Identify best strategic practices to Manage Supply Chain Operations in Construction Supply Chain of Hotel industry in Sri Lanka & Maldives

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Research submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in Supply Chain Management

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March 2018

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ABSTRACT

The identification and implementation of best strategic practices to manage construction supply chain have to be increased in the hotel industry of Sri Lanka and Maldives. To identify and implement these strategies, some attempts have been made initially to identify best practices and then establish a model for measuring construction cost per room before and after implementation of best practices and improving the operations efficiently in construction supply chain of the hotel industry in Sri Lanka and Maldives. Based on a review of the literature and an expert group discussion, an exclusive framework is developed in this paper, which consists of identification of best strategic practices, development of a model for calculation of construction cost per room, and development of supply chain map & concept to manage construction supply chain in both destinations. However, there are obvious deficiencies in these existing practices, models, and concepts. This highlights the need for a systematic framework for the assessment of construction cost per room in the hotel industry in order to analyze and make effective decisions. The proposed framework is evaluated through expert interviews and case studies and this framework provides a roadmap for the improvement of construction supply chain operation in the hotel industry of Sri Lanka and Maldives efficiently. It can be helped hotel organizations to position their current level of construction cost and identify key strategic practices for improvement in the future.

Contractors, being located at the vanguard of the construction supply chain, potentially offer the most effective means of improving construction industry cost performance. As a generalization, cost remains the most important criterion for construction clients; so its reduction (most often than not) represents improved client satisfaction.

Acknowledgments

It is my great pleasure to present my research report, which could not have been possible to fulfill, if not for those great people who were the backbone of my successful research. I wish to acknowledge them all!

First of all, I wish to thank my supervisor and research coordinator, Dr. Pradeepa Jayaratne and Dr. Mahinda Bandara respectively for their support, guidance and continued contribution of ideas and suggestions, which helped me to focus throughout the period of preparing this report.

A special thanks go to all the respondents; the individuals who freely gave their time, knowledge and expertise, to the proper completion and return of the research questionnaire which resulted not only in some fascinating insights but also some valuable contributions to the ideas in this thesis.

I am deeply indebted to my lecturers and the management of the University of Moratuwa and my batch mates, and my friends who supported me with suggestions, advice, and reviews of drafts of the papers throughout the study.

LIST OF ACRONYMS

MEP – Mechanical Electrical Plumbing

FF&E – Fixed Furniture &Equipments

HOE – Hotel Operating Equipments

UNWTO –United Nation World Tourist Organisation

TABLE OF CONTENTS

DECLARATION OF ORIGINALITY…… 2
COPYRIGHT STATEMENT…… 3
STATEMENT OF THE SUPERVISOR.....4
ABSTRACT…… 5
Acknowledgments…… 6
LIST OF ACRONYMS…….. 7
LIST OF FIGURES……..... 10
1 CHAPTER – INTRODUCTION…….. 11
1.1. Background of the research…….. 11
1.1.1 Introduction…….. 11
1.1.2 Hotel industry in Maldives…… 12
1.1.3 Hotel industry in Sri Lanka…… 13
1.1.4 Supply Chain Management in Tourism sector…… 14
1.1.5 Construction supply chain of Hotel industry in Sri Lanka & Maldives……. 15
1.2 Problem Statement/Need for the study…… 17
1.3 Research Objectives…… 18
1.4 Limitation to study…….. 18
1.5 Research Scope…… 19
1.6 Thesis Structure..... 19
1.7 Time plan…… 20
2 CHAPTER - LITERATURE REVIEW……. 20
2.1 Introduction……... 20
2.2 Construction Supply chain management…….. 20
2.3 Efficiently manage construction supply chain……. 22
2.4 Identify strategic practices to efficiently manage construction supply chain..... 22
2.4.1 Integration of Supply Chain…….. 22
2.4.2 Information and Communication Technology…….. 26
2.4.3 Green Supply Chain Management……. 37
2.5 Chapter Summary…….. 47
3 CHAPTER - RESEARCH METHODOLOGY……. 48
3.1 Introduction……. 48
3.2 Research Design……... 49
3.3 Selection of population and sample……. 52
3.3.1 Population…… 52
3.3.2 Sample……. 52
3.4 Data Collection……. 53
3.4.1 Primary data sources…… 53
3.4.2 Secondary data sources…… 54
3.5 Data Analysis……. 54
3.5.1 Developing SC Map the construction supply chain with the process…… 54
3.5.2 Identification of strategic practices in construction supply chain…… 54
3.5.3 Model development……. 55
3.5.4 The comparison of existing method and proposed model..... 56
3.5.5 Development of final concept……. 56
3.6 Chapter Summary…… 56
4 CHAPTER - RESEARCH FINDINGS…… 57

4.1 Introduction……. 57
4.2 Descriptive Analysis…… 57
4.3 Map the supply chain of hotel industry in Sri Lanka & Maldives….. 61
4.3.1 Map the supply chain of hotel industry in Sri Lanka……. 61
4.4 Identification of strategic practices in construction supply chain…… 66
4.5 Model development…….
Error! Bookmark not defined.
4.5.1 Existing model…… 69
4.5.2 Stimulation the model……. 70
4.6 Comparison of construction cost per room based developed model and with typical supply chain process……. 74
4.6.1 Calculation of per room cost for project A in Sri Lanka……. 74
4.6.2 Calculation of per room cost for project B in Maldives…….. 75
4.7 Development of final concept…… 76
4.7.1 Application of new practices to Sri Lanka and Maldives procurement concept……. 77
5 CONCLUSIONS AND FUTURE RESEARCH…… 79
5.1 Conclusions…….. 79
5.2 Future research Directions…….. 80
6 REFERENCE…… 81
ANNEX……. 83
Annexure 02: Mean value calculation of best practices under Integration…….. 91
Annexure 03: Mean value calculation of best practices under Communication and IT.. 92
Annexure 04: Mean value calculation of best practices under Green Management…… 93
Annexure 05 : Construction cost "Project A"……. 94
Annexure 06 : Construction cost "Project B"……. 99

LIST OF FIGURES

Figure 1 : Time plan 20
Figure 2 : Diagram showing BIM maturity map (adapted after Barlish and Sullivan 2012) 33
Figure 3 : use of RFID, GPS, and GPRS technologies 36
Figure 4 : Count of respondents based on designation 57
Figure 5 : Count of respondents based on number of years working in the industry 58
Figure 6 : Count of respondents based on number of employees 59
Figure 7 : Count of respondents based on functional area 59
Figure 8 : Count of respondents based on country of operation 60
Figure 9 : Count of Respondents participate in decision making process 61
Figure 10 : Meta analysis 66
Figure 11 : Best strategic practices in Integration 67
Figure 12 : Best strategic practices in Communication and IT 68
Figure 13 : Best strategic practices in Green Management 69
Figure 14 : Expected cost reduction in Integration 70
Figure 15 : Expected cost reduction in Communication and IT 71
Figure 16 : Expected cost reduction in Green Management 71
Figure 17 : Cost reduction affectsfor main cost components based on Integration 72
Figure 18 : Cost reduction affects for main cost components based on Communication and IT 72
Figure 19 : Cost reduction affectsfor main cost components based on Green Management 73

CHAPTER 1 : INTRODUCTION

1.1. Background of the research

1.1.1 Introduction

Across three decades numerous metropolitan regions have made substantial investments in different tourist amenity packages. These investments were made to either capture a portion of the growing tourism market or establish an image that attracted the human capital needed to advance economic development. (Rosentraub & Joo, 2009)

The World Tourist Organization (WTO) estimated that 25 million tourists visited other countries in 1950. That number grew to 842 million in 2006 illustrating the enormous interest in international travel. The office of travel and tourism industries (OTTI) estimated that all forms of tourism produced more than $700 million indirect output and $1.2 trillion in total output for the US economy in 2006(Rosentraub & Joo, 2009).

However, the remarkable growth in the tourism industry during the last eighty years has brought major challenges in tourism marketing. With the development of the new area in the world for tourism, the destination choices available to consumers have continued to expand. Moreover, present consumers who are facilitated by increased leisure time, wider and varied sources of information, high disposable income and efficient transport networks, have ample opportunity to choose the best one from a larger variety of nations. As a result, in this complex and competitive global marketplace, the national marketers are experiencing a busy time, influencing the consumer to make a decision in their favor. This challenging situation has created the need for positioning the nation in the correct direction in an effective way (Calantone et al., 1989).

As per the UNWTO World Tourism Barometer, international arrivals grew by 4.4% to reach a total of 1.18 billion across the world, in 2015. A number of travelers to international destinations grew by approximately 50 million. Although the overall demand for travel remained strong, individual destinations had mixed performances due to strong exchange rate fluctuations, declining prices of oil and commodities which increased disposable incomes in importing countries but weakened demand in exporting nations. In addition, increased safety and security concerns also had a significant impact to reduce travel to some regions. UNWTO’s projections for 2016 estimate a 4% growth

in international arrivals, at slightly less than the last two years.(Aitken Spence Hotel Holdings PLC, Annual Report, 2015/16)

1.1.2 **Hotel industry in Maldives.**

The Maldives can be categorized as a small island in the developing status which has limited resources for development. Traditionally, the coastal marine environments were associated with fisheries that provided the bulk of national income and considered as the main livelihood of the people. Agriculture both historically and currently plays an insignificant role in the economy and is primarily associated with coconut production for daily diet. The Maldives are considered less developed with a per capita GDP of US$962 in 1999 (Ministry of planning, Human Resources and Environment, 2000). Most of their necessities are imported, including food, construction materials, consumer goods and petroleum products (Domroes, 2001)

Tourism continues to play a major role in the economic development of Asian and Pacific countries. The Maldives, like many developing islands, has a narrow resource base. Its main natural resources consisting of fisheries and a marine environment conducive to international tourism. (Sathiendrakumar R, 1989)

The Maldives remained largely unknown to tourists until the early 1970s. Only 185 islands are home to its 300,000 inhabitants. The other islands are used entirely for economic purposes, of which tourism and agriculture are the most dominant. Tourism accounts for 28% of the GDP and more than 60% of the Maldives' foreign exchange receipts. Over 90% of government tax revenue comes from import duties and tourism-related taxes.

The development of tourism fostered the overall growth of the country's economy. It created direct and indirect employment and income generation opportunities in other related industries. The first tourist resorts were opened in 1972 with Bandos island resort and Kurumba Village (the current name is Kurumba Maldives), (The Age. Melbourne, 2012) which transformed the Maldives economy.

According to the Ministry of Tourism, the emergence of tourism in 1972 transformed the economy, moving rapidly from dependence on fisheries to tourism. In just three and a half decades, the industry became the main source of income. Tourism was also the

country's biggest foreign currency earner and the single largest contributor to the GDP. As of 2008, 89 resorts in the Maldives offered over 17,000 beds and hosted over 600,000 tourists annually.

At present, there are over 105 resorts located in the different atolls constituting the Republic of Maldives. Over the past few decades, the number of tourists in Maldives has risen continuously. In 2009, local island guesthouses started popping up in the Maldives. This was thanks to a change in regulations that began to officially allow tourists to stay among the local population, rather than just on privately owned resort islands. In 2015, a total of 1.2 million tourists visited the Maldives, and another 1.5 million visited in 2016.(The Business Report, 14 July 2017)

1.1.3 **Hotel industry in Sri Lanka**

Sri Lanka is one of the most attractive tourist destinations in Asia. The tourism industry started to develop as a formal industry in the 1960s and developed gradually over the years. However, the ethnic conflict began in the early 1980s, dragged for over three decades and largely obstructed the progress of the tourism industry. With the end of the civil war in 2009, the tourism industry came to the fore as a strategically important growing sector under the new development policy framework.

Following the end of a three-decade-long civil war, Sri Lanka has witnessed unprecedented growth. With a real GDP growth rate of 8% in 2010, a jump of 125.2% in the stock market in 2009, and 32% year-on-year growth in tourist arrivals in 2010, Sri Lanka was on its way to becoming a major tourist destination in South Asia. (Wij I, 2011). In the past one year, HVS India has received numerous inquiries about Sri Lanka from hotel operators, investors, and developers. These queries rightly come at a time when the country's total rooms supply needs to be more than doubled in the next five years to meet the tourist arrivals targets (Wij I 2011).

Sri Lanka's tourist arrivals continued to grow with increasing arrivals by 17.8% to 1.8 million with its post-war growth momentum. The highest growth in arrivals was observed from China with a 67% rise, whilst arrivals from India grew by 30% and the

arrivals from the United Kingdom and Germany by 12% each. Western Europe continued to be the largest tourist origin for Sri Lanka with the number of arrivals increasing by 15.3%. Sri Lanka's earnings from tourism increased substantially by 22.6% to US Dollars 2,431 million, supported by a continued increase in arrivals and spending by tourists. It is encouraging that the average spending per day by a tourist increased to US Dollars 164.1 in 2015, mainly due to higher arrivals of the higher spending tourists and the enhanced facilities offered in the country.(Aitken Spence Hotel Holdings PLC, Annual Report, 2015/16)

1.1.4 **Supply Chain Management in the Tourism sector**

The concepts of a supply chain and supply chain management are receiving increased attention as means of becoming or remaining competitive in a globally challenging environment.

Tourism is an important economic development driver in Sri Lanka & Maldives. Most of the organizations are spending unnecessary expenses due to lack of Strategic practices in Supply Chain. There are only a few organizations focus on identification of new Strategic practices in managing the supply Chains of the new investments in both destinations. Despite such practices, many organizations are struggling to compete in the market due to high cost in new investments. One possible reason is the disconnection between business integration and communication of related departments & organizations. In general, tourism businesses and support organizations should focus on the research & development on strategic practices in supply chain operations for construction projects in tourism-based businesses in order to maximize the profitability & sustainability and hold similar perceptions about strategic investments, which has not covered by the previous researches done up to now, hence this research focuses on filling this research gap.

Further, investment cost per room is very important in this business since it will be directly affected by the selling price which is very competitive & highly effective on the profitability of hotel organizations in these regions.

During last century Maldives and Sri Lanka's Hotel industry construction have been developing individually with less integration with Supply Chain management strategies

available. Especially in the past, they were developed mostly based on the socio-economic requirements then and there, however without a proper strategic & future overview. The compatibility of the traditional management system to the present context is questionable. Though the new constructions of Hotels and Resorts are taking place even today, the absence of integration between construction project management and strategic supply chain management is still observed. Moreover, it is questionable whether the existing properties are really addressed the derived demands created by the present socio-economic patterns and future development plans.

This paper "Identify best strategic practices to Manage Supply Chain Operations in Construction Supply Chain of Hotel industry in Sri Lanka & Maldives" reviews the current concepts on supply chain management (SCM) within the context of tourism. The SCM in the tourism industry has attracted widespread research interest over the past few years, whereas studies of construction SCM in the hotel industry are very limited. Stakeholders in the hotel industry interact with each other to resolve their divergent business objectives across different operating systems. The potential benefit of considering not only individual enterprises but also the hotel value chain becomes evident. The paper examines the characteristics of hotel construction project and identifies and explores core issues and concepts in construction supply chains (CSCs) and tourism supply chain management (TSCM). Although there is an emerging literature on TSCM or its equivalents, progress is uneven, as most research focuses on sales and marketing activities without fully considering the whole range of activities involved in hotel construction supply chain. This is the gap which has to be filled by this research project in order fulfill the development of tourism industry to gain the maximum for the potential economic growth of both destinations.

1.1.5 **Construction supply chain of Hotel industry in Sri Lanka& Maldives**

Managing the supply chain involves understanding the breakdown and traceability of products and services, organizations, logistics, people, activities, information and resources that transform raw materials into a finished product that is fit for its purpose.

Buildings are becoming increasingly complex, and require more design input from specialist suppliers. At the same time, there is increasing fragmentation of the

industry as can be seen from the growth of specialist suppliers/contractors, the proliferation of products and the fragmentation of design and control activities.

The supply chain is relatively unstable, and the industry is project-based with defined start and end points, and a traditional separation between design and construction. Demand is treated as a series of competitively tendered prototypes constructed by temporary coalitions. This all has an impact on organizational relationships.

Project relationships are short-term and have defined start and end points; they are usually informal/ad-hoc and focused on the project, not as a part of the business. Relationships between competencies vary from project to project. The lack of continuity prevents the innovation and improvement of processes as well as the development of more complex relationships. The client may also have an impact on the procurement route and choice of strategic suppliers.

On large or complex projects, responsibility and performance generally cascade down the supply chain to a plethora of suppliers sometimes unknown at the top of the chain. The first and second tier of the supply chain may sign up to fairly onerous agreements but as the chain expanding, the contractual liabilities decrease whereas the suppliers at the end of the chain are often not locked in at all.

Changing the perspective from delivery of a 'project' to the process of 'project delivery' requires the building of long-term relationships (formal and informal), partnering, and alliances with the partners in the supply chain.

Companies offering continuity in construction have taken an increasing interest in establishing relationships beyond direct, first-tier suppliers. Framework contracts and partnering agreements have pioneered this approach, encouraging the involvement of selected suppliers at relatively early stages of projects while offering continuity of work. This has led to greater collaboration between lead designers and product designers to the advantage of all parties.

The Government Construction Strategy recommended three different procurement routes that aimed to improve the SCM process; private finance initiative (PFI), prime contracting and design and build. With each of these, the client enters into a relationship

with a single integrated supply team, which may include the main contractor, designers, sub-contractors, suppliers, facilities managers, and so on. (Designing Buildings Ltd., 2018)

Below research report presents the results of a study on the extent of understanding and implementation of the concept of Supply Chain Management (SCM) in the Sri Lankan and Maldives construction industry. The study highlights the potential benefits of replacing the traditional methods of supply and the adversarial relationships and the short term relationships between the construction contractor, the client and the supplier by Supply Chain Management concept. To achieve the study objectives, the researcher conducted a literature review of the subject and designs a related questionnaire which has been distributed to more than 35 stakeholders in construction supply chain of hotel industry in Sri Lanka and Maldives. The contractors are more oriented towards clients rather than their suppliers in the supply chain. They have more arrangements with clients than with suppliers. The problems in implementing successful SCM within the Sri Lankan and Maldives construction industry are at present associated with an inappropriate traditional culture and the unique features of the organizational structure. Finally, the researcher presented recommendations and developed a concept to increase the awareness of SCM among the Sri Lankan and Maldives construction supply chain to overcome its implementation barriers and to reap all its potential benefits on the whole construction industry.

1.2 Problem Statement/Need for the study

Contractors identify integration as a key strategy for the application of SCM in construction. But there are many factors / strategies important and effective in construction supply chain, which may affect in different levels to overall cost of construction supply chain in the hotel industry.

Decision makers of the supply chain in this industry are struggling due to lack of mechanism or research findings in order to identify the best strategic practices and to determine the real cost saving with the application

1.3 Research Objectives

There are five research objectives which are to be accomplished at the end of the project.

1. Identify and map the present condition/operation of construction supply chain in existing hotel industry in Maldives / Sri Lanka
2. Identify SC strategies to efficiently manage construction supply chain of hotel industry in Maldives / Sri Lanka.
3. Develop the model for calculating the construction cost per room after implementation of SC strategies
4. Calculate the construction cost per room before and after implementation of SC strategies
5. Develop a concept for strategic SC practices.

1.4 Limitation to study

Barriers to success included:

- workplace culture
- lack of senior management commitment
- inappropriate support structures
- Lack of knowledge of SCM philosophy.

Training and education at all levels in the industry are necessary to overcome these barriers.

1.5 Research Scope

This paper examines the **construction supply chain of hotel industry** in order to provide systematic approach and supply chain strategies to be more efficient in the market.

This study "Identify best strategic practices to Manage Supply Chain Operations in Construction Supply Chain of Hotel industry in Sri Lanka & Maldives" uses survey data from the internal relative departments (marketing, finance, engineering, operation...etc.) & external organizations (Architects, consultants, suppliers, transportation companies & government authorities) in Sri Lanka and Maldives to compare how the various actors perceive the most pressing practices in supply Chains for construction projects in hospitality industry in order to compete & meet sustainability challenges.

This research compares the current condition and developed condition of construction supply chain of hotel industry in **Sri Lanka & Maldives** by developing a model for calculation of construction cost per room and also map the supply chain in order to identify best strategic practices and to develop a conceptual process to manage construction projects efficiently in hotel industry.

