Risk assessment in commercial real estate development

An application of analytic network process

Malka Thilini and Nishani Champika Wickramaarachchi
Department of Estate Management and Valuation, University of Sri Jayewardenepura, Colombo, Sri Lanka

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Abstract

Purpose – The purpose of this paper is to analyze the commercial property development risk factors from the entrepreneur's point of view against social, economic, environmental, technological and political risk assessment criteria. After that, this study aims to assess the risk factors based on the analytical network process (ANP) model and to prioritize the key risk factors to identify which risk factor is highly affected to the commercial development process.

Design/methodology/approach – The data were collected through face-to-face interviews using a structured questionnaire. The analysis of the risk factors involved the ANP model using super decision software.

Findings – The results revealed that there are five major risk factors such as environmental, social, economic, technological and political risk, and 32 sub-risk factors. According to the super matrix calculation, the synthesized values for three projects were 0.0704, 0.0532 and 0.0431, respectively. It was identified that Ward City was 0.0704, indicating that it is comparatively less risky and, hence, can be categorized as the best development and considering the sub-risk factors; the results show that the highly affected risk factors for the development are: the council approval process, climate changes and natural disaster, and the least affected risk factors are confidence to the market, lifecycle value, investment return and currency conversion factor.

Practical implications – The paper includes implications for the development of commercial properties, risk and risk assessment criteria to make risk management strategies and policy implementation.

Originality/value – The research findings are helpful in improving risk management strategies in the country, and policy formulation should focus on the above identified three risk factors in order to mitigate the risk in every stage and to achieve sustainable project development while increasing the satisfaction of long-term investment goals.

Keywords Entrepreneur, Risk, Risk assessment, Commercial real estate, Analytic network process, Real estate development

Paper type Research paper

Introduction

Real Estate, compared to other industries, has been making a significant contribution to the economy of the country during the last three decades. As a result, Real Estate has been a field of interest of many entrepreneurs. Investors who are keen on real estate development tend to invest on various types of developments irrespective of the risk. Property development is inherently a riskier business, due to the difficulty of predicting the stage at which a developer must face with risk and uncertainty. In the development process, from the conceptual design to construction, stage, letting on rent occupying the building or the handover stage, risk is a common encounter.

In Sri Lankan setting, investors find the knowledge gap created by inadequate research and analyses on the risk factors in commercial development, a shackle in making business decisions. As a result, bridging this gap on risk factors, particularly in terms of urban areas of Sri Lanka, is of utmost importance. Since the majority of such development has taken place in western province – especially in and around the capital of Colombo – the research mainly focuses on analyzing the risks in commercial real estate development in Gampaha Jaela Ekala area from the entrepreneur's point of view, and identifying the best development

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in this area, and the highly affected risk factors and the least affected risk factors in the commercial real estate development process.

Risk and uncertainty are common to all real estate development and, therefore, the actual return of the investments will differ from what is expected. In certain cases, it includes the prospect of losing the original investment. However, Pidgeon as cited in Khumpaisal *et al.* (2010) classifies risk into "objective" or statistical risk and "subjective" or perceived risk. In this classification, Pidgeon *et al.* point out that the objective risk, which is unique, substantive and physically measurable, can be determined by quantitative risk assessment methods.

Furthermore, Hargitay and Yu have classified risk into systematic risks and unsystematic risks, which is a different reading compared to the previous one. Moreover Hargitay, Yu, Brown, Matysiak, Baum and Crosby as cited in Khumpaisal *et al.* (2010) had observed systematic risk (uncontrollable risk) caused by external factors that affect all investments; examples include market risk, inflation or purchasing power risk, and interest rate risk. Unsystematic or specific risk refers to risk over which the investor has limited control and is specific to a particular company or investment decision-making process.

In those circumstances, where risk and uncertainty are reported according to the RICS Appraisal and Valuation Manual RICS (1996) as cited in Adair and Hutchison (2005) prescribed standards the profession has been condemned for irregularities and letdowns. To reflect risk and uncertainty in certain valuation assignments such as the pricing of urban regeneration land (Syms, 1996). However, Hutchison and Nanthakumaran as cited in Adair and Hutchison (2005) examine issues relating to market efficiency, individual and market worth, and risk analysis. Indeed, the Investment Property Forum and Investment Property Databank (IPD) 2000 as cited in Razali and Adnan (2015) highlighted the need for more rigorous risk assessment measures within the broad property investment industry, comprising asset and fund managers and advisors.

Furthermore, Huffman (2002) put major risks associated with commercial real estate development into three categories such as financial risks, physical risks and regulatory risks. But Booth as cited in Khumpaisal and Chen (2009) shows that the STEEP factors, namely Social, Technological, Economic, Environmental and Political factors, have been widely used in the business context, but with different names, such as PEST, TESP and STEP. In this regard, PEST is an abbreviation of political, economic, social and technological factors; these factors shall be concerned while the decision making. The real estate developers have to take into account the assessment method; the current practice established is the risk matrix ioMosaic; Kindinger and Rafele as cited in Adair and Hutchison (2005) describe the likelihood and consequences of each risk in a tabular format. It states that the risk can strongly influence each project stage: the project conceptual, project feasibility analysis, design and planning, bidding and tendering construction and execution and handover stage.

Risks are associated with every investment; real estate development, as an investment, is not an exception. Real estate development has its own risks, particularly in relation to the decision-making process of a new development project. Hence, risks affect the entire project management process in terms of schedule delay, cost overrun and quality of products, according to Khallafalah, Flyvbjerg and Gehner as cited in Adair and Hutchison (2005).

According to Khumpaisal and Chen (2009), risks in each commercial real estate development can be identified at the project management level, using brainstorming techniques. Risks are generally defined as events that could arise and affect the critical factors of one project (Khumpaisal and Chen, 2009). Khumpaisal and Chen (2009) had identified many direct or indirect reasons why risks may occur in commercial real estate development, and several normal reasons relevant to the fragment existed throughout a project lifecycle covered by design, construction and facilities management, which are consequences of lack of integration of building elements, communication among project partners, and even misapplication of the building structure and its services systems. With regard to competitive enterprise growth and

sustainable urban development, the influence of those risks to a specific project was also to concentrate on impacts to local, regional and national environment, communities and economies in a long-term perspective under climate change scenario. The most significant risk and uncertainty toward investment return is the income stream. In terms of the possible events that affect the income stream and uncertainties of the probability of the outcomes of these events (Khumpaisal *et al.*, 2010) there are subjective elements to be considered in the risk management process, which cover the following areas:

- tenant risk (multi-tenanted less risky);
- demand and supply of property type;
- demand and supply for properties in different locations (local market conditions);
- economic and property market environment (voids, rental growth, leverage and pricing); and
- illiquidity (it may not be possible to sell certain types of property quickly, except at below-valuation prices).

