - and β -risk are inter-dependent. Decreasing β -risk may render the increase of α -risk, while reducing α -risk may cause β -risk to increase. For example, if websites manage β_1 -risk to a very high level, there will be very few bad real estate listings on the websites. However, the α_1 -risk of falsely rejecting good listings may be increased accordingly. On the other hand, if websites have very low α_1 -risk, the possibility of falsely accepting bad listings may increase.

β_1 -risk and β_2 -risk. In real estate e-commerce, managing β_1 -risk by the website manager is considered more important than managing β_2 -risk by potential buyers. First, the good management of β_1 -risk effectively reduces buyers’ exposure of β_2 -risk. Obviously, accurately rejecting bad real estate listings reduces the total number of bad listings in the market, and then decreases the probability for buyers to encounter bad real estate listings.

Also, the good management of β_1 -risk greatly improves the trust between buyers and sellers and the confidence of customers in an e-commerce environment. High β_1 -risk

is not only risky, but also time-consuming and expensive for a buyer in managing β_2 -risk. Most buyers would prefer the websites with low β_1 -risk to save their time and money. Moreover, if a seller wants to sell property soon, the seller would also like to choose the low β_1 -risk websites that have more potential buyers.

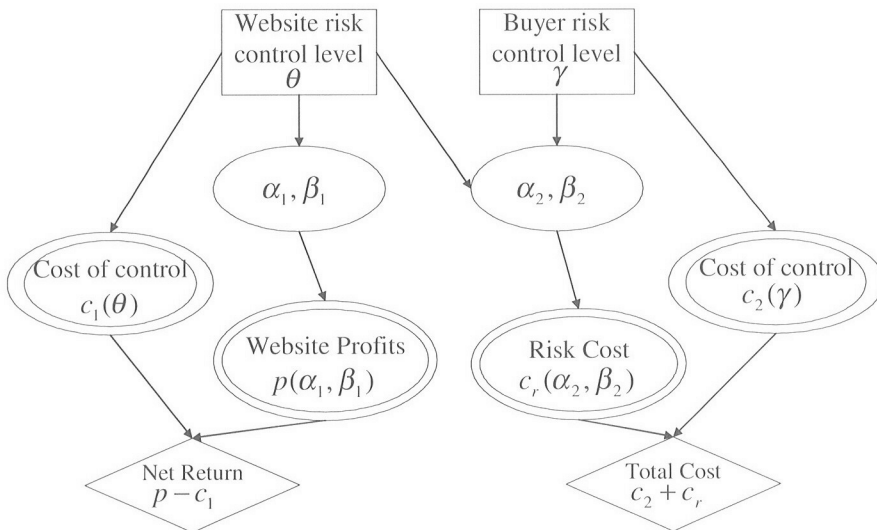
Finally, managing β_1 -risk is more meaningful for real estate websites than for other kinds of websites. While some real estate websites allow sellers to post their own lists without checking the property description, these websites have very high β_1 -risk. Since these websites have no instruments to check the reliability of data entered by sellers, buyers may not think that the description, entered by the sellers, is an accurate representation of the offered property. As a result, buyers will not decide to buy without physically inspecting the properties first.

Cost Analysis

Managing the different levels of risks incurs different costs. In e-commerce, website managers may be concerned with their net return, while buyers may focus mainly on their capital outlay. Thus, it is helpful to analyze the costs involved in the real estate electronic transaction. The influence diagram in Exhibit 4 illustrates the relationships among the different decision elements and associated costs.

From the website manager's point of view, the decision to select a risk management level θ depends on the cost of management denoted by $c_1(\theta)$ and both the α_1 - and β_1 -risks. Since the α_1 - and β_1 -risks affect the number of real estate listings, browsers, participants and transactions, the website profit is given by $p(\alpha_1, \beta_1) = p(f_1(\theta))$. Thus, the net return of the website can be expressed as $p(f_1(\theta)) - c_1(\theta)$.

Exhibit 4
Influence Diagram for Cost Analysis



From the viewpoint of a buyer, if the buyer is interested in real estate found on this website, he has to manage the risk by selecting a level of γ that determines the cost of management denoted by $c_2(\gamma)$. Since γ and θ affect α_2 - and β_2 -risks, the risk cost is given by $c_r(\alpha_2, \beta_2) = c_r(f_2(\gamma|\theta))$. The risk cost represents the expected cost for the buyer to reject “good” real estate or accept “bad” real estate. Thus, the total cost of the buyer can be expressed as $c_2(\gamma) + c_r(f_2(\gamma|\theta))$.

