

Personalized Multidimensional Process Framework For Dynamic Risk Analysis In The Real Estate Industry

Nur Atiqah Rochin Demong^{1,2} and Jie Lu¹

¹*Decision Systems & e-Service Intelligence (DeSI) Lab, Quantum Computation & Intelligent Systems (QCIS) Centre, School of Software, Faculty of Engineering and Information Technology, University of Technology Sydney (UTS), P.O. Box 123, Broadway, NSW, Australia
ndemong@it.uts.edu.au, jielu@it.uts.edu.au*

²*Faculty of Office Management and Technology, Universiti Teknologi MARA, Puncak Alam Campus, Puncak Alam, Selangor, 42300 Malaysia
rochin@salam.uitm.edu.my*

Abstract

The risk analysis for real estate property investment is subject to high risk. It is qualitatively and quantitatively assessed by various techniques such as the analytical hierarchy process (AHP) and the analytic network process (ANP) which determine the risk factors based on expert survey, weight and rank the factors using algorithm and mathematical formula and decide the best investment based on performance index of the alternatives given. However, experts from the field have different opinions and judgments about the environment of the real estate industry and this scenario will affect the result of the risk factor weight and ranking. Moreover, different investors have different goals and objectives to be achieve. Thus, this paper will propose a new personalized multidimensional process (PMP) framework based on knowledge discovery. This framework comprises of two new methods namely the personalized association mapping (PAM) method and the personalized multidimensional – sensitivity analysis (PM-SA) method. The innovations of this research are the justification of risk factor weight and ranking. It will be based on deterministic approach using historical data driven to decision support using knowledge discovery in database and the heuristic approach which is refers to investors' personalization of the risk factors which fulfil their requirements.

Keywords

Multidimensional Analysis, Association Mapping, Sensitivity Analysis, Personalization

1. Introduction

Decision making is a process of gathering input and process the data collected for analysis to produce a list of outcomes based on sources and limitations given (Lu, et al., 2007; Niu, et al., 2009). All decisions made will involve either low, medium or high level risk based on the uncertainty factors that will affect the analysis. There is a positive correlation between the uncertainty of factors related to the decision making and level of risk. That being the case, investors who are familiar with the sources and factors that will affect the decision making, and know on how to monitor and control, thereby lowering the uncertainty factors, would in turn the lower the risk involved. Hence, this paper will propose a new

personalized multidimensional process framework for dynamic risk analysis investment in the real estate industry.

Risk-based decision making concepts and applications have been discovered by many researchers who have applied different techniques or methods to support the decision making process in different fields. For example, practices on risk-based decision making for investment in real estate industry study have been conducted to investigate the risk related issues. It was found that many of the decisions were made based on investigating and analysing factors by giving weight, calculate and select the best option based on highest performance index (Piyatrapoomi, Kumar & Setunge, 2004). There is a gap found in the literature review where there is a need of the justification of risk factor weight and ranking which is based on historical data driven to decision support using knowledge discovery and investors' personalization for real estate investment risk analysis.

Real estate industry business processes includes managing buying and selling properties, rental services for properties, and advertisements of properties for sale or rent. Buying and selling properties involves high cost project or investment and need to be considered carefully before doing any transactions. Real estate has been regarded as a high profit industry and is currently developing quickly in China (Hui, Zhi & Ye, 2009). Even though the investment in real estate industry incurred high cost and slow liquidity, however, the investment in real estate industry yields more value and provides a high rate return of investment in a short period of time. The pull factor of high rates of return in a short period of time attracts investors who have enough budget and capital to invest in real estate industry. Some investors gain their capital for investment through mortgage either from commercial banks or organizations. The prices and value of the property in real estate industry normally increases all the time especially when the location of the property is surrounded by facilities and amenities even though it is still in the development phase. For example, if there are public transport hubs or other amenities such as playgrounds, parks, community centres, schools which are still in development progress, the prices or value of the property will increase once these facilities are complete and ready to be used.