Traditional approaches to risks assessment depend mostly on the result derived from either the panel discussion or the ranking method, which are at times not convincing enough due to the lack of quantitative measurements using reliable tools or instruments with strong theoretical bases. Developers in commercial real estate development are in need of alternative methods such as Bayesian belief network, Monte Carlo simulation and multi-criteria decision analysis of risks assessment (Chen and Khumpaisal, 2009). Furthermore, based on the idea that "risk" is the combination of uncertainties over the probability of events and their consequences, a list of the main risk is presented as follows:

- financial risk (interest rates, delays, etc.);
- land cost (usability, restrictions, local authorities, etc.);
- construction (late changes, big financial risk, exposure, etc.);
- timing (delays, etc.);
- sale/rents (faulty assumptions may lead to decreased income); and
- socioeconomic (macroeconomics).

Risk assessment criteria

Environmental risk

When it comes to developing commercial real estate or any other development, the environment is affected. In Sri Lanka, as rules and regulations to control environmental impacts, such as environmental law, Coastal Conservation Act, etc., have been imposed, they affect the development of the real estate. The adverse environmental impacts can be measured using a developed quantitative approach called Environmental Impact Index (EII). Chen and Khumpaisal (2009) have identified environmental risk as follows:

- adverse environmental impact; and
- climate changes.

However, this idea has not been considered in this research because of unavailable data from the respective parties. Instead, natural disasters impact was considered as an environmental risk in the particular area.

Social risk

Social risks in commercial real estate development are mostly described in subjective forms, and thus, most developers use qualitative analysis methods to measure and assess

social-related risks (Chen and Khumpaisal, 2009). Furthermore, Danter (2007) as cited in Chen and Khumpaisal (2009) explains that developers should measure workforce availability by employing a consensus method or observation of workforce targets in the project trade area. The cultural compatibility of the project is measured through a marketing survey. Acceptability could be measured using degree of benefits, and public hygiene, using the degree of impacts on local public health and safety as a result of the development of specific projects.

Economic risk

Risks associated with economic and financial uncertainties are the most important factors that could make strong impacts on the project development process, which is why most professionals and academics in the field of real estate pay attention to economic risks caused by the variation in interest rate, loan and developer credit. Sagalyn, Case, Nabarro and Key, Strischeck and Blundell as cited in Chen and Khumpaisal (2009) suggest the following criteria to measure risks and assess their impacts:

- Sector balance score: it measures the fund's structure and indicate the weight scores, which differs from IPD universe structure income return.
- Income return: it calculates the net income receives for each year as a percentage of the capital employed over the year.
- Location concentration: it measures the percentage of each fund's capital value invested in the ten most important locations.
- Development exposure: IPD and LaSalle chose the simple percentage of fund capital value in current developments as a risk measure, which include both pre-let and speculative developments.
- Asset/lot size concentration: this measures the percentage of a fund's capital value that is bound up in five big assets.
- Lease length.
- Tenant Credit worthiness (TICCS stress score) is weighted by the rent for each tenant to form the portfolio stress score.
- Tenant concentration: it measures the percentage of the annual rental payments that accounted from the biggest ten tenants.
- Weighted beta.
- Void rate or vacancy rate.

Interest rate is one of the most significant indicators the developers employ for measuring economic risks, as changes in interest rates can affect their earnings by changing its net interest income, the level of other interest-sensitive income and operating expenses associated with each specific real estate development. According to the Financial Services Authority (2005), the borrowing take is high and the inflation rate is increasing day by day in Sri Lanka; both the rates can be identified as an economic risk.

Economic risk in commercial real estate development is associated with 14 risks, which are interest rate, property type, market liquidity, confidence to the market, currency conversion, demand and supply, purchaseability, brand visibility, capital exposure, lifecycle value, area accessibility, buyers, tenants and investment return.

The measurements of risk assessment criteria can be explained as follows:

(1) risks related to interest rate are measured using the degree of impact, due to interest changes;

(2) degree of location concentration is used to assess property type risk;

(3) the market liquidity risks are measured using the selling rate of the same property in the local market, and confidence to the market is measured using degree of expectation to the same kind of properties;

(4) the confidence to the market is measured by the confidence level of the developer;

(5) risk related to currency conversion is measured using the developer's degree of impact due to exchange rate fluctuation;

(6) risks related to demand and supply are measured using the degree of regional competitiveness in developed property;

(7) the risk related to the purchaseability is measured using the degree of affordability to the same kind of property;

(8) the brand visibility is measured using the degree of entrepreneur's reputation in developing each specific commercial property;

(9) the capital exposure is measured according to the rate of estimated lifecycle cost per 1bn rupees;

(10) the risks related to lifecycle value are measured using the five-year property depreciation rate;

(11) risk in area accessibility is measured using the degree of regional infrastructure usability associated with a specific development project;

(12) risks related to buyers are measured using an expected selling rate of a specific development;

(13) risks related to tenant are measured using an expected annual lease rate of a specific development; and

(14) risks related to investment return are measured according to the expected capitalization rate.

Technological risk

Although location selection is an important part in feasibility study, the risks related to site condition are measured using the degree of difficulties in site preparation for each specific development plan (Khumpaisal and Chen, 2009).

Nine risks have been identified under technological risks, i.e. site condition, designers and construction, multiple functionality, constructability, duration, amendments, facilities management, accessibility and evacuation durability. In terms of measuring these risks, the risks related to site selection are measured using the degree of difficulties in site preparation for each commercial development:

(1) designs and construction risks are measured using an entrepreneur's satisfaction to their professional experience regarding the development plan;

(2) the site conditions are measured by the degree of difficulties in site preparation for each specific plan;

(3) multiple functionality of property of risks is measured using the degree of multiple use of the property;

(4) constructability risks are measured according to the technical difficulties in commercial property development;

(5) the duration is measured by the total duration of design and construction per 1,000 days;

(6) amendments are measured by the possibility of amendments in design and construction;

(7) the risks related to facilities managements are measured using the degree of complexities in facilities management;

(8) risks of accessibility and evacuation are measured using the degree of easy access and quick emergency evacuation in use; and

(9) risks related to durability are measured using the probability of refurbishment requirement during building lifecycle.