Optimization of Risk Management

As far as the website manager is concerned, raising the level of risk management level θ would incur greater expenditure by increasing $c_1(\theta)$, while at the same time it would help to improve the website profits $p(f_1(\theta))$. Thus, in order to maximize the net return $p(f_1(\theta)) - c_1(\theta)$, there must exist an optimal management level θ^* for the website manager to select. The optimization model of this risk management problem for the website can be expressed as:

$$\text{Objective: Maximize } \{p(f_1(\theta)) - c_1(\theta)\}. \quad (3)$$

$$\text{Subject to: } \theta_1 \leq \theta \leq \theta_2, \quad (4)$$

$$0 \leq c_1(\theta) \leq B_1, \quad (5)$$

where B_1 is the budget constraint for the management cost of the website. Solving the optimization model (Equations 3–5), the website manager can obtain the optimal management level, θ^* , numerically.

Similarly, in order to minimize the total cost $c_2(\gamma) + c_r(f_2(\gamma|\theta^*))$, there must exist an optimal management level γ^* for the buyer to select. The optimization model of this risk management problem for the buyer can be stated as:

$$\text{Objective: Minimize } c_2(\gamma) + c_r(f_2(\gamma|\theta^*)). \quad (6)$$

$$\text{Subject to: } \gamma_1 \leq \gamma \leq \gamma_2, \quad (7)$$

$$0 \leq c_2(\gamma) \leq B_2, \quad (8)$$

where B_2 is the budget constraint for the management cost of the buyer. Solving the optimization model (Equations 6–8), the buyer can obtain the optimal management level, γ^* , numerically.

Numerical Examples

Suppose the website manager has four options to choose from in managing the property listings on the website: (1) Free posting, *i.e.*, any potential sellers can freely post their listing without any checking; (2) Delete unqualified listings; (3) Rate the listings according to certain criteria; or (4) Hire experts to evaluate or comment on the individual listings. Among the four options, the website managers can select at least one method to manage the lists. Unlike options 2, 3 and 4, which can be

Exhibit 5
Risk Management Levels, Cost, Profit and Net Return for Website Manager

Solution	Option	Cost, $c_1(\theta)$ (\$)	Profit, $p(f_1(\theta))$ (\$)	Net Return (\$)
1	Only 1	500	40	-460
2	Only 2	900	1500	600
3	Only 3	2000	2400	400
4	Only 4	5000	6000	1000
5	2&3	2900	4000	1100
6	2&4	5900	7300	1400
7	3&4	7000	8000	1000
8	2&3&4	7900	9500	1600

combined with one another, option 1 cannot be combined with the other methods. Thus, as shown in Exhibit 5, there are eight possible risk management levels of θ . At each management level, the expected values of his cost $c_1(\theta)$, profit $p(f_1(\theta))$ and net return are shown in the Exhibit 5.

Assuming that the budget of cost B_1 is \$6000, the seventh and eighth solutions are infeasible (over budget), although the eighth one has the largest net return. The sixth solution is found to be the optimum, *i.e.*, $\theta^* = 6$. Thus, the risk management technique is to select the two options: "Delete unqualified listings" and "Hire experts to evaluate or comment on the individual listings."

Suppose now that a prospective buyer wants to buy a property in another state through this website. The prospective buyer has three options to manage risk: (1) Buy the property online directly, based on the website comments; (2) Go to the location and inspect the property personally; or (3) Hire local experts to evaluate the property. Likewise, as shown in Exhibit 6, there are four possible risk management levels of γ . At each management level, the expected values of the cost of management $c_2(\gamma)$, risk cost $c_r(f_2(\gamma|\theta^*))$ and total cost are shown in the Exhibit 6.

Exhibit 6
Risk Management Levels and Cost for the Buyer

Solution	Option	$c(\gamma)$ (\$)	$c_r(f_2(\gamma \theta^*))$ (\$)	Total Cost (\$)
1	Only 1	50	3500	3550
2	Only 2	1200	3000	4200
3	Only 3	1500	2500	4000
4	2&3	2700	2000	4700

Assuming that the budget of management cost B_2 is \$2000, the first solution is the optimum *i.e.*, $\gamma^* = 1$. Here, the risk management technique is to buy the property online, based on the website's comments on the property, and thereby minimize the total cost to \$3550.

