RISK ASSESSMENT TECHNIQUES IN REAL ESTATE INVESTMENT: A CONCEPTUAL REVIEW

Malka Thilini[a*], N.C.Wikcramaarachchi[b], P.A.N.S.Anuradha[c]
[a & b] *Department of Estate Management and Valuation, University of Sri Jayewardenepura, Sri Lanka*
[c] *Department of Finance, University of Sri Jayewardenepura, Sri Lanka*

Abstract

The intrinsic existence of risk in Real Estate investment and often being less quantifiable, encourages to identify, and measure the associated risk to satisfy the expectations of an investment. Hence, choosing an appropriate technique is paramount. Many techniques have been applied in assessing the risk, yet no review has done. This paper aims to present a critical review of the risk assessment models and techniques, already applied. Details of 18 techniques, 12 other possible and applicable techniques and 02 models were used as data and reviewed chronologically. Results revealed that majority are qualitative and varied as per the different scenarios, thus applying a combination is recommended.

Keywords: Risk: Real Estate Investment; Risk Assessment Techniques; Risk Management

Introduction

Real estate investments are generally considered as high risk. Risk is involving the chance of an investment's actual return to be differed from the expected return (Thilini & Wickramaarachchi, 2019) . Risk may affect the entire management or a project. According to (.R.DeLisle, 2010) risk in decision-making can be caused by many factors including:

- Inaccurate Data
- Inadequate Information
- Invalid or Unreliable Predictive Models
- Lack of Understanding of Market Fundamentals
- Changes in Real Estate Law
- Other Regulatory Changes
- Changes in Competitive Environment
- Other Changes. Some of the methods are common and typical, and some of them are rarely used and still not develop hundred percent accurate model to assess the risk in real estate investments

Correct identification would treat the investor on balancing the expectations as well as the output of risk assessment is an input to the decision-making processes. Indeed, the Investment Property Forum, Investment Property Databank (2000) highlighted the need for more rigorous risk assessment measures within the broad property investment industry comprising asset and fund managers and advisors. The Carsberg in 2002 has brought the debate about risk into sharper focus on the reporting of the valuation to end users. In this scenario, assessing risk in real estate

[*]*Corresponding Author: malkathilini@gmail.com*

is pivotal. Risk assessment is the overall process of risk identification, analysis, and evaluation. It can be assessed at organizational level or at individual level. There are many tools and techniques have been used. Different tools and techniques may be appropriate in different contexts, nevertheless, there is no evidence of a review on what is more appropriate than the other. Therefore, this paper intends to conceptually review the techniques that have been applied in the risk assessment in real estate investment.

The Objective of the Study

The focus of this study is to conceptually review the techniques that have been applied in the risk assessment in real estate investment.

Methods

The data collection was purely on literature based. Altogether 30 numbers of techniques (Details of 18 techniques, 12 other possible and applicable techniques) and 02 models already applied in researches have been used as data of this research and was collected referring to published, indexed Journal articles, conference papers and reports up to 2020. Critical review method and descriptive review method were used to analysis the data according to the chronological order.

Literature Review

Various risks originate due to uncertainty arising out of various factors that influence on investment (Anon., 2020).. Risks are associated with every investment; real estate development, as an investment, is not an exception. Risks are generally defined as events that could arise and affect the critical factors of one project (Khumpaisal & Chen, (2009). The most significant risk and uncertainty towards investment return is the income stream. (Khumpaisal , et al., 2010) . In the case of using the risk assessment techniques, project managers rely on information gained from panel / board discussion, which is associated with their experience in identifying or classifying predictable risk events and setting up the Risk assessment models (Khumpaisal, 2007). Here are various techniques that can be used to assess both systematic and non-systematic risks in the real estate idustry .Among them, need of alternative techniques such as Bayesian Belief Network, Monte Carlo Simulation, and multi-criteria decision analysis techniques. real estate developers are mostly described in subjective forms, and thus, most developers use qualitative analysis methods used to measure social related risks (Chen & Khumpaisal, 2009) and ,mostly rely on non-systematic assessment techniques such as panel discussion or use their own background experiences (Gehner et al , 2006 ; Khumpaisal, 2009).