The real estate has an increasingly important role in the national economy. It is regarded as a pillar industry that is able to stimulate gross domestic product (GDP) rapidly. However, the real estate projects are characterized with high risk, high return and long cycle, which need real estate investors to carefully research each project so as to maximize the return and minimize the risk. The real estate business is very risky due to large-scale and long-term, and other factors such as natural, social, economical, regulatory, psychological factors. Once the decision is at fault, investors will suffer huge or even destructive damages. Therefore, risk analysis is necessary using scientific methods and tools to understand the risk situation thoroughly when making decisions on investment (Yu & Xuan, 2010).

Real estate investment risk analysis is performed to determine the best project with low risk and have high return on investment is selected among the real estate portfolio. Real estate investment normally related to capital risk and liquidity risk. Risk occurs at different stages of investment process. Risk arises because of possible consequences and associated uncertainties, and there are several risk factors or variables and risk sources that will affect the level of risk for given alternatives. The evaluation of risk will be affected by different types of risk factors and risk sources for investment in real estate industry.

2. Risk Sources and Risk Factors in the Real Estate Industry

This section explains the five main categories of risk sources and risk factors for investment in the real estate industry, namely financial risk, economic risk, scheduled risk, policy risk, and technical risk and others. Each of these risk sources has its own risk factors as a sub element.

2.1 Financial Risk

Financial risk refers to the uncertainty of profits which originate from the process of financing, money allocation and transfer, and interest payments as financial aspects of a project. The financial risk consists of three sub-categories of risk factors: policy, engineering and market. According to Zhi and Qing (2009), financial risk includes own fund risk, bank loan risk, shares risk and financial structure risk. Financial risk analysis is the core of real estate investment risk analysis and will directly determine the decision making concerning the investment. Real estate investment is subject to high risk because it is heavily dependent on bank loans, and the risks involved can be traced back to the asset security of bank loans (Xiaozhuang, 2008). Financial risk can also be mitigated by analysing the real estate portfolio, based on the financial requirements of the real estate investment (Wu et al., 2009). According to Saleem and Vaihekoski (2008), currency risk can have very important implications for portfolio management, the cost of capital of a firm, and asset pricing, as well as currency hedging strategies, as any source of risk which is not compensated for in terms of expected returns should be hedged. Real estate investment is speculative and its return and risk are influenced by many factors, such as the natural environment, the socio-economic environment, the market, and enterprise purchasing capability (Liu, 2007).

2.2 Economic Risk

Economic risk includes regional development risk, market supply and demand risk, and inflation risk (Zhi and Qing, 2009). Li and Suo (2009) define economic risk factors as consisting of the sales cycle, industry competitiveness, economic operation, exchange rate and interest rate.

2.3 Scheduled Risk

Scheduled risk affects the degree of risk for the given alternatives (Sun et al., 2008). Real estate investment is normally related to capital risk and liquidity risk. Investors must have the knowledge to understand and manage these factors in the real estate industry. The list of projects for an investment need to be analyzed and priority is given to the most beneficial project according to the available budget and time. Liquidity risk is related to scheduled risk because both of these risk sources are dependent on time series.

2.4 Policy Risk

Policy risk refers to uncontrollable elements which can cause great harm as a source of risk in real estate development, even though there is only a small likelihood of their occurrence (Yu & Xuan, 2010). Jin (2010) highlights policy environment risk as the lifecycle risk impact factors of a real estate project. Organization policy and industrial policy are also examples of the variables or factors that might affect the result of risk analysis (Sun et al., 2008).

2.5 Technical Risk and Others

Technical risk refers to the harm and danger caused by technical deficiencies or defects (Yu and Xuan, 2010), and tendering management, design change and project construction are the source of risk factors for technical risk (Sun et al., 2008). Leifer et al. (2000, cited in Strong et al., 2009, define three major dimensions of uncertainty that are relevant for all innovation development projects targeting new lines of business: technological, market organizational, and resource uncertainties. Other risk factors include political risk, construction risk, location factors, and settlement risk.

3. Issues and Challenges

This section will explain the issues and challenges of existing risk analysis techniques which will be the guideline for the proposed framework for this paper.