1.6 Thesis Structure

Chapter breakdown is as follows;

(1) Chapter 1 : Introduction
(2) Chapter 2 : Literature Review
(3) Chapter 3: Research Methodology
(4) Chapter 4 : Research Findings
(5) Chapter 5 : Conclusions and Future Research Directions
(6) Chapter 6 : Reference

1.7 Time plan

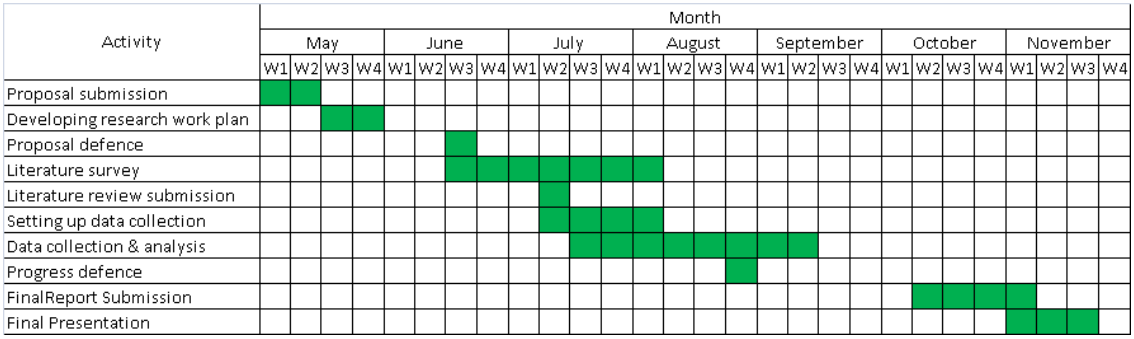


Figure 1 : Time plan

CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

In order to respond to competitive pressures, managers need to know more about the strategic aspects of supply chain management. This paper addresses this need by critically reviewing the supply chain management literature and by suggesting a research agenda for the future. Under this chapter best supply chain strategies and practices have been identified, which helps to develop and implement the survey in order to identify certain assumptions and thoughts made in the literature that must be challenged. The model has been developed to calculate the construction cost after implementation of supply chain strategies based on the findings contributed from the literature. Finally, a research agenda is developed.

2.2 Construction Supply chain management

The concept of the `supply chain provides a useful framework for analyzing the construction process. Stevens (1989) describes the supply chain as the interconnected series of activities concerned with the planning and controlling of raw materials, components and "finished products from suppliers to the final consumer. Mabert and Venkataramanan (1998, p. 538) define the supply chain as the network of facilities and activities which performs the functions of product development, procurement of materials, movement of materials between facilities, manufacturing of goods, distribution of finished goods to customers, and after-market support.

In construction, the supply chain includes all the business and other organizations which are involved in the process from the extraction of raw materials to the eventual demolition of the building, and disposal of its components (Ofori, 2000).

SCM should be considered as essential to the performance and competitiveness of the construction enterprise considering the variety of materials, products, and components it requires on each project, the range of subcontracting companies it normally engages, and the variety of consultants it works with. The construction company must make the strategic decision of considering its suppliers and subcontractors as its long-term partners with which it is working towards a common aim and aspirations, in replacement of the traditional win-lose relationship of business partners with different objectives (Dale et al., 1994).

The construction industry, in general, is characterized by high fragmentation, low productivity, cost and time overruns, and conflicts compared with other manufacturing industries. Supply chain management as an innovative management model provides a new solution for resolving these problems from a systems perspective. Coordination is the core issue to improve construction performance in construction supply chain (CSC). (Xue, Wang, Shen, & Yu, 2007)

It appears that construction supply chain management (SCM) is still in its infancy but some awareness of the philosophy is evident. Contractors identified improved production planning and purchasing as key targets for the application of SCM in construction. Barriers to success included: workplace culture, lack of senior management commitment, inappropriate support structures and a lack of knowledge of SCM philosophy. Training and education at all levels in the industry are necessary to overcome these barriers. (Akintoye, McIntosh, & Fitzgerald, 2000)

Implementing SCM in construction will pose challenges. The construction process is more complex than manufacturing as it has several linkages with other sectors of the economy (Hillebrandt, 1984). Indeed, determining the customer of the construction enterprise is not simple. Ofori (1999) argues that, given the long-term nature of constructed products, the customer extends beyond the initial client to include all users

and subsequent owners over the life of the building. From the environmental perspective, “the customer's” consultants and contractors must consider several other stakeholders, within and outside the country, including generations yet unborn. However, SCM offers possible strategic advantages to individual construction enterprises and the industry, as a whole.

2.3 Efficiently manage construction supply chain

In 1998, a government- sponsored review of the UK construction sector called for the adoption of initiatives from manufacturing industry in order to increase productivity and reduce costs. Subsequent research has focused on how supply chain management practices could be implemented effectively by clients, consultants and large contracting organisations. However, little attention has been paid to the integration of small and medium-sized enterprises (SMEs) in the subcontractor and material supply sectors. It was found that significant barriers exist to supplier integration within the construction sector, which stem from SME skepticism over the motives behind supply chain management practices. It is suggested that the industry must make greater efforts to extol the mutual benefits of supplier integration to SMEs if significant performance improvement is to be achieved.(Dainty, Millett, & Briscoe, 2001)

Increasingly, supply chain management is being recognized as the management of key business processes across the network of organizations that comprise the supply chain. While many have recognized the benefits of a process approach to managing the business and the supply chain, most are vague about what processes are to be considered, what sub- processes and activities are contained in each process, and how the processes interact with each other and with the traditional functional silos. (Croxton, García-Dastugue, Lambert, & Rogers, 2001)

2.4 Identify strategic practices to efficiently manage construction supply chain

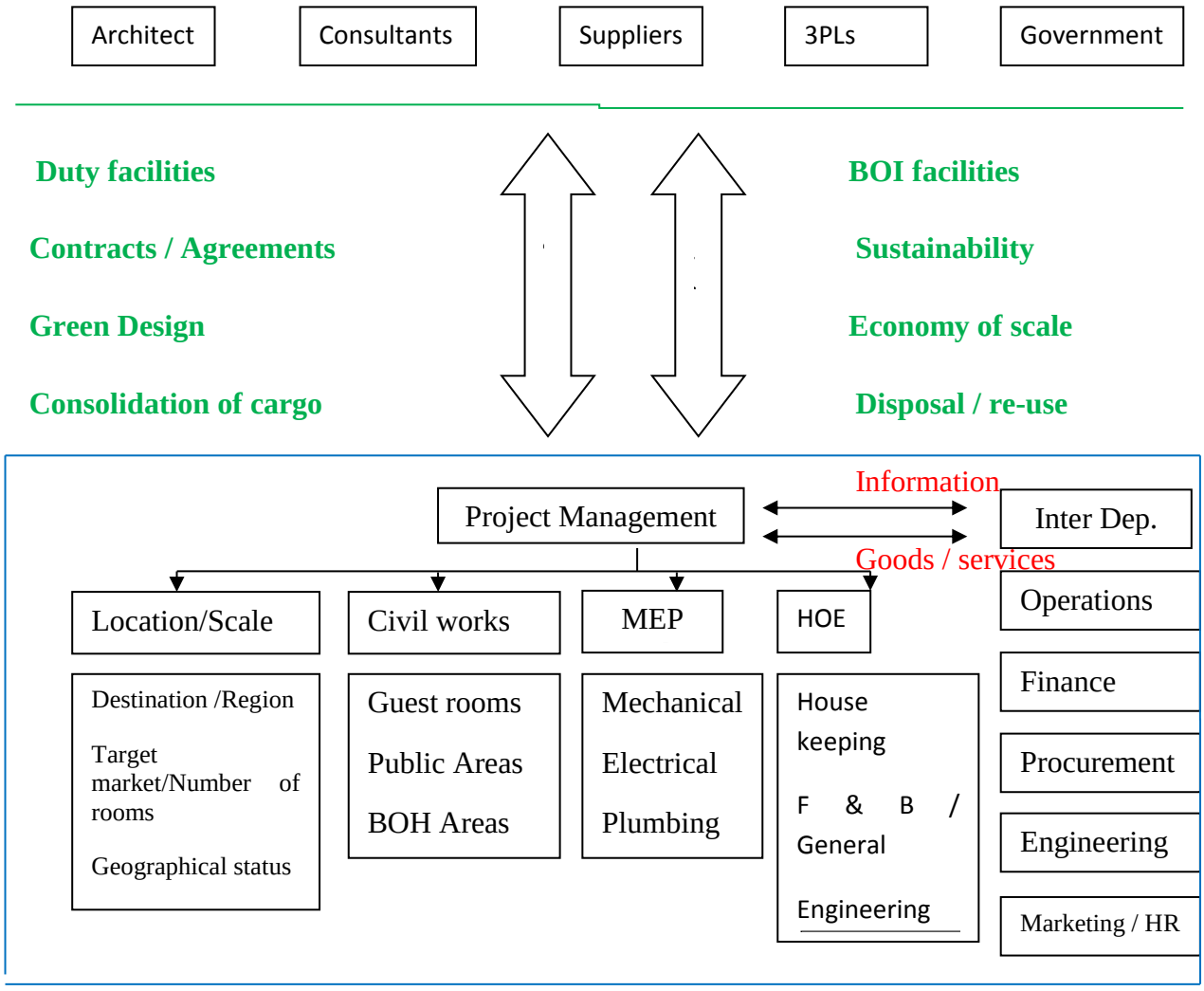
2.4.1 Integration of Supply Chain

Construction project performance relies on different dimensions of project management. Among those, integration management is of paramount importance since effective project management starts with the integration of processes and people within a construction project. According to the research done by Sevilay Demirkesen & Beliz Ozorhon, investigates the influence of various components of integration management

on construction project management performance and quantifies the relationship between those components and integration management. The proposed components of integration management are the development of a project charter, knowledge integration, process integration, staff integration, supply chain integration, and integration of changes; whereas the dimensions of project management performance are time, cost, quality, safety, and client satisfaction.

(Demirkesen & Ozorhon, 2017)

Integration between internal & external stakeholders of supply chain



2.4.1.1 Strategic Relationship with partners

In a construction supply chain, the client is the end customer. On the other hand, various contractors, consultants, and suppliers can be placed at different tiers. Main contractor, designer and project management consultants are the first tier suppliers. Specialist contractors are the second tier suppliers, and labor, materials and equipment suppliers are the third tier suppliers (Beach et al., 2005). Throughout the whole supply chain, different types of relationships may exist at different tiers. For example, the relationship between client and the main contractor may differ from the relationship between the main contractor and specialist contractors. Taking this into account, the developed framework focuses on a customer-supplier relationship rather than the whole supply chain. Through the integration of the assessment of all specific relationships, it is possible to see the whole picture of a construction supply chain

The identification of key relationship indicators has fallen into the following three categories:

- Identification of key factors critical to partnering success;
- Identification of key factors leading to the traditional adversarial relationship; and
- Identification of key factors impeding partnering success.

(Meng, 2010)

2.4.1.2 Enhance Trust with partners

In the last few years,losing the trust can be seen in all areas of human life, including between the participants of economic processes. Along with the general decline of social trust, it is also possible to see greater appreciation for and significance of trust and the need to build and strengthen it in inter-organizational relationships. The basic premise for building supply chain relationships based on trust is the assumption that a company cannot successfully compete on its own but must rather cooperate with other participants within the supply chain (Meng, 2010)

According to (Sako, 1992), there are three types of trust including contractual trust, competence trust, and goodwill trust. With contractual trust, each party adheres to specific written or oral agreements. Competence trust is built on each other's capabilities to carry out their tasks. When goodwill trust is reached, the parties express their willingness to do more than what is normally expected.

2.4.1.3 Better Collaboration with partners

Supply chain collaboration has been viewed as a business process whereby two or more supply chain partners work together toward common goals. This helps all partners in the supply chain to obtain more benefits than what they achieve by working alone or silos (Cao & Zhang, 2012). Cao & Zhang focused on the joint action that linking business processes and process outputs (goals).

Simatupang & Sridharan (2002) defined supply chain collaboration as "Supply chain collaboration is often defined as two or more chain members working together to create a competitive advantage through sharing information, making joint decisions, and sharing benefits which result from the greater profitability of satisfying end customer needs than acting alone". They focused on competitive edge by collectively sharing information, joint decision making and sharing benefits. Results in satisfying end customers (Sridharan & Simatupang, 2002)

Ideally, Supply chain collaboration begins with customers and extends back through the firm from finished goods distribution to manufacturing and raw material procurement, as well as to material and service suppliers (Stank & al., 2001). This integrates all the activities in the total value chain from RM supplier to end customer.

Supply chain collaboration is characterized by sharing information, knowledge, risk, and profits. Collaborative relationships can help firms share risks, access complementary resources, reduce transaction costs and enhance productivity, and enhance profit performance and competitive advantage over time (Mentzer & al., 2000).

In a lean supply chain, collaboration is critical. Collaborative relationships in supply chains enable greater flexibility, responsiveness, and modularity which is critical to reducing the trade-offs of customizing products.

2.4.1.4 Sharing Information with partners

As buildings have become increasingly taller and large-scaled, project managers of high-rise building construction projects experience problems in securing storage and handling space for materials, consequently requiring Just-In-Time (JIT) management to ensure the procurement of materials at the right time and place. To build a JIT management environment, status information of components manufactured based on the request from the construction site as well as delivery information should be effectively available to the parties involved in the planning, manufacturing, shipping, delivering, and erecting processes. That is, information generated through the whole supply chain should be collected and shared with a consistent information framework. (Shin T.-H. , Chin, Yoon, & Kwon, 2011)

2.4.1.5 Collaborative Planning

Collaboration in the supply chain comes in a wide range of forms, but in general have a common goal: to create a transparent, visible demand pattern that paces the entire supply chain.

Supply chain collaboration has been strongly advocated by consultants and academics alike since the mid 1990's under the banner of concepts such as Vendor Managed Inventory (VMI), Collaborative Forecasting Planning and Replenishment (CPFR), and Continuous Replenishment (Holweg, Disney, Holmström, & Småros, 2005).

Supply Chain Collaboration enables partners to jointly gain a better understanding of future product demand and implement more realistic programs to satisfy the demand (Sahay, 2003). A better understanding of the customer results in better planning and execution.

2.4.2 Information and Communication Technology

Information and Communication Technology (ICT) in the construction industry is defined as "the application of decision support tools, which uses electronic machines and programs for processing, storage, analysis, control, transfer and presentation of

construction information during the whole life cycle of a construction project" (El-Ghandour and Al-Hussein, 2004, p. 85). In operational terms, ICT refers to the technologies engaged in the collection, transfer, retrieval, storage, presentation, visualization and conversion of information from various forms (Yang and Huang, 2016). ICT can bring about a wide range of enhancements on different areas of construction projects (Lu et al., 2014). These include supporting management functions, enhancing the quality of decision-making, optimization of resources and improving workers' efficiency (Bowden et al., 2006; Alaghbandrad et al., 2012; Alkalbani et al., 2013; Sutrisna and Kumaraswamy, 2015; Goodrum et al., 2016). Use of ICT improves coordination, communication, and cooperation among project team members and assists on-site personnel with access to well-conveyed data and information (Goodrum et al., 2016; Yang and Huang, 2016).

Information and Communication Technology has the capacity to mediate the incorporation of sustainability into project processes called "Sustainability by Information and Communication Technology" (SICT). While the concept is new and promising, very little empirical work has been done on the avenues through which this could be achieved for construction projects (Hosseini, Banihashemi, Rameezdeen, Golizadeh, Arashpour, & Ma, 2017).

European Journal of Purchasing & Supply Management states that the role of information in construction supply chains witnessed a shift from its passive function in decision-making from the 1990s, to a strategic resource that drives both the processes and competitiveness of companies. This change presents challenges for organizations that participate in the construction supply chain. The way organizations involved in managing the construction supply chain, using information as a strategic resource will have a direct impact on their competitiveness. This is influenced by the information acquisition, processing, utilization and transfer practices of their professional staff (actors) involved in the processes of the construction supply chain (Edum-Fotwe, Thorpe, & McCa!er, 2001).

In recent years, with increasing the level of competition in the global construction market, several research efforts have focused on the application of information technology (IT) as a way to improve the integration process of construction supply chain management

(CSCM). Visual representation of the process can provide an effective tool for monitoring resources in the CSCM. In order to support this objective, integrates building information modeling (BIM) and geographic information systems (GIS) into a unique system, which enables keeping track of the supply chain status and provides warning signals to ensure the delivery of materials. First, the proposed methodology is implemented by using BIM due to its capability to accurately provide a detailed takeoff in an early phase of the procurement process. Furthermore, in order to support the wide range of spatial analysis used in the logistics perspective (warehousing and transportation) of the CSCM, GIS is used to present these model. (Irizarry, Karan, & Jalaei, 2013).

As buildings are now taller, larger, and more complex, it has become increasingly more difficult to secure stockyards for materials and to resolve the surrounding traffic problems, creating an increased need for Just-In-Time (JIT) delivery. To support JIT delivery, it is necessary to build a framework that can facilitate the collection and share of information on construction components and material flow throughout the whole supply chain process. Many researchers have suggested that radio frequency identification (RFID) and wireless sensor network technologies could improve the effectiveness and efficiency of JIT management. In addition, service-oriented architecture (SOA), the services of which enable the interfacing of a heterogeneous system environment of parties involved in the supply chain management process, is suggested in the manufacturing industry as one of the solutions for effective collection and sharing of information in supply chain management. However, the construction industry has limits in applying the framework suggested in the manufacturing industry since the supply chain process in the construction industry is extremely dynamic due to frequent changes in the design and plans of construction projects. (Shin T. , Chin, Yoon, & Kwon, 2011)

2.4.2.1 Use of Mobile/internet to Plan and Managing SC Operations

Construction supply chain management (CSCM) has gained rapid development in last decades. As a result, the conventional Internet fails to fulfill demands for real-time information sharing and communication derived from various participants of the

construction supply chain (CSC).The emerging Mobile Internet (M-Internet)has provided the potential for solving this issue.

The application of M-Internet in CSC covers nearly every phase of construction projects. For design phase, a function–space assignment optimization model based on the occupants' movement data can be tracked for design guide via RFID technology. Augmented reality (AR) technology is also an effective method for construction design such as a case of a real cable-stayed bridge. For the procurement activities management, digital technologies (DTs) are widely employed. For example, Virtual Reality (VR) technology was used to establish what to be purchased, the Web2.0 technology and cloud computing technology are presented to establish the procurement strategy (Shi, Ding, Zuo, & Zillante, 2016)

Delay is one of the common issues in construction projects, which has created significant demands of information sharing between stakeholders. The mobile terminal devices such as a hand-held computer (e.g. PDA) and mobile terminal enabling technology such as RFID technology are adopted in CSCM. Wireless Access Network including WLAN (e.g.Wi-Fi), GPRS and 3G have been widely used. Application Service, Web-based technology, AR and VR technology, cloud computing, and SOA are the best technologies which can be used via mobile internet.(Shi, Ding, Zuo, & Zillante, 2016)

2.4.2.2 Use of technologies such as RFID in operations

The use of RFID (Radio Frequency Identification) tracking has increased considerably in supply chain management during the past ten years. Despite the large diffusion of the technology, the use of RFID tracking has remained scarce in the construction industry despite the intense research. The particular design and temporary operating sites of the construction supply chains delay the diffusion because the best-known RFID tracking systems in other industries are mainly designed to support the retailers' processes. The particular supply chain structure of construction industry, demands different business logic to build and gain benefits of RFID tracking systems. (Hinkka & Tätilä, 2013)

Tracking systems, in general, send a message to the tracking database when a tracked item arrives at a predefined checkpoint in the distribution network. Typically, some

automatic identification technology (like barcode or RFID) is used for registering the passing of a checkpoint. Tracking systems are needed both for linking the information systems and the physical reality in the supply network and for introducing paperless and more accurate information systems.(Hinkka & Tätilä, 2013)

At the moment, the barcode is the most frequently used technology in tracking, even though the use of the technically advanced but more expensive RFID is increasing. One of the main advantages of using RFID technology instead of barcodes is that no line of sight is needed in reading the tagged items. The typical challenges in barcode environment – dirt and wear – are absent when RFID tracking is used, as radio waves may capture the data even through the sides of a lorry. One substantive benefit of RFID technology compared to the barcode technology is that all RF identifiers are unique. If RFID technology is used for tracking, it will also enable the automation of operational supply chain processes and creates possibilities to offer information to support managerial processes. RFID-based tracking systems are already being used in several industries from manufacturing to recycling and waste management. Several successful examples of RFID tracking implementations have improved supply chain operations considerably and brought significant savings for the companies that adopted it. RFID tracking has also brought added value to many supply chain operations and even opened doors for new business opportunities.(Hinkka & Tätilä, 2013)

As buildings are now taller, larger, and more complex, it has become increasingly more difficult to secure stockyards for materials and to resolve the surrounding traffic problems, creating an increased need for Just-In-Time (JIT) delivery. To support JIT delivery, it is necessary to build a framework that can facilitate the collection and share of information on construction components and material flow throughout the whole supply chain process. Many researchers have suggested that radio frequency identification (RFID) and technology could improve the effectiveness and efficiency of JIT management.(Shin T.-H. , Chin, Yoon, & Kwon, 2011)

Although the information provided by RFID tracking clearly has several benefits, the additional costs must be addressed as well. In general, all the shipments should be marked with an identifier on item, parcels, pallets, and shipment level. Currently, most of these identifiers are barcodes but the use of RFID tags is increasing. However, especially when

moving to a more precious level of tracking, the price of an RFID tag arises. The simplest UHF Gen2 RFID tags, which can be used as an identifier for any level of tracking, cost about 0.05–0.10 euro apiece. This price is a significant cost factor especially in item-level RFID tracking comparing to the barcode, which can be printed on the product package usually with none or minimal costs. Therefore, companies such as Wal-Mart's uses RFID tracking system mainly with pallet- and parcel-level, while for items the products' barcodes are used as identifiers.(Hinkka & Tätilä, 2013)

In summary, improved tracking clearly has benefits to supply chain management, and RFID has proved to be a cost-effective technology to realize tracking in several industries. Still, in construction industry, the use of RFID tracking has remained relatively low comparing to other industries. To gain ground in construction industry, the implementation of RFID tracking needs to be perceived useful and ease-of-use among construction industry companies.(Hinkka & Tätilä, 2013)

2.4.2.3 Use of modern technology for Modeling and monitoring operations

The planning and management of supply chains require properly specifying the participating members and identifying the relationships among them. This task is especially challenging in the construction industry because construction supply chains are complex in structure and often composed of a large number of participants who work together in a project-based temporary manner. Construction projects typically involve tens and hundreds of companies, supplying materials, components, and a wide range of construction services. Modeling the structure of participants involved in a construction supply chain can help understand the complexity and the organization in a supply chain. Supply chain network models also facilitate the identification of bottlenecks and provide the basis for supply chain re-configuration and re-engineering.