Results and Discussion

The following all methods are reviewed in a systematic way which might include introduction of the method, suitable context this method can be used to assess risk of real estate investment and its advantages and disadvantages. Further, the application of the method is described as being either strongly applicable, applicable, or not applicable. According to the literature relating to risk assessment techniques, the following methods, techniques and models can be identified.

Brainstorming

Brainstorming involves stimulating and encouraging free-flowing conversation amongst a group of knowledgeable people to identify potential failure modes and associated hazards, risks, criteria for decisions and/or options for treatment. The term “brainstorming” is often used very loosely to mean any type of group discussion (Anon., 2020) However, true brainstorming

involves qualitative techniques to try to ensure that each member's imagination is triggered by the thoughts and statements of others in the group. Brainstorming can be used in conjunction with other risk assessment methods described below or may standalone as a technique to encourage imaginative thinking at any stage of the risk management process and any stage of the life cycle of a system (Valis & Koocky, 2009) . It may be used for high-level discussions where issues are identified, for more detailed review, or at a detailed level for particular problems. According to Khumpaisal & Chen, (2009), risks in each commercial real estate development can be identified at project management level, using brainstorming techniques .This technique is being applicable to risk assessment in real estate industry.

Delphi Technique

The Delphi technique is a procedure to obtain a reliable consensus of opinion from a group of experts. Although broadly used to mean any form of brainstorming, an essential feature of the Delphi technique, is that experts expressed their opinions individually and anonymously while having access to the other expert's views as the process progresses. The Delphi technique can be applied at any stage of the risk management process or at any phase of a system life cycle, wherever a consensus of views of experts is needed (Scheele, 1975).

To explore the activities that constitute the body of knowledge of real estate practitioners in order to represent practice better so that, practice can be improved and real estate education can be aligned with industry requirements using a modified Delphi technique with a panel of real estate experts practicing in the United Kingdom (Boyd, et al., 2020).Further, this is suitable for following cases too (Dagen, et al., 2019)

- Delphi has legitimacy and suitability for solving highly complex problems
- Delphi is flexible and well suited when there is incomplete knowledge about phe-nomena; especially when the goal is to improve the understanding of problems, opportunities or solutions, or to develop forecasts.
- Delphi is appropriate for exploring areas in which controversy, debate or a lack of clarity exist and
- it is also an acceptable substitute for direct empirical evidence when the latter is unavailable

Brainstorming, Nominal Group Technique, and the Delphi technique provide a structured format that helps increase the quantity and quality of participant responses as individuals A R (McMurray, 1994) whereas a brainstorming session is known for interactive group meetings. (Mulder, 2017) . This method is being applicable to risk assessment in real estate industry.

Checklists

Checklists are lists of hazards, risks or control failures that have been developed, usually from experience, either as a result of a previous risk assessment or as a result of past failures. A checklist can be used to identify hazards and risks or to assess the effectiveness of controls. Inspectors will verify and inspect the real estate investment risk management systems of insurance companies using the Risk Management Systems Checklists (Common Items). In recently, **checklist** used to stay on top of all the tasks in a real estate transaction and include any due diligence and contingency deadlines (Brien, 2020). However, it has some weaknesses such as, it is a non-graphical representation. developing a comprehensive checklist may be difficult; cannot provide a quantitative value associated with each risk as well as can not take into account historical information and lessons learned from previous ((H.Martin, 2018) so ,this techniques may be used as part of other techniques.

Failure Modes and Effects Analysis (FMEA) and Failure Modes and Effects and Criticality Analysis (FMECA)

Failure modes and effects analysis (FMEA) is a technique used to identify the ways in which components, systems, or processes can fail to fulfil their design intent. FMEA identifies the following:

- All potential failure modes of the various parts of a system (a failure mode is what is observed to fail or to perform incorrectly);
- The effects these failures may have on the system;
- The mechanisms of failure; and,
- How to avoid the failures, and/or mitigate the effects of the failures on the system

FMECA extends an FMEA so that each fault mode identified is ranked according to its importance or criticality. However, the conventional risk priority number method has been extensively criticized in the literature for a lot of reasons such as ignoring relative importance of risk factors, questionable multiplication procedure, and imprecisely evaluation. (Liv, et al., 2016). These two methods provide only qualitative information. FMEA is widely used in industry as "What if" process. Still this is not applying to real estate industry.