3.1 High Cost and High Risk

Investment in real estate industry involving high cost and high capital properties can be high risk projects as it may have slow liquidity and are not easily sold. Moreover, property prices such as house prices are affected by many factors, for example, interest rate, land supply and inflation rate (Hui, Yu & Ip, 2010). There will be a list of projects for investment that needs to be analysed and priority will be given to the project with the highest returns on investment while considering the limited or available budget and time. Real estate investment is speculative, and its returns and risk are influenced by many factors, such as natural environment, socio-economic environment, market and enterprise purchasing capability (Liu, Zhao & Liu, 2007; Zhou, Zhang & Li, 2008). Moreover, the risk factors changes dynamically over a period of time. These changes will affect the risk level of real estate portfolio. Therefore, there is a need to measure and analyze the risk effectively and efficiently in order to achieve best result and gain profits tangibly or intangibly.

3.2 Uncertainty of Risk Factors

Risk measurement for decision making processes is dealing with the measurement of uncertainty and probability or consequences for the choices given for the investment. The uncertainty of variables or factors that will affect the risk management processes such as risk evaluation result will give impact to the success of the project investment in the real estate industry. The investors must have knowledge, understand and know how to manage the factors that will affect the investment in the real estate industry. Thus, it is important for the investors to make wise decisions for investment in the real estate industry. The risk analysis is part of the process involved when deciding on the project that should be given priority for investment so that the investors' goals and objectives can be met in spite of the limited budget available. In order to control risk and enhance returns, investors of real estate should not exclusively choose projects of "both high" (high risk and high return) or "both low" (low risk and low return), instead they need rationally utilize capital to develop different types of projects (Liu, 2007).

3.3 Insufficient Comprehensive Risk Analysis

There are many risk analysis models and methodologies applied to real estate and other industries. Each of these models or methods has its own features or characteristics, advantages, disadvantages and limitations. Risk analysis consists of three stages: risk identification, risk estimation and risk assessment (Yu & Xuan, 2010). Several examples of risk identification methods at present include: Delphi, Brainstorming, Fault Tree Analysis, SWOT analysis and expert survey. Expert survey method is widely used to identify the risk factors based on heuristic approach which is not sufficient for comprehensive risk analysis.

According to Zhou, Zhang and Li (2008), real estate investment risk evaluation is a complex decision making problem with multiple factors targets. Most existing real estate investment risk evaluations give priority to the single-goal decision making, use the single indexes, such as the maximum expectation, the largest variance, and the minimum standard deviation rate to evaluate the real estate investment. These evaluating methods are easy to understand, but they cannot comprehensively evaluate the quality of an overall program. Also, there are some who use Multi-element Analysis Model (MAM) for real estate investment risk evaluation. The traditional MAM is based on the assumption that the whole are subject to the normal distribution. Yet, the whole distribution of real estate investment program is uncertain, thus, it is inadequately precise to use MAM for real estate investment risk analysis. Furthermore, many

evaluation programs or models involve many evaluation indexes have dimensions that are different and weights which are difficult to determine, which translates to difficulties in the practical application.

3.4 Misinterpretation and Different Judgments of Risk Factors

From the review of literature, studies done by other researchers categorize the risk sources and risk factors differently. Some of researchers classified the risk factors according to the stages of real estate investment and others group it according to the sources. This will lead to misinterpretation of factors that will affect the risk analysis result. Thus, this research will apply the combination of heuristic and deterministic approach to gather information from literature reviews of journals, reports, domain database of Australian Property Monitor and others secondary and published documents to identify the risk sources and its factors that will affect the property investment risk analysis.

Analytic Hierarchy Process (AHP) is a multi-criteria decision analysis technique (Sun et al. 2008). AHP is very popular technique applied in risk analysis to weight and ranks the risk factors using hierarchical data model proposed by Saaty in 1980. Another model introduced by Thomas L. Saaty (1986) is called Analytic Network Process (ANP). ANP is a generalization of AHP which allows both interactions and feedbacks within cluster of elements (inner dependence) and between clusters (outer dependence). Both AHP and ANP determine the risk evaluation index based on expert survey is applied to determine the weight of factors that will influence the decision making process. Experts in the field have different opinions and judgment about the factors and this will affect the result of decision made. Moreover, the investors will view the factors in different ways and sometimes they might not be satisfied or agree with the judgment given by the experts in the field. Personalization is needed to meet the decision maker's requirements (Lu, et al., 2009).