Political risk

The political risk is assessed by the following sub-criteria as political groups, commercial tax policy and council approval:

(1) the political groups are assessed on the degree of protest by the urban communities;

(2) commercial tax policy is measured according to the rate of commercial tax impact; and

(3) the council approval is measured by the total days of construction, design and approval process by urban council.

Table I presents the risk assessment criteria and sub-criteria and valuation method with references. According to the research findings, the criteria of risk factors are summarized as illustrated in Table I.

Methods

Data and data collection

The primary data were collected using face-to-face structured interview. Three questionnaires used to identify the respective people's opinion about risk in commercial real estate development contained five major risk criteria (social risk, economic risk, environment risk, technological risk and political risk) and 32 sub-criteria. Recorded interviews were evaluated and analyzed for an in-depth understanding of risk factors studied in this research.

Case study area

Situated on the north-eastern part of the capital Colombo, Gampaha is a major town in Gampaha District, western province Sri Lanka. Gampaha municipal council is the main administrative authority in charge of the town area with government offices and various departments. Municipal Council and Divisional Secretariat are also located within its city limit. The city is a transit point with approximately over 200,000 people entering into the city on a daily basis. Ja-Ela is a suburb of Colombo, located approximately 20 km (12 mile) north of the Colombo city center and lies on the A3 road that overlaps with the Colombo Katunayake Expressway at Ja-Ela Junction. The economic activities in Ja-Ela consist of commercial enterprises, office and industrial employment. Ekala situated in Ja-Ela local authority area in Gampaha District is the location for the second industrial city of Sri Lanka. With a very large workforce and about 175 factories, Ekala is a suburb of Ja-Ela situated within a radius of 3 km from Ja-Ela.

Sample

Out of several commercial projects in the town area, three commercial projects from Gampaha (Word City), Ja Ela (Reality Plaza) and Ekala (Orex City) were selected. The selection criteria were being within Gampaha, Ja Ela and Ekala area, being close to the city

Table I.
Risk assessment criteria

Criteria	Sub-criteria	Valuation methods	Representative reference
Social risks	Workforce availability	Degree of developer's satisfaction to local workforce market (%)	Danter (2007)
	Community acceptability	Degree of benefits to local communities (%)	Danter (2007)
	Cultural compatibility	Degree of business and lifestyle harmony (%)	Danter (2007)
	Public hygiene	Degree of impacts on local public health and safety (%)	NHS Standards
Technological risks	Site conditions	Degree of difficulties in site preparation for each specific plan (%)	Danter (2007)
	Designers and constructors	Degree of developer' satisfaction of their performances (%)	Khalafallah *et al.* (2005)
	Multiple functionality	Degree of multiple use of the property (%)	Danter (2007)
	Constructability	Degree of technical difficulties in construction (%)	Lam *et al.* (2006)
	Duration	Total duration of the design and construction per 1,000 days (%)	Khalafallah *et al.* (2005)
	Amendments	Possibility of amendments in design and construction (%)	Khalafallah *et al.* (2005)
	Facilities management	Degree of complexities in facilities management (%)	Moss *et al.* (2007)
	Accessibility and evacuation	Degree of easy access and quick emergency evacuation in use (%)	Moss *et al.* (2007)
	Durability	Probability of refurbishment requirements during buildings lifecycle (%)	Chen (2007)
Environmental risks	Adverse environment impacts	Overall value of the Environmental Impacts Index	Chen *et al.* (2005)
	Climate change	Degree of impacts on use and value due to regional climatic variation (%)	UNEP (2007)
Economic risks	Interest rate	Degree of impacts due to the increase of loan rate (%)	Sagalyn (1990), Financial Services Authority (2005), Nabarro and Key (2005), Frodsham (2007)
Economic risks	Property type	Degree of location concentration (%)	Adair and Hutchison (2005), Frodsham (2007)
	Market liquidity	Selling rate of same kind of properties in the local market (%)	Adair and Hutchison (2005)
	Currency conversion	Degree of impacts due to exchange rate fluctuation	Morledge *et al.* (2006), Financial Services Authority (2005), Financial Stability Board (2007)
	Demand and supply	Degree of regional competitiveness (%)	Adair and Hutchison (2005)
	Purchaseability	Degree of affordability to the same kind of properties (%)	www.statistics.gov.uk/
	Brand visibility	Degree of developer's reputation in specific development (%)	D&B (2007), Adair and Hutchison (2005), Gibson and Louragand (2002)
	Capital exposure	Rate of estimated lifecycle cost per 1bn pound (%)	Blundell *et al.* (2005), Moore (2006)
	Lifecycle value	5-year property depreciation rate (%)	Lee (2002), Adair and Hutchison (2005)
	Area accessibility	Degree of regional infrastructures usability (%)	Adair and Hutchison (2005)
	Buyers	Expected selling rate (%)	Frodsham (2007)
	Tenants	Expected annual lease rate (%)	Booth *et al.* (2002)
	Investment return	Expected capitalization rate (%)	Sagalyn (1990), Watkins *et al.* (2004)

(*continued*)

Table I.

Criteria	Sub-criteria	Valuation methods	Representative reference
Political risks	Political groups/activist	Degree of protest by the urban communities (%)	Arthurson (2001)
	Commercial tax policy	Rate of commercial tax impact (%)	Gehner *et al.* (2006), FSB (2007)
	Local tax policy	Rate of council local tax (%)	LCC (2008)
	Council approval	Total days of construction, design approval process by Liverpool City Council (LCC)	Crown Copyright (2008)
	License approving	Total days of license approval process	Crown Copyright (2008)