Preliminary Hazard Analysis (PHA)

PHA is a simple, inductive method of analysis whose objective is to identify the hazards and hazardous situations and events that can cause harm for a given activity, facility, or system. It is most commonly carried out early in the development of a project when there is little information on design details or operating procedures and can often be a pre cursor to further studies or to provide information for specification of the design of a system. It can also be useful when analysing existing systems for prioritising hazards and risks for further analysis or where circumstances prevent a more extensive semi quantitative technique (Valis & Koocky, 2009) and still this is not apply to the real estate industry.

HAZOP

The HAZOP process is a qualitative technique based on use of guide words that question how the design intention or operating conditions might not be achieved at each step inthe design, process, procedure, or system. HAZOP is similar to causes and failure modes techniques in that it identifies failure modes of a process, system, or procedure, their causes and consequences causes and failure modes; whereas, FMEA starts by identifying failure modes.(Valis & Koocky, 2009) . The HAZOP technique was initially developed to analyse chemical process systems, but it has been extended to other types of systems and complex operations. These include mechanical and electronic systems, procedures, and software systems, and even to organisational changes and to legal contract design and review. (Galante, et al., 2014). This technique is qualitative technique but, this is not applicable to the real estate industry.

Structured "What-if" Technique (SWIFT)

SWIFT was originally developed as a simpler alternative to HAZOP. The SWIFT is normally applied at more of a system level with a lower level of detail than HAZOP. While SWIFT was originally designed for chemical and petro chemical plant hazard studies, the technique is now widely applied to systems, plant items, procedures, and organisations generally. In particular, it is used to examine the consequences of changes and the risks thereby altered or created (Valis & Koocky, 2009). This technique still not apply to the real estate industry.

Toxicity Assessment (TA)

Environmental risk assessment is used here to cover the process followed in assessing risks to plants, animals and humans as a result of exposure to a range of environmental hazards. The method involves analysing the hazard or source of harm and how it affects the target population, and the pathways by which the hazard can reach a susceptible target population. used across a very wide range of different risk areas, outside human health and the environment, and is useful in identifying treatments to reduce risk (Valis & Koocky, 2009).but, this technique is not applicable to the real estate industry.

Scenario Analysis (SA)

It can be used to identify risks by considering possible future developments and exploring their implications. The power of scenario analysis is illustrated by considering major shifts over the past 50 year's in technology, consumer preferences, social attitudes, etc. Scenario analysis can not predict the probabilities of such changes but can consider consequences and help organisations develop strengths and the resilience needed to adapt to foreseeable changes.

Real estate investors commonly conduct a real estate analysis for rental income properties they are considering to sell or to purchase in order to help them make the most profitable investment decision. A Rent Scenario Analysis provides investors one such evaluation method (Kobzeff, 2018) so, this technique is being applicable to risk assessment in real estate industry.

Business Impact Analysis (BIA)

Business impact analysis analyses how key disruption risks could affect an organization's operations and identifies and quantifies the capabilities that would be needed to manage it. Specifically, BIA is used to determine the criticality and recovery timeframes of processes and associated resources (people, equipment, and information technology) to ensure the continued achievement of objectives. Additionally, the BIA assists in determining interdependencies and interrelationships between processes, internal and external parties, and any supply chain linkages (Valis & Koocky, 2009). Still, not apply to real estate industry.

Root Cause Analysis (RCA)

The analysis of a major loss to prevent its re-occurrence is commonly referred to as Root Cause Analysis (RCA), Root Cause Failure Analysis (RCFA), or loss analysis. RCA is focused on asset losses due to various types of failures, while loss analysis is mainly concerned with financial or economic losses due to external factors or catastrophes. RCA is applied in various contexts with the following broad areas of usage: (Valis & Koocky, 2009).