3.5 Complexity and Limited Capabilities of Existing Risk Prediction Models or Methodologies

There are several methodologies or models proposed by other researchers to evaluate, analyse, assess or predict the risk for several alternatives or options given. Some of the methods or models include a Monte Carlo method, fuzzy set theory (Sun et al. 2008), Markowitz, fuzzy-analytical hierarchy process (F-AHP), a real option method (Rocha et al. 2007), and a hidden Markov model. These methods or models have different characteristics, advantages and limitations to be applied in different fields (Sun et al. 2008; Lander & Pinches 1998, cited in Rocha et al. 2007). For example, real option methodology may pose problems to the practical implementation of risk management analysis. Some of the problems include the lack of mathematical skills, restrictive modelling assumptions, increasing complexity and limited power to predict investment in competitive markets (Lander & Pinches, 1998 cited in Rocha et al. 2007).

3.6 Unavailability of High Quality Data

Zeng, An and Smith (2007) believes that high quality data is a prerequisite for an effective application of sophisticated quantitative techniques. They therefore agree and suggest that it is essential to develop new risk analysis methods to identify major factors, and to assess the associated risks in an acceptable way in a various environments where such mature tools cannot be effectively and efficiently applied.

In decision making, the correct methodology is important to ensure the right decision is made and will be beneficial to the investors, users or agents. Thus, more formal methodology is necessary in decision making processes (Hussain et al. 2007; Zeng, An & Smith, 2007). Formal methodologies are needed to make sure that the decision made can be assessed effectively and efficiently. Many risk analysis techniques currently used in the UK construction industry are comparatively mature, such as Fault Tree Analysis, Event Tree Analysis, Monte Carlo Analysis, Scenario Planning, Sensitivity Analysis, Failure Mode and Effects Analysis, Programme Evaluation and Review Technique (Zeng, An & Smith, 2007). However, in many circumstances, the application of these tools may not give satisfactory results due to

the incomplete risk data available. In addition, as concluded from the literature review, there are no existing approaches on real estate property investment analysis that takes into account the investors' personalization and applied the multidimensional analysis of the factors that will affect the decision making process.

3.7 Requirement of Historical Data and Information Using Computer System for Risk Prediction

Yu & Xuan (2010) agreed that it is feasible to develop a practical computer system for the real estate risk-based investment decision making. The computer system could effectively predict the level of financial risk of real estate development project and could help the investor control risk effectively. However, the real estate investment decision-making has a strong feature of valuing practice and experience. The expertise practical experiences will have a strong impact on decision making and investors' risk preferences. Moreover, the estimation of the interval values of items in the cash flow statement should be based on adequate market research and historical data and information accumulation. Based on issues and challenges discussed in this section, a new personalized multidimensional process framework will be proposed to help the investors in risk analysis decision making.

4. A Personalized Multidimensional Process (PMP) Framework

A personalized multidimensional process (PMP) framework has been developed to solve the issues and challenges for investment analysis in the real estate industry as shown in Figure 1.