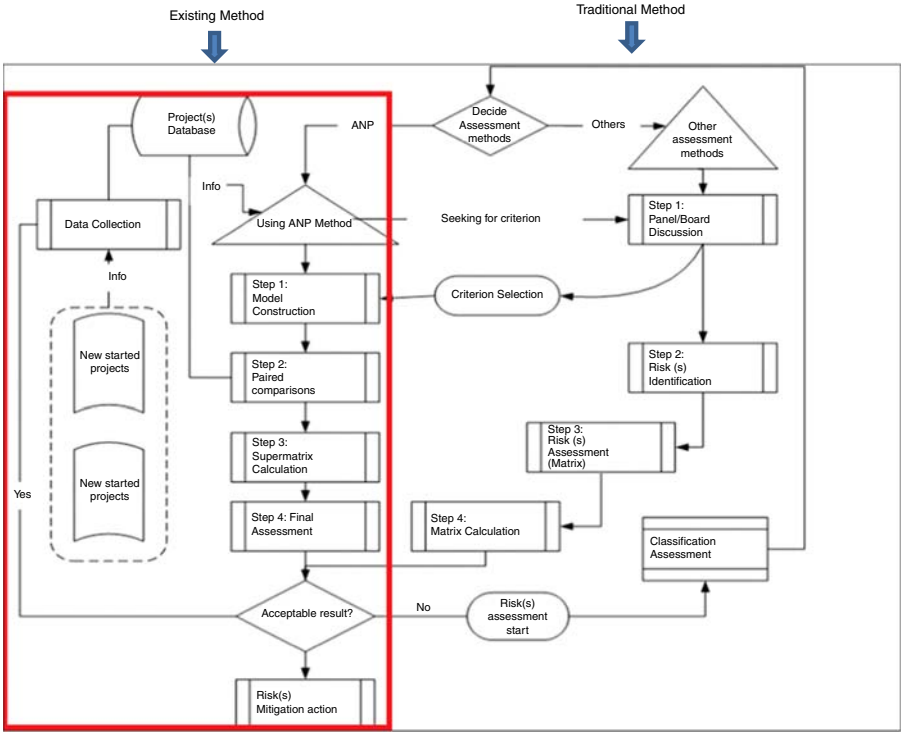
Source: Chen and Khumpaisal (2009)

center, being convenient to the researcher which aims to attract back to city center a higher proportion of catchment population currently lost to outer retail shops and shopping centers, and maximize the use of current and future transport facilities, etc.

"World City Commercial Complex" comprises 196 shops and over 12,000 sq.ft of office space, with ten units of escalators, four elevators including two observation lifts, a basement car park and all amenities. The commercial complex is of seven floor levels including the ground floor. Reality plaza is a shopping complex that is consisted with ample parking facilities, and each floor is equipped with a lot of facilities. It is currently occupied by few saloon owners, and the complex is also suitable for jewelry shops, computer shops or any kind of businesses. "Orex City" has over 500 shopping units approximately 200 sq.ft. All the shops will have individual toilets and other common amenities and ample parking.

Data analysis method

The analytic network process (ANP) introduced by Saaty 2005) as a novel approach to risk assessment in commercial real estate development was used in this research to analyze risk factors in commercial real estate development. The ANP was built using Super Decision software. Generally speaking, the management is mostly undertaken based on the three basic steps, which consist of risk identification and initial assessment, response and mitigation and further risk analysis (see other methods in Figure 1). According to Figure 1 (portion colored in red), the first step is to build an ANP model using the software. Then a paired comparison process is conducted to form a super matrix of quantified



Source: Chen and Khumpaisal (2009)

Figure 1.
ANP and existing risk assessment model

interdependency between paired criteria and alternatives of development plan. According to the synthesized value, the best development project in Gampaha, Ja Ela and Ekala areas can be identified. The results can also be useful to support risk mitigation action undertaken later. However, the authors noted that the traditional approaches to risks assessment mostly depend on the derived from either panel discussion or ranking method, which are sometimes not convincing enough due to the lack of quantitative measurements using reliable tools or instrument with strong theoretical bases. It is assumed that developers use alternative method such as Bayesian belief network, Monte Carlo simulation, multi-criteria decision analysis, etc. As an existing method of risk assessment, the ANP is used.

According to the literature review, the five major risk factors and 32 sub-risk factors were considered for risk assessment (see Table I). The EII could be considered as environment risk, but it was overlooked in this research because of the unavailability of data from respective parties. Instead, the natural disasters impact was considered as an environmental risk in that area. Especially political risk was considered a risk in commercial real estate development in Sri Lanka because of unstable political condition. All the details were based on the literature review. In this paper, the ANP model is set up based on the author's knowledge about risks assessment criteria, which is used to make judgments in quantifying interdependences for the 32 risk assessment criteria inside Clusters 2–6 except the three alternatives in Cluster 1 (see Figure 2), and specific characteristics of alternative plans (see Table II), which is used to make judgments in quantifying interdependences for alternatives in the study area as mentioned above, although interdependences among 32 risk assessment criteria can be measured based on experts' knowledge. Table II presents assumptions of alternative development plans for ANP evaluation.