- Safety-based RCA is used for accident investigations and occupational health and safety
- Failure analysis is used in technological systems related to reliability and maintenance
- Production-based RCA is applied in the field of quality control for industrial manufacturing
- Process-based RCA is focused on business processes; and,
- System-based RCA has developed as a combination of the previous areas to deal with complex systems with application in change management, risk management and systems analysis.

In both quantitative and qualitative risk analysis is used but still, this technique is not applicable to real estate industry.

Fault Tree Analysis (FTA)

FTA is a technique for identifying and analysing factors that can contribute to a specified undesired event ("top event"). Causal factors are deductively identified, organised in a logical manner, and represented pictorially in a tree diagram and their logical relationship to the top event. The factors identified in the tree can be events that are associated with component hardware failures, human errors, or any other pertinent events. A fault tree may be used qualitatively to identify potential causes and pathways to a failure (the top event) or quantitatively to calculate the probability of the top event.

Event Tree Analysis (ETA)

ETA is a graphical technique for representing the mutually exclusive sequences of events following an initiating event according to the functioning/not functioning of the various systems designed to mitigate its consequences. It can be applied both qualitatively and quantitatively. ETA can be used for modelling, calculating, and ranking (from a risk point of view) different accident scenarios following the initiating event. It may be used qualitatively to help brainstorm potential scenarios and the sequences of events following an initiating event and how outcomes are affected by various treatments, barriers or controls intended to mitigate unwanted outcomes (Valis & Koocky, 2009). As a result, technical risks and economical losses of property can be minimized based on these risk analysis tool (Hong *et; al*, 2009) therefor, this method also suitable for the risk assessment in real estate sector.

Cause-Consequence Analysis

Cause-consequence analysis is a combination of fault tree and event tree analysis. The causes of the conditions or failures are analysed by means of fault trees. Cause-consequence analysis was originally developed as a reliability tool for safety critical systems to give a more complete understanding of system failures. Like fault tree analysis, it is used to represent the failure logic leading to a critical event, but it adds to the functionality of a fault tree by allowing time sequential failures to be analysed. The method also allows time delays to be incorporated into the consequence analysis, which is not possible with event trees (Valis & Koocky, 2009).

Cause-and-Effect Analysis

Cause-and-effect analysis is a structured method to identify possible causes of an undesirable event or problem. It organises the possible contributory factors into broad categories, so that all possible hypotheses can be considered. It does not, however, by itself point to the actual causes; since these can only be determined by real evidence and empirical testing of hypotheses (Valis & Koocky, 2009). It is valuable at the beginning of an analysis to broaden thinking about possible causes and then to establish potential hypotheses that can be considered more formally. Risk Assessment for Uzun Construction and Real Estate Company in TRNC the analysis of these results in order to clarify the cause and effect of each professional to keep an eye on a systematic sequence. According to that, this technique is being applicable to risk assessment in real estate industry.

Layers of Protection Analysis (LOPA)

It analyses whether there are sufficient measures to control or mitigate the risk. A cause-consequence pair is selected and the layers of protection that prevent the cause leading to the

undesired consequence are identified. LOPA may be used qualitatively, simply to review the layers of protection between a hazard or causal event and an outcome. Normally, a semi-quantitative approach would be applied to add more rigor to screening processes, for example, following HAZOP or PHA. (Valis & Koocky, 2009).

LOPA can be used to help allocate risk reduction resources effectively by analysing the risk reduction produced by each layer of protection. A process hazard analysis (PHA), such as a Hazard and Operability Study (HAZOP), is a useful tool in identifying potential hazard scenarios; however, a PHA can only give a qualitative indication of whether sufficient safeguards exist to mitigate the hazards. Layer of Protection Analysis (LOPA) is a risk management technique commonly used in the chemical process industry that can provide a more detailed, semi-quantitative assessment of the risks and layers of protection associated with hazard scenarios (Anon., 2014).

Decision Tree Analysis

A decision tree represents decision alternatives and outcomes in a sequential manner that takes into account uncertain outcomes. It is similar to an event tree, in that it starts from an initiating event or an initial decision and models different pathways and outcomes as a result of events that may occur and different decisions that may be made (Valis & Koocky, 2009).. Some articles describes the relationship between construction permit uncertainties and real estate development projects by using the Decision Tree Analysis (DTA) approach together with Monte Carlo simulations (Basdogan, et al., 2018). Therefore, this technique is used qualitative and quantitative analysis.