Standard methods or frameworks for representing and modeling supply chain structures are few. Supply chain structures are commonly recorded as tables that enlist the members of a supply chain or are represented as network diagrams that show the supply chain members as well as the links between them.(Cheng, Law, Bjornsson, Jones, & D. Sriram, 2010)

The process description languages, which are used in business, may be useful in logistics processes. The planning, organization, direction and the control of the logistics processes might be more efficient if these formal languages are applied. During the logistics processes, many problems might arise, which should have already been addressed in the planning phase. In our days, the symptomatic treatment is a common practice, but it does not provide predictability. The obvious solution would be process control, in order to handle the main sources of faults and to give a correct list of what needs to be done during the logistics process. The process description languages may be useful not only in standardization, but they may also help to avoid losses. Simulation experiments, on the basis of built model, also allow for the elimination of problems, standardization and the limitation of losses. (Grzybowska & Kovács, 2016)

The Journal of Cleaner Production has employed Building Information Modeling (BIM) as a new collaborative working platform, aligned to the Modern Method of Construction (MMC). By situating this inquiry within an authentic case study it has highlighted ineffective strategies, policies and leadership, which have prevented full exploitation of the potential of BIM and MMC towards sustainable production. This inquiry supports the integration of the Framework for Sustainable Strategic Development (FSSD) into construction procurement, as a method for implementing bottom-up leadership in a value-driven project. (Alwan, Jones, & Holgate, 2016)

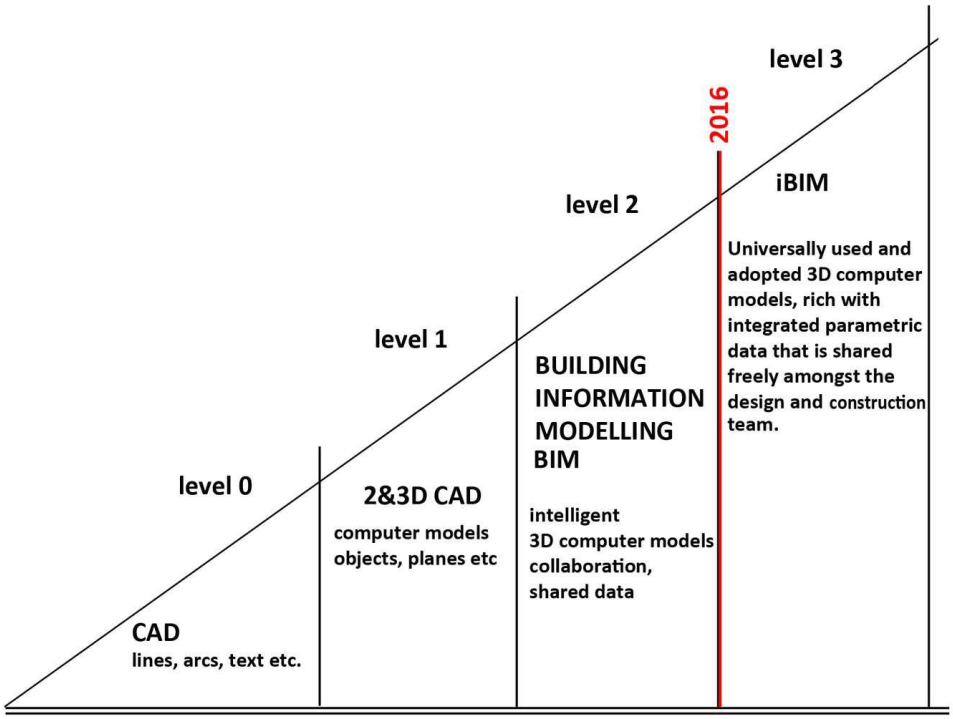


Figure 2 : Diagram showing BIM maturity map (adapted after Barlish and Sullivan 2012)

The majority of the industry currently resides in levels 0 and 1. The BIM process was introduced to facilitate an effective life cycle management approach, with levels 2 to 3 resulting in increased collaboration within the sector. BIM essentially offers a new approach to the design and manufacture of components for the construction industry. The above chart demonstrates a transition from simple 2-dimensional Computer Aided Design (CAD) models, via more sophisticated 2- and 3-dimensional CAD models, to a fully 3-dimensional and shared-data approach (BIM), leading to greater accuracy and better cross-sector collaboration. The ultimate aim is to reach iBIM (level 3), which is an even more sophisticated 3-dimensional digital data platform that enables a much more strategic and integrated systems approach, which in turn can provide an even better support for strategic sustainable development in the construction sector and society as a whole.(Alwan, Jones, & Holgate, 2016)

2.4.2.4 Use of GPS on managing operations

Technically speaking, GPS is a satellite-based radio-positioning system. However, it can also be used to accurately find out the time. GPS is financed by the US Department of Defense. They are also responsible for its design, deployment, and operation.(Oxley, 2017)

Construction projects are extremely complex and often take place in an uncontrolled, unprepared, and dynamic environment where each project goes through several phases leading to completion. Because of this, modern construction management requires real-time and accurate information for sharing among all parties involved to undertake efficient and effective planning, as well as execution, of the projects.

Material is a critical element in civil engineering construction projects and can make significant contributions to the cost effectiveness of projects. This is because the amount spent on materials is higher than other inputs, and may account for 50%–60% of the total cost of a typical project. Thus, planning and managing the logistics of materials is crucial, as they directly affect the construction schedule and the cost. For example, if a problem occurs, it would then trigger cascading problems in other parts of the project, which would result in production delays and cost overruns. Lack of materials when needed, inadequate identification of materials, re-handling and inadequate storage are causes of delay or unnecessary work. Potentially, this could lead to a loss in workforce productivity and an increase in overall project costs.

Construction is identified internationally as a labour and information-intensive industry. This heavy exchange of data and information between project participants on a daily basis is a facet of major construction processes. Thus, during the last two decades, real-time information systems have become an important tool in the management of construction projects. As far as the availability of technologies is concerned, a number of advanced technologies that are appropriate for construction are becoming more effectual. Their accuracy, reliability, and integrity are improving, while their costs continue to decline.

As previously stated studies have proved that materials management plays an essential role in successful completion of any project in construction where the most important part of an effective materials management system is their identification and tracking

along the construction. Automating the task of identifying and tracking the construction materials can provide timely and accurate information on materials availability for the manager. This could lead to a decrease in the standby time for unused materials and, also, to reduce the occurrence of ineffective decisions that are made in the absence of information. Such technology-based management tools could link independent islands of communication in the construction phase, required for efficient identification, locating and tracking of materials throughout construction including off-site, en-route, and on-site, as discussed by(Sardroud & Limbachiya, 2011). Furthermore, this reliable automated management system increases productivity and cost efficiency in addition to improving scheduling, a number of lost items, and site optimization.

A recent advancement in these technologies is Radio Frequency Identification (RFID) which was discussed previously. This has been identified as one of the ten greatest contributing technologies of the 21st century because of its potential benefits, such as ready availability, ease of handling, and affordability. RFID is a wireless sensor technology, based on the detection of electromagnetic signals and radio frequencies, which are used to capture and transmit data from or to a tag.

This investigates an RFID-based ubiquitous system, which involves the use of RFID, GPS, and GPRS technologies to obtain real-time information and the sharing of information amongst the involved participants of the construction project, such as materials manufacturers, suppliers, contractors, and construction site offices as shown in below Figure 3.(Sardroud & Limbachiya, 2011)

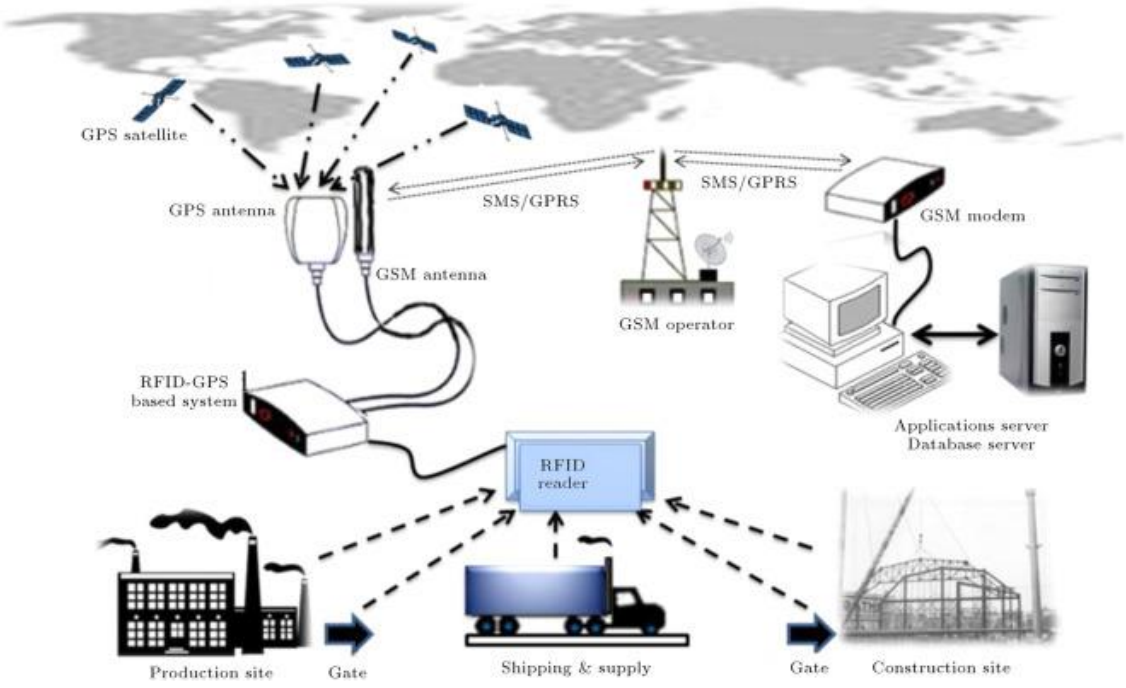


Figure 3 : use of RFID, GPS, and GPRS technologies

2.4.2.5 Use of E-Procurement

The development of internet technology has profoundly changed the way construction industry does business. Value gains from e-Commerce applications, particularly e-Procurement, are well known and it has been accepted across industries. However, the adoption of e-Procurement is considerably low in construction industry, which lags behind other industries such as manufacturing and retail industry. Low adoption of e-Procurement in industry is attributed to the various areas required by e-Procurement investment (i.e. people, process and technology), since e-Procurement is costly and adopting e-Procurement requires substantial changes in internal processes of organizations. Therefore, an increase in the availability of information related to value benefit (tangible and intangible) will be significant as one of the primary motivations for professionals in the industry to adapt to new technologies. The opportunity for direct benefits in their own operations may drive change.

The advent and proliferation of e-Procurement systems in the firms has produced a wealth of information related to both use and implementation. There are numerous empirical studies providing anecdotal evidence to support the idea that e-Procurement

makes the procurement process more efficient and effective and has an impact on firm performance. The following benefits may be seen:

- an increase in process quality,
- reduced procurement cost,
- user satisfaction,
- increased responsiveness,
- improved customer service,
- product innovation,
- market expansion,
- reduction in purchasing cycle time,
- reduction in staff time and
- Managerial effectiveness.

(Hashim, Said, & Idris, 2013)

2.4.3 **Green Supply Chain Management**

It is acknowledged that construction activity has major impacts on the environment. Moreover, the construction process is usually fragmented, and involves several parties with different objectives. Thus, often, none of them normally assumes direct responsibility for protecting the environment. The concept of supply chain management (SCM) and SCM strategies are now commonly applied in business for the mutual benefit of enterprises in the supply chain (from the organization extracting the basic raw material to the final customer).(Ofori, 2000)

The concept of supply chain management (SCM) is viewed as a strategic tool (Dale et al., 1994) which is vital to corporate competitiveness and profitability in today's operating environment (Burgess, 1998). SCM can improve efficiency and productivity, and reduce overall operating costs (Lambert et al., 1998). SCM is neither widely known nor significantly applied in the construction industry in any country. Like the traditional approach to business for which SCM offers an alternative, in Sri Lanka and Maldives construction, business relationships are based on narrow, short-term interests, and win-lose arrangements. It is pertinent to study the possibility of using SCM to improve the

performance of construction enterprises in both destinations, especially their environmental performance.

Recently, enterprises have started considering Green SCM (Supply Chain Management) for the purpose of securing a competitive advantage over other enterprises because of the increase of international conventions related to the recent climate change, the strengthening of global regulations for environment protection, the demand for environmental suitability by stockholders and investors of enterprises, and the consumer's preference for environmentally friendly products. Green SCM is emerging as the strategy to preemptively cope with environmental regulations. However, many small and medium enterprises are less aware of the necessity of its adoption and are not ready to adopt it.

According to a research done on Green supply Chain Management there are main three activities as below;

(a) Green Purchasing
(b) Green Production
(c) Green Logistic
(d) Reuse

This study investigated how green SCM activities of small and medium enterprises can be different in their green management activities across the process stages of their supply chain network. The results show there are correlations between upstream and downstream processes. There was no significant difference between green purchase and production processes. However, there were significant differences between green purchase and other processes such as green logistics and green reuse.(Chun, Hwang, & Byun, 2014)

2.4.3.1 Green Purchasing (Carrying out purchasing activities in eco-friendly manner)

The increasing environmental consciousness and commitment of businesses, governments, groups and individuals has inspired the development of procurement and purchasing policies incorporating environmental requirements which demonstrate their

bargaining and buying power. Walton et al. (1998, p. 2) note: In business today, companies cannot ignore environmental issues. Increasing government regulation and stronger public mandates for environmental accountability have brought these issues into the executive suite, and onto strategic planning agendas. At the same time, companies are integrating their supply chain processes to lower costs and better serve customers. These two trends are not independent; companies must involve suppliers and purchasers to meet and even exceed the environmental expectations of their customers and their governments (Ofori, 2000).

Carter et al. (1998, p. 28) define "environmental purchasing" as consisting of "purchasing's involvement in activities that include reduction, reuse, and recycling Materials". They observe that, despite its importance, research on it is only now beginning to emerge. They note that many firms are becoming environmentally proactive and are developing and implementing "green" strategies which preserve the environment while enhancing the firm's efficiency and effectiveness. These include developing green products and packages, conserving energy, reducing waste, recycling, and creating an environmentally sensitive corporate culture

In 1993, the UK Chartered Institute of Purchasing and Supply launched voluntary guidelines for purchasers entitled "Buying into the Environment" (Anonymous, 1993) which are widely supported and applied. By following the seven principles the guidelines enshrine, companies should achieve: establishment of a business case to make environmental purchasing viable and part of day-to-day operations; understanding of environmental issues affecting the organization and its supply chain; development of a purchasing policy which addresses environmental issues; formulation of environmental criteria for ranking suppliers; evolution of suitable methods for collecting relevant information; and establishment of agreed targets for further environmental performance improvements by suppliers. Anonymous (1995) describes the work of the Centre for Research in Strategic Purchasing and Supply(CRiSPS) which develops and adapts environmental management concepts into practical applications for purchasing managers and strategists.

Prompted by the concept of the triple bottom line (Elkington, 1998), the integration of environmental, economic and social performances to achieve sustainable development has become a major business challenge (Srivastava, 2007; Verghese and Lewis, 2007). In response to stricter governmental regulations and rising public awareness of environmental protection, many firms are now undertaking major initiatives to make their supply chains greener (Zhu et al., 2013; Mirhedayatian et al., 2014). Partner selection in a green supply chain (GSC) is a critical activity because the environmental performance of the whole supply chain is significantly affected by its constituent partners (Kuo et al., 2010). In order to reap the greatest benefits from environmental management, firms must integrate the performance of all the members of a supply chain if it is to be truly green (van Hoek, 1999). In so doing, they face a trade-off between sustainability and cost when selecting new partners (Reuter et al., 2012).

As environmental awareness increases, firms today seek to purchase products and services from suppliers who can provide them with high quality, low cost, short lead time and high flexibility, whilst at the same time displaying high environmental responsibility (Lee et al., 2009). A green partner is expected not only to achieve environmental compliance but also to undertake green product design and life cycle analysis. Thus, in a GSC, companies need to have rigorous partner selection and performance evaluation processes (Kainuma & Tawara, 2006).

2.4.3.2 Use pre-fabricated products (Use of standard products, which can pre-manufacture in large quantity)

Total supply cost in construction production networks is inflated as a result of suboptimal purchasing decisions, variability in shop floor production rates and uncertainty in supply Processes. Safety stocks or contingency inventories are commonly used to increase the service level of manufacturing networks. However inventory buffers in dynamic production environments are wasteful and difficult to optimize in terms of size. An alternative approach to enhance the overall performance of networks and minimize relative costs is to optimize supply configurations. Standard modeling methods such as linear programming have been used in the manufacturing literature to optimize supply decisions. However, such optimization models have not been customized to reflect

unique characteristics of production in off-site construction for example the complexity and comprehensiveness of supply decisions in comparison to traditional construction.

One of the main objectives of optimizing the supply chain configuration in off-site construction is to minimize the overall supply cost. However, selection of suppliers and network configuration is not solely based on lowest supply fees. In real production scenarios in off-site construction, different logical constraints are often considered in the decision making process(Arashpour, Bai, Aranda-mena, Bab-Hadiashar, Hosseini, & Kalutara, 2017)

2.4.3.3 Reuse (Recycling materials in environmental friendly manner)

Construction and Demolition Wastes (CDW) arise from activities such as the construction and total or partial demolition of buildings and infrastructures, disaster debris, road planning and maintenance activities. These consist of materials including concrete, bricks, excavated soil, metals, glass, gypsum, wood, plastic, asbestos and various polymers, many of which can be recycled. However, the lack of knowledge on the composition and other characteristics (i.e. quantity, quality, type and real cost) by many who manage CDW, generally results in the dumping of huge quantities of potentially reusable/recyclable materials, which could be an alternative to their natural counterparts. Furthermore, most small and medium enterprises, which correspond to the largest portion of the construction and demolition industries, want to perform the job as quickly and as cheaply as possible (CIB, 2003) and are unaware that most of these wastes are avoidable and that following the conventional approach often reduces revenues.

