

**AN EVALUATION OF CRITICAL RISK FACTORS IN
LOCAL CONDOMINIUM DEVELOPMENTS
THROUGH ANALYTIC HIERARCHY PROCESS
(AHP)**

**MASTER OF SCIENCE
IN
CONSTRUCTION PROJECT MANAGEMENT**

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(AHP)**

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“This dissertation was submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfilment of the requirements for the Master of Science in Construction Project Management”

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May 2019

Declaration of the candidate & Supervisor

I, the undersigned, hereby declare that the Dissertation entitled “**An Evaluation of Critical Risk Factors in Local Condominium Developments Through Analytic Hierarchy Process (AHP)**” written and submitted by me to the University of Moratuwa, in partial fulfilment of the requirement for the award of degree of Master of Science under the guidance of Dr. Chandana Siriwardana is my original work and the conclusions drawn therein are based on the material collected by myself.

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Dedication

This thesis is dedicated to my loving Parents, Wife and Family
and particularly to
all the stakeholders who have spent their time and effort in the development of
condominiums in Sri Lanka.

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First, I express my sincere thanks to my Supervisor Dr. Chandana Siriwardana and the Staff of University of Moratuwa for guiding me in completing of this study and for encouraging me to publish this work as a paper.

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Abstract

Within the last few decades, the Sri Lankan construction industry is experiencing significant growth in high-rises, particularly the condominiums in Colombo and other highly urbanized areas in Sri Lanka. It is also evident that the condominium market has been expanding with the involvement of both local and foreign investors coming in contributing greater extent of choices and the local construction industry has also been significantly benefited through these developments. However, long term sustainability of these developments is still uncertain due to various socio-economic and political issues. Therefore, it is highly imperative to understand the root causes for such uncertainty and the risks that condominium industry faces in its future developments.

Hence, this study intended to provide an insight on the significance of following a proper risk management framework in condominium projects in Sri Lanka and to enhance the awareness on critical risk factors that might hinder the future developments and progress from the developers' perspective. Thus, the main research question formulated to investigate is "What are the major risks faced by condominium developers as hindrances to the sustainability of condominium developments in Sri Lanka?"

The study has mainly adopted both quantitative and qualitative approaches in data collection, in order to bring the developers' perspective on the risks that have a primary importance from their own point of view. Hence, a desktop study was carried out first to understand the risks that affect the condominium development industry and it enabled to identify fifteen (15) risk factors through published literature. Thereafter, a questionnaire survey was carried out using twenty-one (21) respondents comprising of professionals who are involved in condominium development projects representing three major sectors i.e. Developers, Consultants and Contractors, in order to validate the factors identified. The survey was carried out in two rounds using the Delphi Technique where the questionnaire respondents were requested to rank the risk factors based on their criticality to the condominium developments. Thereafter, the five-most Critical Risk Factors (CRFs) were identified. The data gathered was analyzed and interpreted by adopting Analytical Hierarchical Process (AHP) with the involvement of ten experts selected among the survey respondents.

According to the analysis, the location of a development, inaccurate forecasting on sales and demand, issues related to funding, delays in obtaining clearances and construction challenges due to labour scarcity were considered to be the most critical risk factors in developers' perspective. These risk factors could heavily impact on the investment decisions of the

developers in condominium projects. Thus, the study provides an insight that can be used in policy formation and practices of the Sri Lankan condominium industry to develop a better risk management framework.

Keywords: Condominium projects, Developers, Critical Risk Factors, Risk Management

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LIST OF ABBREVIATIONS

Abbreviation	Description
CMA	Condominium Management Authority
UDA	Urban Development Authority of Sri Lanka
CoC	Certificate of Conformity
CEB	Ceylon Electricity Board
SLT	Sri Lanka Telecom
NWSDB	National Water Supply and Drainage Board
AHP	Analytic Hierarchy Process
CRF	Critical Risk Factor
JV	Joint Venture
BoI	Board of Investment of Sri Lanka
URA	Urban Redevelopment Authority of Singapore
JLL	Jones Lang Lasalle (Sri Lanka)
MMWD	Ministry of Megapolis & Western Development
USA	United States of America
AR	Average Ranks
CRF	Critical Risk Factor
MS	Microsoft

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1 INTRODUCTION

1.1 Background and Problem Identification

This study aims to explore the risk factors that affect developments of condominiums in Sri Lanka. Although condominiums are not a new phenomenon in Sri Lanka, it is only in the past few decades that Sri Lanka is experiencing a rapid growth in high-rise building construction, particularly the condominiums in highly urbanized areas including Colombo, being the commercial capital.

Thus, over the recent years, the continuous transformation of the Colombo city skyline is one of the most noticeable facts. Number of skyscrapers are in the process of providing landmark structures exposing brilliance of modern characteristics of construction technology. Since then, iconic building projects such as “Altair”, “ITC Colombo One” have been added as the novel urban features to Colombo city and that has paved the way for Colombo to be recognized as one of the ultra-modern cities in South Asia. Nevertheless, most of these skyscrapers in Colombo are known to be condominium developments providing urban housing solutions.

According to Herath and Jayasundera (2007), prior to 1977, all the large-scale housing developments had been invested by the public sector and mostly occupied by the public sector employees. According to the authors, this trend had further catalyzed as a result of the amendment to City of Colombo Development Plan in 1999 which promoted high-density development within the garden city concept. However, it should be noted that the initial up-rise of high-rise housing developments in Sri Lanka was taken place with the introduction of the open economy in 1977.

However, it can be noted that with the introduction of the open economy, opportunities were created for the private sector also to invest in large-scale housing developments. The other significant trend is that these housing projects were developed not only for the public sector employees but also to the private sector employees and to a certain extent non-resident Sri Lankans too.

It is notable that following the end of the ethnic conflict in 2009, the real estate market had been experiencing a rapid positive growth and more recently condominium market had settled to a much stable state as a result of factors related to supply and demand, economy and Government policies (Daily FT, 2018). Number of low-rise (above 4 floors) to high-rise (above

13 floors) apartment buildings are being added to the market day by day supported by local and foreign investments.

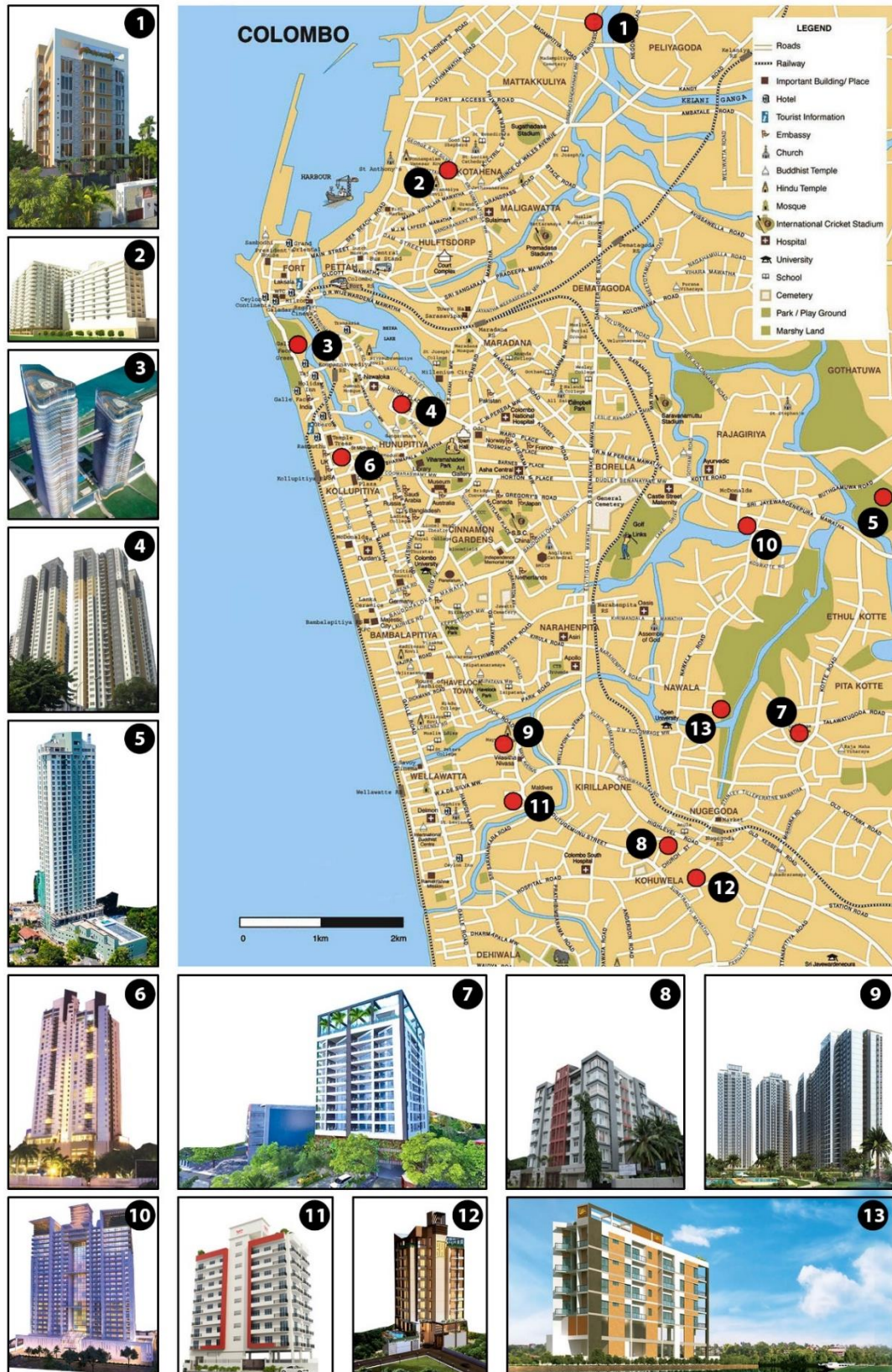


Figure 1: Recent Condominium developments in Colombo & Suburban areas

Consequently, the private sector investments in major condominium projects significantly increased, which delivered thousands of housing units to the urban real estate market (Capital Media (Pvt) Ltd., 2017; Jayasundera, 2017). Particularly, the Colombo Municipal Council region and surrounded sub-urban cities such as Dehiwala, Mount Lavinia, Rajagiriya, Kotte, Nugegoda and Wattala areas are mostly preferred for these developments.

The reason for the condominium developers to prefer above mentioned suburbs was the demand by the potential buyers to reside in such areas, is that it would ease their lifestyles being close to the metropolitan. Another reason for such demand is the scarcity and higher selling costs of lands diminished the affordability of individual houses in these areas. As one of the studies points, as a result of that, people tend to find alternate options for their dwellings and vertical living has provided a sustainable solution in the urban development context. In fact, high-rise apartments not only assure the green garden concept but also optimize the investments on infrastructure, through utilizing less spaces and higher density (Herath & Jayasundera, 2007).

As per the information received from Condominium Management Authority (CMA), which is the main government body in relevance to the condominium developments in Sri Lanka, 989 projects have been requested for approvals between years 2005 – 2016 (Appendix – B). During the period, CMA had approved 880 condominium projects while the provisional condominium approvals have been given for 81 projects. CMA records also indicate that over 200 projects are underway in 2017-January having offered preliminary planning clearances for 205 projects in Year 2016. It shows the demand for condominium projects over the recent years and how competitive the industry has been.

Nevertheless, it seems that there is an asymmetric development within the condominium industry due to several reasons. According to the literature consulted for this study, both local and foreign investors have been involved in these developments providing wide range of products to the real estate market (Raghunathan & Bera, 2014). In addition, there are various categories of condominium units in Sri Lanka, in terms of their location, scale, level of luxurious finishes, common amenities. As a result, the pricing of these condominiums also tends to fluctuate unlikely in many other industries.

It seems that not only the pricing indices but also several other factors govern the behavior of condominium developments in Sri Lanka. Even though condominiums are not a novel feature in Sri Lanka, the present and the future of the condominium developments can be fairly

complicated. The Luxury Apartment sector is about to double the number of properties due to the contributions from the high-end projects such as Altair, Shangri-la, Colombo City Centre, One Colombo One by ITC etc. Even the developers have expressed their concerns over a possible bubble scenario in local high-rise apartment developments (Capital Media (Pvt) Ltd., 2017).

Further to that, the Chairman of Urban Development Authority (UDA), which is the ultimate government regulatory body for similar developments, has predicted the bubble to be exploded within next 5-years period owing to the fact that the demand will be eased even though the supply of apartments upsurges in accordance to an article published in a local broadsheet newspaper (Moorthy, 2017). Thus, it is correct to say that this might cause a lot of problems in the economy unless appropriate measures are not implemented. Even the other stakeholders such as the contractors and financial institutes are becoming watchful about the uncertainties of condominium developments as a result (Daily Mirror, 2017).

The consultation of the research publications on condominium developments in Sri Lanka shows that most of the literature is focused upon market issues or land issues and it seems not much research is done on risk factors involved in developing condominiums in Sri Lanka from the perspective of the stakeholders of the industry. Even though, number of research articles have been published about the experiences in other parts of the world. This may be due to the reason that this is a relatively new phenomenon in Sri Lanka. This itself indicates that there is a need to do more research to study on the risks of condominium developments in Sri Lanka. Thus, it may set a better platform for the local condominium developers to understand and address the issues related to the risk management in condominium development industry.

According to Wiegelmann (2012) from a technical perspective, identification of risks must be the first phase of a risk management process. As he correctly points out, when implementing a proper risk management practices, initially the risks should be clearly identified and recognized, in order to set up a risk management framework. This study provides an insight to the condominium developers to assist them in identifying the risks involved in development projects, as an initiative to the implementation of risk management practices.

There are several stakeholders involved in condominium developments such as developers, contractors, buyers and their risks are different as per their respective roles. Especially, “the developer”, as the body which governs the course of a condominium development, is exposed to risks associated to various fields in addition to the construction. In general, the developers

expect higher profit margins compared to other parties involved in the industry. As a consequence, they may face higher level of risks as well. Moreover, impacts of these risks to the economy and the society could also have an enormous repercussion.

On the other hand, concerns have raised by general public on the repercussions of these developments based on several grounds. As the competition for producing luxury apartments with scenic viewpoints and easy accessibility, the developers are trying to reach new spaces. Sometimes, these repercussions cause difficulties to the neighborhood during the construction period as well as the post-construction period (Herath & Jayasundera, 2007).

When a such development is in progress, the residents in the neighborhood get disturbed due to factors such as heavy vehicle movement, noise and vibration. Even after construction and buyers moved in to the apartments, suddenly the traffic movement, drainage and waste generation tend to increase so does the demand for water and electricity. Unless such infrastructure is not expandable, it might affect the lifestyle of the community to a certain extent.

In the recent past, the local government authorities in Colombo have faced severe complications in disposing solid waste and storm water (Berenger & Fazlulhaq, 2009). As a matter of fact, the high-rise apartment buildings could be a major contributor to the above when compared to the solid waste and storm water generated from an individual dwelling in the same land plot. Having understood the repercussions, relevant authorities have amended some of the regulations and practices for planning of condominium developments, in order to minimize the negative impacts of the rapid changes.

According to Wijedasa and Wipulasena (2015), records states that more than 200 condominiums do not possess deeds for their properties. The reason for CMA to not award the certification for those properties said to be the developers' inability to obtain the Certificate of Conformity (CoC) from their respective Local Authorities upon completing construction. Majority of said developments are located in Colombo and they have failed to comply to the building regulations. Generally, the construction works are initially permitted by the planning division of the local authority through a tedious process and yet, the construction works are deviated from the initial plans.

1.2 Research Questions

The discussion above shows that identifying risks that affect the condominium developments in Sri Lanka is imperative for the future development and sustainability of the industry. Therefore, this study intends to provide an insight on the significance of following a proper risk management framework in condominium projects in Sri Lanka as well as to enhance the awareness on critical risk factors. Hence, the study intends to explore the following research question.

“What are the major risks faced by condominium developers as hindrances to the sustainability of condominium developments in Sri Lanka?”

Several other sub-questions are also addressed in this study in support of the main research question as mentioned below.

- Do the real estate market saturations affect condominium development?
- What are the land-related issues that constraint the condominium industry?
- Are there any political or administrative hindrances?
- How critical are the construction related risks for the development process?

1.3 Objectives

Main objectives of this research are as follows.

- To identify the Critical Risk Factors (CRFs) that affect the condominium developments in Sri Lanka
- To rank the critical risk factors through the condominium developers' perspective

1.4 Research Methodology

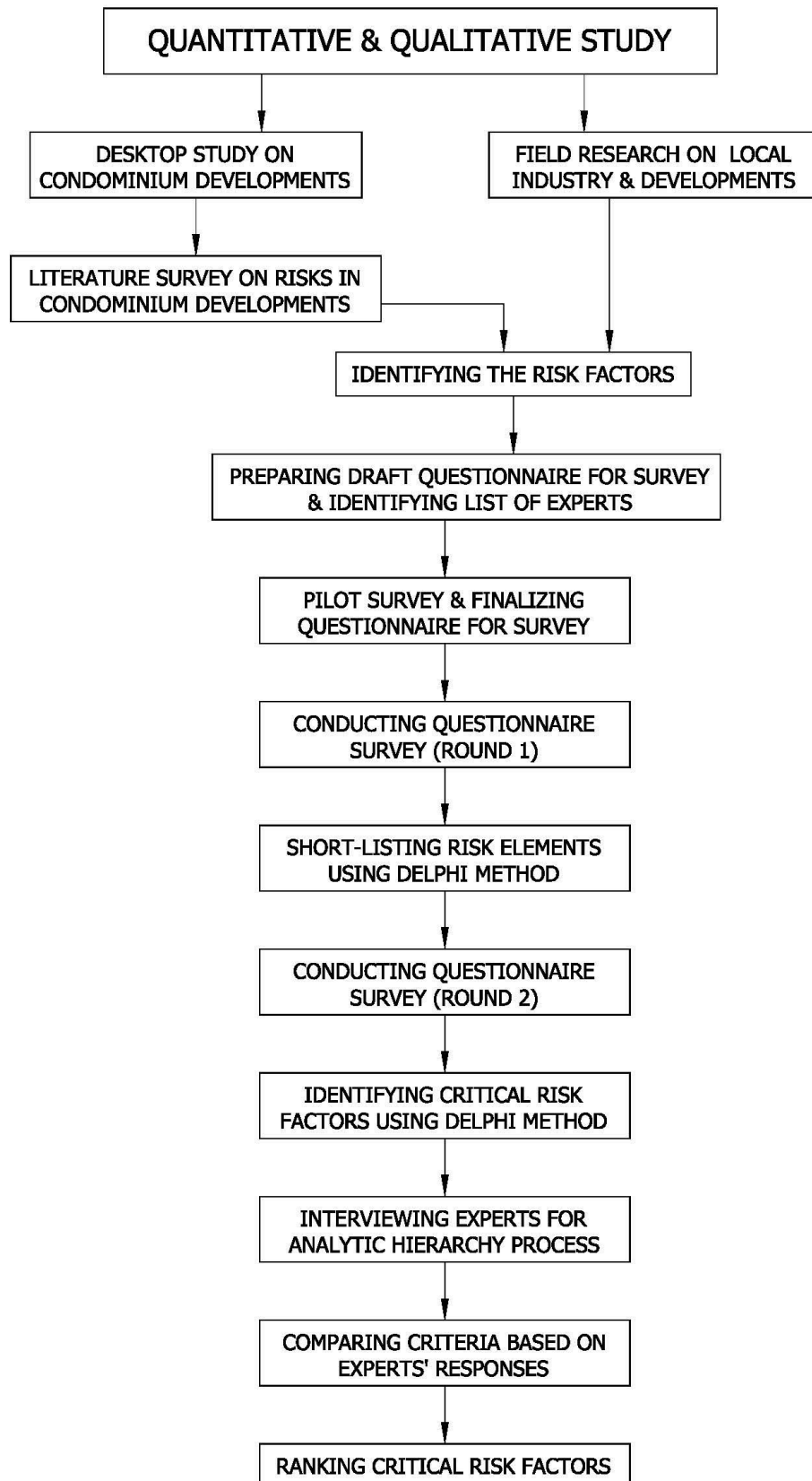


Figure 2: Flow Diagram of Research Methodology

1.5 Limitations of the Study

This study is limited to the condominium projects in the Colombo Municipality and its suburban areas as most of the condominium projects are located in these areas.