Human Reliability Assessment (HRA)

Human reliability assessment (HRA) deals with the impact of humans on system performance and can be used to evaluate human error influences on the system. Many processes contain potential for human error, especially when the time available to the operator to make decisions is short. The probability that revealing ways in which these errors and other failures (hardware and software) can be "recovered" by the human operators and maintenance personnel. HRA can be used qualitatively or quantitatively. Qualitatively, it is used to identify the potential for human error and its causes so the probability of error can be reduced. Quantitative HRA is used to provide data on human failures into FTA or other techniques (Valis & Koocky, 2009).

Other Possible and Applicable Techniques

According to the (Valis & Koocky, 2009), the following methods also can apply to risk assessment in real estate.

- Bow tie analysis,
- Reliability centred maintenance,
- Sneak analysis (SA) and sneak circuit analysis (SCI),
- Markov analysis,
- Monte Carlo simulation,
- Bayesian statistics and Bayes Nets,
- FN curves,
- Risk indices,
- Consequence/probability matrix,
- Cost/benefit analysis (CBA),
- Multi-criteria decision analysis (MCDA), and
- Learning curve – entropy (Duffey/Saul approach), etc.

Among them, the Chen and Khumpaisal 2009, the developers in commercial real estate development are in need of alternative methods such as Bayesian Belief Network, Monte Carlo Simulation, and multi-criteria decision analysis of risks assessment and Social risks in commercial real estate development are mostly described in subjective forms, and thus, most developers use qualitative analysis methods to measure and assess social related risks (Chen & Khumpaisal, 2009).an Real estate developers mostly rely on non-systematic assessment methods such as panel discussion or use their own background experiences (Gehner et al , 2006 ; Khumpaisal, 2009).

Analytical Network Process Model

The model adopts the principles of Multi Criteria Decision Making and is developed based on the grounded theories of Analytic Hierarchy Process (AHP). The ANP team wrote the program working for the Creative Decisions Foundation, which implements the ANP developed by Professor Thomas Saaty (2005). The ANP model is a powerful and flexible decision-making tool that helps investors or decision makers to set priorities and make the best decision when both qualitative and quantitative aspects of a decision need to be considered (Cheng and Li, 2004 ; Saaty, 2005). Saaty (2005), Cheng, et al (2005) and Chen et al (2006).

According to the (Thilini & Wickramaarachchi, 2019), the Analytic Network Process model would allow the synthesis of risk assessment criteria and comparisons among factors and would also help developers to structure the decision-making process in commercial real estate development risk assessment. Therefore, this model is being applicable to risk assessment in real estate industry.

The Stochastic Valuation Model

(Bergmann, et al., 2020) Is improved the understanding of uncertainties in the real estate industry by using a stochastic risk assessment approach and to broaden the risk assessment methodology. An uncertain aggregated cash- flow is modeled through the accumulation of the uncertain cash-flow of each period discounted by risk-free interest rates to the valuation date (t = 0). The resulting distribution of the aggregated cash flow (risk profile) is valued by a one-period certainty equivalent model using the corresponding multi-period risk premium $l_{1,..,T}$. Such modeling implies an infinite risk-bearing capacity at any point of time t, which corresponds to the view of the interviewed developers, as all projects are backed by the parent company. As a result, the accumulated stochastic discounted value of all cash flows is valued using with a one-period model. The model is based on previous literature.

Conclusion

Results revealed that majority of the techniques are qualitative and varied as per the different scenarios. The ANP model and Stochastic Valuation Models are quantitative techniques and can be accommodated more information therefore, it gives a comprehensive analysis than other techniques. Hence, investors are advised to apply recently developed models in assessing the risk and not to depend completely on one technique thus, applying a combination and the use of software applications are recommended.

Reference

Adnan, Y. M., Daud, M. N. & Ibiyemi, A., 2015. *Exploring the Delphi strategy for integrating sustainability issues into industrial real estate valuations where no market exists.* KUALA LUMPUR, MALAYSIA, Reserch Gate .