Aside from the general lack of knowledge on the proper disposal approach, in many cases, the aforementioned companies are not compelled enough to reduce CDW generation and find added-value to it, due to insufficient legislation or simply have no choice other than disposal by landfill. A great amount of time and experience are needed for a waste management system to fully develop into a reliable, skillful, marketable and sustainable industry, which is one of the reasons why so many feel discouraged in venturing into the reuse and recycling market. Even in a context in which one of the stakeholders would be interested in adopting a more ecological stance, this would only be a half-measure, since it is essential that all parties involved in the process

(manufactures, clients, contractors, designers, and planners) play their part for this attempt to grow into a fully sustainable system.(Silva, Brito, & Dhir, 2017)

2.4.3.4 Green Production (Carrying out construction activities in an eco-friendly manner)

As the significance of the environment is more recognized, the correlation between environment and business management activity is getting more important. That is, the factor of the correlation between business management and the environment is very important for securing international competitiveness regardless of the size of the enterprise. In the situation that the influence of the environmental issue is becoming bigger along with the increase of the enterprise's social responsibility, small and medium enterprises can be no exemption. Even though their capability to cope with environmental problems is weak because of more vulnerable management conditions than those of conglomerates, environment management for harmony between environment and economy has become a significant task to them. As a matter of fact, the environment management by enterprises has gone through the expansive conversion to so-called product-centered environment management, which includes the consideration of the entire process of production from the past enterprise's process-centered environment management since the late 90's, and accordingly conglomerates have played a leading role in highlighting the interest in the development of environment-friendly products.

Recently, the significance of Green SCM has increased under the condition of these new regulations. A lot of global enterprises have already adopted Green SCM or are considering its adoption for such various factors as a response to diverse environmental legislation and regulation, improvement of the image of their enterprise brand, work innovation, and cost reduction. In fact, the small and medium enterprises, however, are usually unequipped with enough information and human resources to cope with those environmental problems effectively. In addition, the majority of small and medium subcontractors are feeling much pressure due to the demands of the environment of their companies. While aware of the necessity of Green SCM, they are complaining of the difficulty in its practice because of the problems of cost, response time, onerous reporting, technology, and communication, including the lack of understanding of the issues relating to the environment.

Christie (1995) has defined a cleaner production system as "the producing method to minimize the production of harmful wastes and maximize the efficiency of energy and resource use and added that the ultimate purpose of this kind of cleaner production is to reduce or remove the roots producing polluted substance in the process of production for the realization of productivity improvement and energy and resource conservation." That is, utilization of eco-friendly products may be the driving force for the creation of the added value of products and cost reduction to the effect that the environmental elements should be taken into consideration from the very stage of product designing in order to cause the effective use of resources and a basic reduction in environmental pollution.(Chun, Hwang, & Byun, 2015)

Currently there are three major methods utilized to assess the environmental impact of buildings. Eco-labeling is the practice of branding the environmental qualities of a product or system so that consumers can make environmentally-based decisions. Life Cycle Assessment, on the other hand, is a comprehensive methodology for evaluating the environmental impact of a system or product. Finally, Leadership in Energy and Environmental Design (LEED) represents a national, voluntary standard for developing high-performance, sustainable buildings, and structures, and is based on accepted energy and environmental principles, practices, and emerging concepts in the construction industry.

The Leadership in Energy and Environmental Design (LEED) Green building rating system is a point-based system for certifying the level of a building's sustainability. Sustainable buildings are achieved through integrated building design. For example, in an integrated design approach, a mechanical engineer will analyze the energy use and its cost implications. Similarly, a structural engineer will choose the structural system, whether steel, wood or concrete and analyze the chances of using recycled-content materials into the building project, thus creating opportunities for green design strategies (Ho, Shalishali, Tseng, & Ang, 2009).

2.4.3.5 Green Logistics (Carrying out logistics activities in an eco-friendly manner)

Sbihi and Eglese (2010) suggested that the way for the current government to establish plans for green logistics that can prevent the waste of resources. Liu Ping (2009)

emphasized the continuous interest in development and advance of green logistics while stating the effect created by each environmental factor such as noise and air pollution from means of transportation, waste of unnecessary packing material and other factors caused from the warehouse. Bowersox and Closs (1996) argued that even if a logistics system might be a potential cause of environmental pollution in the process of transportation and packing, it is one of a nation's available resources that can reduce or resolve ecological problems from the point of a positive view. Sarkis (2003) defines the concept of environmental logistics as the combination of environmentally friendly enterprise management and reverse logistics. That is, the activities of green logistics are to construct a system of resource recycling through the ultimate reduction and recycling of wastes by treating the wastes produced in the entire process of logistic activity from the producing phase of products to recovery and treatment when their lives come to an end. A green logistics system should also be systematically driven by enterprises from the aspects of strategy for the core business.

The transport processes play an extremely important role in the supply chain. On the way to their realization, they affect both the logistics strategy and organizational solutions occurring in the individual chain links, and they are related to the elimination of ineffective solutions and the desire to reduce the cost of their own business. The actions taken within the supply chain and related to the implementation of the transport processes include the following:

- support of various types and forms of cargo,
- optimization of the using of means of transport,
- optimization of the unit load,
- optimization of routes,
- provide timely delivery,
- locations transshipment points,
- organizational, functional, and technical specifications in the movement, handling, and storage,
- the legal and financial, and
- rotation packaging and recycling.

It is also important that actions were taken in the process of transport and modern application are often held at the legal level (e.g., by the need for appropriate standards

for emissions), organizational (by optimizing and modeling of routes), economic (economic benefits achieved through the use of modern technology, including new contracts, have the ability to reduce operating costs). Definition of the green transportation in the framework of the green chain requires a statement of its most important features desired. It should start from the means of transport, which should meet the requirements of the low-carbon transport. Another element is the proper integration and optimization of the transport, and it is also related to its cost-effectiveness and efficiency. Another element is the implementation of IT systems, the use of which will allow for eliminating the negative impact of transport on the environment. They allow, inter alia, for the monitoring of the vehicles, and pollution.

These elements are a part of the green supply chain. In practical solutions, its essence and objectives are hidden under the concept of green logistics, which also includes the green storage processes. The elements that define green transport are as follows: electric vehicles, fuel cells, and bio-diesel efficiency, use hybrid vehicles for distribution and delivery, proper planning of shipment (Tundys, 2017).

2.4.3.6 Use of green less toxic materials and renewable energy on production / Operation

The traditional supply chain comprises five parts: raw material, industry, distribution, consumer, and waste. Each of the links in the supply chain can be a reason for pollution, waste, and other hazards to the environment. Regarding raw materials, a company may use environmentally harmful materials such as lead. However, organizations can put pressures on suppliers to use more environmentally friendly materials and processes.

Oil is one of the chief raw materials used by both industries and consumers at various stages of the supply chain. Oil is used as a raw material in many processes varying from power generation to petrol products and as fuel to run engines that are used in agriculture, automobiles, etc. As the combustion of oil leads to the emission of greenhouse gases, its usage needs to be curtailed and if possible is to be eliminated completely. With the industrialization of world's populous countries like China and India, oil usage is expected to reach new highs in near future with most of it imported. Even European resilience on oil is expected to reach 90% by 2030. With the increased demand for oil, the availability of which is limited, countries are forced to embrace alternative technologies or see their

economies falling apart. Moreover, much of the oil is imported from countries that promote terrorism. This factor too forces the world to adopt alternative technologies.(Ho, Shalishali, Tseng, & Ang, 2009)

Current practices in construction material production and disposal consume vast amounts of non-renewable energy resources. An example is the production of steel, a common material in modern building construction. Coal is readily used in the production of this material. However, the manufacturing process is not the only stage where this non-renewable fossil fuel is utilized. A quick analysis of the life-cycle of this building product reveals that material extraction and recycling also use this fuel source that induces vast amounts of air pollution and its depletion as well. (Ho, Shalishali, Tseng, & Ang, 2009)

2.4.3.7 Use of renewable energy on operations

According to most prognoses, the numbers of people traveling for business or pleasure will continue to increase, in some regions very rapidly. While providing a significant boost to many local and national economies, tourism, particularly mass-tourism, has been shown to pose a significant environmental and socio-cultural threat to many of the environments in which it is developed and pursued. Among other resources, the hospitality industry uses substantial amounts of energy for providing comfort and services to its guests, typically with an alarmingly low level of energy-efficiency. The effects on the environment include emissions to and pollution off water resources, soil, and the air, noise, as well as the excessive use of locally available and/or imported natural and other resources. (Bohdanowicz, Churie-Kallhauge, & Martinac, 2001)

The development and operation of sustainable hotels requires the close and continuous cooperation of specialists from a broad spectrum of disciplines, including architects, spatial planners, building and services engineers, mechanical (systems) engineers, as well as environmental and marketing specialists, preferably already during the stages of planning and design. (Bohdanowicz, Churie-Kallhauge, & Martinac, 2001)

There is a widespread misconception in the hotel sector that substantial reductions in the energy use in hotels can only be achieved by installing and using advanced, high-maintenance, and prohibitively expensive technologies. While this may be true in some contexts, in the majority of cases, major energy savings can be achieved by adopting a

common sense approach, requiring neither advanced expertise nor excessive investments. This is particularly true, when the concepts of energy efficiency and resource conservation are accounted for already when planning and designing a hotel facility. A wholesome evaluation of the sustainability of a specific site needs to integrate considerations from the domain of regional land planning, appropriate site selection and site planning and design.

Important issues that need to be considered when planning/designing hotel facilities with a focus on energy efficiency and conservation include: (Bohdanowicz, Churie-Kallhauge, & Martinac, 2001)

- Appropriate site selection
- Availability of local building material and (renewable) energy resources
- Implications on customer-behaviour, services provided, and overall cost
- Design aspects.

Chapter Summary

Although many authors discussed construction supply chain strategies and practices, there is no research carried out particularly for construction supply chain strategies in the hotel industry. So this research focused on construction supply chain in the hotel industry and identifies best strategic practices and also helps to develop a model to calculate construction cost per room even with the implication of impact of best supply chain practices in order to take effective management decisions based on following research objectives and research question.

1. Identify and map the present condition/operation of construction supply chain in existing hotel industry in Maldives / Sri Lanka
2. Identify SC strategies to efficiently manage construction supply chain of hotel industry in Maldives / Sri Lanka.
3. Develop the model for calculate the construction cost per room after implementation of SC strategies
4. Calculate the construction cost per room before and after implementation of SC strategies
5. Develop a concept for strategic SC practices.

Contractors identify integration as key strategy for the application of SCM in construction. But there are many factors / strategies important and effective in construction supply chain, which may effect in different levels to overall cost of construction supply chain in hotel industry.

Decision makers of supply chain in this industry are struggling due to lack of mechanism or research findings in order to identify the best strategic practices and to determine the real cost saving with the application

In this paper, we provide best strategic practices in construction supply chain and operational descriptions of each practice within the supply chain processes. Our aim is to provide managers with a framework to be used in implementing supply chain management, and researchers with a set of opportunities for further development of the field.

The methology for this whole process focusing on above objectives in order to find a solution for research question will be described in next chapter.

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction

The development of the research design and the research methods used for this dissertation will be discussed in detail, in this chapter. Prior to this chapter, the background of the industry and the problem statement (under chapter 1.0 – Introduction)

was explained in depth. The literature review (under chapter 2.0) covered identification of supply chain strategies for the hotel industry in Sri Lanka and Maldives. Since the background and literature review has laid the foundation for creating awareness and building knowledge, the research methodology can now be presented.

This chapter explains the methodology used to carry out the research .This includes the research design, target population, data collection methods and data analysis used in the research.

This study adopts a wide range of research methods, e.g. literature review, focus group discussions, expert interviews and case studies to meet the research objectives. It started with a comprehensive literature review. The initial review of relevant literature helped to identify the research gap and further analysis helped to identify three main supply chain strategies (integration, communication and information technology and Green management) and some detailed best practices relevant construction supply chain of the hotel industry.

Two case studies were carried out by using the simplest assessment. The purpose of case studies was to provide construction cost per room for applying and examining the proposed model and existing mode in practice. The two case studies were related to two projects in a large hotel operating company. One was a 143rooms beach hotel in Sri Lanka. The other was 151rooms resort type hotel including 50 beach villa, 75 water villas and 26 water suites in Maldives. They had two separate contracts and two separate designs. They have also procured all client supplied items separately through the European Union (EU) and all other countries in the world in wide competitive tendering. As a result of the selection, a local contractor won the two contracts for civil works respectively in Sri Lanka and Maldives

.

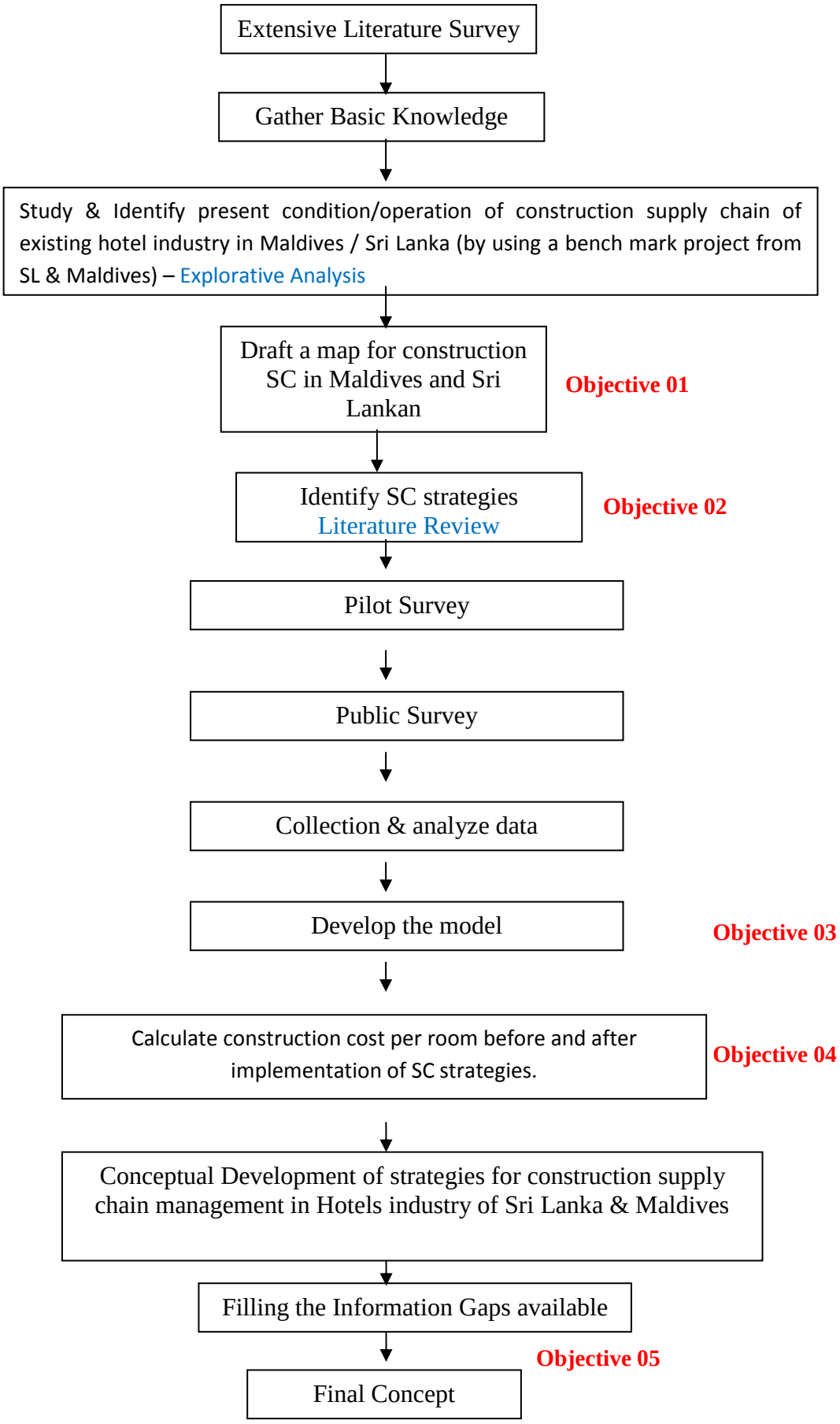
3.2 Research Design

'As business and management researchers we need to be aware of the philosophical commitments we make through our choice of research strategy since this has a significant impact not only on what we do but we understand what it is we are investigating'(Jackson & Clark, 2006)

The research philosophy is an important element where it enhances knowledge in this subject area. The philosophical direction for any research is therefore important for a number of reasons as it helps to clarify the research design, it helps to recognize which designs will work and which will fail, and it helps the researcher identify and even to create new designs that maybe outside of his experience (Easterby-Smith, Thorpe, & Lowe, 2002). Research philosophies promote a structured approach when carrying out any dissertation/thesis. First, it helps to clarify research designs; second, knowledge of philosophy can help the researcher to recognize which designs work best; finally, knowledge of philosophy helps the researcher to identify and adapt research designs according to the constraints of different subject or knowledge structures. (Easterby-Smith, Thorpe, & Lowe, 2002).

The research design is the blueprint that guides the research process in coming up with the solutions to the research problem (Nachmias & Nachmias, 1996). It constitutes the plan and structure of investigations for the collection, measurement, and analysis of 8data conceived to obtain answers to the research questions (Cooper & Schinder, 2003). In order to achieve the research objectives, two benchmark case studies respectively in Sri Lanka and Maldives were analyzed in order to identify how to strategic practices and effectively manage construction supply chain of the hotel industry in Sri Lanka and Maldives.

Research Design



3.3 Selection of population and sample

3.3.1 Population

All three stars to five stars hotels and resorts in Sri Lanka and Maldives. There were many reasons behind the selection of hotel industry in Sri Lanka and Maldives for the research such as they are some of the main regions in the development stage of hotel industry, it represents many construction projects due to the development in tourism sector, the region contains both high and medium scale construction projects, available of many contractors, material suppliers, consultants, architects in this region.

3.3.2 Sample

The purposive sampling and simple random sampling technique was used in the study. Initially, five experts have been selected based on purposive sampling as appended below and data were collected as a pilot survey. Finally, more than 35 stakeholders have been selected based on simple random sampling from executive and above capacity in different fields in order to carry out the public survey as appended below.

Pilot survey – 5 Experts in construction industry

- MD of cost Consultancy Company,
- Chief QS of main construction company,
- MD of Project Management Company,
- Chief QS of Project Management company
- Director/GM/Manager – Hotel Industry

Public Survey – More than 35 stakeholders.

- Contractors / suppliers
- Consultants
- Architects

- Hotel industry Employers (Executive and above).
- Project Managers
- Logistics providers …etc.

3.4 Data Collection

The data was collected using direct interview, online survey and secondary data collected from company database, which is found suitable to the context of the study. The data used in the research was both primary data and secondary data. A structured questionnaire form was developed to collect the data is given in Annex 01.

3.4.1 Primary data sources

3.4.1.1 Direct interview

The expert interview was the first step of the evaluation process. A semi-structured interview was carried out between the interviewer and interviewees face to face. Five construction practitioners and one supply chain (hotel industry) experts were selected as interviewees. Among four industrial practitioners, two represented project Management Company, one represented cost consultants, one represented main contractor, and one represented supply chain of the hotel industry. The positions of these industry experts included Managing directors, supply chain manager/GM, chief quantity surveyors, and so on. All of them had many years' experience in the construction supply chain management.

3.4.1.2 Questionnaire

An online survey was carried out in order to understand the opinion of stakeholders in supply chain with regard to the identified strategies/practices and their impact on the overall construction cost of the hotel industry in Sri Lanka and Maldives,

According to Fielding, et al (Fielding, Lee, & Blank, 2008) there is no agreed terminology for surveys conducted online; 'web survey, internet survey and online survey tend to be used interchangeably'. As Gaiser & Schreiner (Gaiser & Schreiner, 2009) states, one of the major benefits going online to conduct your survey is access to a very broad population.

The survey was limited to 15 questions in order to gather more respondents.

3.4.2 **Secondary data sources**

The data has been collected from Company database, which consist of more accuracy relevant to the research background. Further particular company is operating around 14 hotels in Sri Lanka and Maldives with five star categories. Also annual reports of same company reviewed in order to collect more descriptive data.

More than 25 web journals, articles, and past research papers, mostly very recently published have been reviewed specially related to construction supply chain in order to observe more relevant data.

3.5 Data Analysis

3.5.1 **Developing SC Map the construction supply chain with the process**

Study & Identify present condition/operation of construction supply chain of existing hotel industry in Maldives / Sri Lanka by using a benchmark project from Sri Lanka & Maldives. Explorative Analysis carried out in order to identify existing supply chain concept and to develop the existing supply chain map.