The risks in condominium industry are discussed with respect to their impacts to the real estate developers. Besides, it does not take the view points of the residents of condominiums as stakeholders to evaluate risk factors as the study is to understand the risk management from the point of view of the development processes and procedures.

1.6 Research Deliverables

- Identification of Risk factors in Condominium developments
- Application of Delphi Method to validate the risk factors in local condominium development context
- Application of Analytic Hierarchy Process (AHP) analysis to evaluate CRFs in local condominium projects, in developers' perspective

1.7 Guide to Thesis

Chapterization:

Chapter 01 - Introduction

The Introduction offers a brief outline of the research background, problem identification, importance of the study and guide to the succeeding chapters.

Chapter 02 – Literature Survey

Chapter 2 discusses the facts collected from available literature related to condominiums in order to establish the research background. This consists of general information on condominiums and their legislation, local and international experiences, real estate development process as well as the risks involved. This chapter sets the points of departure for this study.

Chapter 03 – Research Methodology

Chapter 3 describes the research methodology adopted for this study and provides an in-depth detailing on research techniques used for gathering data and the techniques for data analysis.

Chapter 04 – Data Collection and Analysis

Chapter 4 presents the data collected through the questionnaire survey and the application of the techniques described in the earlier chapter. By way of collating the data gathered through field survey and desk study, it analyzes and interprets the findings of the study.

Chapter 05 – Conclusions and Recommendations

Chapter 5 has two main sections. Section one presents the summary of the main findings of the preceding chapters and the conclusions arrived. Section two provides suggestions and recommendations. The concluding chapter also discusses the provisions for future studies in risk management of condominium development in Sri Lanka.

2 LITERATURE SURVEY

This chapter discusses the existing literature that provides a comprehensive understanding of the condominium industry. Therefore, the chapter focuses on the literature on theoretical and conceptual explanations of the condominium development and related risks. It will also survey the literature on the methodological tools for identification of risks and the literature on risks related to condominium developments in Sri Lanka and elsewhere.

2.1 What are condominium properties?

According to Anthonisz and Perry (2015), condominium properties are also a part of real estate development, commonly in urban areas where the lands are limited irrespective of the rising population. As the authors pointed out, a high-rise condominium property is a property which comprises of land with at least a building consists of more than one residential or non-residential accommodation. Wiegelmann (2012) shows that real estate development is all about three factors; Space, Time and Money and this is an important aspect because, as a part of real estate development, condominium developments are also grounded on the very same factors.

In a research published by Ariyawansa and Udayanthika (2012) describes that parcels in the condominium structures are owned and/or used by individuals while a certain portion is owned by the tenants as a common space. This particular phenomenon of individuality and community is the basis for the term condominium which derives from Latin. Apartment owners possess the title of their respective condominium units while the dwellers commonly own the areas which do not form part of any unit such as car park, lift, landscaped areas, corridors, pools, clubhouses etc. (Edirimanne, 2006; Collier, Collier, & Halperin, 2008).

Senaratna et al. (2010) further describe the condominiums as a western style of living which is currently being adopted by the Eastern countries as a result of land scarcity and higher population density.

According to Collier et al. (2008), one of the significant aspects of condominium properties is that the condominiums are constructed in a particular order, as they are planned and built with the intention of forming a condominium facility. Across the world, it is very seldom that you find re-forming an existing building to a condominium property. However, the conversion of a building to a condominium is seemed to be much faster than a new construction takes place (Collier, Collier, & Halperin, 2008).

Lawson (1976) identified the reasons that attract people towards condominiums. Over and above, the relief from maintenance issues, exclusive recreational facilities and the rise of asset value along with the increasing land cost have been reasonably justifying the investments of buyers. Hence, the real estate developers also tend to embrace the opportunity in developing more condominiums (Senaratna et al., 2010).

As the literature shows, in developers' perspective, real estate field is relying significantly on the time factor. Due to the spatial constraints as well as over-population in certain areas have been recognized for real estate investments not only locally, but also in the global arena (Anghel & Hristea, 2015). Moreover, the authors emphasize the significance of a healthy economy towards investing in the real estate market, where the governments' roles are critically appraised. This phenomenon is widely discussed later in this chapter.

Ariyawansa et al. (2012) had also presented a list of factors which determine the demand and supply of condominium properties in a particular market and further analyzed the reasons for the higher demand for the high-rise apartments in Sri Lanka. Study showed that the demand for housing basically depends on the population-related factors such as the size of family, number of families, net income etc. Apart from them, the economy and investment trends set the base for varying the demand for housing on account of prices of housing and stocks, bank interest for mortgage and potential appreciation of property values. In a nutshell, the demand-side factors are governed by the social requirements and investment aptitudes of the general public.

On the other hand, as these authors point, the supply of housing is dominated by the actions of investors who are having greater capitals. Their investment appraisals are conducted on the basis of cost of developments which include their expenditure on land and construction. In addition to that, their equation for costs also comprises of cost of capital, lending rates, inflation and the market behavior. For example, the developers will be somewhat reluctant to invest on new housing complexes when the expenditures are too high (Ariyawansa & Udayanthika, 2012).

2.2 Theoretical and conceptual explanations

Renn (1985) explains that risk analysis as one of the key areas that engage expertise in regulating industrial hazards. According to the author, risk analysis itself is a controversial subject and therefore it needs to be addressed through risk analysis approaches and techniques, which leads to assisting regulatory decision making as well as to determine their limitations. In this literature, the author comprehensively examines the factors that govern the risk analysis, i.e. modern risks in perspective, main steps for risk analysis, the approaches to risk analysis (engineering approach, the decision analytic approach, the risk perception approach and the policy analytic approach). The author concludes that the risk analysis can be defined in two broad attitudes towards risk analysis: firstly, risk as a property or an objective that can be measured by scientific methods and secondly, risk as a subjective judgments of possible outcomes of decisions and events, using knowledge about all relevant aspects. The author also points that this is something that may not be quantifiable.

Renn (1985) further argues that a risk analysis should attempt to consider all aspects of risk and therefore, a researcher should gather, analyze and manage relevant information. Thus, understanding approaches to risk too is important because they contribute to rules and objectives, make analyses more relevant to practical problem solving, bringing more people to influence decision making and to understand what the results of policies are likely to be in the real world setting and to realization of the future demands from different social groups. This literature has set the ground for this study in terms of theoretical and conceptual aspects.

2.2.1 Risks and Risk Categories in Real Estate Developments

Definitions on risk analysis

Risk has been defined in different perspectives for various industries hence, there are several definitions available. However, the real estate developers' risks are wide-ranging than the usual risks encountered by contractors or consultants. Gehner et al. (2006) carried out a study on the risk management in Dutch real estate industry, where the developers' risks were identified as the exposure to the possibility of economic or financial losses.

Wiegelmann (2012) defined the risk in a real estate development perspective as, *“the uncertainty expressed through the significance and likelihood of events and their outcomes that could have a material effect on the goals of a real estate development organization over a stated time horizon”* (p. 38).

Another definition gives the risk as a combination of the probability of an event and its consequences. It can be shown as an equation as follows.

$$\text{Risk} = \{\text{Probability of an event}\} \times \{\text{Magnitude of loss/gain}\}$$

According to the author, each real estate development project provides new opportunities to cope with, due to the uniqueness of them. Nevertheless, uncertainty and risk are two components always attached to this industry along with the assumptions envisaged and thus the risk management has to be ensured in order to a developer to be successful (Wiegelmann, 2012).

Wiegelmann (2012) presented a flow diagram of a real estate development plan, mainly consisting of four (4) stages to elaborate the risks involved during the development process. Those stages of a project are:

- Initiation : Market research for proposed development, appraisal for design, cost and programme
- Conception : Feasibility Analysis and Decision making
- Realization : Design, Construction and Management
- Marketing Disposal : Sales and Marketing

Project Conception stage is considered to be the most critical phase of the process in terms of risk management, providing that the future of the project is forecast at the end of that particular stage. Feasibility Study generally covers the market information, location prospective, Concept & Design characteristics, risk and profitability analyses. Ultimately, the feasibility study results justify the developer's intent whether to go ahead with the project or to abort.

Generally, at the start of a project, the developer may face maximum level of uncertainties which tends to decrease when the project moves ahead. Such ambiguities in early stages hamper the decision making considering the ultimate success of the project. The purpose of carrying out a feasibility study is to scrutinize the initial concepts minimizing the possible elements of risks identified.

Among the multiple definitions for Risk and Uncertainty, Loizou and French (2012) used the following definitions for their analysis on the decision-making tool "Monte Carlo simulation" for real estate projects.

Risk – when an outcome may or may not occur, but its probability of occurring is known.

Uncertainty – when an outcome may or may not occur and its probability of occurring is unknown (due to lack of knowledge / deficient information).

Boucher (1993) too categorized the risks faced by the developers during the development process and they are listed below.

- Risks related to physical characteristic of the land eg: identifying the soil condition of the site as poor after acquiring the land than expected
- Risks related to government regulations and controlling developments
- Risks of varying costs of development
- Risks due to unexpected delays
- Risks due to changes in economic and consumer-related factors

Subsequently, Wiegelmann (2012) listed out major elements of risks involved in real estate development projects. A summary of the findings is given below in Table 1.

Table 1: Elements of Risks in Real Estate Developments

Risk Category	Description	How to mitigate
Development Risk	Risk of meeting sufficient returns and market demand	Evaluation of developer's capacity Selection of qualified stakeholders to outsource/partnering A comprehensive feasibility study
Time Risk	Delays may increase the cost of capital as well as reduce returns and reliability of market data	Implementing better project management practices to coordinate and communicate Selection of qualified stakeholders to outsource/partnering Scheduling marketing on time
Cost Risk	This is dependent on the time risk and also affect the feasibility of the project	Implementing better project management practices to cost control
Financing Risk	Cost of capital and financing schemes affect the return and feasibility of a project.	Finalizing the form of capital after the feasibility study Forming strategic alliances i.e. JVs
Building Site Risk	Risks involved with the site properties and its environment	Consulting qualified technical and engineering professionals for due diligence Construction safety
Approval Risk	Risks related to obtaining approvals from planning authorities	Early communication with stakeholders Involvement of Architects/planners

Another categorization of sources of risk/uncertainty was carried out by Loizou and French (2012) identifying Six (6) main aspects (See Table 2). Under these, there can be several sub-factors which would influence at various stages of the development process. These sources are mostly inter-related and ultimate impact should not be measured in isolation.

Table 2: Sources of Risks (Loizou & French, 2012)

Source of Risk	Variables	Possible Outcomes
Construction	Costs vary due to <ul style="list-style-type: none"> • Type and quality of the development • Site condition/physical properties of land • Aesthetic Value • Building regulations • Sustainability aspects • Design changes 	<ul style="list-style-type: none"> • Price variations • Time delays
Time	<ul style="list-style-type: none"> • Scheduling of the project • Time for planning & development • Delays in completion 	<ul style="list-style-type: none"> • Higher finance costs • Disputes among stakeholders • Legal implications
Financial	<ul style="list-style-type: none"> • Fluctuating interest rates (in case of loans) • Tax/Government Policy changes • Cost implication due to Construction delays 	<ul style="list-style-type: none"> • Cost variations • Profit becomes less (sometimes unviable)
Land Cost	Land value depends on <ul style="list-style-type: none"> • the usability for intended purpose • building regulations 	<ul style="list-style-type: none"> • Unforeseen site conditions • Lapses in forecasting of costs & buildability
Sales/Rent	<ul style="list-style-type: none"> • Estimated costs • Projected income 	<ul style="list-style-type: none"> • Profit increment • Unforeseen losses
Socio-economic (External risks)	<ul style="list-style-type: none"> • Political changes • Economic fluctuations 	<ul style="list-style-type: none"> • Financial losses

Time as a critical aspect

As mentioned earlier in this chapter, “time” happens to be one of the most critical aspects, as far as the risks in condominium development projects are concerned. In generic terms, time does its part in affecting cost of the projects, in terms of the time value (Bell, 2011). Therefore, the supply of the final product to the market in lesser duration may reduce the risks of the developer, as the market tends to change certainly as the time goes on (Collier, Collier, & Halperin, 2008). Anghel and Hristea (2015) have also noted the fact that there is a permanent imbalance between the supply and demand due to the lengthy periods of developments.

Bell (2011) studied on the economics with respect to real estate project delays and the study identified that property valuations are mostly done based on the forecasting of schedules and

revenues against the time. Even with the best project management practices being followed, projects tend to delay due to unforeseen circumstances, in which some of them are beyond the control of the developers. Delays can occur due to various reasons and could impact the development not only during planning & construction but also in sales and marketing as well.

2.2.2 Risk Identification & Risk Assessment in Real Estate Developments

Importance of risk identification

Gehner (2008) described that the core of real estate development is making investment decisions through proper risk management. In other terms, proper risk management means addressing the risks in a project in advance, in a way which would not hamper the decision making in the development process because in developers' perspective, real Estate development is all about management of risks. Therefore, risk management is a key aspect throughout the development process, particularly in developers' perspective.

Since risks have been defined in many ways, risk management can also be interpreted in the same manner. Generally, it can be considered as a discipline which facilitate the successful handling of risks within an organization in a systematic manner (Wiegelmann, 2012). According to him, the risk management process consists of four phases.

- Risk Identification
- Risk Assessment
- Risk Control
- Risk Monitoring (Documentation)

As Loizou and French (2012) argue, the significance of knowing the risks to a developer is that it does facilitate the developer to estimate the required return with respect to the losses that could cause due to the risk elements.

Gehner et al. (2006) also pointed out that the knowledge on the behavior of real estate market is very important for effective management of risks. Through the study on the Dutch real estate industry, it was shown that the designs have to be fairly flexible as at times, as the developers even tend to consider changing the design in view of making the projects profitable. It has also been stated that the construction-related risks could be manageable in several perspectives i.e. by conducting required investigations on site condition, transferring risks to other contractors/consultants etc.

Risk assessments

As the above explanation provided by Renn (1985), risk analysis itself is a controversial subject due to the fact that it is not only objective but subjective as well. Therefore, the literature consulted for this study (Wiegelmann, 2012; Jarrett & Westcott, 2010; Gehner, 2008; D'Alpaos & Canesi, 2014) shows that it is difficult to provide a clear-cut definition for risk assessment. However, Khumpaisal and Chen (2010) state that risk assessments can be done through quantitative statistical frameworks. Booth, Matysiak and Ormerod (2002) quoted in Khumpaisal and Chen (2010) suggested that the desirable methodology for real estate development should allow for the synthesis of the criterion, comparisons of each factor and to help developers structure the decision-making process. Thus, Titarenko (1997) states that it could be concluded that risk assessment process in the real estate development shall be supported by the modern method of mathematical statistics. Therefore "risk matrix" method is generally an accepted tool for risk assessments in property development and this applies to condominium industry too. Thus, according to the literature surveyed for this study, feasibility studies are a vital tool for risk assessments in real estate industry.

Nevertheless, there are several types of real estate developers based on their strategic capital role, ownership structure, type of product etc. Wiegelmann (2012) too argues that risk management shall be done based on each category and for that, a "Risk Management Model" will be mostly preferred.

According to Ariyawansa and Udayanthika (2012), one of the main steps should be carrying out an economic feasibility study for a real estate development. In that, capital costs are considered as one of the three main factors which should be accounted for when an economic feasibility study is carried out for a proposed facility. Such study should consist of cost of lands including preparation works, construction costs including professional fees and costs of furnishing.

Moreover, Boucher (1993) also explained that a developer to be successful in real estate development, a feasibility analysis is essential. The feasibility study may integrate factors related to location, type of development, market demand and affordability, construction programme and costs for particular product, and finally the cost of capital.

Similarly, the level of market demand and the financial feasibility of a facility shall be identified in the first place prior to start on planning a proposed condominium facility. Such

studies can mitigate the developers' risks involved in real estate investments. Financial feasibility often becomes the governing factor more than the market demand. Not only building costs and estimated revenues, but also the local planning requirements need to be studied during the preliminary economic feasibility (Lawson, 1976).

A study carried out by Anthonisz and Perry (2015) identified the main aspects that need to be followed in order to develop a marketing plan for condominium units. According to their argument, to pre-sell all the condominium units by the time the construction works of the facility are completed, following procedures should be attended.

1. Finding the maximum extent of the selected land allowed for development as per the regulations
2. Determining the form of development and optimum number of units as per the market behavior
3. Preparing Terms of Reference for Architect / Designer i.e. Architect's Brief
4. Obtaining required statutory approvals including the Development Permit prior to start construction
5. Obtaining Board of Investment status (BOI) for tax concessions for imports etc.
6. Developing the basis for condominium pricing
7. Identifying the target market
8. Deciding the date for market launch
9. Establishing the timeline for construction

The first two elements discussed above are directly affecting the feasibility of a condominium project such that, the cost of the land and the allowable building limits (height and floor area) should be taken in to account, with respect to the size of the land and the expected type of development. Even though Lawson (1976) says these elements are beyond the control of the developer, he too identifies that proper utilization of them can support a critical project to be viable (Lawson, 1976).