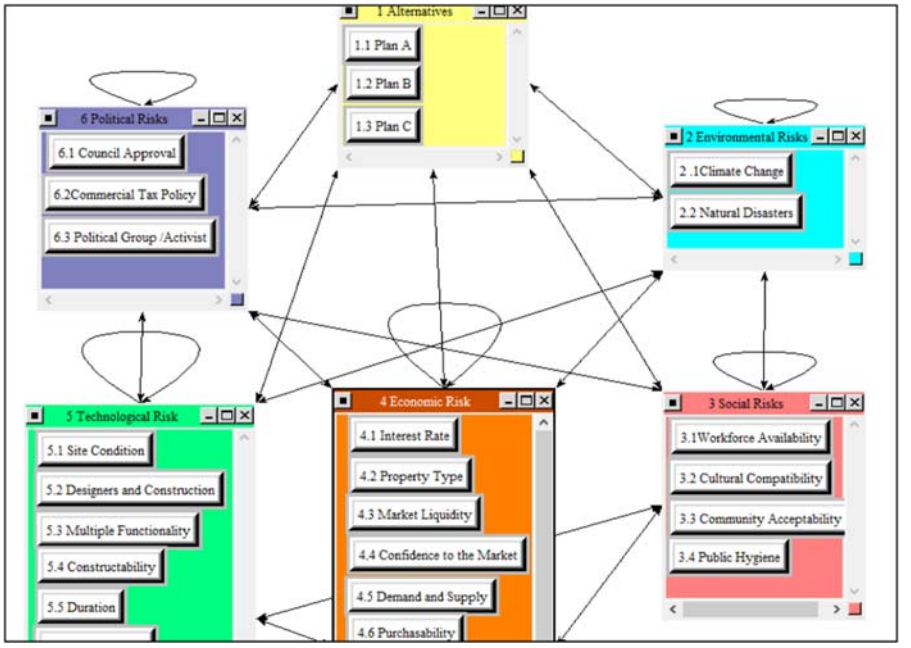


Figure 2.
ANP model for commercial real estate development risk assessment

Source: Compiled by author

Sub-criteria	Valuation methods	Unit	Plan A (%)	Plan B (%)	Plan C (%)
2.1. Climate changes	Degree of impacts to use and value due to regional climatic variation	%	60	30	40
2.2. Impact of natural disasters	Degree of impacts due to natural disaster	%	60	30	40
3.1. Workforce availability	Degree of developer's satisfaction to local workforce market	%	60	50	60
3.2. Cultural compatibility	Degree of benefit for local communities	%	80	90	80
3.3. Community acceptability	Degree of business and lifestyle harmony	%	80	85	75
3.4. Public hygiene	Degree of impacts to local public health and safety	%	25	20	25
4.1. Interest rate	Degree of impacts due to increment of loan rate	%	40	60	40
4.2. Property type	Degree of location concentration	%	65	60	65
4.3. Market liquidity	Selling rate of same kind of properties in the local market	%	80	80	80
4.4. Confidence to the market	Degree of impact due to exchange rate fluctuation	%	20	40	20
4.5. Demand and supply	Degree of regional competitiveness	%	50	60	50
4.6. Purchaseability	Degree of affordability to the same kind of properties	%	80	60	80
4.7 Brand visibility	Degree of developer's reputation in specific development	%	85	80	85
4.8. Capital exposure	Rate of estimated lifecycle cost per 1m rupee	%	90	75	85
4.9. Lifecycle value	5-year property depreciation rate	%	12.5	20	12.5
4.10. Area accessibility	Degree of regional infrastructure usability	%	75	75	75
4.11. Buyers	Expected selling rate	%	80	75	70
4.12. Tenants	Expected annual lease rate	%			
4.13. Investment return	Expected capitalization rate	%	25	30	20
5.1. Site condition	Degree of difficulties in site preparation for each specific plan	%	30	20	30
5.2. Designers and constructors	Degree of developer's satisfaction to their performances	%	75	70	75
5.3. Multiple functionality	Degree of multiple use of the property	%	25	20	25
5.4. Constructability	Degree of technical default in construction	%	30	35	30
5.5. Duration	Total duration of design and construction per 1,000 days	%	146	95	110
5.6. Amendments	Possibility of amendments in design and construction	%	25	25	25
5.7. Facilities management	Degree of complexities in facilities management	%	80	75	80
5.8. Accessibility and evacuation	Degree of easy access and quick emergency evacuation in use	%	60	50	60
5.9. Durability	Probability of refurbishment requirements during buildings lifecycle	%	20	20	20
6.1. Political groups/ activists	Degree of protest by the urban communities	%	20	25	20
6.2. Commercial tax policy and local tax policy	Degree of commercial tax policy affect to project	%	20	20	20
6.3. Council approval	Total days of license approval process by urban council	%	40	40	40

Source: Compiled by author

Table II.
Assumptions of alternative development plans for ANP evaluation

Risk assessment model (Step 1)

The risk assessment model was constructed using super decision software. Figure 2 illustrates the ANP model for commercial real estate development.

Figure 2 illustrates that the ANP model is based on the 32 defined risks. What is intriguing of ANP method is that it provides an effective mechanism for decision makers to

quantitatively evaluate interrelations between either paired criteria or paired sub-criteria, and this makes it possible for decision makers to reuse expertise for commercial real estate development in terms of the assessment of all defined risks (Table I). As illustrated in Figure 2, the ANP model consists of five clusters, including alternatives, environmental risks, social risks, economic risks, and technological risks and political risks. There are 32 nodes in total inside the ANP model, out of which three nodes are inside the alternative cluster, i.e., Plan A, Plan B and Plan C. They are alternative plans for a specific commercial real estate development in Gampaha, Ja-Ela and Ekala in an experimental case study in this research to demonstrate the effectiveness of using ANP in finding the most appropriate plan. The other 32 nodes are located in other five clusters. In addition, two-way and looped arrow lines in Figure 2 describe the interdependences that exist between paired clusters as well as nodes (Saaty, 2005); in other words, fixed interrelations between paired clusters are observed. Similar fixed interrelations are noticed between paired nodes inside one cluster as well as from two different clusters. To quantitatively measure all interrelations inside the ANP model, questionnaire survey to comparison of relative importance between paired clusters as well as nodes is required. The questionnaire survey is helpful to apprehend experts' knowledge in each specific domain and concentrate it into the ANP model. This result in the ANP model being applicable as a decision-making support tool based on knowledge reuse.

The structure of the ANP model is shown in Figure 2. However, the pair-wise comparison is adopted using subjective judgments made in regard to the fundamental scale of pair-wise judgments (Saaty, 2005). Table II gives a general description of how to conduct the pair-wise comparison between paired clusters as well as nodes in regard to their interdependences defined in the ANP model (Figure 2), and relative importance based on their specific characteristics and experts' knowledge. In this paper, the ANP model is set up based on the authors' knowledge about risk assessment criteria, which is used to make judgments in quantifying interdependence for 32 risk assessment criteria inside Clusters 2–6 except the three alternatives in Cluster 1 (Figure 2) and specific characteristics of alternative plans which is used to make judgment in quantifying interdependence for alternatives in case study. Table III is shown the scale of pair-wise comparisons.

Paired comparison (Step 2)

In order to quantify all the possible interdependent relations inside the model, the pair-wise comparison is adopted using subjective judgments made in regard to the fundamental scale of pair-wise judgments (Saaty, 2007). Table III gives a general description as to how to conduct the pair-wise comparison between paired clusters as well as nodes defined in the ANP model (Figure 1). The relative importance is based on the specific characteristics and expertise knowledge.

Scale of pair-wise comparisons

Notes

(1) The fundamental scale of pair-wise judgments: 1 – not important; 2 – not to moderately important; 3 – moderately important; 4 – moderately to strongly important;

Clusters/nodes	±1	±2	±3	±4	±5	±6	±7	±8	±9
Cluster I	x	x	x	x	x	✓	x	x	x
Cluster J									
Node I_i	x	x	x	x	x	✓	x	x	x
Node J_j									

Table III.
ANP judgment between paired clusters/nodes

Source: Chen and Khumpaisal (2009)

5 – strongly important; 6 – strongly to very strongly important; 7 – very strongly important; 8 – very strongly to extremely important; and 9 – extremely important.