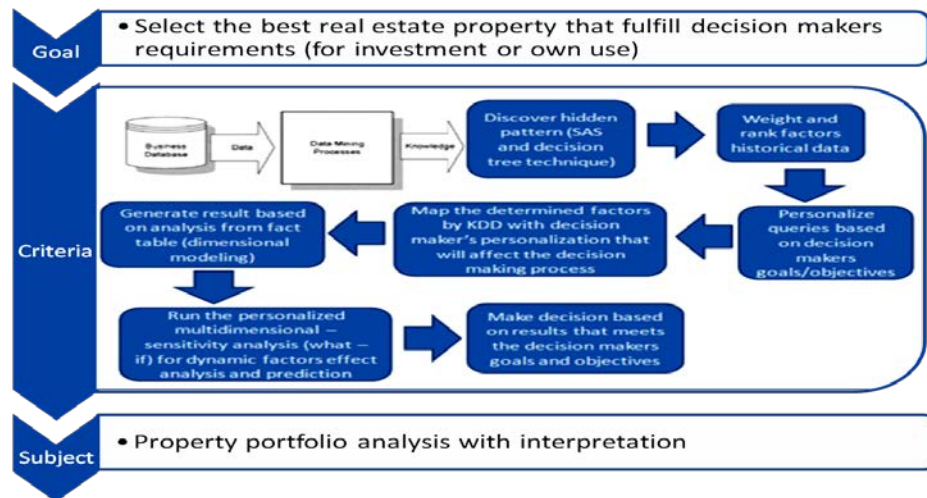


Figure 1: A personalized multidimensional process (PMP) framework.

The personalized multidimensional process (PMP) framework consists of nine major different steps. This framework applies the bottom up approach to support the decision making process for dynamic risk analysis for investment in the real estate industry. This framework will provide the pattern of data, hence, determine the factors that contribute to the buying or selling of real estate property analysis which discover three main types of questions: what? why? and when?. For example, the data driven approach will explain which factors that contribute to the short time frame for property sold. Is it because of the features of the property, location, price, type of property, type of sale, sale result, size of property for certain period of time or which real estate agency that have outstanding performance in handling the transactions? This framework presents a data driven system and a process from data to patterns and from patterns to applicable rules/methods for decision support. The investors need to set up their goals and objectives before proceeding with the data analysis. Once the goals and objectives have been identified,

the pattern of data using SAS tool and knowledge discovery in database or data mining technique will be explored. The application of data mining technique or knowledge discovery used to determine, weigh and rank the risk factors that will affect the decision making process in the real estate industry which applied the heuristic through deterministic approach will be more reasonable. Hence, the application of knowledge discovery for the real estate property analysis helps to overcome the lack of information and precise objective data, misinterpretation and different judgments of probability estimations made by the experts in the field which are often based on inadequate information and intuition. Moreover, not all solutions provided by the technology meets the investors goals and objectives. A PMP framework based on knowledge discovery dealing with risk analysis process will be developed to deal with the real estate property investment analysis that meets investors' requirements. The PMP framework will helps the investors to achieve their goals and objectives using heuristic through deterministic approach.

Based on the pattern of data discovered, the system will automatically give the weight and rank the risk factors. A data mining technique known as decision tree induction will be used to identify the pattern of data and will give the weight and ranking of the factors of the real estate property to be sold in a certain period of time. These weight and ranking of factors provided by the data mining technique might not meet the investor's requirement. Hence, the investors will personalize their queries based on their requirements.

Then, the personalized association mapping (PAM) method will be develop to map the determined factors by knowledge discovery with investor's personalization that will affect the decision making process. This method will help the investors to achieve their goals and objectives using deterministic and heuristic approaches. Deterministic approach is based on historical and pattern data while the heuristic approach is based on investors' personalization. The system will generate the result based on investors' personalization and pattern of data from the online analytical processing combine with data mining approach. A dimensional modeling using star schema will be used to generate the result. A star schema refers to a fact table which is surrounded by dimensions table. Time dimension is a mandatory dimension in a star schema to identify the changes of attributes over a period of time.

Next, sensitivity analysis will be conducted to understand how sensitive the factors are to the variation of the investors' personalization since uncertainties are involved in the factor determination over a period of time. The variation of the result in the factors personalized by the investors that will affect the real estate property sold in a certain period of time can be traced and identified using this personalized multidimensional – sensitivity analysis (PM-SA) method. Based on the findings or results from the analysis, the investors will choose the best option that meets their requirements.

5. Summary

This paper suggests a new framework that is applicable for investment in the real estate industry. Risk-analysis is an important area of focus in real estate investment, which involves high risks and cost. Risk with high uncertainties will lead to the occurrence of a higher percentage of probabilities and consequences. The uncertainties of a number of risk factors and risk sources contribute to the level of dynamic risk prediction, which is dependent on what takes place from the initial investment to the later stages of the real estate development.

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