However, in the reality, the Developers are taking certain assumptions in to the consideration as well as keeping provisions for contingencies for mathematical modelling. Thus, the accuracy of those parameters is questionable providing that the market condition could subject to vary with the time. One of the main reasons for that is the developers are unaware of the products that their competitors are bringing in to the market instantaneously. Hence, the assumptions could produce serious errors in judgement (Boucher, 1993; Loizou & French, 2012).

2.3 Stages of Development

As the above section explained, risk assessment and understanding the process of condominium development are instrumental in the view of studying elements of risks involved in each phase of projects. The literature survey done for this study indicates that based on different aspects, number of models have been introduced by previous researchers and the studies that are most important for this research will be discussed below.

The process of residential Real Estate development by Thomas M. Boucher (1993) explains a sequence of development that was established by interviewing two developers. It also explains that the steps in a development process are not necessarily occurred in a pre-defined order as sometimes the process could be varied from one project to another. Fig. 3 shows a graphical interpretation of a general condominium development process.

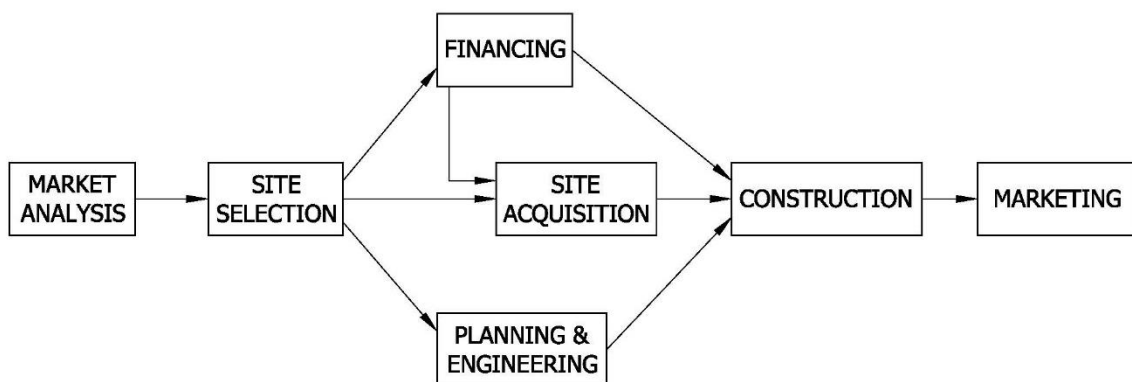


Figure 3: Condominium Development Process (Boucher, 1993, p.3)

Planning and Engineering commences with the process of requesting approvals from the local government authorities through the preliminary development plans, prepared according to the site layout and conditions. Once the preliminary approval is obtained, the developer shall continue with the detailed planning together with the Engineering design. If the developer uses several parties to accomplish the designs, he needs to ensure that the coordination and communication between different disciplines should be taken place properly before submitting the drawings for final approval. Further, the developer needs to make fees for approval as designated by the authorities.

Peca (2009) introduced a more comprehensive outline of the activities that may take part in a real estate development process based on six (6) different phases. Following table (Table 3) gives an overview of the same.

Table 3: Typical Real Estate Development Process (Peca, 2009)

Phase of Development	Processes	Outputs
Study Phase	Evaluating site/ Preliminary studies on market, Budget, Finance and Approval processes/ Conceptual Design	<ul style="list-style-type: none"> • Preliminary Feasibility Report • Concept Design
Feasibility Phase	Market study / Evaluate programme & Design criteria/ Set Budget and Milestones/ Pro forma/ Planning	<ul style="list-style-type: none"> • Final Feasibility Report
Preconstruction Phase	Site Acquisition/ Market Study cont./ Schematic Design and Design Development/ Estimate Budget, Obtain Approvals, Prepare Final Development plan	<ul style="list-style-type: none"> • Land titles • Contract Documents • Construction Drawings and Specifications • Approvals • Final Bid Estimate • Final Development Plan • Agreements/Contracts
Construction Phase and Initial Occupancy Phase	Update Market studies/ Marketing/ Prepare selling documents/ Construction Management and supervision/ Monitor time and cost/ Obtain approvals	<ul style="list-style-type: none"> • Sales Agreements • Progress Reports • Occupancy Permits • Supplemental documents
Occupancy and Investment Management Phase	Update Market studies/ Evaluate costs and leasing/ Evaluate potential property improvements/ Finalize Documentation and approvals/ Tenant coordination	<ul style="list-style-type: none"> • Progress Reports • Project Review

Khedekar and Dhawale (2015) examined the life span of a condominium project in several stages, in order to identify the risks involved in each phase. The classification is as follows.

- i. Concept and Feasibility Study Phase
- ii. Fund Raising and Financial Closure
- iii. Tendering, Bidding and Award of Project
- iv. Project Planning and Main Procurement
- v. Contract Execution, Monitoring and Control
- vi. Project Closure, Sale/Operations and Maintenance

According to the literature surveyed, it seems that construction sub-process also plays a major role within a condominium development process, in risk management perspective. By the time the construction works commences, the developer is legally bound and committed to the project in terms of finance and resources. Accordingly, the sources of risks related to construction sub-process presented by Loizou and French (2012), includes weather, cost of resources (labour, materials), availability, interpretation of conditions of contract and geotechnical characteristics of the site.

2.4 Developers and Stakeholders

Any study focusses upon risk factors in condominium developments needs to examine and identify the responsibilities and tasks of the developers and other stakeholders who are related to development process. Thus, this section will survey the related literature.

In a research article published by Ferguson (2012), the developer is described as the body who controls all the affairs related to the condominium until the management committee is formed. It suggests that the developer has the responsibility of the construction and management of the condominium until such time a reasonable number of units are sold.

Chen (2010) emphasized the significance in developer's role in the initial phase of the project, in view of the final outcome of the project. Developers' actions could heavily impact on the profitability of the condominium projects as well as the conformity to the planning requirements of the local government authorities.

Senaratna et al. (2010) elaborated the role of the condominium developer which usually comprises of purchasing the land, introducing and constructing infrastructure and selling the

units. In other terms, the industry has to cope with various disciplines such as local authorities, legal departments, local public etc. in their endeavors.

Involvement of other stakeholders

In a study on the process of real estate development, Boucher (1993) explained that the developer himself is assisted by various disciplines though it is seen as a single entity. Some of such professionals who are related to construction industry are Planners, Engineers, Architects, Contractors, Construction Managers and Surveyors. Although all these services are not utilized in every project, the developer may need to seek the assistance of their knowledge at some point during the process of development.

Outsourcing developers' works to consultants is also emphasized by Wiegelmann (2012) and the author explained that the number of consultants utilized may depend on the scale of the development and the capability of developer's in-house team to undertake. Boucher (1993) has also shown that the Engineer's role in design is significant since, the cost of the development is decided mostly on that. At the same time, it emphasized on the importance of cooperation among individual professionals who need to work as a team lead by the developer. Effective communication and mutual understanding on the work performed are vital aspects in coordination.

Developers need to make some things flawless in order to attract people to buy their condominium units. Providing sufficient lighting and ventilation, effective ways to dispose waste, adequate mechanical provisions are some of the aspects which have to be taken care in this context. It is on one of the critical tasks of the designers who are taken onboard to form the developers' team. (Senaratna et al., 2010)

Though the condominium industry seems to be fairly complex, the developers are attracted to invest in these developments due to the higher profit margins expectable relative to the risk involved. In Sri Lankan context, the main reason for this is the positive trend of pre-selling almost all units prior to completing the construction (Senaratna et al., 2010). Apart from that, the competition among developers getting increased with the inflowing foreign developers who possess more expertise than local counterparts (Anghel & Hristea, 2015; Mayank & Robin, 2014).

2.5 International Experiences

This section presents the survey of literature produced on international experiences and the topics covered in such literature. Several themes have emerged from the survey namely, history of the concept, role of the governments in condominium developments, regulatory practices, the developers' role and risk management practices.

History

The earliest evidence on condominium concept according to the literature surveyed was found in 1804, in article 664 of the Code of Napoleon in France. It has contained information related to separate ownership of floors as well as regulations for common parts of buildings. However, the modern condominium legislation has been enacted since early 20th century from Belgium and France. Soon after, this trend had been followed by other European countries as well as the Latin American countries later in 1950s. Consequent to the rapid urban growth took place in southern part of the region, USA and Canada embraced this form in early 1960s (Rosen & Walks, 2013; Conway, 2012).

According to the above authors, one of the main reasons behind this rapid transformation was the convenience offered to people by condominiums to become house owners rather than being tenants. It only provided not only affordable dwellings, but also the caused revolution in the urban structure in North America. It also indicates that the condominium concept has revealed the secrets to development of major cities and downtowns in USA.

Role of government

Rosen & Walks (2013) have emphasized on the role of government, in the process of developing condominium legislation and the outcomes of different countries. Especially after the losses occurred during the World War II in Japan and Europe, condominium concept had been widely instigated considering the escalating construction cost and dense population in urban areas.

Rosen (2013) and Sing (2001) have also highlighted some important facts regarding the government's involvement in condominium development in Singapore. In 1974, this concept was first introduced to Singapore as a measure to minimize land scarcity issue. Urban Redevelopment Authority (URA) possesses the responsibility of planning physical developments and utilization of lands in Singapore. URA also acts as the central governing body for condominiums which is capable of providing up to date statistics on real estate market.

Advancement of Singapore's condominium market is well defined through the research published by Sing (2001), where it has described how well the state agencies had controlled the real estate policies. Rapid economic growth in early 1980s has been the main reason for the rise of demand for condominiums. Since then, number of ups and downs had been taken place in the industry and each time the government had stepped up to steady the market.

Few such instances are as follows.

- In 1996, condominium growth had reached a peak and then government had imposed an 80% mortgage loan to value restriction in order to make the rapid progression temperate by reducing buying power of people. Previously it had been allowing loans up to 90% of the mortgage value.
- Simultaneously, government had increased duty on condominium transactions to discourage buyers as well as to lessen the demand.
- As the industry declined due to the Asian economic recession in 2001, the government had implemented a land sale programme to strengthen the developers and the market.

Regulatory practices

Edirimanne (2006) has described the status of condominium regulations and practices currently being followed in Sri Lanka in the book published on the concept of condominiums. Some of the aspects are compared with developed countries where the condominium management practices are also found to be in a quite advance status than other countries. Singapore, a country which is renowned for multi-story residential and commercial condominiums, implemented a strong legal framework to protect buyers as well as to regulate the developers. According to the regulations, any developer whose project consists of more than 4 units, ought to have a developer's license which makes the developer comply to the rules that are in place pertaining to agreements, managing monetary requirements and proper workmanship etc. Any developer who fails to do so, may get penalized as well as suspended (Edirimanne, 2006).

According to this author, in local context, the lack of provision in legislation for condominium development in phases, the developers may have to depend on the consent of majority of owners wherever an expansion of a project needs to take place. However, in United States, there is a provision in the legal system for expandable properties in condominium where the Deed of Declaration is entitled to incorporate future expansions (Edirimanne, 2006).

Moreover, Collier et al. (2008) stated that, the condominiums in United States are authorized and governed at the State levels generally. Thus, the legislations and regulations on condominiums vary according to the governing State agency. As a matter of fact, the State of Florida, which comprises of large number of condominiums, does possess a very comprehensive statute system.

On the other hand, Chen (2010) emphasized the loopholes in Chinese condominium legislation through the study carried out comparing its characteristics with the system in United States. Though the Chinese real estate industry is in a flourishing state, the condominium legislation still seems to be immature, which happens to be the root cause of many problem that the industry is currently being encountered. Also, the paper acknowledges the importance enactment of Chinese Property Code in 2007 to formalize the condominium ownership. It has strengthened the legal system in order to demarcate the freedom of developers as well as to safeguard unit owners' rights. Notably, it provides the guidelines for the process of condominium development from the point of land sub-division until the completion of construction works of a project.

According to Chinese law, it is mandatory to submit a feasibility study to the local authorities verifying the land-usage for a given premises. Upon receiving the approval for the feasibility study, the developer must obtain a land-use right for the proposed condominium site, prior to stepping in to planning works of the building. Finally, the developer has to obtain development permits once the approvals are obtained for building plans developed conforming to the regulations.

Developers' role

Chen (2010) further highlights the developers' role through a comparison done between industries in United States and China. One of the most significant phenomena is that the developer's declaration of a particular condominium project as per the Uniform Common Interest Ownership Act (UCIOA) in the Unites States. This is recognized as a constituent document. Basically, the "declaration" consists of the key details of the project including its name, location, number of units and their extent, common amenities etc. and any other aspect that developer finds appropriate in terms of the demarcation of the development such as restrictions on occupation, usage and partitioning.

Yet, the Chinese condominium industry does not have a constituent document as such. The system in Chinese industry looks quite similar to the Sri Lankan counterpart, where the development process is generally administered by the local government, even though a detailed constituent document is not prepared at the initial phase as it is being done in the United States.

Risk management practices

Risk management in real estate developments has been considered as a noteworthy element with respect to the vulnerability of the industry itself. Thus, several studies have been carried out in Thailand related to risk management in real estate developments. A study carried out by Khumpaisal and Chen (2010) reiterated the factors causing risks in real estate developments in terms of “STEEP” i.e. Social, Technological, Economic, Environmental and Political factors which eventually created the collapse of not only the industry, but also the economy of the country. The authors state that responsible parties have neither taken adequate measures to overcome the risks nor clearly understood the consequences of risks, even though the issues have been identified through numerous studies. Further, the authors go on to highlight the impact of risks to the project management processes which in the end could affect the project timeline and cost estimates (Khumpaisal & Chen, 2010).

Another study carried out by Gehner et al. (2006) provides evidence for risk management in the real estate developments in Dutch market which discusses risks in terms of the phases of the development. Basically, it describes three main phases of developers’ processes i.e. acquisition, development and construction where two decisive moments are identified on the verge of acquiring the land and the commencement of construction. Both these points on the timeline provide options to the developers either to continue or terminate the project without further commitment or losses.

A similar study carried out on the risk management of the real estate industry of Maharashtra, India by Khedekar and Dhawale (2015) which identified the risk factors as well as their criticality based on numerical scale according to the phases of the development process which discussed earlier in this chapter.

D’Alpaos and Canesi (2014) also emphasized the fact of subjectivity of risks of developments in a study carried out on the real estate industry of Italy following the financial crisis broke out in United States in 2006. The authors presented a numerical strategy for assessment of risks in real estate projects through a case study.

Similarly, numerous studies have been carried out worldwide on risk management practices in real estate developments which could be considered as precedents when reviewing the current status of the local condominium industry.

2.6 Local Condominium Industry

The previous section looked at the literature produced in other parts of the world on condominium developments and risk management. Thus, this section will explore the literature produced on condominium industry in Sri Lanka. Several aspects have been highlighted in the survey on local condominium developments namely history, current trends, categorization of condominium and regulatory practices.

History

Multi-story dwelling concept is evident in Sri Lanka since 1970s as then state-owned rental buildings had been privatized encouraging the owner to buy their own. Due to the lack of awareness of the theory of condominiums, the management and maintenance of the facilities had been troublesome, mostly to the government as well as the tenants (Wasala, 2007). Owing to such reasons, the condominium projects executed by the government were not able achieve the milestones expected, in terms of social and commercial perspectives (Ranepura, 2014).

The first legislation for condominium properties in Sri Lanka was enacted by the Condominium Property Act No.12 of 1970. Currently, the condominium properties are governed under the Apartment Ownership (Amendment) Act No. 39 of 2003, including both residential and commercial subdivisions (Edirimanne, 2006). Condominium Management Authority (CMA) which is established under Common Amenities Board (Amendment) Act No: 24 of 2003 (presently being monitored under the Ministry of Housing, Construction and Culture Affairs) is the regulatory body which governs the certification and administration of condominiums in Sri Lanka (Condominium Management Authority, 2016).

Current trends

Colombo, being the commercial capital as well as the largest city of the island, has its infrastructure developed remarkably in comparison to the other parts of the country. Formation of luxurious hotels, pubs, restaurants and more importantly, high-rise condominiums are an indication of that fact (Anthonisz & Perry, 2015). Thus, being the administrative capital, the development in infrastructure and other facilities such as health and education in Colombo are

clearly at a higher level, in comparison to the other areas of the country. So as the employment opportunities, both in state and private sectors (Ranepura, 2014).

Consequently, people tend to migrate into the city and the demand for housing and other infrastructure development is correspondingly amplified. Thus, the multi-storied apartment concept is upraised as a potential resolution to the scarcity of lands in the urban areas (Ariyawansa & Udayanthika, 2012). Ranepura (2014) also described that the development of condominiums in a country depends on the nature of township evolution and the legal establishment for ownership.

Herath and Jayasundera (2007) revealed that Sri Lanka had rarely encouraged rural-urban migration, in comparison to the other developing countries. They further emphasized on five main reasons which rejuvenated immigration to the Colombo city. One of those reasons was the growth in demand for apartments by the community who got unsettled due to the influences of conflicts in North and East.

Jones Lang Lasalle (JLL Sri Lanka), an international firm's local establishment, who provides financial and professional services regarding commercial real estate investments had done a research on the local real estate market in 2014. They have identified different sub markets of apartments in the Colombo city and the apartments have been classified based on their prices. It has been found out that the apartment prices are risen as a result of the rising construction cost of high-rise structures and higher cost of capital. Apparently, the affordability of apartments in Colombo is becoming limited to the high-earning society. (Raghunathan & Bera, 2014)

Similarly, Ariyawansa and Udayanthika (2012) and Anthonisz and Perry (2015) revealed that the condominium developers mostly target two communities for the sales of high-rise luxury apartments; foreigners who work in Sri Lanka and non-resident Sri Lankans. The rationale behind is that such luxury housing units could offer living standards alike to developed countries. Even the Government of Sri Lanka is preferred to have the foreign investments on local condominium properties where it allowed foreign buyers the provision to borrow 40% of the apartment's value from local banks, as a budget proposal in 2017 (Jayasundera, 2017).

Apart from the above, one of the key reasons for the rise of demand for condominiums is its power in investment perspective. Both foreigners and high-income earning locals are interested in buying luxurious apartments, even at exclusively high rates, as a potential source of

investment (Herath & Jayasundera, 2007). As a result of this trend, large-scale apartment developments such as Havelock City and Celestial Residencies (now known as Hyatt Regency) were ignited since 2003, with the involvement of public sector through releasing the larger size land plots to the real estate industry.