3.5.2 **Identification of strategic practices in construction supply chain.**

More than 25 related research papers have been observed and analyzed in order to identify supply chain strategies and practices. The main strategies and practices have been identified through a thorough content analysis of research papers, journals and articles of construction supply chain published in very recent past.

Further mainly three strategies (Integration, communication and information technology and Green management) and number of practices under each strategy have been identified based on a meta analysis.

Finally all strategies and practices have been included to questioner and expert's opinion collected, reviewed, and analyzed in order to identify the best practice and its impact to the construction cost of hotel industry.

3.5.3 **Model development**

3.5.3.1 Existing model

By use of this model the total construction cost has been calculated based on secondary data collected from company database including Civil, MEP, FF&E, HOE and other cost components, then derived to construction cost per room by dividing a number of guest rooms available in the hotel.

In this model total construction cost including public areas, landscape, swimming pools, car parks, laundry..etc. will be segregated into the room cost since main revenue is generating from full board room sales. This value will help to take some important management decisions.

$$\text{Construction cost per room} = \frac{\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others}{\text{Total number of room in the hotel}}$$

MEP = Mechanical, Electrical, and plumbing cost

FF&E = Fixed Furniture and Equipment cost

HOE = Hotel Operating Equipment cost

It is to be calculated by using Microsoft Excel spreadsheet and formulas based on collected data.

3.5.3.2 Stimulation the model

The model has been developed based on existing model to calculate the construction cost per room and responses received from the public survey for different strategies and expected cost savings from each strategy.

$$\text{Construction cost per room} = \frac{\text{Civil} - \text{A\%} + \text{MEP} - \text{B\%} + \text{FF\&}E - C\% + HOE - D\% + Others - E\%}{\text{Total number of room in the hotel}}$$

MEP = Mechanical, Electrical, and plumbing cost

FF&E = Fixed Furniture and Equipment cost

HOE = Hotel Operating Equipment cost

A% = Expected percentage of cost reduction for civil cost

B% = Expected percentage of cost reduction for MEP cost

C% = Expected percentage of cost reduction for FF&E cost

D% = Expected percentage of cost reduction for HOE cost

E% = Expected percentage of cost reduction for Other cost

3.5.4 **The comparison of existing method and proposed model.**

Required data for above calculation has been collected from company data based on two benchmark projects. One was a 143rooms beach hotel in Sri Lanka. The other was 151rooms resort type hotel including 68 beach villa, 57 water villas and 26 water suites in Maldives.

Comparison of construction cost per room was carried out before and after implementing best supply chain practices. The total construction cost has been calculated based on secondary data collected from company database including Civil, MEP, FF&E, HOE and other cost components, then derived to construction cost per room by dividing the number of guest rooms available in the hotel.

3.5.5 **Development of final concept**

The current supply chain process and supply chain map have been developed based on the explorative analysis done through direct interviews with experts in the construction supply chain of the hotel industry. Secondly, best supply chain strategies have been identified through an extensive literature review and best practice for each strategy have been identified based on the online survey. The final concept has been developed with the implication of best practices to the current construction supply chain process.

3.6 Chapter Summary

Whole research needs to follow each step indicates in the research design. Further outcomes/ findings of research will be discussed in next chapter based on collected data and analysis

CHAPTER 4 - RESEARCH FINDINGS

4.1 Introduction

The objective of this chapter is to present the Primary and secondary research findings. Primary data was gathered through an online survey which experts of the construction supply chain were the main respondents and series of in-depth interviews were carried out where the construction-related hotel industry experts were questioned on key elements of the research area. Secondary research was gathered through peer-reviewed journals, books, web, conference publications, and research reports.

4.2 Descriptive Analysis

A web version of the questionnaire was utilized in order to collect responses to this online survey. A target audience of 50 was chosen and reached through emails and web links (on mobile). 35 respondents were able to participate and completed the survey.

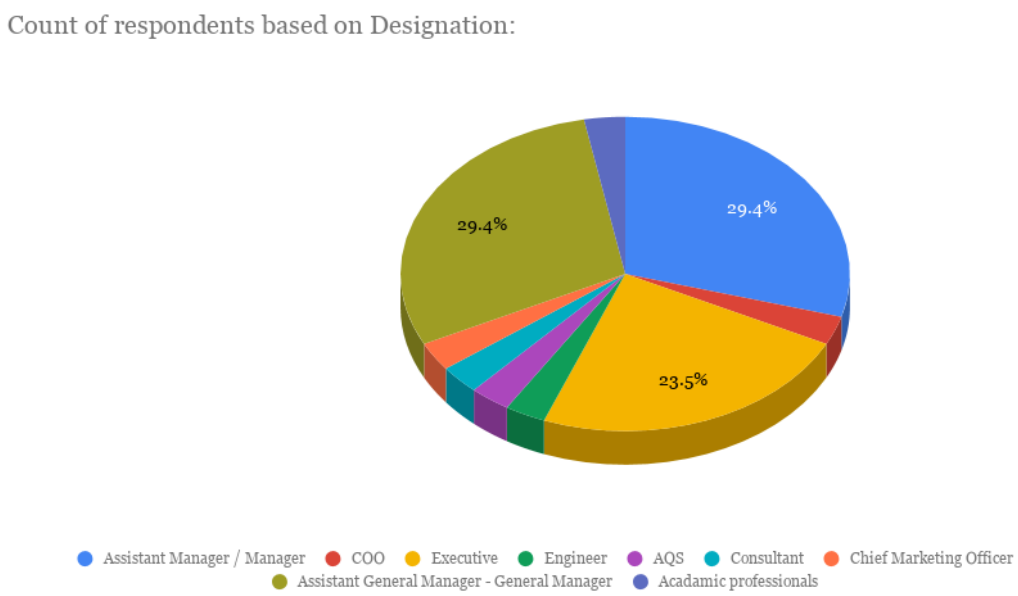


Figure 4 : Profile of the Sample by Management Level

It is very important to notice designation levels of the selected sample. All high designated experts in the field have been selected for the survey due to the technical questions were included in the questionnaire and only higher level managers can provide most valid answers due to their experience and knowledge. Among the

received responses 29.4% from Assistant Manager/ Manager level, Assistant General Manager / General Manager level, and 23.5% from Executive level as indicated in the above Figure **4** It is indicated that more than 82.3% respondents are from above Executive level.

Further out of all respondents 60% have more than 5 years' experience in the industry and 22.9% have 3 to 5 years' experience in the field. Altogether more than 82.9% respondents have more than 3 years' experience in the field as shown in Figure 5. This shows that majority of respondents are well experienced in the field.

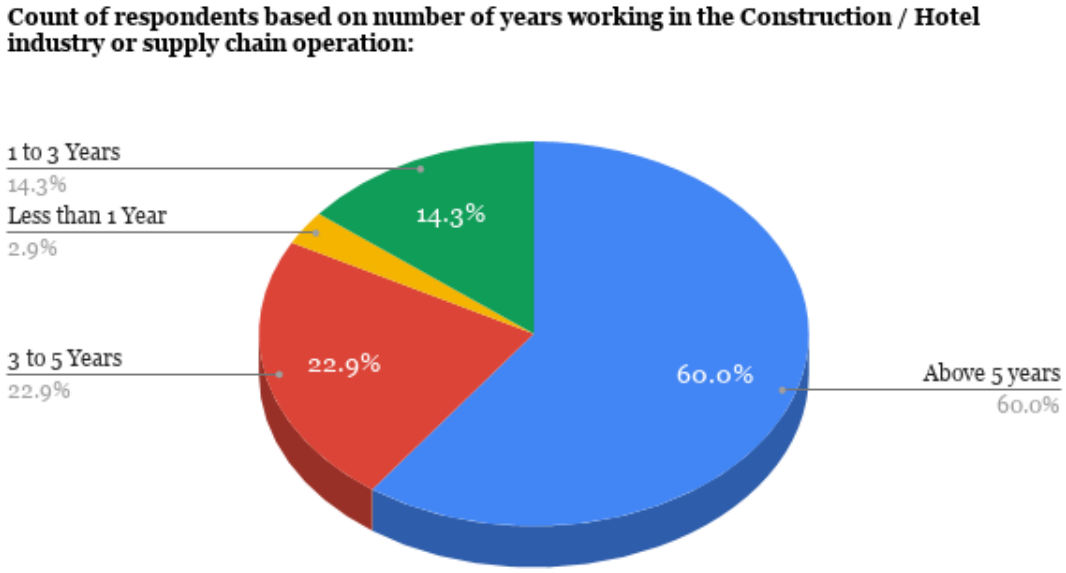


Figure 5 : Profile of the sample based on Experience

More than 15 respondents are working in the organizations that consist of more than 400 employees. Only 7 respondents participated from companies which have less than 100 employees. It shows that most of the participants represent well-established organizations in the construction supply chain as per below

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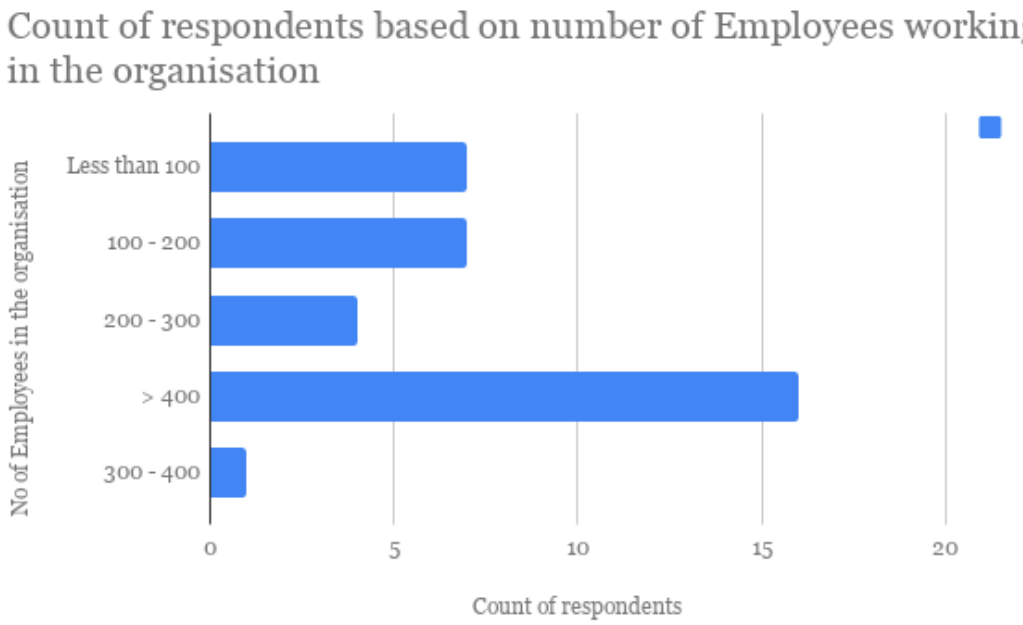


Figure 6 : Count of respondents based on number of employees

As shown in Figure 7, the respondents from all operations areas of construction supply chain was included in the sample and around 86% of them represent the supply chain operations.

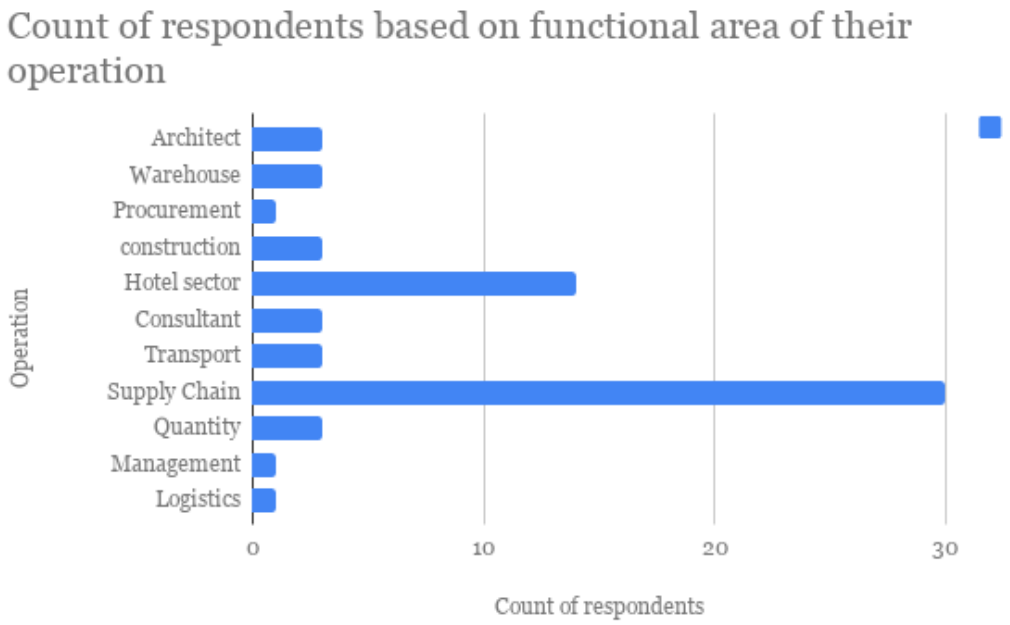


Figure 7 : Count of respondents based on functional area

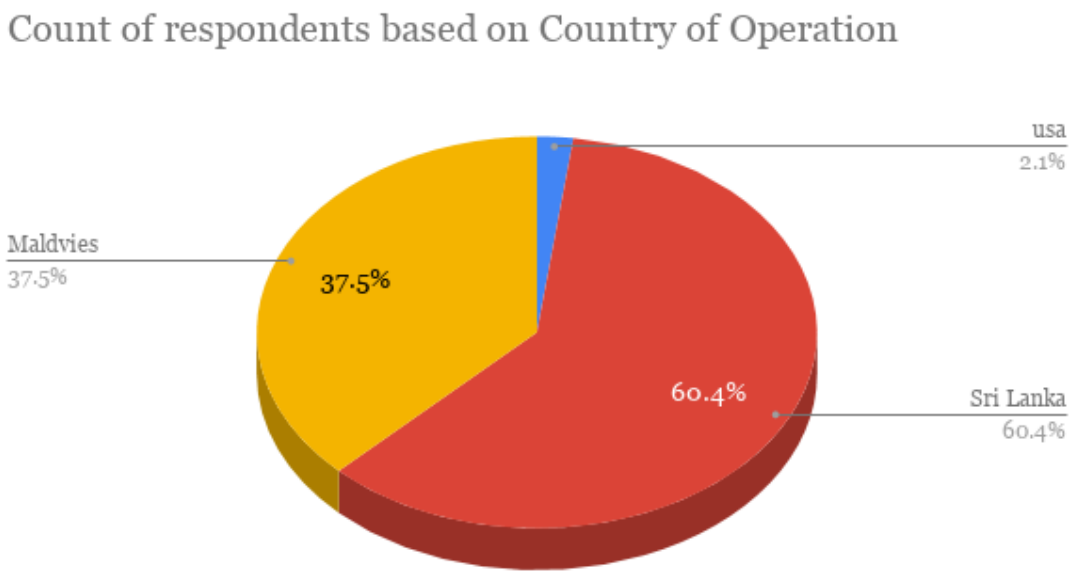


Figure 8 : Count of respondents based on country of operation

As shown in Figure 8 97.9% respondents are engaged in Sri Lanka and Maldives operation and on 2.1% response received from out of research focused countries. This result represents fairly considerable volume from both destinations and this will help to make accurate decision and conclusions for construction supply chain of both destinations.

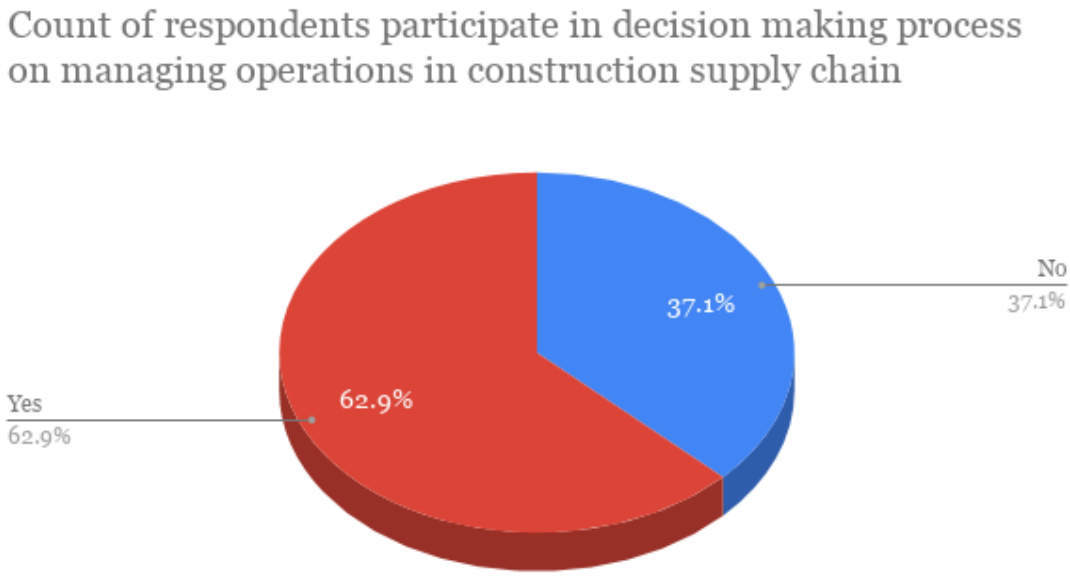


Figure 9 : Count of Respondents participate in decision making process

As illustrated in Figure 9, around 63% of the respondent's participate in the decision-making process on managing operations construction supply chain. Hence credibility and relevancy of their response are very high and effective. Although balance 37.4% respondents do not involve decision-making process on managing construction supply chain, they still involved in operation of construction supply chain as illustrated in Figure 7 above

4.3 Map the supply chain of hotel industry in Sri Lanka & Maldives

4.3.1 Map the supply chain of hotel industry in Sri Lanka

4.3.1.1 Process Map – Sri Lanka

Developing the map consists of 14 steps as described below;

Step 1 Selection of Architect gets the design done based on requirement and budgeted amount.

Step 2 Selection of quantity surveyor and get the priced BOQ done.

Step 3 Selection of project manager and decide on project start time, duration etc.

Step 4 Allocation of total scope to main tenders and decide on client-supplied items

Step 5 Preparation of tender documents & origination of capexes for client supplied items by Project Manager.

Step 6 Follow the tender process and election of suppliers for main works (Civil, MEP) and subcontract works (RO, STP, Generators, Laundry and Kitchen …etc.)

Step 7 Process client supplied items capexes and deliver the goods on expected time

Step 8 Preparation of contract documents and obtaining necessary signatures.

Step 9 Arrangements for advance payments, LC, DP and TT payments for import items.

Step 10 Arrangements and follow up with international (Sea/Air) or/and domestic transportation modes.

Step 11 Arrangements for duty-free facilities and clearing process.

Step 12 Unloading, inspection and safe storage.

Step 13 Conducting project management meetings and review the progress weekly basis.

Step 14 Rectification of defects and completion of the project.

4.3.1.2 CSC Map – Sri Lanka

Based on the analysis a map was developed for Sri Lankan CSC and given below.