Risk Management Methods

Arising from the above risk analysis, some suggestions on risk management methods will be discussed to mitigate its adverse effects. Information technology is not a major impediment to the adoption of electronic markets (Lee and Clark, 1997; Muhanna, 2000; and Brice, 2001). Most risks, uncertainties and barriers stem from social, economic and legal factors, rather than information technology-related obstacles.

Website Risk Management Methods

Every market transaction consists of information gathering, contract formation and trade settlement (Lee and Clark, 1996). To manage website risks, the first important thing is to reduce the incomplete or distorted information in the electronic market. Lee and Clark identified two features that are crucial for reducing the misinformation involved in electronic markets: (1) certain standards for product ratings, and (2) a trusted party to carry out product inspection. Both pure electronic real estate markets and electronic markets from other industries demand buyers to purchase products from descriptions (information) without physically inspecting them. Therefore, these two features, which are fundamental to the success of other industries, are also applicable to real estate electronic markets. However, the non-homogeneous nature of real estate limits the usefulness of "product ratings."

To build an internationally trusted party in real estate e-commerce, an international or national Authority for Uniform Specification of Property (AUSP) should be established as a trusted party to provide consistent quality standards and accurate descriptions of property. The property websites, whose major concern is that misinformation might discourage buyers from purchasing property electronically, can require that AUSP-accredited assessors inspect all property lists. The assessors would describe the quality of properties using certain standards and objectively comment on them in detail.

To build trust between buyers and sellers, the electronic markets bear the onus of determining what to do when buyers or sellers default on an obligation, when fraudulent information is provided, or in other situations (Westland, 2002). Therefore, insurance and arbitration services are needed. Some insurance should be provided for buyers or sellers to guarantee that all information about the property is accurate or that payment will be passed to sellers according to contracts, and so on. If disputes arise between any participants, special arbitration services should be available to deal with them.

Buyer Risk Management Methods

If buyers want to reduce their risks, they can inspect the property personally before making any decision. However, if the property were located at a distance, buyers would have to incur more time and money to inspect it personally. On the other hand, because of the efficiency of the electronic market, these distant buyers may forgo the opportunity to buy the property, since a property at a good price and quality is attractive to many buyers. Therefore, for these distant buyers, the alternative method of risk management is to hire local experts to evaluate the property.

Hiring local experts to evaluate the property has several merits. First, it saves commuting time and then decreases the possibility of the property being sold to another buyer. Second, local experts are familiar with the local conditions. Finally, local experts would be able to provide buyers with detailed and specific information, which helps the buyer to make an informed decision.

Alternatively, buyers can also consider buying insurance, especially those buyers who want to use pure electronic transactions. By doing so, the risks associated with electronic transactions will be hedged or compensated by other parties.

Conclusion

This paper discussed the growth of electronic transactions in the real estate market and how information technology affects the different stages in the transaction process. The different types of risks in relation to their costs were analyzed and an optimization model developed for managing these risks. Finally, some risk management techniques were presented for both real estate website managers and buyers.

Although legislation and techniques already exist for facilitating electronic transactions in real estate, its application in which these transactions can be conducted is still very much in its infancy. Like other electronic transactions, developing trust between participants is a vital key for the full growth of real estate electronic transactions (Hsiung, Scheurich and Ferrante, 2001; and Westland, 2002). Hence, real estate firms and agents should conscientiously work towards building confidence and trust in order to attract more buyers and sellers to adopt electronic transactions.

References

- Aalberts, R. J. and A. M. Townsend, Real Estate Transactions, the Internet and Personal Jurisdiction. *Journal of Real Estate Literature*, 2002, 10:1, 27-44.
- Atif, Y., Building Trust in E-commerce, *IEEE Internet Computing*, 2002, 6:1, 18-24.
- Baen, J. S., The Effects of Technology on Retail Sales, Commercial Property Values and Percentage Rents, *Journal of Real Estate Portfolio Management*, 2000, 6:2, 185-201.
- Baen, J. S. and R. S. Guttery, The Coming Downsizing of Real Estate: Implications of Technology, *Journal of Real Estate Portfolio Management*, 1997, 3:1, 1-18.
- Brice, B., E-Signatures in the Real Estate World, *Real Estate Issues*, 2001, Summer, 43-6.