Categorization of condominiums

In the current context, another report from JLL Sri Lanka (Mayank & Robin, 2014) categorized the Residential market in Colombo city in to segments based on the cost and area of apartments.

Table 4: Residential Market Segments in Colombo with approximate value

Market Segment	Average Unit Cost (LKR)
Lower Mid - Level	10 Million
Mid - Level	20 Million
Premium	28-30 Million
Luxury	45-50 Million
Ultra Luxury	N.A.

During the time of that study, there have not been any apartment in Colombo which falls in to the ultra-luxury segment (average unit value above LKR 60 million). However, it is evident that the particular statement may not be a fact any more in the near future, providing the current sight of the city skyline (Daily Mirror, 2016).

Most of these luxury apartments are located in central and secondary submarkets of Colombo (Ragunathan & Bera, 2014) while the semi-luxury apartments are placed more towards suburban areas such as Rajagiriya, Dehiwala, Nugegoda, Wattala etc. At a time, the demand for the luxury apartments in Colombo was such immense that, 98% of the completed units had been sold since 2005 to 2014.

Price and location of the apartments are most significant aspects the people consider when deciding to buy an apartment. In addition to that, the demand for condominiums depends on the aesthetic appearance as well as the infrastructure facilities. Besides, it eradicates the burden of constructing individual dwellings, in terms of cost and time, for the process from finding a land till moving in. Yet, the convenience, security and affordability may be lesser than what people find in condominiums, with respect to the location and facilities amidst the prevailing land scarcity in metropolitan areas (Senaratna, Zainudeen, & Wedikkara, 2010; Edirimanne, 2006).

Most of the local condominium developers tend to produce luxury apartments expecting comfortable profit margin, in order to cover higher construction costs where it is somewhat difficult to manage if they concentrate on lower-luxury units. Consequently, it has set up a market where the affordability of those apartments for local people is quite tough. The same cause attracts foreigners and non-resident locals to invest more in these apartments.

Regulatory practices in Sri Lanka

It is great initiative from the government's perspective that concentrating on providing affordable housing for locals, probably finishes are lesser compared to the luxury apartment units. Urban Development Authority (UDA) currently under the purview of Ministry of Megapolis & Western Development (MMWD) as well as the Ministry of Housing, Construction and Culture Affairs have initiated numerous affordable housing schemes for lower and middle-income people in association with the involvement of developers in the private sector (Ministry of Housing, Construction and Culture Affairs, 2017).

As per the mentioned legislation, a property be complied with following features in order to be identified as a Condominium property.

- The building should be built on a single land with boundaries demarcated
- The building can be divided in to individual units as condominium parcels
- Each condominium parcel shall be sold, leased or mortgaged similar to the other free hold property.

It also recognizes the proposed facilities as “Provisional Condominium Property” and the properties which are currently being built as “Semi Condominium Property” (Edirimanne, 2006).

Development of a condominium in Sri Lanka has to follow a process to obtain relevant approvals/clearances from statutory bodies prior to commencement of construction, in order to get the essential certification from CMA. A common list of approvals/clearances required for a general real estate development is described in Table 5. Having obtained the development permit either from the UDA or Local Government Authority i.e. Municipal Council/Urban Council, there is another procedure to follow to acquire the CMA certificate, which is a mandatory requirement for registration of a condominium property (Condominium Management Authority, 2016).

Table 5: Approvals required for condominium developments

Stage of Development	Type of Clearance / Approval	Agency / Authority
Prior to Construction	Early Piling Approval	Urban Development Authority
	Excavation Approval	Urban Development Authority
	Preliminary Planning Clearance	Urban Development Authority
	Traffic Planning Clearance	Urban Development Authority
	Civil Aviation Clearance for Height	Civil Aviation Authority of Sri Lanka
	Clearance for Water Supply	National Water Supply & Drainage Board
	No objection Letter for underground services	Water Supply & Drainage Division (NWSDB) of Relevant Local Authority
	Clearance for Sewerage	Local Government Authority
	Solid Waste Management Approval	Local Government Authority
	Clearance for Storm water connections	Local Government Authority
	Fire Clearance	Local Government Authority / Fire Department
	Clearance for Electricity Supply	Ceylon Electricity Board (CEB)
	Preliminary Clearance for Condominiums	Condominium Management Authority
	Environmental Clearance	Central Environment Authority
	Traffic Planning Clearance	Urban Development Authority
Development Permit	Urban Development Authority	
During Construction	Clearance for Road Excavation for Service Lines i.e. Electricity, Telephone, Drainage etc.	Local Government Authority, Relevant Police Division and corresponding Line Agencies i.e CEB, SLT, NWSDB etc.
End/Post Construction	Clearance for Fire Protection System	Local Government Authority / Fire Department
	Drainage Certificate	Local Government Authority
	Certificate of Conformity	Local Government Authority / Urban Development Authority
	Certificate for Full Condominium Property	Condominium Management Authority

Even though, the Central Bank report shows that misconducts do happen as some of the developers tend to refrain from registering the provisional condominium plans prior to sale of the units. Sometimes, the buyers purchase units during pre-sales which are not legally registered at CMA (Central Bank of Sri Lanka, 2017). Therefore, the line Ministry is in the process of amending the Condominium Management Authority Act No. 10 of 1973 as a measure of regulating the industry in order to safeguard the buyers' rights.

Literature on risk and risk management in local condominium industry

Prathapasinghe et al. (2018) highlighted the current trend in Sri Lankan condominium development industry showing that there are more than 15,000 apartment units in the market through almost 900 certified completed properties and further 13,000 units are about to be delivered by year 2022. This paper aims to provide an insight to the policy-makers and industry specialists and other professionals who are responsible for condominium developments in Sri Lanka. Thus, it provides a comprehensive account of the evolution of local condominium industry through a chronological profile. The author concludes that the living in condominiums is the only solution in urban areas like Colombo where the land deficit is high.

A research carried out by Senaratne et al. (2010) studied the factors affecting condominium developments in Sri Lanka and further discussed the significance of collecting data on related aspects in order to minimize the effects due to uncertainties. The authors argue that it helps the developer making several decisions in advance to mitigate potential impacts. This article also provides a good knowledge about the condominium profile in Sri Lanka to assist developers to make decisions regarding investing opportunities in condominiums.

Jayalath (2016) identifies the determinants of market value of condominium properties in Colombo. This study describes that the location of the development as the most governing factor in formulating the market value of a unit. Further, it shows that the market value depends on the neighbourhood and the community-related factors.

De Silva et al. (2008) in their study focused upon condominium properties in Sri Lanka state that maintaining a modern building can be a costly affair as architectural, design and functional requirements and complexities have increased in Sri Lanka. The evidence these authors have gathered from the literature review and the empirical research shows that there is a significant increase of the maintenance budget in the recent past. The authors argument is that the reasons for such increase is due to the fact that these complexities eventually generate many

deficiencies and difficulties and in turn, creates a tremendous maintenance workload and an undue budget. Thus, the research has focused upon to discuss factors related to such issues in the form of risks involved in the maintainability of buildings and further to explore several strategies and industry actions at the industry level to resolve this.

Arguing in the same line as the above-mentioned research paper, De Silva and Ranasinghe (2010) also focused their attention on the maintenance budget issue of condominium industry in Sri Lanka with survey carried across the industry. The paper concludes that there are thirteen (13) critical maintenance-related problems and forty-three (43) maintainability risk factors which certainly sets a proper guidance for the developers as stakeholders.

However, Perera et al. (2016) carried out another study aiming to propose a framework to control the operational and maintenance costs of condominiums built in Sri Lanka through identification of their determinants. A survey was done to achieve their objectives and the findings of the study shows three factors that are dominant in terms of operation and maintenance costs of condominiums namely; tenants' expectations, building services and Finishes of the property. Authors further emphasize the suitability of this study for the building managers in assistance of preparing realistic maintenance budgets in respect of each operational and maintenance aspect within the appropriate time.

Annual Report (Central Bank of Sri Lanka, 2017) highlights the involvement of Construction Industry Development Authority (CIDA) on implementing various policy initiatives in view of the sustainability of the construction industry, particularly the urban housing and development. It has covered multiple areas that are considerably the needs of the hour including introduction of proper standards for high-rise construction, alternatives for scarce resources i.e. river sand and skilled labour, reviewing procurement guidelines to ensure contractors' cash flow matters.

Even though there are quite a few studies had been carried out regarding local condominium developments, hardly any evidence found on the success rate or profitability of developments (Anthonisz & Perry, 2015). Similarly, Wiegelmann (2012) highlighted the issue on the insufficiency of studies carried out on the risk management aspects of real estate developments. It could also be a main cause for abandoning projects/ventures midway after launching, jeopardizing time and money of different stakeholders.

2.7 Summary

This chapter has provided an in-depth and comprehensive understanding of the published primary and secondary literature related to theoretical, methodological and conceptual discussions and empirical studies done at global and local level on condominium industry. The literature examined in this chapter on theory and concepts were primarily useful in identifying the theories and concepts that would ground this study while the discussion on methodological tools provided the basis for identifying the most appropriate methods and techniques for data collection, collation, and analysis and interpretation of the findings of the study.

The research published on the condominium industry at the global and local levels provided valuable insights on the reasons for the emergence of the condominium industry and the risks it faces. The literature also highlights the importance of condominiums as a solution for housing due to high urbanisation around the world and particularly in Sri Lanka in the last few decades.

The above-mentioned literature on the development of the industry at the global and local levels have identified the risks related to condominium development in various broad perspectives such as legal, environmental, political, social, economic, consumerist or cultural. Nevertheless, hardly there were any literature that attempted to gauge the risks from the point of view of the developers as one of the major stakeholders or ranked the risks according to developers' own perspectives, which is critical for the sustainability of the condominium industry, especially in Sri Lanka. Thus, this study will address the prior mentioned gap in research by adopting AHP analysis to gain a useful insight on the significance of following a proper risk management framework in condominium projects in Sri Lanka and to identify and rank the critical risk factors from the developers point of view, which is paramount for the future development of the industry in Sri Lanka.

3 RESEARCH METHODOLOGY

As stated in the introduction, this study has used both quantitative and qualitative methods to gather data (Refer Fig. 2). Accordingly, the current trends and facts on local condominium development industry were collected through the literature survey done for the study. This has helped to identify the gaps in research on condominium industry developments and especially the perspectives of the developers as stakeholders. Subsequently, data was gathered through a field research in order to fill this gap.

3.1 Method of data collection

Statistics on condominium projects in Sri Lanka during the period between 2005 – 2016 were collected from the Condominium Management Authority (CMA), in order to validate the current state and trends in the market. Those data included the number of projects that had been applied and approved, projects on-going and the registered developers (Appendix B).

Facts related to condominiums and other real estate development industries in foreign countries and risk factors were recognized through literature. Hence, various aspects related to condominium developments were gathered including the experiences of countries such as Singapore, Thailand, USA and Malaysia, in order to compare their practices with the local scenario. Meantime, the phases of a general real estate development process were studied from literature, so that the risk factors could be easily categorized in to each phase/area of development. Accordingly, the risk factors were classified in to six categories namely:

- i. Land-related risks
- ii. Political and administration related risks
- iii. Design & Planning related risks
- iv. Construction related risks
- v. Economic & Financial related risks
- vi. Marketing & sales related risks

However, in this study, the risks of condominium projects were considered in developers' context by identifying the developers as a separate entity, which deals with a wide range set of activities throughout their process to completion of a condominium project. Hence, a desktop study was conducted to list out the identified risk elements in to respective risk categories mentioned above.

Afterwards, a questionnaire survey was carried out with the purpose of validating the risk factors identified previously, for their relevance to the local practice. Initially, as mentioned in the section 2.4 of the thesis, thirty-five (35) probable respondents were listed as stakeholders, comprising of various professionals representing all the disciplines engaged in local condominium industry i.e. Engineers, Architects, Quantity Surveyors, Project Managers, Planners, marketing/finance agents etc. Besides, their involvement in the practice was also taken in to account as to categorize them into three major sectors: the developers, the consultants and the contractors.

Nevertheless, it was important to recognize the career background of each respondent as only the responses of competent professionals were required to consider as satisfactory. Therefore, the minimum criteria for selection of respondents were established as either 5-years of experience or 3-projects related to condominiums in their respective fields. Based on the above criteria, twenty-one stakeholders have been selected as the research sample for this study.

A draft questionnaire was prepared which consisting of two (2) parts. First part (Part I) was to collect the respondents' experience in the condominium industry, in order to recognize their involvement in condominium projects of similar nature. The second part (Part II) of the questionnaire was comprised of fifteen (15) risk factors identified through literature survey which the respondents were requested to rank them, in terms of their criticality/impact to the outcome of the project. Primarily, a pilot survey was conducted by circulating the draft questionnaire to five experts. Having obtained their responses, the questionnaire was further reinforced and finalized (See Appendix – C and D).

Respondents were requested to rank the risk factors based on their field experience, using a numerical scale from 1 to 15 where number 1 to be given to the most significant risk element. The Questionnaire Survey was carried out in two rounds based on the Delphi Technique. (Hsu & Sandford, 2007). Delphi technique is a conventional and efficient tool for converging opinions of experts. According to Adnan et al. (2015) this is a long-established method which has been widely used in accumulating responses from experts based on their practical know-how.

3.2 Method of data analysis

Delphi technique facilitates several iterations (or commonly known as rounds) of collecting feedback from respondents in view of developing a consensus of ideas. Hsu and Sandford (2007) state that:

Iterations refer to the feedback process. The process was viewed as a series of rounds; in each round every participant worked through a questionnaire which was returned to the researcher who collected, edited, and returned to every participant a statement of the position of the whole group and the participant's own position. A summation of comments made each participant aware of the range of opinions and the reasons underlying those opinions (p. 2).

Most importantly, multiple iterations provide respondents the opportunity to re-evaluate their responses with the short-listed questionnaire. It can be effective in many ways, as the same set of Delphi participants are required to take part in all the iterations and their declarations in the previous iterations can still be validated considering the collective results. Thus, the knowledge and experience of same set of experts are being utilized in this survey multiple times, in consideration of short-listing the most critical factors. Further, there is no restriction for data analysis stipulated and any appropriate data analysis technique can be used to interpret the responses of the Delphi participants (Hsu & Sandford, 2007).

Hence, Average Ranks (AR) ranking method was preferred in this study for analysis of the responses received from the Delphi participants. AR is a simple method which is commonly used for ranking preferences obtain from respondents in surveys like these (Brazdil & Soares, 2018). Thus, the questionnaire was circulated among the selected group of experts via E-mails as well as having face-to-face meetings with some personnel. At the end of the first round of the survey, the responses for Part II of the questionnaire were listed. Thereafter, a numerical value was given to the ranks given by respondents using a numerical scale of 1-15 i.e.

Number 1 ranked factor has a weight of 15

Number 2 ranked factor has a weight of 14

Number 14 ranked factor has a weight of 2

Number 15 ranked factor has a weight of 1

If the weight for rank is w_i and number of responses is n , the average ranking was calculated for each factor as $[\sum(w_i)/n]$. Outcomes were sorted in terms of the average weight and the top 10 risk elements were selected to proceed with the next round of the survey.

During the second round of the survey, the questionnaire was sent to the same team of experts with the risk elements being short-listed to 10. Similar to the first round of survey, respondents were requested to rank the given elements of risks. Similar to the first round of the survey, the experts' responses were tabulated and ranked the risk elements in terms of the average weight. Accordingly, the 5-most Critical Risk Factors (CRF) were identified by scrutinizing the responses collected.

Generally, Delphi survey can be planned with as many rounds as possible, in view of converging to precise set of expert opinions (Adnan, Daud, & Ibiyemi, 2015). Yet, in this case, only 2 rounds of Delphi survey were preferred. Though, one can argue that few more survey rounds could have built up a collective discussion among the experts about their opinions and could have prepared a better platform to discuss a confined set of factors. However, mainly owing to the limitations of having industry experts' valuable time in responding to this survey had impacted on restricting the frequency of Delphi rounds, as most of them cooperated amidst the tight schedules of their professional careers.

A panel of experts was selected out of the Delphi participants based on their experience, to engage in the semi-structured interviews as a part of the Analytic Hierarchy Process (AHP). The selected panel consists of 10 experts who were given the task of pair-wise comparing the five CRFs shortlisted through Delphi rounds with the purpose of assessing the criticality of said factors.

Since the main objective of this study was to evaluate the local condominium developers' risks, the said panel was selected mostly representing the professionals representing well-known condominium development organizations in Sri Lanka. Also, during the first two rounds of survey, it was evident that the responses from people representing developers' role were much more pertinent to the rationale of this study.

The five CRFs selected above were considered as criteria for AHP Analysis where the outcome of the analysis is expected to provide a ranking of same criteria through a Matrix operation.

As Siriwardana (2016) and Risath and Siriwardana (2018) explained, AHP is an effective tool in a process of obtaining experts' opinions where complex and intangible factors are involved. In fact, AHP enables combining criteria which exist on different platforms such as properties which are measured in different scales i.e. length, weight as well as intangible factors. The analysis is done through a process of ranking each criterion against others individually, based on its relative significance to the outcome of the subject. Following the argument of Saaty and

Vargas (2012), the pair-wise rankings are added based on their respective weights to calculate the final standing with respect to their potential impact to the ultimate objective. Through the adoption of AHP analysis to this study, it leaves the individual expert to compare each risk factor relative to the others in depth, using their experience in the industry and to get the real impression for validation rather than getting their own opinion influenced by the other experts' inputs.

As these CRFs are intangible aspects, a numerical interpretation was introduced for pair-wise comparison in order to formulate a mathematical expression from the experts' responses. As Saaty (2008) explained, a scale from 1-9 had been established to compare the criterion with each other. When comparing the Criterion A with respect to Criterion B, the score of 9 indicates that A is extremely critical in comparison to the other while the score of 1 indicates the both criteria are equally critical.

Table 6: Scale for comparison of Criteria (Saaty, 2008)

Level of criticality	Score
Extremely Critical in comparison to the other Attribute	9
Very Strongly Critical in comparison to the other Attribute	7
Strongly Critical in comparison to the other Attribute	5
Slightly Critical in comparison to the other Attribute	3
Both criteria are equally Critical	1
2,4,6,8 Intermediate values between adjacent judgements	

Since these scores are used to appraise one factor's criticality relatively to another, the reciprocal of the same also indicates the reverse state of the above. For example, if the score of 9 indicates that "factor A" is extremely critical relative to "factor B", $1/9$ automatically suggests that the relative criticality of "factor B" to factor A is extremely low.