(2) The symbol "x" denotes item under selection for pair-wise judgment, and the symbol "$\surd$" denotes selected pair-wise judgment.

(3) I and J denote the number of clusters, while i and j denote the total number of nodes.

(4) The symbol "±" denotes importance initiative between compared nodes or clusters.

Super matrix calculation (Step 3)

After pairing comparison to form a two-dimensional super matrix for further calculations, the calculation of super matrix is required to acquire useful information for development plan selection. The calculation of super matrix is conducted through three steps: transform an initial super matrix or un-weighted one based on pair-wise comparison to a weighted super matrix and then to a synthesized super matrix. The result from the synthesized super matrix is given in Table AI.

Final risk assessment (Step 4)

According to the results, Plan A is identified as the most appropriate plan for the specific development, because it indicates the highest synthesized priority weight among the three alternatives. According to Table IV, the synthesized values for three projects were 0.0704, 0.0532 and 0.0431, respectively. It was identified that Ward City was 0.0704, indicating that it is comparatively less risky and, hence, can be categorized as the best development. As a result, Plan A which is Word City development project is selected by the ANP model for the regeneration project in Gampaha.

Types of risk prioritization

Prioritization of the key risk factors affecting to the commercial real estate development process is important in making decisions, as it helps to comprehend as to what risk factors are the highly affected and the least affected risk factors in the commercial real estate development process. Table V demonstrates the risk type and prioritized value.

According to Table V, the minimum affected risk factors are confidence to the market, lifecycle value, investment return, currency conversion and the like. The highly affected risk factors being council approval process, the natural disaster impact, climate changes, cultural compatibility, community acceptability and the like are also considered other affected risk factors. Those factors are helpful to all the real estate developers to manage some risk factors.

Risk management

After assessing the risk some risk cannot be avoided, thus risk management is an important concept. If organizations are attempting to manage the corporate real estate risk, then they need a framework to identify the sources of risk in a similar way to that developed for strategic business risk by Simons 1999 cited in Frodsham (2007); Simons

Table IV. Comparisons of alternative development plans based on ANP modeling

Results	Plan alternatives Plan A	Plan B	Plan C
Synthesized priority weights	0.0704	0.0532	0.0431
Ranking	1	2	3

Source: Compiled by author

Name	Risk Type	Normalized By Cluster
4.4 Confidence to the Market	Economic Risk	0.01304
4.9 Lifecycle value	Economic Risk	0.01462
4.14 Investment Return	Economic Risk	0.01631
4.11 Currency Conversion	Economic Risk	0.01814
4.1 Interest Rate	Economic Risk	0.02405
5.9 Durability	Technological Risk	0.02425
4.5 Demand and Supply	Economic Risk	0.02636
5.6 Amendments	Technological Risk	0.03103
5.3 Multiple Functionality	Technological Risk	0.03468
3.4 Public Hygiene	Social Risk	0.03973
5.4 Constructability	Technological Risk	0.04258
4.2 Property Type	Economic Risk	0.04501
5.1 Site Condition	Technological Risk	0.05544
4.6 Purchasability	Economic Risk	0.07303
5.8 Accessibility and Evacuation	Technological Risk	0.07434
4.13 Tenants	Economic Risk	0.07544
5.2 Designers and Construction	Technological Risk	0.11323
4.10 Area Accessibility	Economic Risk	0.13160
4.12 Buyers	Economic Risk	0.13199
4.3 Market Liquidity	Economic Risk	0.13671
4.8 Capital Exposure	Economic Risk	0.14581
3.1Workforce Availability	Social Risk	0.14716
4.7 Brand Visibility	Economic Risk	0.14787
6.3 Political Group /Activist	Political Risk	0.17403
6.2Commercial Tax Policy	Political Risk	0.19128
5.7 Facilities Management	Technological Risk	0.22240
5.5 Duration	Technological Risk	0.40207
3.2 Cultural Compatibility	Social Risk	0.40579
3.3 Community Acceptability	Social Risk	0.40732
2.1 Climate Changes	Environmental Risk	0.5
2.2 Natural Disaster	Environmental Risk	0.5
6.1 Council Approval	Political Risk	0.63469

Highly affected Risk Factors

Table V.
Risk prioritization table

Source: Compiled by author

conducted a survey into risk management practice and disclosed that, while investing in the commercial real estate assets, it will deliver a return in the form of an income stream, but the income stream is uncertain to forecast as well as any events which would affect the income stream. On the other hand, Strischek (2007) suggested that some

mandatory data should be added into risks measurement criterion, including original appraised value, bank-adjusted appraised value, capitalization rate from appraisal and loan to value at inception.

Conclusion and recommendation

The results revealed five major risk factors, i.e. environmental, social, economic, technological and political risk and 32 sub-risk factors. According to the super matrix calculation, the synthesized values for three projects were 0.0704, 0.0532 and 0.0431, respectively. Ward City being 0.0704 indicates that it is comparatively less risky, and hence, can be categorized as the best development. Considering the sub-risk factors; the results show that the highly affected risk factors for the development are: the council approval process, climate changes and natural disaster, and the least affected risk factors are confidence to the market, lifecycle value, investment return and currency conversion factor. Duration, cultural compatibility and community acceptability moderately impact on commercial development. Therefore, policy formulation should focus on minimizing the risk in the highly affecting risk factors in Sri Lanka. Further researchers should concentrate on improving different network structures using the ANP model with regard to risks.