- Bond, M. T., M. J. Seiler, V. L. Seiler and B. Blake, Uses of Websites for Effective Real Estate Marketing, *Journal of Real Estate Portfolio Management*, 2000, 6:2, 203–10.
- Borsuk, M., Nowhere Yet Everywhere: Integrating Online Buying's Impact on Retail Property Values, Working paper, University of North Texas, Presented at the ARES Annual Meeting, Tampa, FL, 1999.
- Chan, S., Risky E-business, *Internal Auditor*, 2001, December, 62–3.
- Fletcher, J., Touring the Tangled Web of For-Sale-by-Owner Homes, *The Wall Street Journal*, 1997, June 6, B12.
- Guttery, R. S., J. S. Baen and J. Benjamin, Alamo Realty: The Effects of Technology Changes on Real Estate Brokerage, *Journal of Real Estate Practice and Education*, 2000, 3:1, 71–84.
- Heller, F. A. and J. Krukoff, Staking a Claim on the Electronic Frontier: Real Estate Finds a Home Online, *Database*, 1997, 20:1, 50–2, 54–9.
- Hemel, E. and C. R. Schmidt, Shopping Center Real Estate Investment Trusts: Internet's Potential Impact on Retail Real Estate, *Merrill Lynch In-depth Report*, RC#60206301, March, 4, 1999.
- Hsiung, H., S. Scheurich and F. Ferrante, Bridging E-business and Added Trust: Keys to E-business Growth, *IT Professional*, 2001, 3:2, 41–5.
- Jung, C., I. Han and B. Suh, Risk Analysis for Electronic Commerce Using Case-based Reasoning, *International Journal of Intelligent Systems in Accounting, Finance & Management*, 1999, 8:1, 61–73.
- Lee, H. G. and T. H. Clark, Impacts of Electronic Marketplace on Transaction Cost and Market Structure, *International Journal of Electronic Commerce*, 1996, 1:1, 127–49.
- ., Market Process Reengineering Through Electronic Market Systems: Opportunities and Challenges, *Journal Of Management Information Systems*, 1997, 13:3, 113–36.
- Lucas, H. C., Information Technology and Physical Space, *Communications on the ACM*, 2001, 44:11, 89–96.
- Manchala, D. W., E-commerce Trust Metrics and Models, *IEEE Internet Computing*, 2000, 4: 2, 36–44.
- Mander, E., The Electronic Landlord: The Net Not Yet a Threat to Mall Retail, *Shopping Centers Today*, 1996, August, 17–8.
- Miller, N. G., Retail Leasing in a Web-Enabled World, *Journal of Real Estate Portfolio Management*, 2000, 6:2, 167–84.
- Muhanna, W. A., E-commerce in the Real Estate Brokerage Industry, *Journal of Real Estate Practice and Education*, 2000, 3:1, 1–16
- National Association of REALTORS, Realtors and the Internet: The Impact of Online Technologies on the Real Estate Industry, July 1999, (<http://www.onerealtorplace.com/online.nsf/>).
- Rodriquez, M., J. Lipscomb and W. Yancey, Under All is the Net: Surfing the Internet for Real Estate Information, *Journal of Real Estate Literature*, 1996, 4:2, 207–27.
- Schwarz, M., How Will Internet Commerce Change the Retail Scene, *Urban Land*, 1997, 70.
- Skevington, P. J., From Security to Trust-confidence to Trade Electronically, *IEE Colloquium (Digest)*, 1998, 460, 1–6.
- Southerland, R., Just Sign on the Pixilated Line, *National Real Estate Investor*, 2002, April, 71–5.
- Su, J. W. and D. W. Manchala, Trust vs. Threats: Recovery and Survival in Electronic Commerce, Proceedings of the 19th IEEE International Conference on Distributed Computing Systems, 1999, 126–33.
- Thrall, G. I., Real Estate Information Technology: The Future is Today, In G. H. Castle III, (Ed.), *GIS in Real Estate: Integrating, Analyzing, and Presenting Locational Information*. Colorado Springs: GIS World and Appraisal Institute, 1999.

- Tse, R. Y. C. and J. R. Webb, The Effectiveness of a Web Strategy for Real Estate Brokerage, *Journal of Real Estate Literature*, 2002, 10:1, 121-30.
- Wheaton, W. C., A Perspective on Telecommunications Technology and Real Estate Office, Industrial and Retail Markets, *Real Estate Finance*, 1996, 13:2, 13-7.
- Westland, J. C., Transaction Risk in Electronic Commerce, *Decision Support System*, 2002, 33: 1, 87-103.