Selection of the panel of experts for AHP analysis was carried out on the basis of extracting the inputs from the questionnaire respondents who had sufficient amount of experience in the condominium developers' sector. Furthermore, Saaty (2008) emphasized on the importance of selecting moderate number of experts as respondents where the number of respondents can be varied depending on its requirements as well as the experience of the respondents. Besides, Kil et al. (2016) showed that there is evidence of studies which had been carried out through AHP with number of respondents being limited to less than ten (10). Therefore, this study was carried out with the panel of experts being limited to ten (10), having considered the composition of the panel of experts.

4 DATA COLLECTION AND ANALYSIS

The data collection and analytical techniques were elaborated in the Introduction to the thesis and in the previous chapter on Research Methodology. Accordingly, a desktop research was carried out to find out the existing knowledge on risks in condominium developments in Sri Lanka and elsewhere in the world and based on that, risk categories and individual risk elements were identified. Finally, fifteen (15) number of risks were selected as condominium developments' perspective for preparing the questionnaire to be given to the selected research sample of twenty-one (21) respondents.

4.1 Questionnaire Survey

A pilot survey was carried out with a sample group of respondents, in order to verify the appropriateness of the questions to the larger research population, to rule out any incompatible results, to have a clear view of the contours of the research and to ensure the effectiveness of the type of survey selected for the study. Thus, five respondents were given a draft questionnaire to establish the above-mentioned requirements.

A semi-structured questionnaire was circulated through e-mails to the selected research sample of five respondents. Apart from general information, fifteen number of risks identified through the literature survey was attached to the pilot survey questionnaire. The survey expected them to rank the risk factors from a 1 to 15 scale based on their criticality to the project from the perspective of the interviewees.

The results of the pilot survey showed that some of the answers to the questionnaire was not consistent. It was noted that the reason was the manner the questions were not phrased out appropriately and the interviewees may not have understood the questions well. The other reason for the inconsistency was that the questions were not prepared in order to understand the scale of the project. Therefore, the questions were needed to be re-structured based on the outcomes of the pilot survey.

Therefore, the questions were amended accordingly and the main survey questionnaire was prepared to be given to the twenty-one (21) respondents.

Cross section of the selected respondents, in terms of their practicing disciplines are shown below.

Table 7: Cross-section of Respondents (Discipline-wise)

Practicing Discipline	Number of respondents
Engineering	7
Architecture	3
Project Management	3
Quantity Surveying	2
Sales & Marketing	4
Finance	2
Operations	2
Total	21

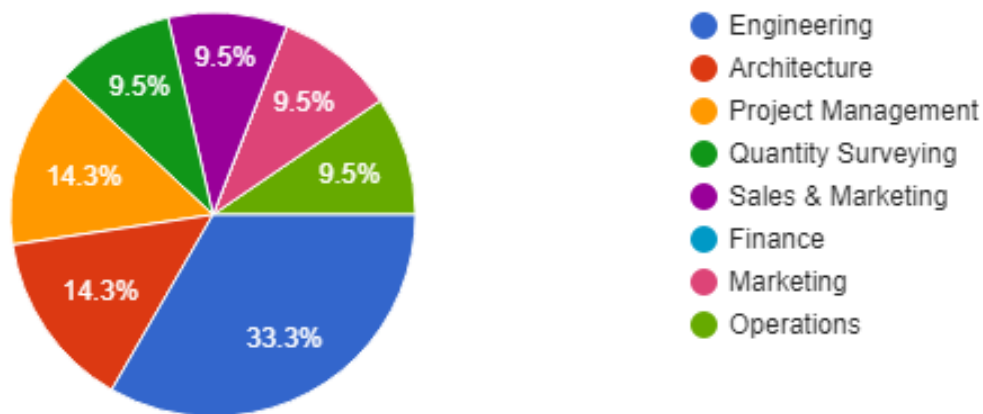


Figure 4: Cross-section of Respondents (Profession-wise)

Cross section of the selected respondents, in terms of their involvement in the condominium industry are shown below.

Table 8: Cross-section of Respondents (Sector-wise)

Type of Involvement in the industry	Number of respondents
Developer / Client	10
Designer / Consultant	8
Contractor	3
Total	21

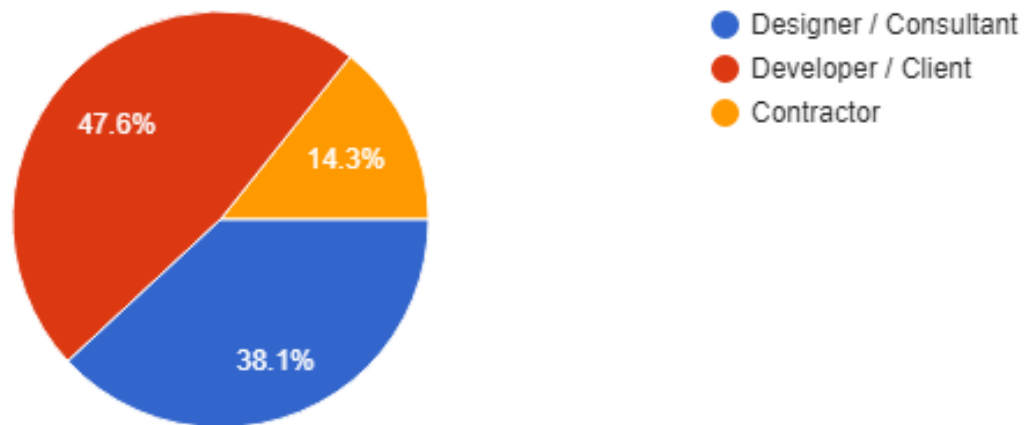


Figure 5: Cross-section of Respondents (Sector-wise)

Based on the findings of the pilot survey and the literature survey, the final questionnaire was prepared with the fifteen (15) number of risk elements identified and distributed to the twenty-one (21) respondents. The list of risk elements used for the first round of questionnaire survey is tabulated below.

Table 9: Risk Elements

Risk Categories	Risk Elements
Land-related Risks	1. Variable costs
	2. Location of the Land
Political/ administrative	3. Delays in obtaining planning clearances
	4. Change of government policies or regulations
Design & Planning	5. Delay in completing designs and tendering
	6. Changes in design / scope
	7. Mistakes in contract documents, specifications
Construction	8. Construction Delays due to Labour Scarcity
	9. Construction Delays due to contractor's improper planning
	10. Cost Overruns due to Poor Project Management
	11. Cost Overruns due to disputes in contract documents
Economic & Financial (Funding related)	12. Unavailability of funds
	13. Increment of Tax and interest rates
Marketing & Sales	14. Inaccurate forecasting on sales & demand
	15. Inaccurate estimation of revenues/costs

The final questionnaire survey was carried out in two rounds to short-list the risk factors identified in the table above. This data collection was occurred during the period of July 2017 – April 2018.

As explained in section 3.2 of the methodology chapter, Delphi method was used to facilitate the process of short-listing. The objective of applying the Delphi method was that it streamlines the process to converge respondents' opinions over few iterations. It facilitates the respondents to re-assess their judgements given in the previous round of survey, based on a confined set of options.

4.2 Application of Delphi Method

In the 1st Delphi round, the responses for 2 parts of the questionnaire (Appendix – C and D) were separately collected and the responses for Questionnaire – Part II were scrutinized (Table 10). The Table 10 indicates the way the respondents ranked the criticality of risks from their point of view. As mentioned in the section 3.2, since there is no restriction for data analysis stipulated for application of Delphi method, Average Ranking (AR) method was preferred in this study for analysis of the responses received from the Delphi participants.

Based on the AR method, the risk factors of the 10-highest average values were preferred to be included for the next round of the survey. After examining the results, it was found out that the following risk factors had been identified as causing lesser impacts to the outcomes of the condominium development projects in developers' point of view, providing that they have the least average weights, as shown in the Table 10.

- Variable costs of lands
- Change of government policies or regulations
- Mistakes in contract documents and specifications
- Construction delays due to contractor's improper planning
- Cost overruns due to poor project management

Therefore, the above-mentioned 5 risk factors were excluded from the next Delphi round.

Table 10: Results from Delphi round 1

Risk Elements	Respondents (x _i)																					Total Σ(w _i)	Avg. Weight [Σ(w _i)/ Σ(x _i)]	Rank
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
	Weight (w _i)																							
1. Variable costs of lands	3	5	2	4	1	2	5	4	2	5	2	2	2	4	5	2	5	3	1	1	3	63	3.00	14
2. Location	15	12	13	13	14	11	14	15	15	15	15	15	15	13	12	12	15	14	14	11	11	284	13.52	1
3. Delays in getting planning clearances	14	10	12	11	13	15	11	12	13	11	11	13	12	12	11	11	11	15	12	15	14	259	12.33	4
4. Change of government policies or regulations	4	1	3	2	2	1	3	2	4	4	4	1	5	3	3	3	6	5	2	5	5	68	3.24	11
5. Delay in completing designs and tendering	10	8	9	10	9	7	7	6	7	9	8	7	10	9	8	9	7	6	8	8	10	172	8.19	8
6. Changes in design / scope	7	11	7	8	8	10	6	8	9	10	6	14	8	6	7	7	8	9	10	9	6	174	8.29	7
7. Mistakes in contract documents , specifications	5	3	5	5	3	3	1	5	3	1	3	3	4	1	2	5	3	4	4	2	1	66	3.14	13
8. Construction delays due to labour	3	13	11	12	12	14	12	13	11	13	14	10	11	11	15	13	12	12	15	14	15	256	12.19	5
9. Construction delays due to contractor's improper planning	2	2	1	1	4	5	2	3	1	2	1	8	3	5	1	4	4	1	3	3	4	60	2.86	15
10. Cost overruns due to poor project management	1	4	4	3	5	4	4	1	5	3	5	6	1	2	4	1	1	2	5	4	2	67	3.19	12
11. Cost overruns due to disputes in contract documents	6	6	6	6	7	6	10	10	8	6	7	5	7	8	6	10	9	7	9	7	9	155	7.38	9
12. Unavailability of funds	12	14	14	14	11	13	15	11	14	12	13	11	13	15	14	14	13	13	13	13	12	274	13.05	3
13. Increment of Tax and interest rates	8	7	8	7	6	8	8	9	6	8	9	4	6	7	9	8	2	10	6	10	7	153	7.29	10
14. Inaccurate forecasting on sales & demand	11	15	15	15	15	12	13	14	12	14	12	12	14	14	13	15	14	11	11	12	13	277	13.19	2
15. Inaccurate estimation of revenues / costs	9	9	10	9	10	9	9	7	10	7	10	9	9	10	10	6	10	8	7	6	8	182	8.67	6

Accordingly, 10-risk factors chosen for the Delphi round 2 are tabulated below in Table 11.

Table 11: Risk Elements used for Delphi round 2

Risk Categories	Risk Elements
Land-related Risks	1. Location of the land
Political/ administrative	2. Delays in obtaining planning clearances
Design & Planning	3. Delay in completing designs and tendering
	4. Changes in design / scope
Construction	5. Construction Delays due to Labour Scarcity
	6. Cost Overruns due to disputes in contract documents
Economic & Financial (Funding related)	7. Unavailability of funds
	8. Increment of Tax and interest rates
Marketing & Sales	9. Inaccurate forecasting on sales & demand
	10. Inaccurate estimation of revenues/costs

The Table 12 shows the findings of the Delphi round 2 and similar to the round 1, 5-least averaged risk factors were identified in order to short-list the following 5-most critical risk factors and the rest were excluded from the analysis.

1. Location of the site
2. Delays in obtaining planning clearances
3. Unavailability of funds
4. Inaccurate forecasting on sales and demand
5. Contractors' delays due to labour scarcity

Table 12: Results from Delphi round 2

Risk Elements	Respondents (x _i)																					Total Σ(w _i)	Avg. Weight [Σ(w _i)/ Σ(x _i)]	Rank
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
	Weight (w _i)																							
1. Location	7	10	9	7	7	8	7	5	10	10	6	8	9	10	6	8	10	8	9	9	5	168	8.00	2
2. Delays in getting planning clearances	8	9	8	6	6	7	6	9	6	7	7	7	8	7	10	6	8	10	10	8	9	162	7.71	4
3. Delay in completing designs and tendering	3	5	4	3	2	4	4	1	2	2	4	4	2	5	2	5	2	5	1	3	1	64	3.05	8
4. Changes in design / scope	5	2	3	5	3	1	2	2	3	1	5	6	4	3	5	3	9	4	4	2	7	79	3.76	6
5. Construction delays due to labour	10	8	7	8	10	6	8	6	9	5	10	1	10	6	9	7	5	9	8	10	8	160	7.62	5
6. Cost overruns due to disputes in contract documents	2	1	2	2	1	3	5	7	2	4	1	3	3	2	1	1	3	3	3	5	2	56	2.67	9
7. Unavailability of funds	6	7	6	9	9	10	9	10	8	8	8	9	6	8	8	9	6	7	6	7	10	166	7.90	3
8. Increment of Tax and interest rates	1	3	1	4	4	2	3	3	4	3	3	2	1	1	3	2	1	1	5	4	4	55	2.62	10
9. Inaccurate forecasting on sales & demand	9	6	10	10	8	9	10	8	7	9	9	10	7	9	7	10	7	6	7	6	6	170	8.10	1
10. Inaccurate estimation of revenues / costs	4	4	5	1	5	5	1	4	5	6	2	5	5	4	4	4	4	2	2	1	3	76	3.62	7

As discussed in section 3.2, AHP analysis was used to identify the order of the criticality of the critical risk factors. The above five (5) risk factors were selected as the criteria for the AHP analysis and semi-structured interviews were conducted with the ten (10) of the participants who were selected for the AHP analysis.

4.3 Analytic Hierarchy Process

One of the objectives of this study was to find the criticality of each risk factor, in order to understand the priority of the elements. Saaty (2008) had introduced the decision-making process convenient by means of a pair-wise comparison of each of the selected criteria. Likewise, a scale of digits was used to compare the criticality of a criterion with respect to another.

A sample response received from one of the experts out of the selected ten (10) is shown below.

Table 13: Sample response for pair-wise comparison

Criteria		More important?	Scale
A	B	A or B	(1-9)
Criterion 1	Criterion 2	A	5
	Criterion 3	A	3
	Criterion 4	A	1
	Criterion 5	A	9
Criterion 2	Criterion 3	B	5
	Criterion 4	B	9
	Criterion 5	A	1
Criterion 3	Criterion 4	B	1
	Criterion 5	A	5
Criterion 4	Criterion 5	A	9

See Appendix – G for set of responses collected from experts. Goepel (2013) introduced an MS Excel-based AHP calculator to ease the process of solving the pair-wise comparison matrix, (Goepel, 2013). Similarly, this study used the MS Excel calculator to obtain results of pair-wise comparison and the corresponding output for the response demonstrated in Table 13 is shown in Fig. 6. The summary of the results obtained through the MS Excel calculator is shown in Table 14. Summary output from the calculator is attached as Appendix- H.

AHP Analytic Hierarchy Process

n= 5

Input 6

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A** or **B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	37%
2	Criterion 2	Delays in obtaining clearances	5%
3	Criterion 3	Unavailability of funds	21%
4	Criterion 4	Inaccurate forecasting of sales and demand	33%
5	Criterion 5	Contractors' delays due to labour scarcity	4%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 6 1 α : 0.1 CR: 5% 1
 Name Weight Date Consistency Ratio Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	5
1	3		Criterion 3	A	3
1	4		Criterion 4	A	1
1	5		Criterion 5	A	9
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	9
2	5	Criterion 5		A	1
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	B	1
3	5		Criterion 5	A	5
3	6		Criterion 6		
3	7		Criterion 7		
4	5	Criterion 4	Criterion 5	A	9
4	6		Criterion 6		
4	7		Criterion 7		
5	6	Criterion 6	Criterion 7		
5	7		Criterion 8		
6	7	Criterion 7			
6	8	Criterion 8			
7	8	Criterion 8			

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

Figure 6: Sample Output from AHP Calculator

Table 14: Summary of results of pair-wise comparison

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Weights	Rank
Criterion 1		2 1/8	1 8/9	1 2/5	2 4/9	30.4%	1
Criterion 2	1/2		2/3	1/2	1 1/4	13.3%	4
Criterion 3	1/2	1 1/2		3/4	2	20.0%	3
Criterion 4	5/7	1 7/8	1 1/3		2 7/8	25.8%	2
Criterion 5	2/5	4/5	1/2	1/3		10.5%	5

As per the results obtained through the AHP calculator, the ranking of the risk factors, in terms of their criticality as follows.

- I. Selecting a “Prime Location” for development
- II. Inaccurate forecasting on Sales and Demand
- III. Funding issues
- IV. Delays in obtaining clearances
- V. Construction challenges due to labour scarcity

4.4 Discussion on Results

Even though the local condominium industry is still in the early ages of its development and at the same time, also having reached one of its peaks in the recent past, the selection criteria were assumed as satisfactory. Therefore, it was important to collect data which are relevant to the recent projects, that can be useful to explore the current market behavior.

As the results indicated in the above section 4.3, criticality of risk factors was ranked. Accordingly, it was recognized that “Selecting a prime location” is the most critical risk, in terms of the success of a project. Alternatively, it indicates that a better location can ease much of the risks that a developer needs to consider of, during the planning of a project. According to the findings of the literature survey and the discussion with the panelists, this has several facades, as the potential clientele might vary depend on the characteristics of the location of the property (See Table 2: Sources of Risks, page 16)

According to the findings of the study carried out by Zarin and Bujang (1999), a prime location could be defined in respect of several norms. One of them is the “ease of accessibility or mobility” with regard to the site location. When a site is selected with proper access roads and ease of movement, it naturally becomes attractive to customers. In such a case, right of way to the site and the provisions from the local authority regulations should be envisaged during the initial planning stages.

Furthermore, the interviewees for the study emphasized the fact that the “proximity to the metropolitan area and other infrastructure” i.e. schools, hospitals, banks and government institutions will reduce the risks, with respect to the location of the project. Having considered the current trend among the local community to reside close to the heart of the Colombo, it seems it is correct to say that one of the most convenient ways of housing has become buying a condominium property. According to the literature surveyed for the study, it could even provide relief in avoiding the time in the traffic too (Ariyawansa & Udayanthika, 2012).

Most importantly, the “aesthetical value” to the site would be an added advantage in certain aspects, as per the opinion of the interviewees so as the literature consulted (Zarin & Bujang, 1999). A waterfront or a vantage point capturing a picturesque scene in the vicinity would charm more buyers. In the current context, prominent landmarks are being constructed in front of “Galle Face Green” as well as “Beire” and “Diyawanna” lakefronts with hundreds of apartment units.