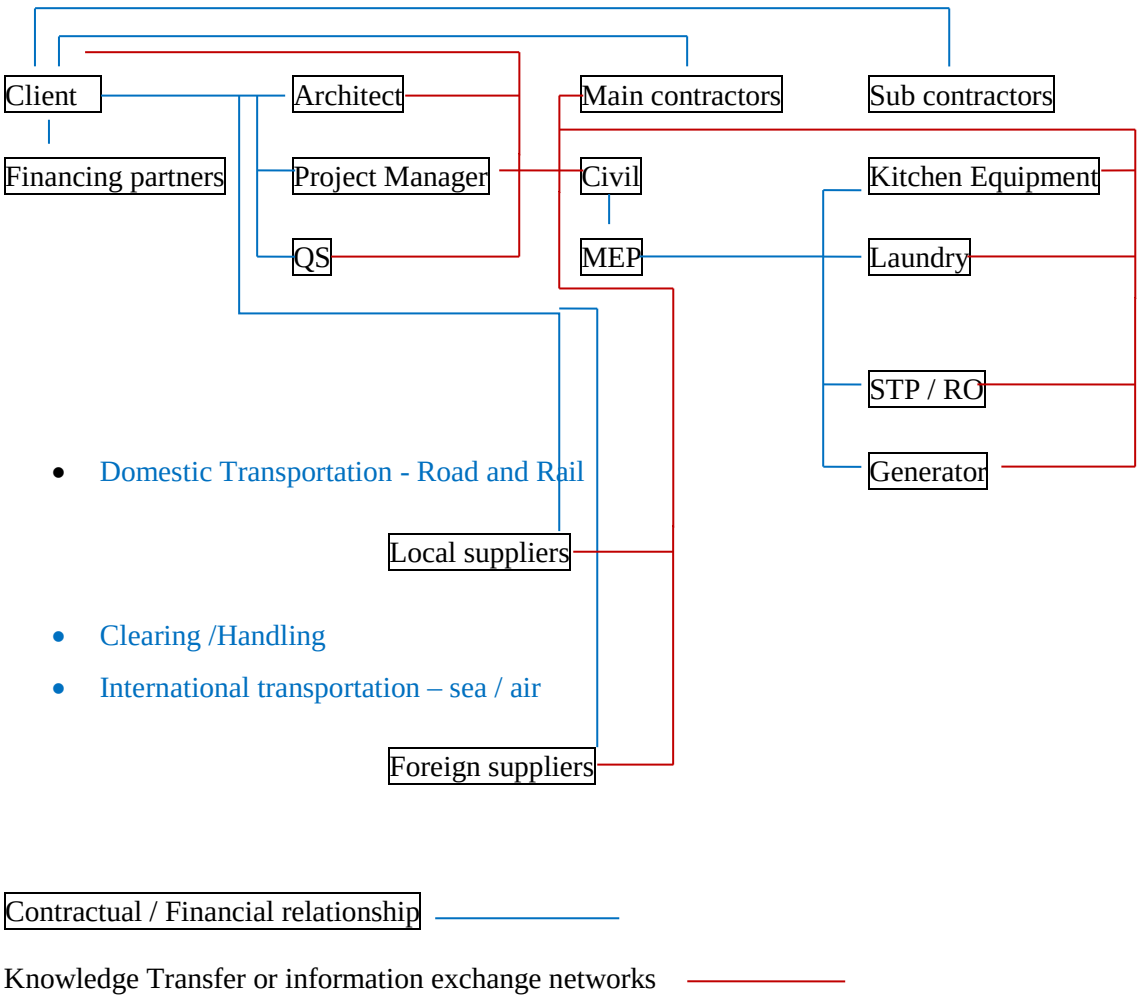
In the initial stage of the project, the client will interface with Architect, Quantity surveyors and financial partners in order to understand the requirement and do the designing part of the project.

Once the design and financing matters are finalized, it is required to appoint a good project manager to plan and carry out the expected project during the allocated time period based on budgeted project cost.

Finally main contractor and subcontractors are appointed by the client in order to execute the project with project manager's supervision and guidance based on the scope of work determined in the initial stage. Further client supplied items should be supplied from local and foreign suppliers at the right time for smooth process and complete the project on expected time within the allocated budget.

In consideration of transport and logistics, all inward goods are receiving from sea and airports mainly from a centralized location (Colombo/Katunayake). Further inland transport basically covered by road and railway transportation up to the destination.

Different relationships with main stakeholders of the construction supply chain have been mapped below in order to understand the total process of construction supply chain in hotel industry, Sri Lanka.



4.3.1.3 Process Map – Maldives

Developing the map consists with 14 steps as described below;

Step 1 Selection of Architect get the design done based on requirement and budgeted amount.

Step 2 Selection of quantity surveyor and get the priced BOQ done.

Step 3 Selection of project manager and decide on project start time, duration etc.

Step 4 Allocation of total scope to main tenders and decide on client-supplied items

Step 5 Preparation of tender documents & origination of capexes for client supplied items by Project Manager.

Step 6 Follow the tender process and election of suppliers for main works (Civil, MEP) and subcontract works (RO, STP, Generators, Laundry and Kitchen …etc.)

Step 7 Process client supplied items capexes and deliver the goods on expected time

Step 8 Preparation of contract documents and obtains necessary signatures.

Step 9 Arrangements for advance payments, LC, DP and TT payments for import items.

Step 10 Arrangements and follow up with international (Sea/Air) or/and domestic transportation modes.

Step 11 Arrangements for duty-free facilities and clearing process.

Step 12 Unloading, inspection, and safe storage.

Step 13 Conducting project management meetings and review the progress weekly basis.

Step 14 Rectification of defects and completion of the project.

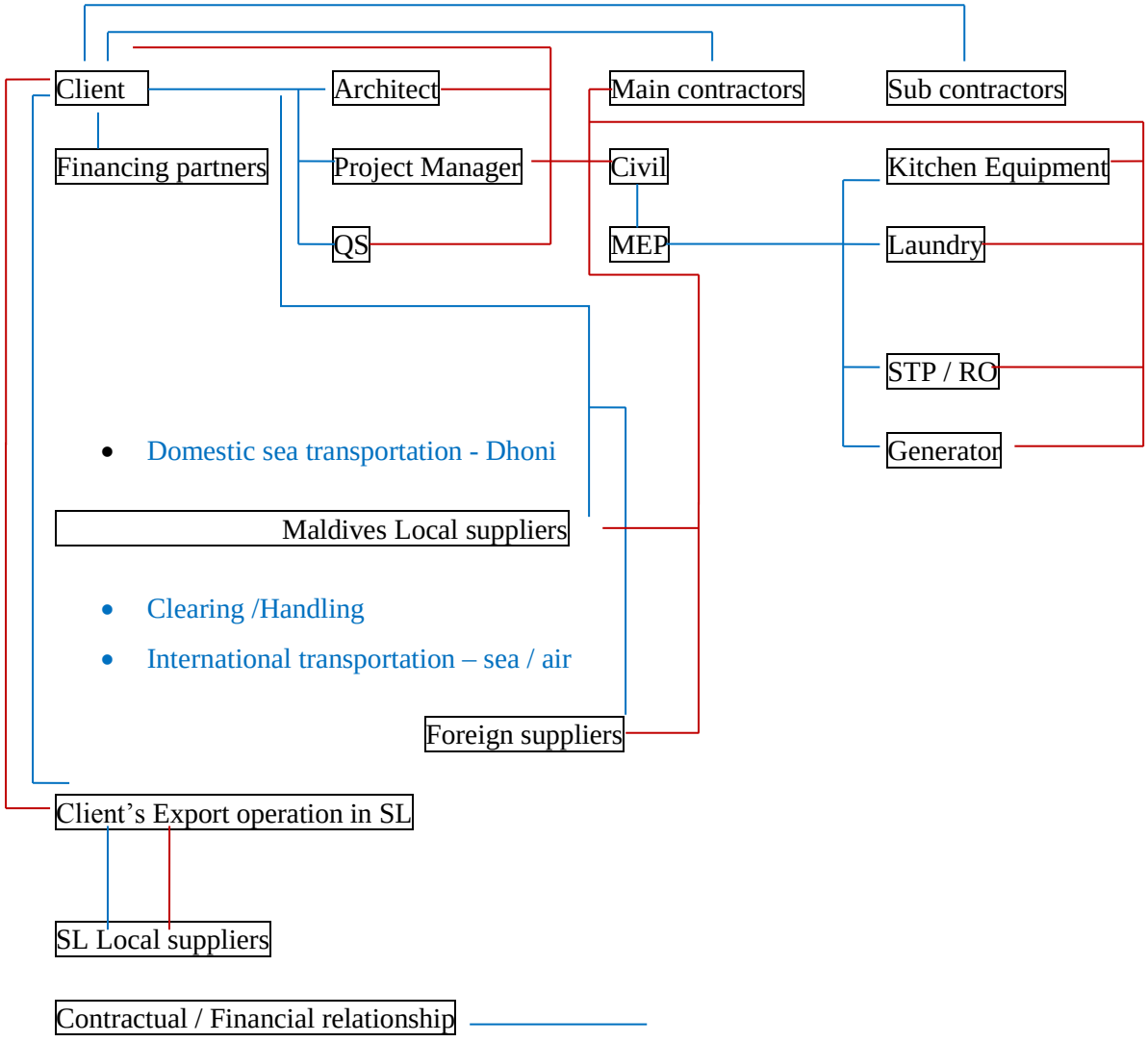
4.3.1.4 CSC Map – Maldives

Based on the analysis a map was developed for Maldives CSC and given below.

There is no significant change in the initial process of the project in this region as against Sri Lanka.

In consideration of transport and logistics, all inward goods are receiving from sea and airports mainly from a centralized location (Male'). Further inland transport basically covered by inland sea transportation (Dhoni/Land crafts etc.) up to the destination.

Different relationships with main stakeholders of the construction supply chain have been mapped below in order to understand the total process of construction supply chain in hotel industry, Maldives.



4.4 Identification of strategic practices in construction supply chain.

More than 45 related research papers have been observed and analyzed in order to identify supply chain strategies and practices based on Meta analysis as appended below in Figure **10**.

Figure 10 : Meta analysis

	Green Management activities	Integration	Recycled materials	Trust Formation	Communication and Information T	Usage of pre-fabricated products (	Modeling and monitoring	Relationship & collaboration
Abd Shukor, Mohammad, Mahbub, & Halil, 2015		1						
Alwan, Jones, & Holgate, 2016		1					1	
Arashpour, Bai, Aranda-mena, Bab-Hadiashar, Hosseini, & Kalutara, 2017						1		
Beach et al., 2005		1						
Bowden et al., 2006					1			
Cao & Zhang, 2012		1						
Cheng, Law, Bjornsson, Jones, & D. Sriram, 2010								
Chong Wu, David Barnes, 2015	1							
Chun, Hwang, & Byun, 2014	1							
Demirkesen & Ozorhon, 2017		1						
El-Ghandour and Al-Hussein, 2004					1			
F.T. Edum-Fotwe, A. Thorpe, R. McCa!er,2001					1			
George Ofori,2000	1							
Grzybowska & Kovács, 2016							1	
Hashim, Said, & Idris, 2013					1			
Ho, Shalishali, Tseng, & Ang, 2009	1							
Holweg, Disney, Holmström, & Småros, 2005		1						
Hosseini, Banihashemi, Rameezdeen, Golizadeh, Arashpour, & Ma, 2017					1			
Hinkka & Tätilä, 2013					1			
Irizarry, Karan, & Jalaei, 2013					1			
Katarzyna Grzybowskaa, Gábor Kovácsb,2016							1	
Kainuma & Tawara, 2006	1							
Lu et al., 2014					1			
Marieke Venselaar, VincentGruis, FenneVerhoeven,2014								1
Meng, 2010				1				
Mentzer & al., 2000		1						
Oxley, 2017					1			
Ofori, 2000	1							
Sahay, 2003		1						
Sardroud & Limbachiya, 2011					1			
Shi, Ding, Zuo, & Zillante, 2016		1			1			
Shin, Chin, Yoon, & Kwon, 2011		1						
Silva, Brito, & Dhir, 2017			1					
Sridharan & Simatupang, 2002		1						
Stank & al., 2001		1						
Tae-Hong Shin , Sangyoon Chin b, Su-Won Yoon, Soon-Wook Kwon, 2010		1			1			
Tundys, 2017	1							
Urszula Ryciuk, 2016				1				
Ville Hinkka , Jaakko Tätilä, 2016					1			
Wibowo, Sholeh,Adji, 2016			1					
Xianhai Meng, 2010		1						1
Yang and Huang, 2016					1			
	7	14	2	2	14	1	3	2

Mainly three strategies (Integration, communication and information technology and Green management) and practices of each strategy identified and described based on literature review. It was found that most researchers identified integration as well as communication & information technology as vital on managing supply chain efficiently

and effectively. Out of the 45 research papers reviewed, 14 have discussed the use of these two strategies. On the other hand, the strategies such as usage of pre-fabricated products were discussed only in one paper out of selected research papers.

Then it was verified from a pilot survey carried out through face to face interviews with the expert of the industry. Finally, all the strategies and practices have been evaluated by the selected main stakeholder of construction supply chain via public survey in order to identify the best practice and other related factors to the research. Likert scale type questions were included and respond converted to values and observed the mean value in order to identify the best practice as per Annexure 01/, Annexure 02/Annexure03and following results were observed for practices under each strategy as indicated below in Figure 11,Figure 12 and Figure 13.

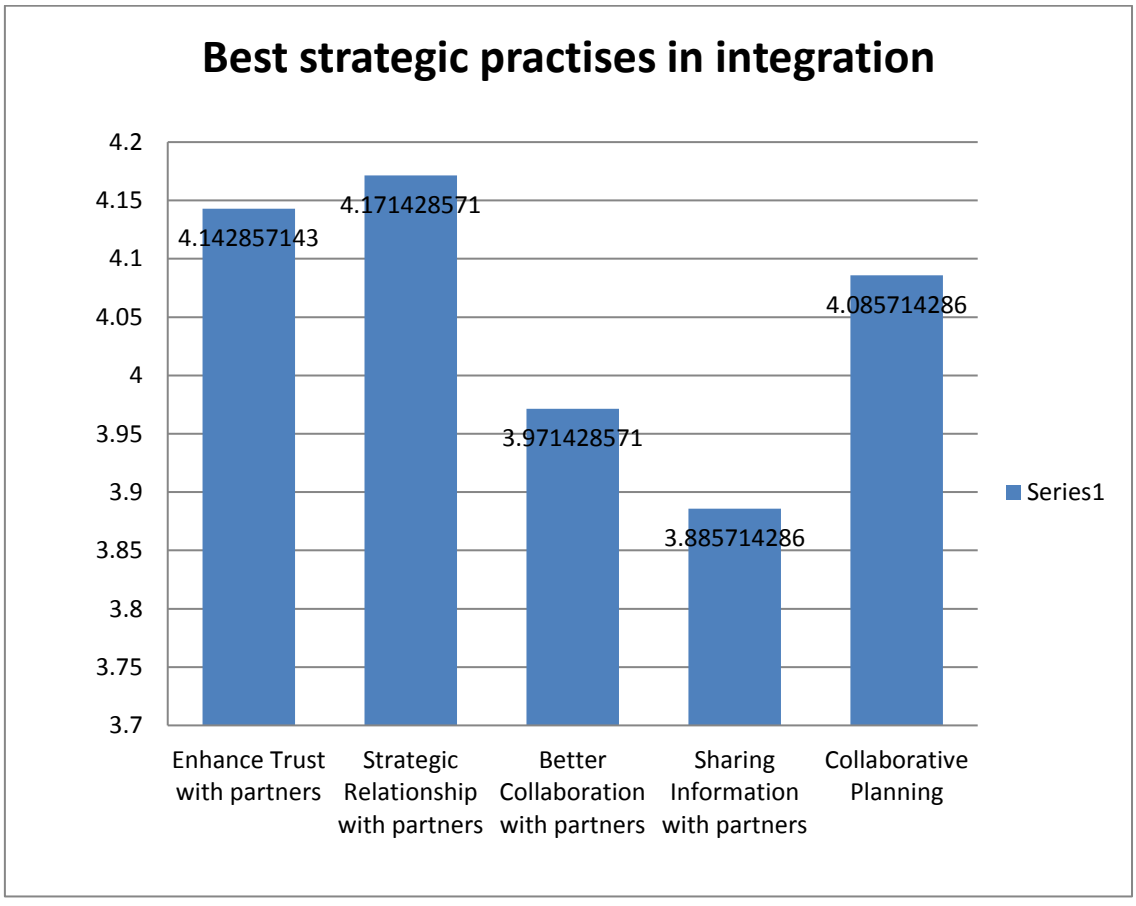


Figure 11 : Best strategic practices in Integration

Values of most of the practices are close to 4 or more than 4, which indicates that all given practices are accepted by the respondents and highest value indicates by “Strategic relationship with partners” which scored 4.17 points under this category as per above Figure 11.

Figure 12 : Best strategic practices in Communication and IT

Also in this category values of most of the practices are close to 4 or more than 4, which indicates that all given practices are accepted by the respondents and highest value indicates by “Use of modern technology for Modeling and monitoring operations” which scored 4.29 points under this category as per above Figure 12.

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Figure 13 : Best strategic practices in Green Management

Finally, in this category, all values of practices are more than 4, which indicates that all given practices are highly accepted by the respondents and highest value indicates by "Use of renewable energy on operations" which scored 4.4 points under this category as per above Figure 13.

Accordingly, highest values (4.4) records under Green Management strategies and most accepted practice is "Use of renewable energy on operations" in order to efficiently manage construction supply chain of hotel industry.

4.5 Model Development for Cost Calculation

4.5.1 Existing model

By use of this model the total construction cost can be calculated based on secondary data collected from main categories of cost components including Civil, MEP, FF&E, HOE and other cost components, then derived to construction cost per room by dividing a number of guest rooms available in the hotel.

In this model total construction cost including public areas, landscaping, swimming pools, car parks, laundry..etc. will be segregated into the room cost since main revenue is generating from full boardroom sales. This value will help to take some important strategic management decisions.

$$\text{Construction cost per room} = \frac{\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others}{\text{Total number of room in the hotel}}$$

4.5.2 **Stimulation the model**

The model has been developed based on existing model to calculate the construction cost per room and responses received from the public survey for different strategies and expected cost savings from each strategy as indicated in below

Figure 14, Figure 15 and Figure 16.

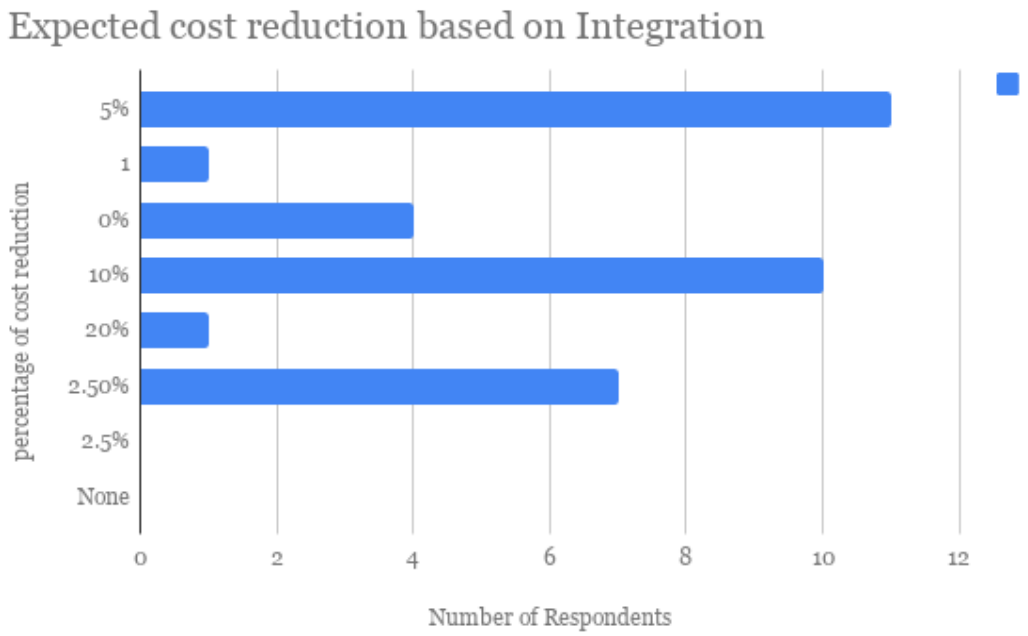

Figure 14 : Expected cost reduction in Integration

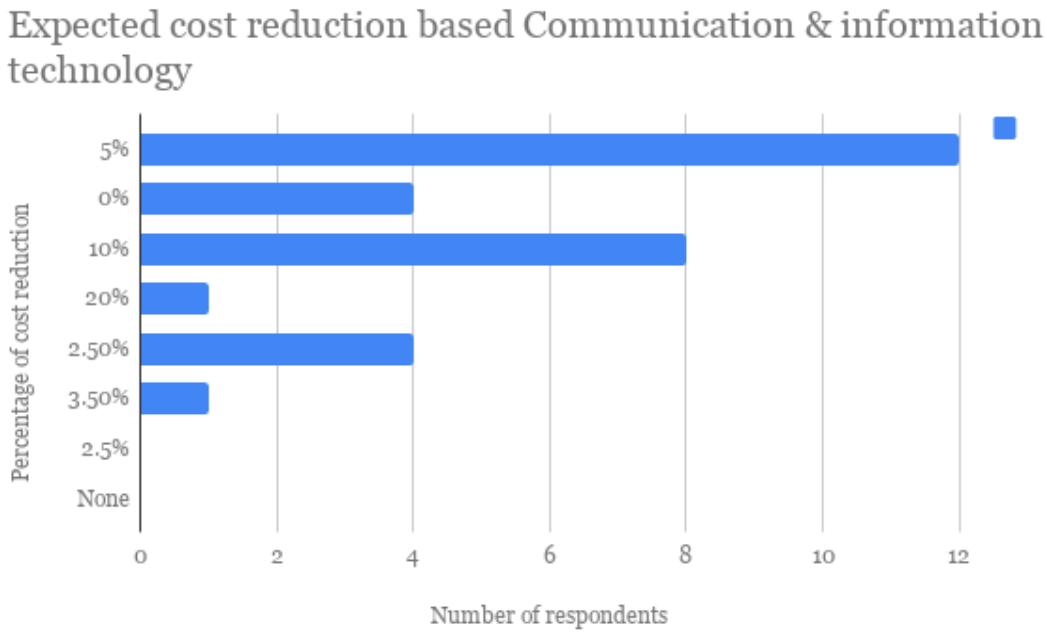

Figure 15 : Expected cost reduction in Communication and IT

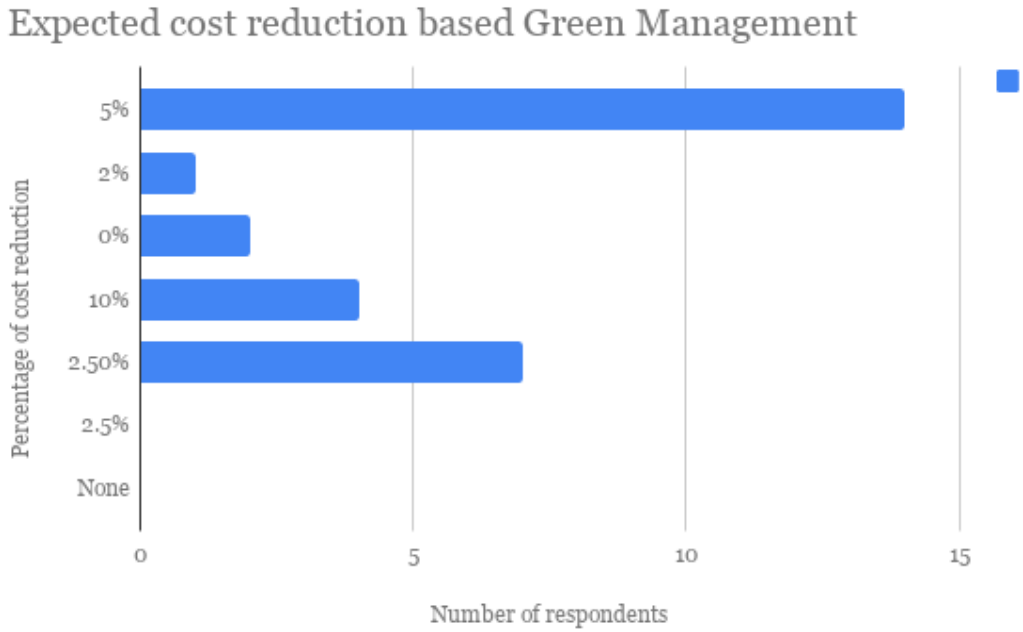

Figure 16 : Expected cost reduction in Green Management

According to above data, most of them are expected 5%cost reduction by implementing integration, communication & information technology and Green management to construction supply chain of hotel industry. More than 10 respondents confirm that there is a possibility of reduction of construction cost by 5% with implementing of above strategies.