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Corresponding author
Malka Thilini can be contacted at: malkathilini@gmail.com

Appendix

	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
1.1	0.000000	0.666667	0.666667	0.730161	0.730161	0.461539	0.090909	0.173913	0.428571	0.125000	0.466667	0.333333	0.166667	0.125000	0.470588	0.473684	0.473684
1.2	0.500000	0.000000	0.333333	0.076662	0.076662	0.076923	0.818182	0.782609	0.142857	0.750000	0.066667	0.333333	0.666667	0.750000	0.058824	0.052632	0.052632
1.3	0.500000	0.333333	0.000000	0.193176	0.193176	0.461538	0.090909	0.043478	0.428572	0.125000	0.466667	0.333333	0.166667	0.125000	0.470588	0.473684	0.473684
2.1	0.500000	0.500000	0.500000	0.000000	1.000000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000
2.2	0.500000	0.500000	0.500000	1.000000	0.000000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000
3.1	0.095313	0.095313	0.095313	0.095313	0.095313	0.000000	0.470588	0.470588	0.470588	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313
3.2	0.434181	0.434181	0.434181	0.434181	0.434181	0.470588	0.000000	0.470588	0.470588	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181
3.3	0.434181	0.434181	0.434181	0.434181	0.434181	0.470588	0.470588	0.000000	0.058824	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181
3.4	0.434181	0.434181	0.434181	0.434181	0.434181	0.470588	0.470588	0.000000	0.058824	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181
4.1	0.036325	0.036325	0.036325	0.036325	0.036325	0.058824	0.058824	0.058824	0.000000	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325
4.2	0.015836	0.031879	0.014108	0.020988	0.020988	0.022914	0.020988	0.020988	0.020988	0.000000	0.024763	0.059943	0.023788	0.022351	0.041134	0.024033	0.025181
4.3	0.092111	0.031879	0.034682	0.039202	0.039202	0.041738	0.039202	0.039202	0.039202	0.043720	0.000000	0.063299	0.082668	0.048718	0.063788	0.046348	0.045827
4.4	0.071607	0.100943	0.075525	0.152862	0.152862	0.150159	0.152862	0.152862	0.152862	0.148280	0.157332	0.000000	0.189018	0.141107	0.130077	0.180870	0.160912
4.5	0.044315	0.031879	0.019840	0.020988	0.020988	0.022914	0.020988	0.020988	0.020988	0.030004	0.024763	0.047973	0.024095	0.000000	0.028454	0.024033	0.025181
4.6	0.071607	0.031879	0.075525	0.074797	0.074797	0.075722	0.074797	0.074797	0.074797	0.089487	0.072854	0.072393	0.061046	0.078473	0.000000	0.091139	0.087099
4.7	0.153216	0.100943	0.212350	0.152862	0.152862	0.150159	0.152862	0.152862	0.152862	0.132712	0.157332	0.127289	0.123492	0.141664	0.110289	0.000000	0.234090
4.8	0.127934	0.100943	0.212350	0.152862	0.152862	0.150159	0.152862	0.152862	0.152862	0.115690	0.157332	0.144141	0.126716	0.143888	0.167158	0.180870	0.000000
4.9	0.027701	0.014156	0.007440	0.008471	0.008471	0.008156	0.008471	0.008471	0.008471	0.064974	0.009311	0.039732	0.038733	0.025185	0.061437	0.009213	0.018787
4.10	0.049180	0.085675	0.075525	0.152862	0.152862	0.150159	0.152862	0.152862	0.152862	0.067955	0.157332	0.130308	0.107912	0.126467	0.116845	0.180870	0.150380
4.11	0.031667	0.041357	0.008541	0.010680	0.010680	0.010615	0.010680	0.010680	0.010680	0.082606	0.012001	0.040617	0.036622	0.029748	0.050714	0.011802	0.022289
4.12	0.074462	0.100943	0.034682	0.152862	0.152862	0.150159	0.152862	0.152862	0.152862	0.074689	0.157332	0.130308	0.107912	0.139440	0.088404	0.180870	0.150380
4.13	0.203232	0.306829	0.212350	0.039202	0.039202	0.034805	0.039202	0.039202	0.039202	0.067461	0.045648	0.075096	0.063943	0.058313	0.052277	0.046348	0.056358
4.14	0.030404	0.008479	0.008541	0.010680	0.010680	0.021724	0.010680	0.010680	0.010680	0.061160	0.012001	0.040847	0.014054	0.014180	0.074198	0.011802	0.011758
5.1	0.037377	0.090479	0.029381	0.052210	0.052210	0.051255	0.052210	0.052210	0.052210	0.052210	0.052210	0.052210	0.052210	0.052210	0.052210	0.047047	0.052210
5.2	0.022517	0.030731	0.014579	0.123445	0.123445	0.221970	0.123445	0.123445	0.123445	0.123445	0.123445	0.123445	0.123445	0.123445	0.123445	0.127268	0.123445
5.3	0.033630	0.273910	0.025662	0.014452	0.014452	0.014394	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.024571	0.014452
5.4	0.033630	0.052789	0.201885	0.025193	0.025193	0.024901	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.029810	0.025193
5.5	.479867	0.264529	0.304290	0.455699	0.455699	0.452461	0.455699	0.455699	0.455699	0.455699	0.455699	0.455699	0.455699	0.455699	0.455699	0.423755	0.455699
5.6	0.020148	0.039236	0.029381	0.025193	0.025193	0.024901	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.025193	0.029810	0.025193
5.7	0.237361	0.127782	0.246896	0.234937	0.234937	0.142001	0.234937	0.234937	0.234937	0.234937	0.234937	0.234937	0.234937	0.234937	0.234937	0.230106	0.234937
5.8	0.112955	0.089811	0.133347	0.054420	0.054420	0.053722	0.054420	0.054420	0.054420	0.054420	0.054420	0.054420	0.054420	0.054420	0.054420	0.050353	0.054420
5.9	0.022517	0.030731	0.014579	0.014452	0.014452	0.014394	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.014452	0.037281	0.014452
6.1	0.666667	0.666667	0.666667	0.666667	0.666667	0.666667	0.666667	0.800000	0.800000	0.606061	0.666667	0.800000	0.800000	0.800000	0.800000	0.800000	0.800000
6.2	0.166667	0.166667	0.166667	0.166667	0.166667	0.166667	0.166667	0.000000	0.000000	0.242424	0.166667	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6.3	0.166667	0.166667	0.166667	0.166667	0.166667	0.166667	0.166667	0.200000	0.200000	0.151515	0.166667	0.200000	0.200000	0.200000	0.200000	0.200000	0.200000