The second-most critical factor identified by the respondents of this study, in Condominium development process is “forecasting on sales and demand”. This is basically related to the behaviour of the market as well as the aspects considered for the financial feasibility. Supply and demand side factors are not similar for all projects, as the findings of this study pointed out. Accordingly, the deliverables shall be accustomed, in terms of the floor area, number of bedrooms/bathrooms, other facilities and finishes to match the demand of the potential buyers. Along with that, sales plan has to be finalized (Anthonisz & Perry, 2015).

The above-mentioned facts are generally a part of the Market Study. At several phases of the development process, market study needs to be carried out (Peca, 2009). According to Peca (2009), during the Study phase, which is the initial stage of the planning, a preliminary market study shall be carried out. If the success criteria are satisfactorily met, the Feasibility phase is started where a detailed market study needs to be implemented.

In this phase, market behaviour should be properly identified as the outcomes of this phase are directly affecting the design and planning works of the project. In addition, the feasibility of the project is also assessed based on the market requirements. In addition, during the next phases, the market study shall be reviewed and updated, in order to verify the path of the project is in line with the plan. (See Table 3: Typical Real Estate Development Process, page 21)

Under the second-most critical risk factor, pricing of condominiums was also a significant aspect mentioned in both the literature and the interviews done for the study. According to Graaskamp (1992) generally, the pricing of the apartment units is decided based on number of aspects.

- Direct Costs
 - Cost of the land
 - Cost of construction
- Indirect Costs
 - Design & Management fees
 - Costs for approvals / Taxes & Levies
 - Legal fees
 - Marketing
- Time-related Costs
 - Costs of mortgage
 - Interests
 - Inflation
- Profit & Overheads

Cost of construction will be approximately assumed during the financial feasibility study, based on the type of the building and previous projects of similar nature. When a market study is carried out, it should be able to verify that the demand side requirements can be met at the expected costing. If the construction cost increase in the process of meeting the demand-side factors, it would affect the overall financial plan.

The third-most critical factor identified in the view of the respondents is the importance in “validating the funding strategy” during the Feasibility stage and therefore the expenditure for mortgaging i.e. bank loan interest (if required) should be incorporated in the pricing of units. According to the interviewees, various developers opt to follow different methods for finding

of the project, as some of the developers tend to raise the capital on their own until the pre-sales take place to a certain extent. That type of scenario would minimize the expenses such as bank interests etc. but the risk is high, according to the respondents of the study.

Thus, it seems when the developers are over-dependent on the pre-sales and consider very less on funding and a deficit comes, that could cause major problems in condominium projects. However, the new-coming developers who do not have precedents in completion of projects face difficulties in pre-sales, as they are short of popularity and credibility in comparison to the other leading counterparts. According to the respondents, as a countermeasure, they tend to produce “show apartments” also known as “mock-ups” to make the customers aware on the details of the project which is about to construct, as is the case in Sri Lanka.

The fourth-most critical factor in condominium developers’ perspective is the need to obtain numerous “approvals and clearances from Local Authorities and State Agencies” throughout the project timeline. The Table 5 shows a list of approvals required to obtain for a given condominium project with the corresponding authorities. According to this table, approvals are needed from prior to construction to post-construction. This shows that during the whole process of obtaining approvals, condominium developers face several risks. Firstly, for certain projects, there are exemptions as well as additional requirements based on their location and type of development.

For example, according to the respondents, the projects close to shoreline shall consider clearances from Coastal Conservations Department and some sites need attention from Land Reclamation and Development Corporation. Likewise, approvals from Ministry of Defense, Department of Archaeology and Agrarian etc. shall be sought as necessary.

Secondly, the building regulations differ for project to project, based on the geography, scale and type of development. Generally, the allowable number of floors for a particular project is determined mainly based on the size of the plot, width of the road and site frontage. Relationship on plot size. In order to optimize the return on investment, the developers try to waive off certain restrictions and get clearance for extra floors, as disclosed at the interviews of this study.

Thirdly, the time that could take to obtain the required clearances/approvals are not quite estimated accurately. One of the main reasons for that is concurring nature of these processes providing that some regulations have interests of multiple entities nonetheless, the coordination among them is uncertain at times. Thus, according to the interviewees of the study, the

developers have very less control of most of these events since they are governed under strict protocols and guidelines stipulated by the administrative bodies. Still, the delays caused by above could be harmful to the timeline of a development so as the financial aspects. Prathapasinghe et al. (2018) had also identified in their study the need to address the bottlenecks in the approval processes, in view of the sustainability of the local condominium industry.

On the other hand, another factor related to the above is that state-related affairs i.e. regulations, approvals, policies etc. tend to change periodically which could critically affect the developers' plans. One such instance is the introduction of the Capital Gains Tax (CGT) under the Inland Revenue Act, No. 24 of 2017 which came in to effect from 01st April 2018. 10% tax will be imposed on the profits from the sale of a property based on the market price (Lanka Property Web (Pvt) Ltd., 2018). Re-introduction of this could mostly due to the fact that the government's infrastructure development had aided the rise of real estate prices and the government also expects to get a financial benefit in return.

The fifth-most critical risk factor cited in the research was the construction challenges faced by the developers due to the "labour scarcity" among the several construction challenges in condominium developments in Sri Lanka. According to them, while managing the total development process, most developers offer the construction works to specialist building contractors. By doing so, the developers expect to transfer the risks in construction to a separate party. Nowadays, the contractors face various challenges in completing projects in time within the fixed budget. Nevertheless, according to the interviewees, recently, the difficulties they encountered due to the scarcity of labour has become very critical. Apparently, the impact is transferred to the developer as well, since it could hinder their target milestones.

A study carried out by De Silva et al. (2008) also points out that, the above-mentioned issue has been discussed in several perspectives and regarded as one of the most important challenges in the Sri Lankan construction industry. According to them, lack of skilled workers is a major issue that most of the local construction companies are facing. The acuteness of the labour shortage can be elaborated through the measures taken by the relevant governing bodies taking steps to allow developers to bring construction workers from neighboring countries like Nepal, Myanmar etc. under strict guidelines (Chamber of Construction Industry Sri Lanka, 2017).

Among the reasons for the shortage of labour for the construction industry, lack of training, skills development and other social issues are major causes in Sri Lanka (De Silva, Rajakaruna, & Bandara, 2008).

Nevertheless, according to the interviews done for the study, having considered the facts above, sometimes the developers do not tend to find fault with the contractors for not having sufficient manpower. Even the delays caused due to such shortages in resources likely to tolerated, if properly recorded. Therefore, it seems the condominium developers also find it difficult to manage such aspects with respect to the impact they have made in the overall industry.

Summary

As a summary of the analysis, it can be pointed out that the major risk factors to the condominium development industry of Sri Lanka from the perspective of the developers as stakeholders, according to the ranking process through the AHP analysis are; prime locations for development, inaccurate forecasting on Sales and Demand, funding issues, delays in obtaining clearances and construction challenges due to labour scarcity. The discussion of this study strongly shows that the local condominium industry and its management are still in the process to its maturity, with respect to the other developed countries and this can be cited as the fact for the above-mentioned ranking by the condominium developers of Sri Lanka.

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study explored what are the major risks faced by condominium developers as hindrances to the sustainability of condominium developments in Sri Lanka. The data gathered for the research were analyzed by using Delphi method and Analytic Hierarchy Process (AHP) in order to rank the risk factors that affect and hinder the condominium developments in Sri Lanka from the perspective of the developers.

As the same, this study is grounded on the hypothesis that developers as a key stakeholder of the industry and their risks are higher than that of the buyers and construction-related parties as other stakeholders because they are the decision-makers in regard of investments. Therefore, the study aimed to understand the risk factors that hinder the condominium developments from the perspective of the developers.

The findings of the study show that the condominium industry in Sri Lanka has been experiencing a significant progress with the rapid changes taking place as a result of socio-economic and political developments within the country. As it was discussed in the thesis, at the end of decades-long civil war in Sri Lanka, the demand for housing has increased and new approaches and solutions were needed to address this issue. Consequently, numerous skyscrapers have been built producing a vast number of apartment units, particularly in Colombo and its suburbs to cater the increasing demand for housing, especially in urban areas. The data collected for study show that due to several factors including land scarcity and population growth, vertical living seems to be a better solution for urban housing. Thus, it seems that both local and foreign investors considered investing in condominium developments will bring higher returns.

The literature consulted for the study shows that along with the developments in the condominium industry, the risk factors that may hinder the growth also emerge due to economic, social, political, environmental and technical aspects. As a result, risk management has been a vital part of the condominium development process. Thus, the study was focused upon identifying Critical Risk Factors (CRF) related to condominium projects, in local context as a preliminary measure of establishing a risk management framework.

The second chapter looked in to the theoretical and empirical studies that were done on condominium development industry in world and particularly in Sri Lanka. Further, attention

was paid to studies done on the risk factors that are affecting the condominium industry. The existing literature consulted provided a comprehensive understanding of the condominium industry, theoretical and conceptual explanations of the condominium development and related risks, the methodological tools for identification of risks and the literature on risks related to condominium developments in Sri Lanka and elsewhere.

According to the literature consulted, condominium properties are also a part of real estate development, commonly in urban areas where the lands are limited irrespective of the rising population. A high-rise condominium property is a property which comprises of land with at least a building consists of more than one residential or non-residential accommodation. The condominium properties are owned or used by individuals while a certain portion is owned by the tenants in common. This particular phenomenon of individuality and community is the basis of the term of condominium.

According to findings from the literature, the developers' actions could have a significant impact upon the profit making from the condominium projects as well as the conformity to the planning requirements of the local government authorities. The condominium developers are entrusted on purchasing the land, introducing and constructing infrastructure and selling the units. Thus, they have to engage with other parties such as local authorities, legal departments, local public etc. in order to fulfill their role.

The literature shows that the demand for housing basically depends on the population-related factors such as the size of family, number of families, net income etc. Apart from them, the demand for condominiums also rely on factors such as the economy and investment trends. Hence, the social requirements and investment aptitudes of the general public seem as important for the growth of condominium industry.

According to the literature consulted, there seems to be a strong case to argue that the industry is not risk-free even though there is an increasing demand for condominiums around the world. Therefore, in recent times, a considerable amount of research has been projected to understand the risks involved in the condominium developments. Not only that, understanding approaches to risk too is considered as important because they contribute to rules and objectives, make analyses more relevant to practical problem solving. The literature consulted for the study shows that researchers identify six-major elements of risks in general that affect the

condominium developments i.e. development risks, time risks, cost risks, finance risks, building site risks and approval risks.

As same above, the literature review pointed that it is paramount for the condominium developers to have a clear understanding of how to manage the risks mentioned above. The literature shows that risk management can be construed in various ways. In general, the risk management can be considered as a discipline which facilitate the successful handling of risks within an organization in a systematic manner. The risk management process can be seen as consists of four major phases: Risk Identification, Risk Assessment, Risk Control and Risk Monitoring. The factors causing risks in real estate factors development are identified in terms of “STEEP” i.e. Social, Technological, Economic, Environmental and Political. These factors can be responsible for the collapse of not only the industry, but also the economy of a country.

The studies on empirical situations in USA, Singapore, Malaysia, Canada, China, Thailand, India and Sri Lanka, very strongly point out that those studies are primarily focused upon investigating the role of the government, regulatory practices, developers’ role and risk management practices adopted by the industry in general. However, there is a strong case to argue that not much of attention was paid to understand the risk factors from the perspective of the developers in Sri Lanka. Thus, this study was designed to fill the gap in the research on Sri Lanka. Therefore, quantitative and qualitative methods were adopted to gather and analyze the data for this study.

The findings of the literature review and the field study revealed five major critical risk factors that have a strong influence on the condominium developments as a burgeoning industry in Sri Lanka.

In the fourth chapter these critical risk factors were ranked according to their criticality assessed by the respondents for this study. As per their perspective, prime locations for development, inaccurate forecasting on Sales and Demand, funding issues, delays in obtaining clearances and construction challenges due to labour scarcity are the five major critical risk factors that hinder the condominium development industry in Sri Lanka, which discussed in details in the chapter four.

It was evident from the findings that the projects which are having prime locations have the highest success rate. The respondents’ view was having an easy accessibility to places such as schools, hospitals and being close to the metropolitan or properties that are close to places

which has aesthetic values are the prime locations. The condominiums that are not built in such locations have a higher potential of risk. Hence, the developers have a tendency to select the locations that would produce a landmark project. Accordingly, it can be argued that the planning and estimating of a condominium depend on the location of the property. Thus, it was recognized that “selecting a prime location” is the most critical risk, by the respondents. Alternatively, it indicates that a better location can ease much of the risks that a developer needs to consider of, during the planning of a project. According to the findings of the literature survey and the discussion with the respondents, this has several facades, as the potential clientele might vary depend on the characteristics of the location of the property.

The second most critical factor identified by the study is “forecasting on sales and demand”. This is basically related to the behaviour of the market as well as the aspects considered for the financial feasibility. It is a must that the deliverables match the demands of the buyers otherwise the project may face risks. On the other hand, the costs of the production also generate risks due to direct costs, indirect costs, time-related costs and profit & overheads. If one does not take these in to an account and do a financial feasibility study before the construction starts, the project will face major risks.

The third-most critical factor identified in the view of the respondents is the importance in “validating the funding strategy” during the Feasibility stage. According to the respondents, various developers opt to follow different methods for finding of the project. One of the methods is to self-fund the project until the pre-sales take place and that helps to minimize the expenses but the risk is very high. Therefore, it can be concluded that when the developers are over-dependent on the pre-sales and consider very less on funding and a deficit comes, that could cause major problems in condominium projects.

The fourth-most critical factor in condominium developers’ perspective is the need to “obtain numerous approvals and clearances from Local Authorities and State Agencies” throughout the project timeline. Various approvals are needed from prior to construction to post-construction stages. There are certain exemptions or additional approvals are required based on the project location and the type of development. Thus, it needs to consult several authorities to get approvals. Another factor is the regulations differ from project to project. This shows that during the whole process of obtaining approvals, condominium developers face several risks and it hinders the opportunities to optimize the returns on investments.

The fifth critical risk factor for condominium developments identified by the respondents is the “scarcity of labour”. There is a tendency in Sri Lanka to outsource the constructions to specialist building contractors. However, the findings of the study show the contractors themselves have issues with budget, timeline and labour scarcity which cause delays in construction. The causes for labour scarcity are lack of skilled workers and lack of training. Consequently, the industry has a tendency to hire migrant labour from neighbouring countries with the approval of the government. Even so, the respondents of this study iterated that labour scarcity has become a critical risk to the industry and have a severe effect on not only the contractor, but also on the developers as well.

The discussion of this study strongly shows that the local condominium industry and its management are still in the process to its maturity, with respect to the other developed countries and this can be cited as the fact for the above-mentioned ranking by the condominium developers of Sri Lanka. Therefore, it can be concluded that this study would pave a way of understanding of the risk factors that need to be taken into consideration both in planning aspects and policy formation in related to condominium developments in Sri Lanka.

5.2 Recommendations

Based on the above findings of the study, following recommendations were suggested:

Since condominium developments is an industry that faces fluctuations according to the market and other related socio-political economic factors in Sri Lanka. First and foremost, it is important to make necessary amendments to the policy framework regularly based on the market behavior. Even though the industry performs in an effective manner at a particular period, rather than expecting immediate results, the amendments to policies should be implemented forecasting the future. As the industry has multiple internal and external relationships, sufficient time shall be allowed for adoption of such amendments. Otherwise, the outcomes might not be efficient as much it would have expected.

The findings of the study show that there is a need for the local condominium developers putting an emphasis on the necessity of following a risk management framework, even from the initial stages of the projects such as during the Feasibility studies. The study suggests that not only the local condominium developers, but also the funding agencies should also request risk management plan submitted by the developer along with the project appraisal.

Even though, this study highlighted the risks in a generalized approach, it should be noted that the impact of these risk factors can be varied depending on the scale, location and type of developments. Thus, it is recommended that the analyzing of the risk factors must be based on number of floors/units and zoning of the project as well as the pricing of apartment units.

It is the Government of Sri Lanka the highest authority in regard of making policies and laws regarding condominium developments. Nevertheless, the current tendency is that more and more private sector involvement in condominium developments and the need of regulations being efficient and the speedy have become need of the day. Therefore, the study suggests, it is high time to review the policy framework and its administration and make subtle changes wherever required, in view of the betterment of the industry's short and long-term sustainability.

As this study showed at the beginning, the Government of Sri Lanka also has a fair share of controlling the stability of the condominium industry providing that huge foreign and local investments are being made in these developments. Also, the Government shall consider the impact that condominium industry could cause to the country's economy, in case of a debacle in its own. Though we found quite a few evidences from Singaporean government which had

been proactively taking measures in view of the equilibrium of the market, very seldom the Government of Sri Lanka had taken similar measures in the recent history. Thus, the study suggests that there should be a regulating mechanism to minimize the impact on economy in general. For an example, when examined the experiences of countries such as Singapore and the United State of America, it is evident that these countries have established structured procedures over the years with effective results. One of the major examples is the formation of efficient governing authorities with better legal framework. that will not only formalize and streamline the development process but also secure the accountability of stakeholders.

One of the main objectives of this study was to identify the criticality of risk factors that will be encountered by developers in condominium developments in Sri Lanka. The need of having a detailed risk management plan for each condominium project and its significance to assist stakeholders' meeting their objectives has been highlighted by this study. However, risk identification is only a part of the Risk Management process and this study is a stepping stone for the future of risk management in local condominium industry.

This study highlights the importance of identifying critical risks in condominium developments as a part of a well-defined risk management practice, which is rarely being followed in the Sri Lankan industry. Even though the projects tend to carry out feasibility studies, they are mostly accounting financial aspects where lapses in accommodating risk management principles are relatively noticeable. At a time where the local condominium industry is reaching new heights, implementation of a comprehensive risk management plan could also be encouraged as a sustainable measure.

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APPENDICES

UNIVERSITY OF MORATUWA
Department of Civil Engineering
Moratuwa, Sri Lanka



{ Tel : Head of Department – 2650422
General – 2650567, 2650568
Fax : 011-94-2651216

My Ref:

Your Ref:

Dr. Chandana Siriwardana,
Senior Lecturer.

12th January 2017.

General Manager,
Condominium Management Authority,
Sir Chithampalam A. Gardiner Mawatha,
National Housing Department Building,
1st Floor, Colombo-02.