Further, it was questioned and tested whether all cost components (Civil cost, MEP cost, FF&E cost and HOE cost) are subjective to above cost reduction and following outcomes were observed as appended below in

Figure 17,

Figure 18, and Figure 19

Respondent's opinion with regard to above cost reduction (Separately evaluated for each main cost component) as against each practice of integration

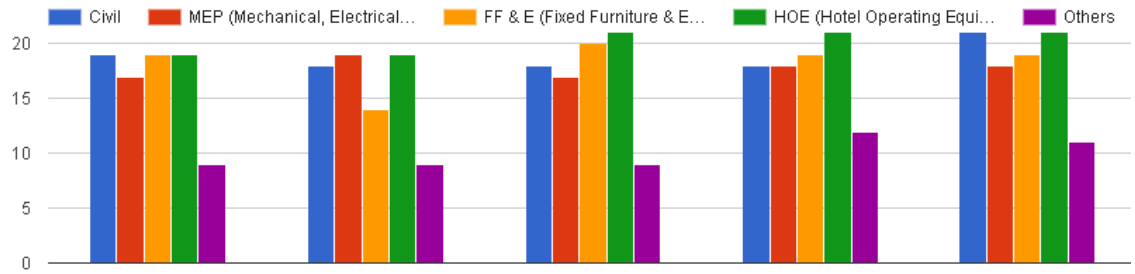

Figure 17 : Cost reduction effects for main cost components based on Integration

Respondent's opinion with regard to above cost reduction (Separately evaluated for each main cost component) as against each practice of communication and information technology.

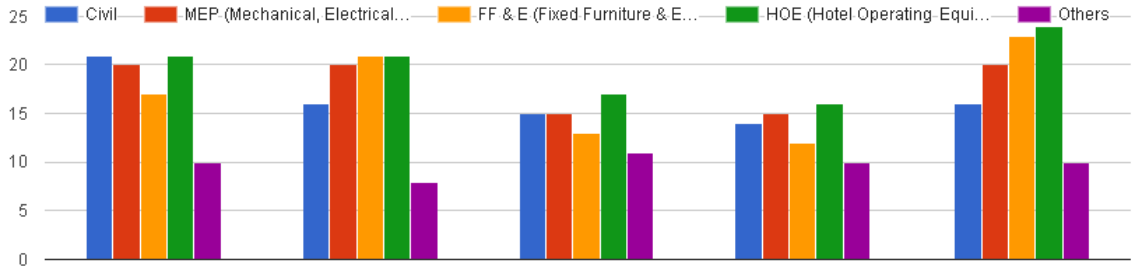

Figure 18 : Cost reduction effects for main cost components based on Communication and IT

Respondent's opinion with regard to above cost reduction (Separately evaluated for each main cost component) as against each practice of Green SC Management

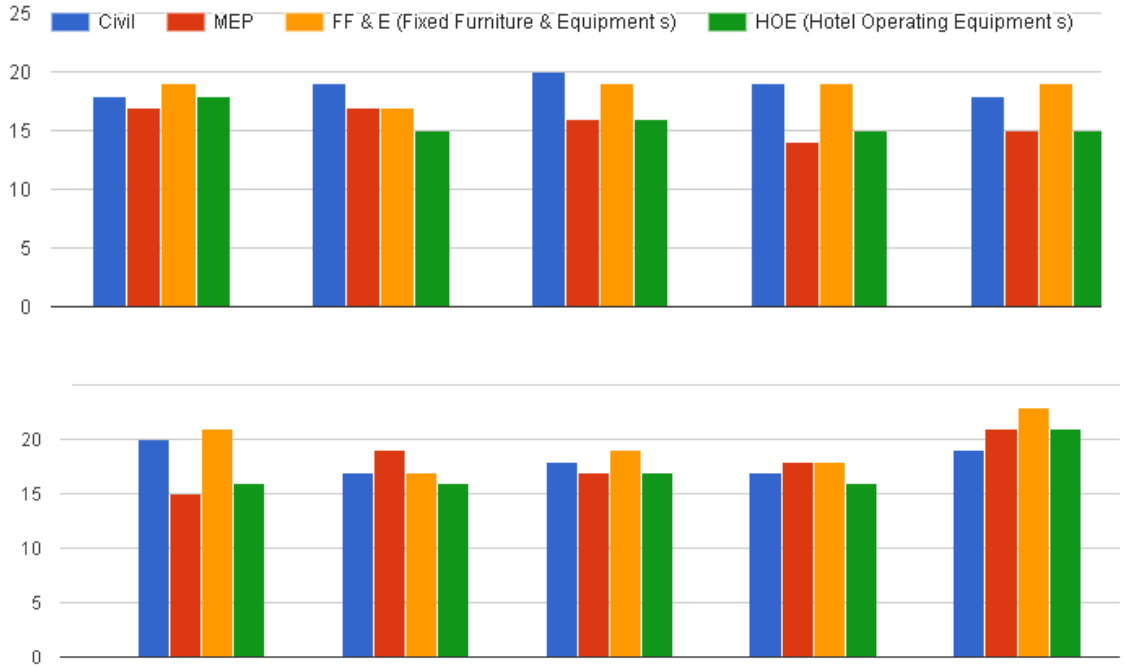

Figure 19 : Cost reduction effects for main cost components based on Green Management

According to the responses received from respondents it can be observed that their opinion is generally the cost reduction may effects for all main cost components of construction projects in the hotel industry. Therefore the new model for construction cost per room can be stimulated as appended below.

$$\text{Construction cost per room} = \frac{(1 - .05) * (\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others)}{\text{Total number of room in the hotel}}$$

$$\text{Construction cost per room} = \frac{(0.95) * (\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others)}{\text{Total number of room in the hotel}}$$

4.6 Comparison of construction cost per room based developed model and with typical supply chain process

4.6.1 Calculation of per room cost for project "B " in Sri Lanka.

For this calculation, researcher has been selected one of the bench mark projects "Project B" from Sri Lanka, a five-star beach hotel consists of 143 Guestrooms. And also this project is inclusive of other public area construction such as swimming pools, Restaurants, Kitchen, Laundry, gymnasium, landscaping, staff quarters and office area.etc. Basically, this project developed based on 7 stories building to complete the project and most of the buildings made out of bricks and cement according to the LEEDS standards. The calculation has been done based on main cost components (Civil, Mechanical Electrical & Plumbing, Fix Furniture & Equipment's, Hotel Operating Equipment's, other) of the project collected from the selected company. (Refer Annexure 06).

4.6.1.1 Before implementing SC strategies

$$\text{Construction cost per room} = \frac{\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others}{\text{Total number of room in the hotel}}$$

$$\text{Construction cost per room} = \frac{1{,}578{,}130{,}564 + 1{,}641{,}889{,}350 + 410{,}177{,}981 + 485{,}398{,}383 + 64{,}130{,}079}{143}$$

$$\text{Construction cost per room} = \frac{4{,}179{,}726{,}357}{143}$$

Construction cost per room $=$LKR 29,228,855.64

4.6.1.2 After implementing SC strategies

As described in section 4.4, implementing strategies such as Integration, communication and information technology and Green management results in reducing the costs mainly civil, MEP, FF&E, and HOE cost components. Hence, the Construction Cost per room is reduced by 5% as discussed in above 4.5 section and the model can be adjusted as follows;

$$\text{Construction cost per room} = \frac{(0.95) * (\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others)}{\text{Total number of room in the hotel}}$$

$$\text{Construction cost per room} = \frac{(0.95) * (1{,}578{,}130{,}564 + 1{,}641{,}889{,}350 + 410{,}177{,}981 + 485{,}398{,}383 + 64{,}130{,}079)}{143}$$

$$\text{Construction cost per room} = \frac{(0.95) * (4{,}179{,}726{,}357)}{143}$$

$$\text{Construction cost per room} = \text{LKR } 27{,}767{,}412.86$$

The cost saving is LKR 1,461,442.78 with implementation SC strategies based on above formula. Comparatively construction cost per room in project B is low compared to project A due to its design (7stories building inclusive of 143 guest rooms) and transport/logistic cost of the destination (Sri Lanka). Also selling cost of the room is low (Rs.35,000- Rs.50,000) compared to project A in Maldives.

4.6.2 **Calculation of per room cost for project "A" in Maldives.**

For this calculation, researcher has been selected one of bench projects "Project A" from Maldives, a five-star high-end Resort type hotel consist of 151 Guest rooms including 68 beach villas, 57 water villas, and 26 water suite villas. And also this project is inclusive of other public area construction such as swimming pools, Restaurants, Kitchen, Laundry, gymnasium, land-scaping, staff quarters and office area.etc. Basically, this project developed based on single resort type buildings on water and on land to complete the project and most of the buildings made out of timber according to the LEEDS standards. The calculation has been done based on main cost components (Civil, Mechanical Electrical & Plumbing, Fix Furniture & Equipments, Hotel Operating Equipments, Other) of the project collected from the selected company. (Refer Annexure 05).

4.6.2.1 **Before implementing SC strategies**

$$\text{Construction cost per room} = \frac{\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Others}{\text{Total number of room in the hotel}}$$

$$\text{Construction cost per room} = \frac{4{,}391{,}308{,}164 + 2{,}701{,}184{,}018 + 230{,}447{,}665 + 676{,}963{,}033 + 279{,}656{,}919}{151}$$

$$\text{Construction cost per room} = \frac{8{,}279{,}559{,}799}{151}$$

$$\text{Construction cost per room} = \text{LKR } 54{,}831{,}521.84$$

4.6.2.2 After implementing SC strategies

$$\text{Construction cost per room} = \frac{(0.95) * (\text{Civil cost} + \text{MEP cost} + \text{FF\&}E + HOE + Ot\square ers)}{\text{Total number of room in the hotel}}$$

$$\text{Construction cost per room} = \frac{(0.95) * (4{,}391{,}308{,}164 + 2{,}701{,}184{,}018 + 230{,}447{,}665 + 676{,}963{,}033 + 279{,}656{,}919)}{151}$$

$$\text{Construction cost per room} = \frac{(0.95) * (8{,}279{,}559{,}799)}{151}$$

$$\text{Construction cost per room} = \text{LKR } 52{,}089{,}945.75$$

The cost saving is LKR 2,741,576.09 with implementation SC strategies based on above formula. Comparatively construction cost per room in project A is high compared to project B due to its design (individual villa type rooms on land and on water inclusive of 151 guest villas), and transport/logistic cost of the destination (Maldives). Also selling cost of the room is high (USD 750 – USD 1000) compared to project B in Sri Lanka.

4.7 Development of final concept

The existing procurement concept and Map has been developed based on data collected from explorative analysis among stakeholders of construction supply chain initially in order to achieve the first objective of the research.

Mainly three strategies (Integration, communication and information technology and Green management) and practices of each strategy identified and described based on literature review. Then it was verified by the expert of the industry by carrying out a pilot survey on face to face interviews. Finally, all the strategies and practices have been evaluated by the selected main stakeholder of construction supply chain via public survey in order to identify the best practices and other related factors to the research.

According, to the response received for practices under integration highest value indicates by "**Strategic relationship with partners**" which scored 4.17pointsand highest value indicates by "**Use of modern technology for Modeling and monitoring operations**" which scored 4.29 points under communication and IT, and finally highest

value of 4.4 records under Green Management strategies and most accepted practice is "**Use of renewable energy on operations**" based on analysis reports discussed above.

Accordingly the existing procurement concept of construction supply chain can be developed as appended below in order manage efficiently and reduce the construction cost per room in hotel construction.

4.7.1 **Application of new practices to Sri Lanka and Maldives procurement concept.**

Step 1 Selection of Architect get the design done based on requirement and budgeted amount.

- Design to be developed to use more renewable energy as per LEEDS standards.
- Modern technology to be used for modeling and monitoring operation for effective communication.
- Job scope and responsibilities to be clearly specified in order to maintain the strategic relationship with project partners.

Step 2 Selection of quantity surveyor and get the priced BOQ done.

- Modern technology to be used for modeling and monitoring operation for effective communication.
- Job scope and responsibilities to be specified clearly in order to maintain the strategic relationship with project partners.

Step 3 Selection of project manager and decide on project start time, duration etc.

- Modern technology to be used for modeling and monitoring operation for effective communication.
- Job scope and responsibilities to be specified clearly in order to maintain the strategic relationship with project partners.

Step 4 Allocation of total scope to main tenders and decide on client supplied items

Step 5 Preparation of tender documents & origination of capexes for client supplied items by Project Manager.

- Design/items to be specified to use more renewable energy as per LEEDS standards.

Step 6 Follow the tender process and selection of suppliers for main works (Civil, MEP) and sub contract works (RO, STP, Generators, Laundry and Kitchen …etc.)

- Selection of Green suppliers.
- Modern technology to be used by the selected suppliers for modeling and monitoring operation for effective communication.

Step 7 Process client supplied items capexes and deliver the goods on expected time

- Items to be selected and purchased to use more renewable energy as per LEEDS standards.
- Selection of Green suppliers.

Step 8 Preparation of contract documents and obtaining necessary signatures.

Step 9 Arrangements for advance payments, LC, DP and TT payments for import items.

Step 10 Arrangements and follow up with international (Sea/Air) or/and domestic transportation modes.

- Modern technology to be used for modeling and monitoring operation for effective communication by all stake-holders.

Step 11 Arrangements for duty-free facilities and clearing process.

Step 12 Unloading, inspection and safe storage.

Step 13 Conducting project management meetings and review the progress weekly basis.

- Modern technology to be used for modeling and monitoring operation for effective communication by all stake holders.

Step 14 Rectification of defects and completion of the project.

CHAPTER 5 - CONCLUSIONS AND FUTURE RESEARCH DIRECTION

5.1 Conclusions

The identification and implementation of best strategic practices to manage construction supply chain needs to be increased in the hotel industry of Sri Lanka and Maldives. To identify and implement these strategies, some attempts have been made initially to understand the existing construction supply chain and concept in order to develop the MAP to achieve the first objective of the research. This task has been completed through an explorative analysis and expert interviews.

Then identified best practices and established a model for measuring construction cost per room before and after implementation of best practices to improve the operations efficiently in construction supply chain of the hotel industry in Sri Lanka and Maldives. Initially based on a review of the literature and an expert group discussion, three main supply chain strategies have been identified and best practices for strategy have been listed for verification from stakeholders of the construction supply chain. This covers the second objective of the research. Further following best practices detected based on responses received from the online surveyor.

Integration– "Strategic relationship with partners"

Communication and information technology –"Use of modern technology for Modeling and monitoring operations"

Green Management – "Use of renewable energy on operations"

The expected cost reduction by the implementation of above strategies has been tested by an online surveyor and most frequent percentage was 5% for all above three categories. Further, it has been tested, whether this cost reduction effects for all main cost components of the construction project which are Civil cost, MEP cost, FF&E cost, and

HOE cost. It could be proved by the surveyor results that the cost reduction equally affects the main cost components of the project. Therefore the new model for calculating construction cost per room has been developed in order to satisfy the third objective of the project.

Then construction cost per room has been calculated for both projects (Project A and Project B) identified from each destination before and after identification of strategies based on above model. This process fulfilled the 4th objective of the research.

Finally, procurement concept has been developed based on identified strategic practices to full fill the final/5th objective of the research.

This highlights the need for a systematic framework for the assessment of construction cost per room in the hotel industry in order to analyze and make effective decisions. The proposed framework is evaluated through expert interviews and case studies and this framework provides a roadmap for the improvement of construction supply chain operation in the hotel industry of Sri Lanka and Maldives efficiently. It can be helped hotel organizations to position their current level of construction cost and identify key strategic practices for improvement in the future.

Contractors, being located at the vanguard of the construction supply chain, potentially offer the most effective means of improving construction industry cost performance. As a generalization, cost remains the most important criterion for construction clients; so its reduction (most often than not) represents improved client satisfaction.

5.2 Future research Directions

- This research mainly focused on cost impact due to the implication of supply chain strategies to the construction supply chain of Hotel industry. There are some other qualitative factors which have not been evaluated in this research.
- There can be an impact on other operation such as marketing which indirectly affected for development of hotel industry.
- Also effectiveness of the application of strategic practices to the concept can be checked and find proper methods of the implication of strategic practices.
- This research focused on 5-starcategory hotels in Sri Lanka and Maldives. This can be done other categories of hotels even in the other part of the world.

CHAPTER 6 - REFERENCE

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ANNEX

Annexure 01: Questionnaire

QUESTIONS RESPONSES 35

Identify best strategic practices to Manage Supply Chain Operations in Construction Supply Chain of Hotel industry in Sri Lanka & Maldives

I am M D C Asanka, MBA student at Department of Transport and Logistics Management, University of Moratuwa.

Herewith, kindly invite to full fill the following questionnaire as you are an expert in the sector. It would be highly appreciated if you could answer for all questions since it would greatly help on my research. Also you have the flexibility to skip any questions if you feel uncomfortable. The information collected through the survey would be keeping confidential and will not be shared with any third party.

If you have any inquiry or clarifications please feel free to contact me through,
Mail – mdcasanka1980@gmail.com
Mobile – 0773 063941

Your Designation:

- [ ] Executive
- [ ] Assistant Manager / Manager
- [ ] Assistant General Manager - General Manager
- [ ] Other...

How long you have been working in the Construction / Hotel industry or supply chain operation:

- [ ] Less than 1 Year
- [ ] 1 to 3 Years
- [ ] 3 to 5 Years
- [ ] Above 5 years

No of Employees *

- [ ] Less than 100
- [ ] 100 - 200
- [ ] 200 - 300
- [ ] 300 - 400
- [ ] > 400

Functional area that you are working

- [ ] construction
- [ ] Quantity Surveyor
- [ ] Consultant
- [ ] Architect
- [ ] Hotel sector
- [ ] Supply Chain
- [ ] Transport
- [ ] Warehouse
- [ ] Other...