	4.9	4.10	4.11	4.12	4.13	4.14	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.1	6.2	6.3
1.1	0.250000	0.333333	0.166667	0.470588	0.571429	0.333333	0.428571	0.470588	0.428571	0.166667	0.778491	0.333333	0.470588	0.461539	0.333333	0.200000	0.333333	0.333333
1.2	0.750000	0.066667	0.333333	0.666667	0.750000	0.058824	0.052632	0.052632	0.500000	0.333333	0.666667	0.470588	0.285714	0.333333	0.142857	0.058824	0.142857	0.666667
1.3	0.250000	0.333333	0.166667	0.058824	0.142857	0.333333	0.428572	0.470588	0.428572	0.166667	0.179925	0.333333	0.470588	0.461538	0.333333	0.200000	0.333333	0.333333
2.1	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000
2.2	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000
3.1	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.095313	0.124400
3.2	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.343464
3.3	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.434181	0.494343
3.4	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.036325	0.037794
4.1	0.019269	0.023932	0.021898	0.024033	0.033123	0.027188	0.021151	0.020988	0.020988	0.020988	0.020988	0.034766	0.020988	0.020988	0.020988	0.020988	0.020988	0.071429
4.2	0.037049	0.044670	0.039206	0.046348	0.059306	0.045287	0.039369	0.039202	0.039202	0.039202	0.039202	0.054576	0.039202	0.039202	0.039202	0.039202	0.039202	0.071429
4.3	0.009904	0.011768	0.009330	0.011802	0.024533	0.012188	0.010711	0.010680	0.010680	0.010680	0.010680	0.020627	0.010680	0.010680	0.010680	0.010680	0.010680	0.071429
4.4	0.019269	0.023932	0.021898	0.024033	0.072085	0.027188	0.021078	0.020988	0.020988	0.020988	0.020988	0.029504	0.020988	0.020988	0.020988	0.020988	0.020988	0.071429
4.5	0.073057	0.091174	0.105219	0.091139	0.086656	0.078330	0.074754	0.074797	0.074797	0.074797	0.074797	0.083401	0.074797	0.074797	0.074797	0.074797	0.074797	0.071429
4.6	0.073057	0.091174	0.105219	0.091139	0.086656	0.078330	0.074754	0.074797	0.074797	0.074797	0.074797	0.083401	0.074797	0.074797	0.074797	0.074797	0.074797	0.071429
4.7	0.156919	0.180719	0.113194	0.180870	0.136827	0.132395	0.152976	0.152862	0.152862	0.152862	0.152862	0.115476	0.152862	0.152862	0.152862	0.152862	0.152862	0.071429
4.8	0.156919	0.180719	0.150610	0.180870	0.109384	0.164558	0.152976	0.152862	0.152862	0.152862	0.152862	0.128469	0.152862	0.152862	0.152862	0.152862	0.152862	0.071429
4.9	0.000000	0.009191	0.006972	0.009213	0.034357	0.042403	0.008491	0.008471	0.008471	0.008471	0.008471	0.065688	0.008471	0.008471	0.008471	0.008471	0.008471	0.071429
4.10	0.156919	0.000000	0.105888	0.180870	0.119192	0.113344	0.152976	0.152862	0.152862	0.152862	0.152862	0.077889	0.152862	0.152862	0.152862	0.152862	0.152862	0.071429
4.11	0.009904	0.011768	0.000000	0.011802	0.039768	0.051998	0.010711	0.010680	0.010680	0.010680	0.010680	0.063033	0.010680	0.010680	0.010680	0.010680	0.010680	0.071429
4.12	0.156919	0.180719	0.150610	0.000000	0.106168	0.114663	0.152976	0.152862	0.152862	0.152862	0.152862	0.051605	0.152862	0.152862	0.152862	0.152862	0.152862	0.071429
4.13	0.037049	0.048919	0.077221	0.046348	0.000000	0.058064	0.038146	0.039202	0.039202	0.039202	0.039202	0.092632	0.039202	0.039202	0.039202	0.039202	0.039202	0.071429
4.14	0.009904	0.011768	0.047345	0.011802	0.041775	0.000000	0.010711	0.010680	0.010680	0.010680	0.010680	0.039865	0.010680	0.010680	0.010680	0.010680	0.010680	0.071429
5.1	0.051583	0.052210	0.052210	0.052210	0.052210	0.048616	0.080828	0.080828	0.065029	0.064961	0.077476	0.053006	0.078080	0.032003	0.050318	0.052210	0.052210	0.052879
5.2	0.099974	0.123445	0.123445	0.123445	0.123445	0.124883	0.000000	0.000000	0.190711	0.173643	0.170314	0.119582	0.224101	0.117528	0.119838	0.123445	0.123445	0.123880
5.3	0.143173	0.014452	0.014452	0.014452	0.014452	0.025039	0.018098	0.018098	0.000000	0.092433	0.062843	0.015701	0.014519	0.017868	0.014550	0.014452	0.014452	0.019454
5.4	0.205295	0.025193	0.025193	0.025193	0.025193	0.026429	0.035062	0.035062	0.027479	0.000000	0.028362	0.026631	0.210319	0.032003	0.023324	0.025193	0.025193	0.021606
5.5	0.158772	0.455699	0.455699	0.455699	0.455699	0.442531	0.494524	0.494524	0.253631	0.213916	0.000000	0.483783	0.306181	0.511808	0.481705	0.455699	0.455699	0.452184
5.6	0.106510	0.025193	0.025193	0.025193	0.025193	0.026429	0.035062	0.035062	0.055564	0.048884	0.086368	0.000000	0.032302	0.032003	0.023324	0.025193	0.025193	0.025964
5.7	0.110555	0.234937	0.234937	0.234937	0.234937	0.233169	0.238309	0.238309	0.222501	0.201515	0.295193	0.237653	0.000000	0.238919	0.237501	0.234937	0.234937	0.234496
5.8	0.079294	0.054420	0.054420	0.054420	0.054420	0.058373	0.080019	0.080019	0.093055	0.114935	0.165963	0.047943	0.119980	0.000000	0.049440	0.054420	0.054420	0.054923
5.9	0.044845	0.014452	0.014452	0.014452	0.014452	0.014531	0.018098	0.018098	0.092030	0.089714	0.113482	0.015701	0.014519	0.017868	0.000000	0.014452	0.014452	0.014614
6.1	.800000	0.800000	0.800000	0.800000	0.800000	0.800000	0.666667	0.606061	0.606061	0.606061	0.606061	0.606061	0.800000	0.800000	0.606061	0.000000	0.800000	0.800000
6.2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.166667	0.242424	0.242424	0.242424	0.242424	0.242424	0.000000	0.000000	0.242424	0.800000	0.000000	0.200000
6.3	0.200000	0.200000	0.200000	0.200000	0.200000	0.200000	0.166667	0.151515	0.151515	0.151515	0.151515	0.151515	0.200000	0.200000	0.151515	0.200000	0.200000	0.000000

Table AI.
Un-weighted
super matrix