Anon., 2014. *Asset Investment Risk Management System Checklist,* s.l.: https://www.fsa.go.jp/en/refer/manual/hoken_e/h10.pdf.

Anon., 2020. *The Economic Times.* [Online] Available at: https://economictimes.indiatimes.com/definition/risk

McMurray, A.R, 1994. Three decision-making aids: brainstorming, nominal group, and Delphi technique.. *Journal of Nursing Staff Development,* 10(2), pp. 62-65.

Basdogan, S., Remoy, H. & Binnekamp, R., 2018. *Valuation Construction Permit Uncertainties in Real Estate Development Projects with Stochastic Decision Tree Analysis,* s.l.: idea .

Bergmann, P., Kamaras, E., Gleibner, W. & Guenther, E., 2020. Enhanced Cash Flow Valuation in Real Estate Management by Integrating Innovative Materials and Risk Assessment. *Journal of Sustainability,* p. 12(6).

Boyd, D., Amidu, R. A. & Smith, M., 2020. Developing a Practice-based Body of Real Estate Knowledge: A Delphi Study. *Journal of Real Estate Practice and Education,* pp. 139-167.

Brien,J.,2020.*RISMedia.*[Online] Available at: https://rismedia.com/2014/08/03/risk-management-for-real-estate-agents-12-best-practices/

Chen , Z. & Khumpaisal, S., 2009. An analytic network process for risks assessment in commercial real estate development. *Journal of Property Investment & Finance* , 27(3), pp. 238-258.

Fink-Hafner, D. et al., 2019. *Delphi Method: Strengths and Weaknesses,* Solvaia: Reserch Gate.

Galante, E., Costa, D. & Nobrega, M., 2014. *Risk Assessment Methodology: Quantitative HazOp.* [Online]
Available at:
https://www.researchgate.net/publication/269099839_Risk_Assessment_Methodology_Quantitative_HazOp

H.Martin, 2018. *Proprofs Discuss.* [Online] Available at: https://www.proprofs.com/discuss/q/75328/what-is-the-major-disadvantage-to-using-only-checklists[Accessed 19 August 2020].

Khumpaisal , S., Ross , . A. & Abdulai , R., 2010. An examination of Thai practitioners ' perceptions of risk assessment techniques in real estate development projects. *Journal of Retail & Leisure Property* , Volume Vol. 9, 2, , p. 151–174 .

Kobzeff,J.,2018.*PROAOD.*[Online]Availableat:https://www.proapod.com/Articles/scenario.htm[Accessed 16 August 2020].

Lee, J. & Lee, D. K., 2018. Application of Industrial Risk Management Practices. Application of Industrial Risk Management Practices. *International Journal of Geo Iformation,* 7(377).

Liv, H. C., Chen, Y. Z., You, J. X. & Li, H., 2016. Risk evaluation in failure mode and effects analysis using fuzzy digraph and matrix approach. *Joural of Interlectual Maufacturing,* Volume 27, pp. 805-816.

Mulder,P.,2017. *toolshero.* [Online] Available at: https://www.toolshero.com/decision-making/delphi-technique/#:~:text=With%20the%20Delphi%20Technique%2C%20you,individually%20thinking%20about%20the%20problem.[Accessed 19 August 2020].

Saripalli, P. & Walters, B., 2010. *QUIRC: A Quantitative Impact and Risk Assessment Framework for Cloud Security.* Miami, FL, USA, IEEE.

R.DeLisle, J., 2010. *Foundamentals of Real Estate ,Part ii -Space Time Demention of Real Estate.* s.l.:s.n.

Thilini, M. & Wickramaarachchi, N. C., 2019. Risk assessment in commercial real estate development: An application of analytic network process. *Journal of Property Investment & Finance,* 37(5), pp. 427-444.

Valis, D. & Koocky, M., 2009. Selected overview of risk Assessmnet Techniques. pp. 19-32.

Yao, J. & Jaafari, A., 2003. Combining Real Options and Decision Tree: An Integrative Approach for Project Investment Decisions and Risk Management. *The Joural of Structured finance ,* 9(3), pp. 53-70.