Dear Sir,

Requesting information regarding condominium projects in Sri Lanka

Eng. Damitha Ranasinghe, is a postgraduate student registered for the MSc. degree in Construction Project Management at Department of Civil Engineering, University of Moratuwa. As a requirement of the degree, he is currently carrying out a research study under me, in condominium development projects in Sri Lanka.

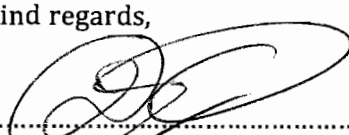
In the view of obtaining further literature on this study, he needs to acquire following information (for the period of 2005 to date) from your establishment;

- Requests for approval of condominium developments
- Condominium projects approved by CMA
- Projects which obtained clearance certificates from CMA
- Data on current condominium projects in Sri Lanka (under construction)
- Developers registered under CMA for developments

Therefore, it would be highly appreciated if you could make necessary arrangements to release above information to him.

Thank you in advance.

Kind regards,


.....
Dr. Chandana Siriwardana

For contact :

Damitha Ranasinghe
0777 229908

Appendix - B

25/01/2017

Requesting information regarding Condominium Projects in Sri Lanka

- Requesting for approval of Condominium developments - (2005 - 2016)
No of Projects - 989

- Condominium projects approved by CMA - (2005 - 2016)

Condominium	- No of Projects	880
Provisional Condominium	- No of Projects	81
Semi Condominium	- No of Projects	31

- Projects which obtained clearance Certificates from CMA
No of Projects 572 (2011 - 2016)

- Date on current Condominium projects in Sri Lanka (under construct)

Preliminary Planning Clearance (2016)	- No of Projects	205
Provisional Condominium (2016)	- No of Projects	30

- Developers registered under CAM for developments
No of registered Condominium developers - 23

Questionnaire For Research

Identification of Local Condominium Developers' risks

* Required

1. Email address *



Questionnaire - Part I

General information about respondent's background is expected as the response.

2. Practicing Discipline? *

Mark only one oval.

- Engineering
- Architecture
- Project Management
- Quantity Surveying
- Sales & Marketing
- Finance
- Other: _____

3. Type of Involvement currently in the industry? *

Mark only one oval.

- Designer / Consultant
- Developer / Client
- Contractor

4. Current Designation as an employee?

5. Experience in Condominium Development industry (in years)? *

6. No. of condominium projects involved in your career? *

7. Indicate the phases of condominium projects you have been involved in so far. (Tick one or more)

Check all that apply.

- Pre-planning
- Design
- Tendering
- Construction
- Closing

Skip to question 7.

Questionnaire - Part II

Expecting details of a selected project which the respondent has been a part of.

8. Location of the Project (Please write the area Eg: Colombo 04, Rajagiriya etc.)

9. Nature of the Project Developer/Client

Mark only one oval.

- Local
- Foreign

10. Was there any foreign stakeholders involved during design/construction phases?

Mark only one oval.

- Yes
- No

11. Method of Procurement followed in the project

Mark only one oval.

- Traditional Contract
- Design & Build
- Turnkey
- Other: _____

12. Construction Cost (in LKR Million)

13. No. of Apartment units

14. Original project duration (in months)?

15. Was the project construction completed within the planned duration?

Mark only one oval.

Yes

No

16. If your answer is "NO", the extended time period with respect to the initial planned duration (in months)?

17. Was the project completed within the estimated budget?

Mark only one oval.

Yes

No

18. If your answer is "NO", the varied amount (in LKR Million)?

Ranking of Risks in the particular condominium project

Rank the given risk factors using 1-15 scale based on their effect on the success of the project.
(Please see the table attached with the E-mail)

Send me a copy of my responses.

Powered by



Appendix - D

Annexure for Questionnaire Part II

Risk Categories

Rank the following factors according to their criticality in order to meet condominium developers' objectives?

Use digits 1-15 to rank them from most critical factor to least critical factor, in terms of occurrence.

Category	Risk Elements	Rank	Responsible Party			
			Developer	Designer/Consultant	Contractor	Other
Land Acquiring Risks	1. Variable costs					
	2. Location of the Land					
Political/administrative	3. Delays in obtaining planning clearances					
	4. Change of government policies or regulations					
Design & Planning	5. Delay in completing designs and tendering					
	6. Changes in design / scope					
	7. Mistakes in contract documents, specifications					
Construction	8. Construction Delays due to Labour scarcity					
	9. Construction Delays due to Contractor's improper planning					
	10. Cost Overruns due to Poor Project Management					
	11. Cost Overruns due to disputes in contract documents					
Economic & Financial (Funding related)	12. Unavailability of funds					
	13. Increment of Tax and interest rates					
Marketing & Sales	14. Inaccurate forecasting on sales & demand					
	15. Inaccurate estimation of revenues/costs					

Questionnaire For Research

Identification of Local Condominium Developers' risks

Email address *

[REDACTED]



Questionnaire - Part I

General information about respondent's background is expected as the response.

Practicing Discipline? *

Engineering

Architecture

Project Management

Quantity Surveying

Sales & Marketing

Finance

Other: _____

Type of Involvement currently in the industry? *

Designer / Consultant

Developer / Client

Contractor

Current Designation as an employee?

Experience in Condominium Development industry (in years)? *

15

No. of condominium projects involved in your career? *

10

Indicate the phases of condominium projects you have been involved in so far. (Tick one or more)

- Pre-planning
 - Design
 - Tendering
 - Construction
 - Closing
-
-

Questionnaire - Part II

Expecting details of a selected project which the respondent has been a part of.

Location of the Project (Please write the area Eg: Colombo 04, Rajagiriya etc.)

Colombo 02

Nature of the Project Developer/Client

- Local
- Foreign

Was there any foreign stakeholders involved during design/construction phases?

- Yes
- No

Method of Procurement followed in the project

Traditional Contract

Design & Build

Turnkey

Other: _____

Construction Cost (in LKR Million)

No. of Apartment units

Original project duration (in months)?

24

Was the project construction completed within the planned duration?

Yes

No

If your answer is "NO", the extended time period with respect to the initial planned duration (in months)?

30

Was the project completed within the estimated budget?

Yes ▼

If your answer is "NO", the varied amount (in LKR Million)?

0

Ranking of Risks in the particular condominium project

Rank the given risk factors using 1-15 scale based on their effect on the success of the project. (Please see the table attached with the E-mail)

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Questionnaire For Research

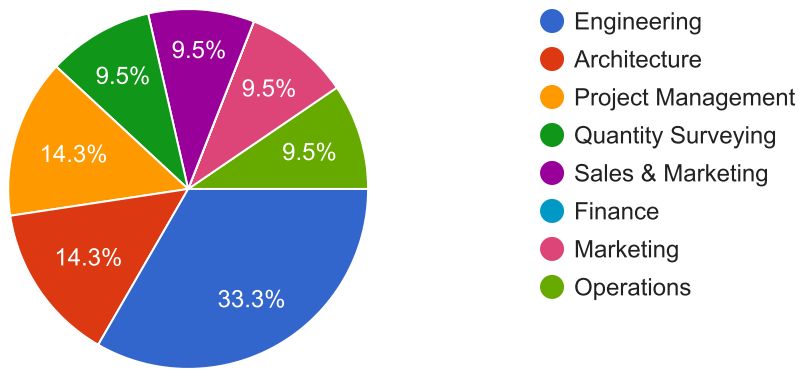
21 responses

Questionnaire - Part I



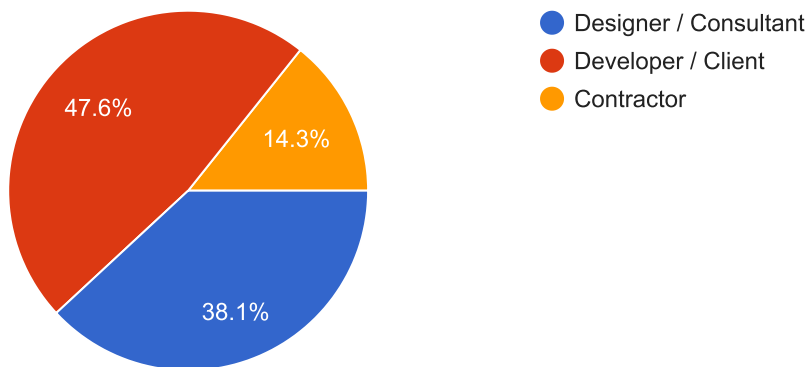
Practicing Discipline?

21 responses



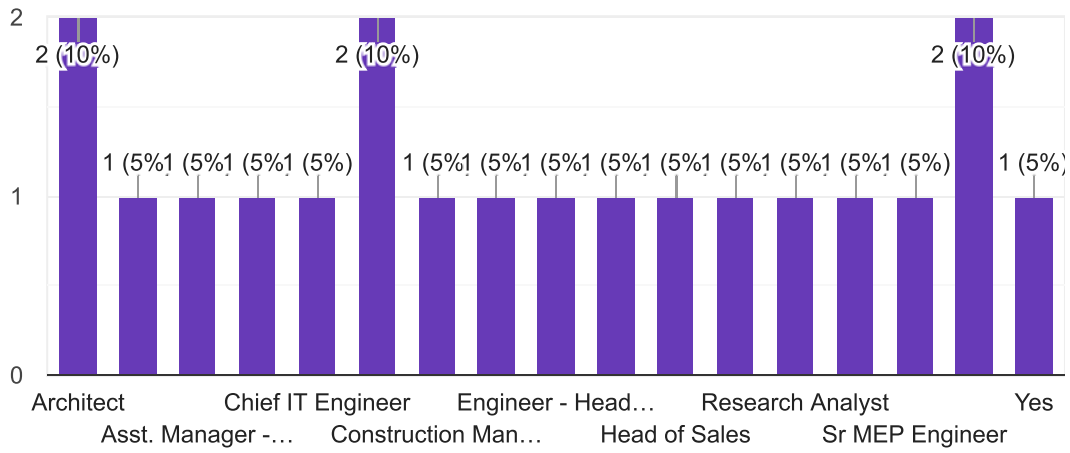
Type of Involvement currently in the industry?

21 responses



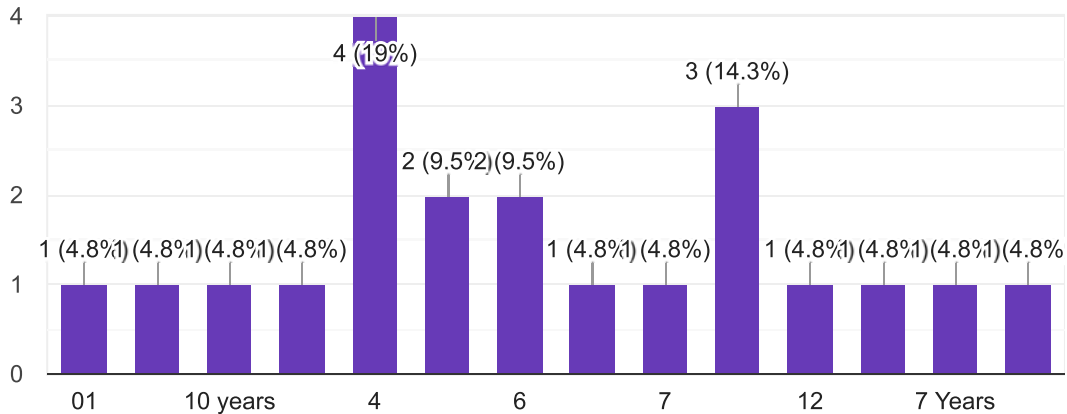
Current Designation as an employee?

20 responses



Experience in Condominium Development industry (in years)?

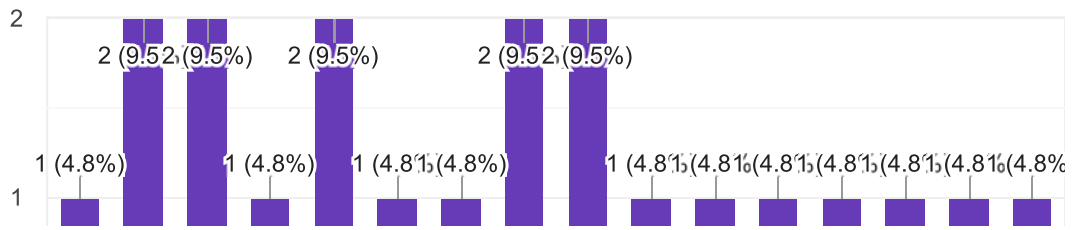
21 responses



No. of condominium projects involved in your career?

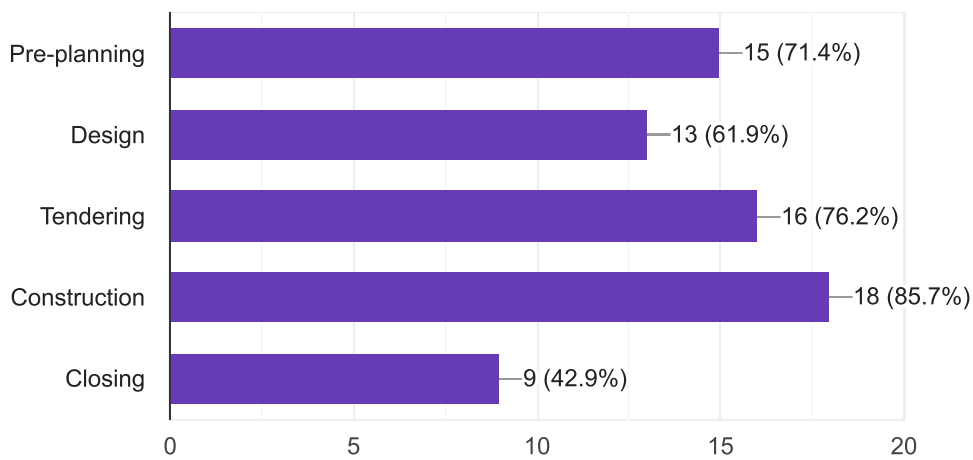
21 responses

Questionnaire For Research



Indicate the phases of condominium projects you have been involved in so far. (Tick one or more)

21 responses

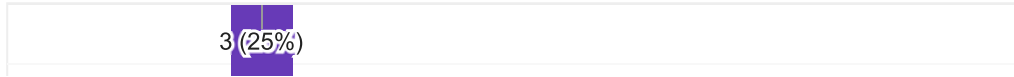


Questionnaire - Part II

Location of the Project (Please write the area Eg: Colombo 04, Rajagiriya etc.)

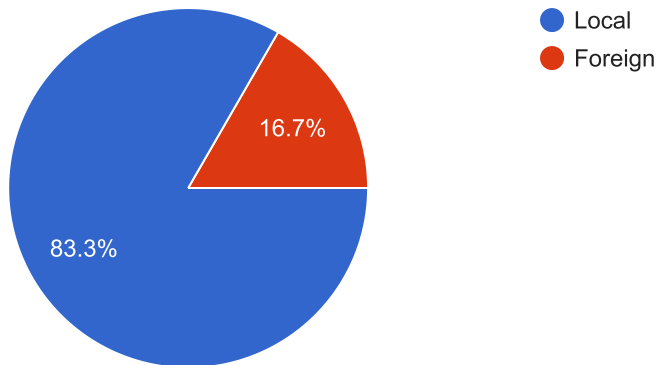
12 responses

3



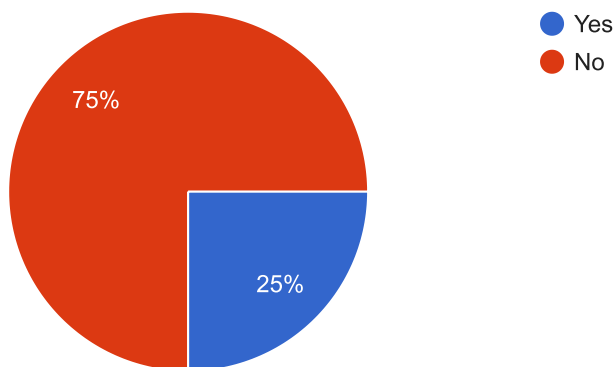
Nature of the Project Developer/Client

12 responses



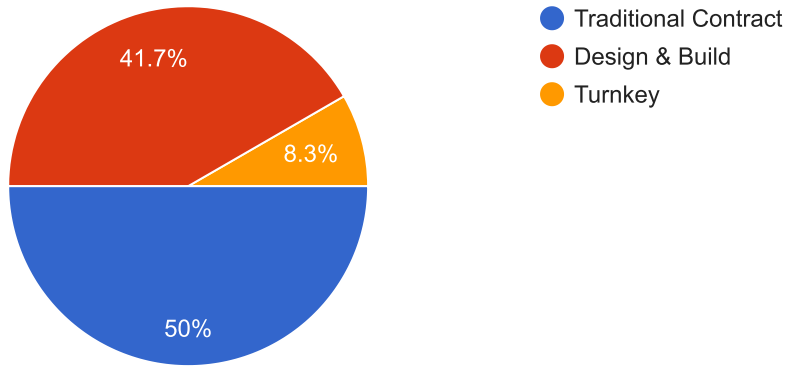
Was there any foreign stakeholders involved during design/construction phases?

12 responses



Method of Procurement followed in the project

12 responses



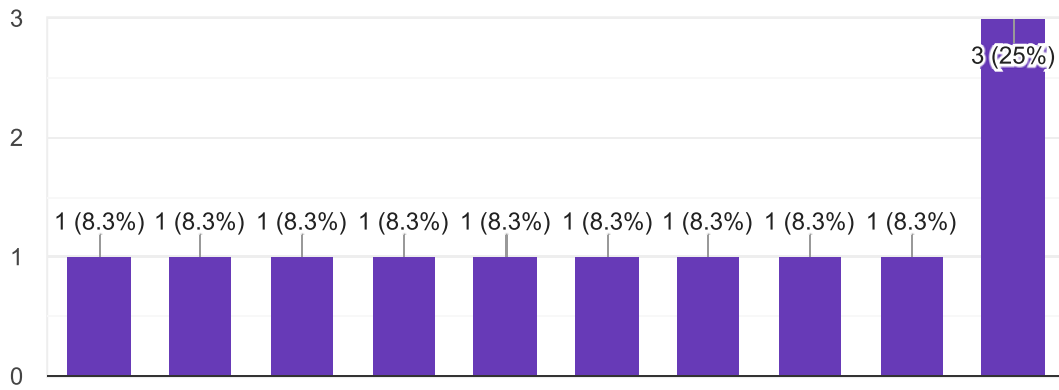
Construction Cost (in LKR Million)

12 responses

- 6000
- 12800
- 5500
- 450 US\$ Millions
- RS. 2.2 Billions
- 550 million
- Rs.220 m
- 520M / 220M / 205M
- 5850
- 210
- 800
- 1700

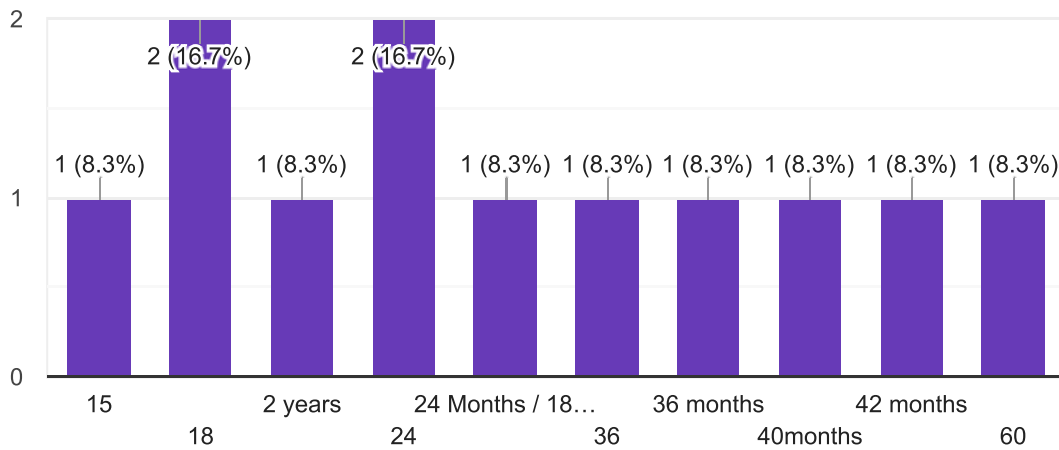
No. of Apartment units

12 responses



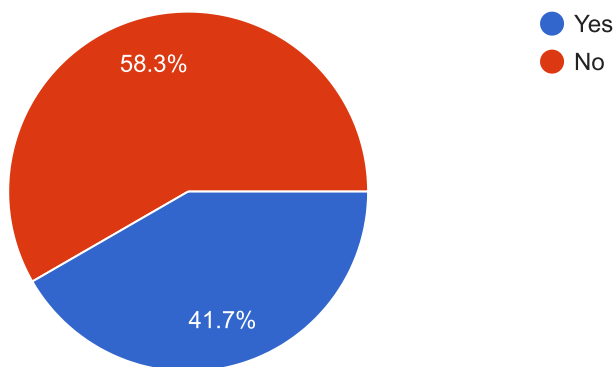
Original project duration (in months)?

12 responses



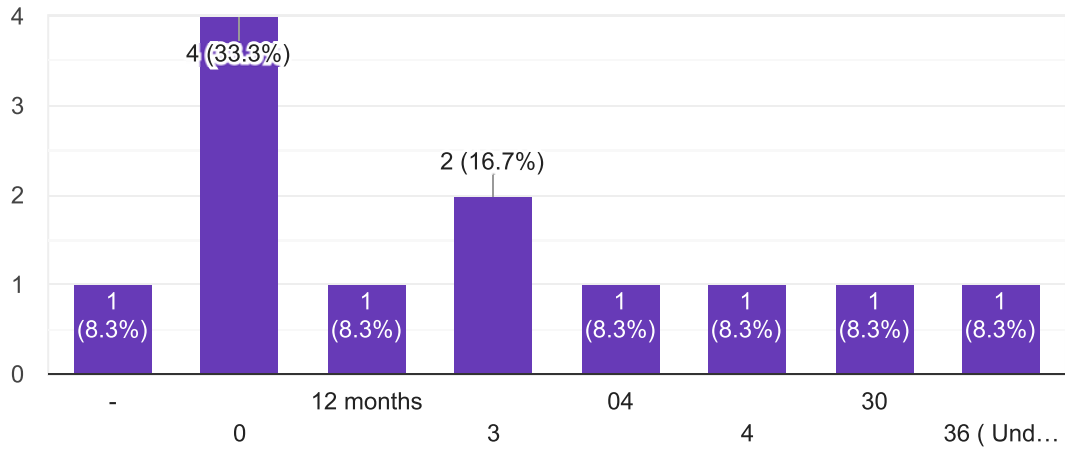
Was the project construction completed within the planned duration?

12 responses



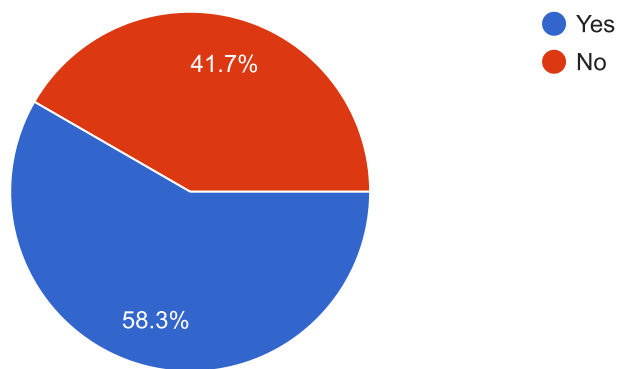
If your answer is "NO", the extended time period with respect to the initial planned duration (in months)?

12 responses



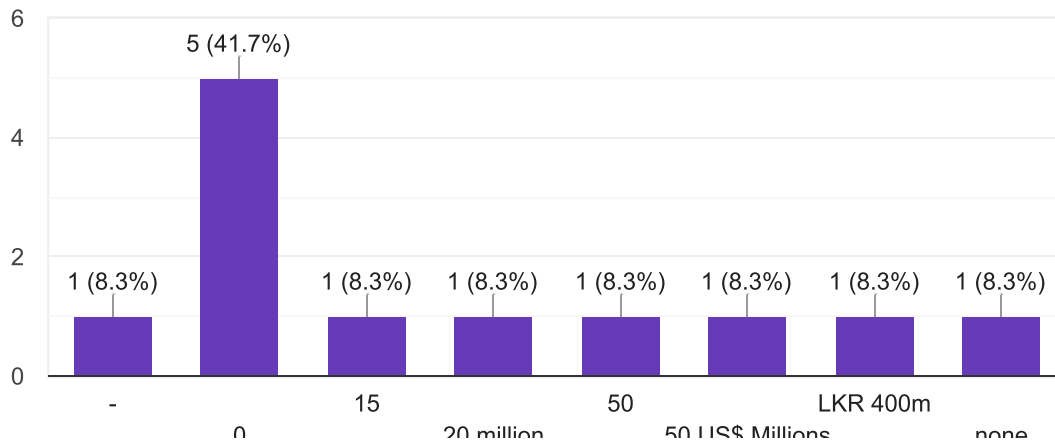
Was the project completed within the estimated budget?

12 responses



If your answer is "NO", the varied amount (in LKR Million)?

12 responses



Ranking of Risks in the particular condominium project

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Google Forms

AHP Analytic Hierarchy Process

n= 5

Input 1

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	67%
2	Criterion 2	Delays in obtaining clearances	14%
3	Criterion 3	Unavailability of funds	4%
4	Criterion 4	Inaccurate forecasting of sales and demand	7%
5	Criterion 5	Contractors' delays due to labour scarcity	7%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 1 | 1 | | α : 0.1 | CR: 10% | 1

Name | Weight | Date | Consistency Ratio | Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	9
1	3		Criterion 3	A	9
1	4		Criterion 4	A	9
1	5		Criterion 5	A	9
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	A
2	4	Criterion 4		A	3
2	5	Criterion 5		A	1
2	6	Criterion 6			
2	7	Criterion 7			
2	8	Criterion 8			
3	4	Criterion 3	Criterion 4	B	3
3	5		Criterion 5	A	1
3	6		Criterion 6		
3	7		Criterion 7		
4	5	Criterion 4	Criterion 5	A	1
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 5	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 6	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 7	Criterion 8		

AHP Analytic Hierarchy Process

n= 5

Input 2

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	55%
2	Criterion 2	Delays in obtaining clearances	11%
3	Criterion 3	Unavailability of funds	4%
4	Criterion 4	Inaccurate forecasting of sales and demand	11%
5	Criterion 5	Contractors' delays due to labour scarcity	19%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 2 1
 Name Weight Date α : 0.1 CR: 8% Scale 1

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	5
1	3		Criterion 3	A	7
1	4		Criterion 4	A	9
1	5		Criterion 5	A	3
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	A
2	4	Criterion 4		A	1
2	5	Criterion 5		B	3
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	B	3
3	5		Criterion 5	B	5
3	6		Criterion 6		
3	7		Criterion 7		
3	8		Criterion 8		
4	5	Criterion 4	Criterion 5	A	1
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6		Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7		Criterion 7		
6	8		Criterion 8		
7	8		Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 3

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	32%
2	Criterion 2	Delays in obtaining clearances	6%
3	Criterion 3	Unavailability of funds	29%
4	Criterion 4	Inaccurate forecasting of sales and demand	28%
5	Criterion 5	Contractors' delays due to labour scarcity	5%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 3 1 α : 0.1 CR: 5% 1

Name Weight Date Consistency Ratio Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	9
1	3		Criterion 3	A	1
1	4		Criterion 4	A	1
1	5		Criterion 5	A	5
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	5
2	5	Criterion 5		A	3
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	A	1
3	5		Criterion 5	A	3
3	6		Criterion 6		
3	7		Criterion 7		
3	8		Criterion 8		
4	5	Criterion 4	Criterion 5	A	5
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 6	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 7	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 8			

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 4

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	15%
2	Criterion 2	Delays in obtaining clearances	9%
3	Criterion 3	Unavailability of funds	3%
4	Criterion 4	Inaccurate forecasting of sales and demand	21%
5	Criterion 5	Contractors' delays due to labour scarcity	52%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 4 | 1 | | α : | CR: |

Name | Weight | Date | Consistency Ratio | Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	3
1	3		Criterion 3	A	5
1	4		Criterion 4	A	1
1	5		Criterion 5	B	7
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	A
2	4	Criterion 4		B	3
2	5	Criterion 5		B	5
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	B	9
3	5		Criterion 5	B	9
3	6		Criterion 6		
3	7		Criterion 7		
3	8		Criterion 8		
4	5	Criterion 4	Criterion 5	B	3
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 6	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 7	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 8	Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 5

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	13%
2	Criterion 2	Delays in obtaining clearances	8%
3	Criterion 3	Unavailability of funds	35%
4	Criterion 4	Inaccurate forecasting of sales and demand	35%
5	Criterion 5	Contractors' delays due to labour scarcity	9%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 5 1 α: CR:

Name Weight Date Consistency Ratio Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	B	1
1	3		Criterion 3	B	3
1	4		Criterion 4	A	1
1	5		Criterion 5	A	1
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	7
2	5	Criterion 5		A	1
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	A	1
3	5		Criterion 5	A	3
3	6		Criterion 6		
3	7		Criterion 7		
4	5	Criterion 4	Criterion 5	A	7
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 5	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 6	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 7	Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 6

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	37%
2	Criterion 2	Delays in obtaining clearances	5%
3	Criterion 3	Unavailability of funds	21%
4	Criterion 4	Inaccurate forecasting of sales and demand	33%
5	Criterion 5	Contractors' delays due to labour scarcity	4%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 6 | 1 | α : CR: Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	5
1	3		Criterion 3	A	3
1	4		Criterion 4	A	1
1	5		Criterion 5	A	9
1	6				
1	7				
1	8				
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	9
2	5	Criterion 5		A	1
2	6				
2	8				
3	4	Criterion 3	Criterion 4	B	1
3	5		Criterion 5	A	5
3	6				
3	8				
4	5	Criterion 4	Criterion 5	A	9
4	6				
4	7				
4	8				
5	6		Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7		Criterion 7		
6	8		Criterion 8		
7	8		Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 7

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	9%
2	Criterion 2	Delays in obtaining clearances	19%
3	Criterion 3	Unavailability of funds	58%
4	Criterion 4	Inaccurate forecasting of sales and demand	11%
5	Criterion 5	Contractors' delays due to labour scarcity	4%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 7 | 1 | | α : 0.1 | CR: 14% | 1

Name | Weight | Date | Consistency Ratio | Scale

		Criteria		more important ?	Scale	
i	j	A	B	A or B	(1-9)	A B
1	2	Criterion 1	Criterion 2	B	5	2 B2
1	3		Criterion 3	B	5	
1	4		Criterion 4	B	1	
1	5		Criterion 5	A	3	
1	6		Criterion 6			
1	7		Criterion 7			
1	8		Criterion 8			
2	3		Criterion 2	Criterion 3	B	7
2	4	Criterion 4		A	3	
2	5	Criterion 5		A	3	
2	6	Criterion 6				
2	7	Criterion 7				
3	4	Criterion 3	Criterion 4	A	5	
3	5		Criterion 5	A	9	
3	6		Criterion 6			
3	7		Criterion 7			
4	5	Criterion 4	Criterion 5	A	5	3 A3
4	6		Criterion 6			
4	7		Criterion 7			
4	8		Criterion 8			
5	6		Criterion 6			
5	7		Criterion 7			
5	8		Criterion 8			
6	7		Criterion 7			
6	8		Criterion 8			
7	8		Criterion 8			

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 8

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	19%
2	Criterion 2	Delays in obtaining clearances	7%
3	Criterion 3	Unavailability of funds	34%
4	Criterion 4	Inaccurate forecasting of sales and demand	33%
5	Criterion 5	Contractors' delays due to labour scarcity	6%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 8 1 α : 0.1 CR: 6% 1

Name Weight Date Consistency Ratio Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	3
1	3		Criterion 3	A	1
1	4		Criterion 4	B	3
1	5		Criterion 5	A	3
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	3
2	5	Criterion 5		A	1
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	A	1
3	5		Criterion 5	A	7
3	6		Criterion 6		
3	7		Criterion 7		
4	5	Criterion 4	Criterion 5	A	5
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 6	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 7	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 8			

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 9

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	18%
2	Criterion 2	Delays in obtaining clearances	38%
3	Criterion 3	Unavailability of funds	20%
4	Criterion 4	Inaccurate forecasting of sales and demand	18%
5	Criterion 5	Contractors' delays due to labour scarcity	7%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 9 1 α : 0.1 CR: 9% 1

Name Weight Date Consistency Ratio Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	1
1	3		Criterion 3	A	1
1	4		Criterion 4	A	1
1	5		Criterion 5	B	1
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	A
2	4	Criterion 4		A	3
2	5	Criterion 5		A	5
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	A	1
3	5		Criterion 5	A	5
3	6		Criterion 6		
3	7		Criterion 7		
3	8		Criterion 8		
4	5	Criterion 4	Criterion 5	A	3
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 5	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 6	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 7	Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process

n= 5

Input 10

Objective: To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Only input data in the light green fields!

Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, **A or B**, and **how much** more on a scale 1-9 as given below.

Once completed, you might adjust highlighted comparisons 1 to 3 to improve consistency.

n	Criteria	Comment	RGMM
1	Criterion 1	Location of the site	23%
2	Criterion 2	Delays in obtaining clearances	12%
3	Criterion 3	Unavailability of funds	26%
4	Criterion 4	Inaccurate forecasting of sales and demand	32%
5	Criterion 5	Contractors' delays due to labour scarcity	6%
6	Criterion 6		
7	Criterion 7		
8	Criterion 8		
9		for 9&10 unprotect the input sheets and expand the	
10		question section ("+" in row 66)	

Participant 10 | 1 | | α : | CR: |

Name | Weight | Date | Consistency Ratio | Scale

		Criteria		more important ?	Scale
i	j	A	B	A or B	(1-9)
1	2	Criterion 1	Criterion 2	A	1
1	3		Criterion 3	B	1
1	4		Criterion 4	A	1
1	5		Criterion 5	A	5
1	6		Criterion 6		
1	7		Criterion 7		
1	8		Criterion 8		
2	3		Criterion 2	Criterion 3	B
2	4	Criterion 4		B	5
2	5	Criterion 5		A	3
2	6	Criterion 6			
2	7	Criterion 7			
3	4	Criterion 3	Criterion 4	A	1
3	5		Criterion 5	A	3
3	6		Criterion 6		
3	7		Criterion 7		
3	8		Criterion 8		
4	5	Criterion 4	Criterion 5	A	5
4	6		Criterion 6		
4	7		Criterion 7		
4	8		Criterion 8		
5	6	Criterion 6	Criterion 6		
5	7		Criterion 7		
5	8		Criterion 8		
6	7	Criterion 7	Criterion 7		
6	8		Criterion 8		
7	8	Criterion 8	Criterion 8		

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong Importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

AHP Analytic Hierarchy Process (EVM multiple inputs)

K. D. Goepel Version 04.05.2016 Free web based AHP software on: <http://bpmsg.com>

Only input data in the light green fields and worksheets!

n= Number of criteria (2 to 10) Scale: AHP 1-9

N= Number of Participants (1 to 20) α : Consensus: 60.8%

p= selected Participant (0=consol.) 2 7 Consolidated

Objective To evaluate the Critical Risk Factors of Condominium developments in Sri Lanka

Author DR

Date Thresh: Iterations: 5 EVM check: 2.0E-08

Table	Criterion	Comment	Weights	Rk
1	Criterion 1	Location of the site	30.4%	1
2	Criterion 2	Delays in obtaining clearances	13.3%	4
3	Criterion 3	Unavailability of funds	20.0%	3
4	Criterion 4	Inaccurate forecasting of sales and demand	25.8%	2
5	Criterion 5	Contractors' delays due to labour scarcity	10.5%	5
6	Criterion 6		0.0%	
7	Criterion 7		0.0%	
8	Criterion 8		0.0%	
9		for 9&10 unprotect the input sheets and expand the	0.0%	
10		question section ("+" in row 66)	0.0%	

Result

Eigenvalue lambda:

Consistency Ratio 0.37 GCI: CR:

Matrix	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8	0	0	normalized principal Eigenvector
	1	2	3	4	5	6	7	8	9	10	
Criterion 1	1	2 1/4	1 1/2	1 2/5	2 4/9	-	-	-	-	-	30.39%
Criterion 2	4/9	-	2/3	1/2	1 1/4	-	-	-	-	-	13.31%
Criterion 3	2/3	1 1/2	-	3/4	2	-	-	-	-	-	20.05%
Criterion 4	5/7	1 7/8	1 1/3	-	2 7/8	-	-	-	-	-	25.76%
Criterion 5	2/5	4/5	1/2	1/3	-	-	-	-	-	-	10.49%
Criterion 6	-	-	-	-	-	-	-	-	-	-	0.00%
Criterion 7	-	-	-	-	-	-	-	-	-	-	0.00%
Criterion 8	-	-	-	-	-	-	-	-	-	-	0.00%
0	-	-	-	-	-	-	-	-	-	-	0.00%
0	-	-	-	-	-	-	-	-	-	-	0.00%