Country of Operation *

- [ ] Sri Lanka
- [ ] Maldvies
- [ ] Other...

Do you participate in decision making process on managing operations in construction supply chain

- ○ Yes
- ○ No

Integration

(Linking stakeholders in Supply Chain)

Please indicate your level of agreement for the following as strategic practices based on Integration in construction Supply Chain Management.

	1. Strongly disagree	2. Disagree	3. Neither disagree nor agree	4. Agree	5. Strongly agree
Enhance Trust with partners	○	○	○	○	○
Strategic Relationship with partners	○	○	○	○	○
Better Collaboration with partners	○	○	○	○	○
Sharing Information with partners	○	○	○	○	○
Collaborative Planning	○	○	○	○	○

If there is any other strategic practices that increase the integration along the supply chain, please list them and your level of agreement

Ex : Better collaboration (4)Agree

Long answer text

Based on your experience, what is the expected total construction cost reduction (as a percentage from total construction cost) by implementing strategies related to supply chain Integration indicated above?

- [ ] None
- [ ] 2.5%
- [ ] 5%
- [ ] 10%
- [ ] Other...

Please indicate cost components that may effect the above cost reduction.

	Civil	MEP (Mechanical, Electrical & Plumbing)	FF & E (Fixed Furniture & Equipment s)	HOE (Hotel Operating Equipment s)	Others
Enhance Trust with partners	☐	☐	☐	☐	☐
Strategic Relationship with partners	☐	☐	☐	☐	☐
Better Collaboration with partners	☐	☐	☐	☐	☐
Sharing Information with partners	☐	☐	☐	☐	☐
Collaborative Planning	☐	☐	☐	☐	☐

Communication and information technology

(Use of real time data & information)

Please indicate your level of agreement on use of followings as strategic practices related to Communication and information technology on improving the efficiency of managing construction Supply Chain.

	1. Strongly disagree	2. Disagree	3. Neither disagree nor agree	4. Agree	5. Strongly agree
Use of modern technology for Modeling and monitoring	○	○	○	○	○

Use of Mobile/internet on planning and managing operations	○	○	○	○	○
Use of technologies such as RFID in operations	○	○	○	○	○
Use of GPS on managing operations	○	○	○	○	○
Use of E-Procurement	○	○	○	○	○

Is there any other best practices that can be used under this category?

Indicate the practice and your level of agreement

Short answer text

As per your opinion what is the expected total construction cost reduction percentage from Communication and information technology, if the above practice is efficiently managed.

- ○ None
- ○ 2.5%
- ○ 5%
- ○ 10%
- ○ Other...

Please indicate cost components that may effect the above cost reduction.

	Civil	MEP (Mechanical, Electrical & Plumbing)	FF & E (Fixed Furniture & Equipment s)	HOE (Hotel Operating Equipment s)	Others
Use of modern technology for Modeling and monitoring operations	☐	☐	☐	☐	☐
Use of Mobile/internet on planning and managing operations	☐	☐	☐	☐	☐

Use of technologies such as RFID in operations	☐	☐	☐	☐	☐
Use of GPS on managing operations	☐	☐	☐	☐	☐
Use of E-Procurement	☐	☐	☐	☐	☐

Green Management

(Carrying out construction activity in eco-friendly manner)

Please indicate your level of agreement for the followings as strategic practices based on Green Management in construction Supply Chain Management.

	1. Strongly disagree	2. Disagree	3. Neither disagree nor agree	4. Agree	5. Strongly agree
Green Purchasing(Carrying out purchasing activities in eco-friendly manner)	○	○	○	○	○
Green Production(Carrying out construction activities in eco-friendly manner)	○	○	○	○	○
Green Logistic (Carrying out logistic activities in eco-friendly manner)	○	○	○	○	○
Re use(Recycling materials in environmental friendly manner)	○	○	○	○	○
Use pre-fabricated products(Use of standard products, which can pre-manufacture in large quantity)	○	○	○	○	○
Use of green /less toxic materials on production	○	○	○	○	○
Use of renewable energy on operations	○	○	○	○	○
Use of Greener transport modes on distribution of materials	○	○	○	○	○
Greener operations in warehousing	○	○	○	○	○
Use material suppliers who posses standards such as ISO 14000, 9000, 25000	○	○	○	○	○

Is there any other best practices that can be used under this category? (Level of agreement) Example :- Green Purchasing (Strongly Agree)

Short answer text

As per your opinion what is the expected total construction cost reduction percentage from Green Management, if the above practice is efficiently managed.

- [ ] None
- [ ] 2.5%
- [ ] 5%
- [ ] 10%
- [ ] Other...

Please indicate cost components that may effect the above cost reduction.

	Civil	MEP	FF & E (Fixed Furniture & Equipment s)	HOE (Hotel Operating Equipment s)
Green Purchasing (Carrying out purchasing activities in eco-friendly manner)	☐	☐	☐	☐
Green Production (Carrying out construction activities in eco-friendly manner)	☐	☐	☐	☐
Green Logistic (Carrying out logistic activities in eco-friendly manner)	☐	☐	☐	☐
Reuse (Recycling materials in environmental friendly manner)	☐	☐	☐	☐
Use pre-fabricated products (Use of standard products, which can pre-manufacture in large quantity)	☐	☐	☐	☐
Use of green /less toxic materials on production	☐	☐	☐	☐
Use of renewable energy on operations	☐	☐	☐	☐
Use of Greener transport modes on distribution of materials	☐	☐	☐	☐
Greener operations in warehousing	☐	☐	☐	☐
Use material suppliers who posses standards such as ISO 14000, 9000, 25000	☐	☐	☐	☐

Annexure 02: Mean value calculation of best practices under Integration

SP1	SP2	SP4	SP5	SP6
5	4	3	4	4
3	3	3	3	3
4	5	4	3	5
5	4	5	4	5
5	5	5	4	5
3	3	3	3	3
4	4	4	4	4
4	4	3	4	4
4	4	4	4	4
4	4	4	2	4
4	4	4	4	4
4	5	5	4	5
4	4	4	4	4
4	4	3	4	3
5	5	5	5	5
4	4	3	3	4
5	5	5	5	5
4	4	4	4	4
5	5	5	5	5
5	5	5	4	4
5	5	5	5	5
4	5	4	4	4
5	5	5	5	5
4	4	3	3	4
5	5	3	5	4
4	4	5	4	4
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
1	1	1	1	1
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
4.142857	4.171429	3.971429	3.885714	4.085714

Annexure 03: Mean value calculation of best practices under Communication and IT

SP1	SP2	SP3	SP4	SP5
3	4	1	5	4
4	5	4	3	4
3	4	3	2	4
5	4	5	5	5
5	5	4	4	4
4	4	3	3	4
4	4	4	4	4
5	5	5	5	5
5	4	4	4	4
4	4	4	4	4
5	4	4	5	4
5	5	3	4	5
4	4	3	2	5
4	4	3	2	3
4	4	5	4	4
5	5	3	2	3
5	5	5	5	5
4	4	4	3	3
5	4	4	3	2
5	5	5	4	5
4	4	3	3	4
4	4	4	4	4
5	5	5	5	5
5	4	3	2	3
4	4	5	4	5
3	4	4	3	4
3	4	3	3	3
4	4	4	4	4
5	5	5	5	5
4	4	4	4	4
5	4	4	5	5
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
4	4	4	4	4
4.285714	4.257143	3.885714	3.742857	4.085714

Annexure 04: Mean value calculation of best practices under Green Management

SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10
3	3	3	3	3	3	4	3	3	3
5	5	5	5	4	4	5	4	4	5
3	4	4	4	3	4	5	4	4	4
5	5	5	5	5	4	5	5	5	4
4	5	4	4	3	4	5	4	4	5
4	4	4	4	4	4	4	3	3	5
4	4	4	4	4	4	4	4	4	4
4	5	4	5	5	5	5	5	5	5
5	5	5	5	3	4	4	4	4	3
4	4	4	4	4	4	4	4	4	4
5	5	4	5	4	4	5	5	4	4
5	5	5	5	5	5	5	5	5	5
3	5	5	5	5	5	5	5	5	5
5	5	5	5	2	3	5	3	5	5
5	5	5	5	5	5	5	5	5	5
1	1	1	2	3	3	3	3	3	3
5	4	4	5	4	4	5	5	5	4
4	4	4	3	4	5	5	5	5	5
3	5	4	5	5	5	5	4	4	5
4	3	3	4	4	4	3	3	4	4
4	4	4	4	4	5	5	4	4	5
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	4	5
3	3	2	4	4	5	5	3	4	2
5	4	4	4	4	4	4	4	4	4
5	5	4	4	4	4	4	4	4	4
4	4	4	5	4	4	4	4	4	5
4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
5	4	4	4	5	5	4	5	5	5
4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4
4.1143	4.2000	4.0286	4.2571	4.0286	4.2000	4.4	4.114286	4.171429	4.257143

Annexure 05 : Construction cost "Project A"

Job No.	Customer	Item	Requeste	Actual Amou	US$)	
L 6086	Project A	Artificial Roof Thatch	Civil	41,190		
L 6087	Project A	Timber for Service Jetty	Civil	71,662		
	Project A	Civil Main contract	Civil	19,600,175		
L 6239	Project A	Timber Doors & Windows	Civil	272,000		
L 6282	Project A	Tiles for MIR Staff Quarters and Family Rooms	Civil	24,600		
L 6296	Project A	Hard Timber for Timber Deck (Alternative Proposal) ar	Civil	18,072		
L 6297 a	Project A	Vanity Mirror	Civil	587		
L 6317 (i)	Project A	Cloth Line 3 Nos.	Civil	46		
L 6336	Project A	Hard Timber for screens, Wall Cladding & Hand Rail - c	Civil	0		
L 6339	Project A	Parquet Floor - Construction of 03 Nos. Mock-up Villas	Civil	4,637		
L 6350	Project A	Plunge Pool	Civil	8,585		
L 6352 a	Project A	Staff Accommodation, Restaurant & Other - Tiles	Civil	32,500		
L 6352 b	Project A	Resort Manager, Visiting Corporate Manager & Genera	Civil	12,600		
L 6352	Project A	Splash Tiles	Civil	3,600		
L 6380	Project A	Artificial Roof Thatch	Civil	1,611,405		
L 6385	Project A	Plywood Door Sashes for Staff & Service Area Building	Civil	664		
L 6385 a	Project A	Plywood Doors for HOD Buildings	Civil	16,500		
L 6386	Project A	Tile Grout	Civil	985		
L 6389	Project A	Aluminium Doors & Frames - Staff & Service Area Buil	Civil	82,018		
M 6484	Project A	Grout - Jasmine Colour - 40 Kgs.	Civil	1,369		
M 6680	Project A	Full Sawn Timber for Roof & Deck - As per attachment	Civil	635,000		
M 6733	Project A	Solid Timber Doors & Windows with Frames on Land	Civil	195,044		
M 6734	Project A	Fire Rated Doors	Civil	6,800		
M 6741	Project A	Plywood Door Sashes	Civil	5,800		
M 6745	Project A	RFID Door Lock System - Guest Accommodation	Civil	49,350		
M 6746	Project A	Solid Timber Doors & Windows with Frames on Buildi	Civil	337,956		
M 6755	Project A	Alternative Tiles for Bath Rooms	Civil	1,791		
M 6757	Project A	Tiles - Construction, completion and maintenance of (	Civil	34,477		
M 6757	Project A	Tiles (Travertine) - Construction, completion and mair	Civil	118,801		
M 6758	Project A	Full Sawn Timber for Roof & Deck for Public & Support	Civil	721,539		
M 6760	Project A	Ceiling Fans - Construction, completion and maintena	Civil	14,803		
M 6779	Project A	Tiles for Public Buildings (On Land) - Slate Stacking Til	Civil	1,375		
M 6779	Project A	Pool Mosaic Tiles, Grout & Adhesive for Swimming Po	Civil	36,800		
M 6779	Project A	Sealer and Adhesive for Tiles for Public Buildings (On	Civil	655		
M 6779	Project A	White Full Body Wall Tiles - 9830 Nos.	Civil	47,739		
M 6779-a	Project A	Porcelain Tiles with grout & adhesive - 7850 Nos.	Civil	11,775		
M 6782	Project A	Tiles - Construction, Completion and Maintenance of (	Civil	26,300		
M 6783	Project A	Tiles for Public Buildings (On Land) - Part 2 of 2	Civil	6,930		
M 6783	Project A	Public Area - Mosaic Tiles - Auusfrasia	Civil	9,331		
M 6787	Project A	Tiles for Support Facility Buildings (On Land)	Civil	15,300		
M 6792 & I	Project A	Travertine Slabs, Sealer & Adhesive for Villas & Suites	Civil	165,000		
M 6816	Project A	Tiles - Construction, Completion and Maintenance of (	Civil	0		
M 6851	Project A	Tiles - Construction, Completion and Maintenance of (	Civil	113,989		
M 6872	Project A	Tiles for Public Buildings (On Water) - Slate stacking ti	Civil	1,375		
M 6872	Project A	Feature Mosiac	Civil	38,168		
M 6872	Project A	Sealer and Adhesive for Tiles for Public Buildings (On	Civil	655		
M 6872/M	Project A	Porcelain Tiles for Public Area - Auusfrasia	Civil	99,780		
M 6872/M	Project A	Porcelain Tiles for Public Area - Ranjanas	Civil	7,949		
M 6872/M	Project A	Slate Tiles for Public Area - Davinci	Civil	16,300		
M 6872	Project A	Porcelain Tiles for Public Area - Evo Homes	Civil	145,000		
M 6872	Project A	Mosaic Tiles - Public Area - Evo Homes	Civil	14,500		
M 6918	Project A	STONE WALL SHELF FOR GUEST VILLAS (ON LAND)	Civil	1,440		
M 6919	Project A	MEP Related Civil Work Contract 01 : Construction, Cor	Civil	575,000		
M 6919 a	Project A	Construction of Service Centre, Fuel Pump Room and I	Civil	700,000		
M 6920	Project A	Solid Timber for Roof & Deck - Guest Accommodation	Civil	2,000,000		
M 6927	Project A	Door & Window Frames (On Land) - 10 Nos.	Civil	0		
M 6928	Project A	Roller Door for Maintenance Work Shop	Civil	1,859		
N 7128	Project A	Back of the House - Tile re-order	Civil	9,560		
N 7190	Project A	Back of the House - Manufacturing, safe transport & in	Civil	89,500		
N 7196	Project A	Construction, completion & Maintenace Buildings of (	Civil	482,772		
N 7200	Project A	Solid Timber Doors & Windows - SPA Revised	Civil	12,351		
N 7201-a	Project A	Tiles for Kids Club & Infinity Lagoon Pool - Guest Accor	Civil	5,620		
N 7212	Project A	Additional Ironmongery for Timber Doors & Windows	Civil	108,381		
N 7241	Project A	Tiles for Public Buildings - Rest Rooms (On Land & On '	Civil	6,300		

N 7242	Project A	Tiles for Public Buildings - SPA Reception & Changing	Civil	8,900		
N 7243	Project A	Tiles for Guest Buildings - Beach Villa, Pool Beach Villa	Civil	16,200	28,701,361	4,391,308,164
L 6235	Project A	Curtains & Blinds	FF&E	9,129		
L 6297 b	Project A	Wall Art	FF&E	916		
L 6349	Project A	Ceiling Fans - Construction of 3 Nos. Mock-up Villas at	FF&E	2,358		
L 6351	Project A	Built-in Furniture	FF&E	32,313		
M 6798	Project A	Mosque Prayer Carpet	FF&E	3,600		
M 6817	Project A	Built-in Furniture-Guest Villas on Land & On Water	FF&E	0		
M 6817	Project A	Built-in Furniture-Guest Villas on Land & On Water	FF&E	1,394,340		
M 6849	Project A	Staff Room Curtains	FF&E	12,600		
M 6899	Project A	BUILT IN REFRIGERATOR - 26 NOS.	FF&E	23,139		
N 7204	Project A	Monsoon Blinds - All Public Buildings	FF&E	27,800	1,506,194	230,447,665
L 6299	Project A	Mattress for Water Villa - 01 No.	HOE	490		
L 6300	Project A	Mattress for Beach Villa - 01 No.	HOE	490		
L 6301	Project A	Mattress for Water Suite - 01 No.	HOE	960		
L 6302	Project A	Ready Made Furniture as per attachments - Water Vill	HOE	12,258		
L 6303	Project A	Ready Made Furniture as per attachments - Beach Vill	HOE	12,258		
L 6304	Project A	Ready Made Furniture as per attachments - Water Suit	HOE	12,258		
L 6305	Project A	Custom Furniture as per attachment - Water Villa	HOE	12,258		
L 6305 b	Project A	Loose Basket with Lid - 02 Nos.	HOE	528		
L 6306	Project A	Custom Furniture as per attachment - Beach Villa	HOE	12,258		
L 6306 b	Project A	Loose Basket with Lid - 02 Nos.	HOE	528		
L 6308	Project A	Floor Rug as per attachment - Water Suite - 01 No.	HOE	650		
L 6309	Project A	Floor Rug as per attachment - Beach Villa - 01 No.	HOE	650		
L 6310	Project A	Floor Rug as per attachment - Water Villa - 01 No.	HOE	650		
L 6311 a	Project A	HOE Items (Stand fan) - Water Suite	HOE	1,615		
L 6311 b	Project A	HOE Items (TV stand) - Water Suite	HOE	355		
L 6311 c	Project A	HOE Items (Mini bar 40L / 60L) - Water Suite	HOE	1,697		
L 6311 d	Project A	HOE Items (Sink) - Water Suite	HOE	0		
L 6311 e	Project A	HOE Items (Waste bin) - Water Suite	HOE	419		
L 6311 f	Project A	HOE Items (Refrigirator) - Water Suite	HOE	0		
L 6312 b	Project A	HOE Items (Safe) - Water Villa	HOE	996		
L 6312 c	Project A	HOE Items (TV stand) - Water Villa	HOE	355		
L 6314	Project A	Bed Linen as per attachement - Water Suite	HOE	15,600		
L 6315	Project A	Bed Linen as per attachement - Beach Villa	HOE	36,500		
L 6316	Project A	Bed Linen as per attachement - Water Villa	HOE	48,300		
L 6317 -AR	Project A	Home Theatre Systems - 1 No.	HOE	990		
L 6317 -AR	Project A	I Pod Dock System	HOE	1,051		
L 6317 b	Project A	Bottle Openers	HOE	380		
L 6317 a	Project A	Hospitality Trays	HOE	343		
L 6317 - AF	Project A	Double Layer Bins - 04 Nos.	HOE	2,803		
L 6313 c	Project A	HOE Items (TV stand) - Beach Villa	HOE	355		
L 6347	Project A	Loose Cushion for Custom - made furniture	HOE	2,011		
L 6377 a	Project A	LED TV's - 04 Nos.	HOE	2,608		
L 6392 a	Project A	Wooden Hangers - BV, WV, WS - 12 Nos. each 36 Nos.	HOE	93		
L 6392 d	Project A	Espresso Machine - Capsule Type - 01 No.	HOE	357		
L 6392 e	Project A	Digital Scale - upto 200 kilos - BV, WV, WS - 01 each (0	HOE	124		
M 6436	Project A	TV Cabinet, Tub Stool - 01 No.	HOE	875		
M 6775-SK	Project A	Shisha Units - 14 Nos. and Shisha Pipe Mouth Pieces (5	HOE	1,527		
M 6775	Project A	Ice Cream Cart - 01 NO,	HOE	4,100		
M 6775-HI	Project A	Buffet Equipment-ADD Interactive Buffet - 14 items	HOE	9,500		
M 6784	Project A	Canon Digital Camera D30 (Water Proof Camera) with	HOE	373		
M 6795 - b	Project A	Mockup Amenities - Ash Trays - 04 Nos.	HOE	98		
M 6795 - b	Project A	Mockup Amenities - Double Layer Bins - 8 Nos.	HOE	277		
M 6799	Project A	Office Furniture	HOE	27,029		
M 6801	Project A	PA System	HOE	1,600		
M 6803	Project A	Water Dispensers	HOE	1,300		
M 6804	Project A	Staff Bunk Beds with Mattress - 130 Nos.	HOE	52,000		
M 6806	Project A	Staff Waste Bins	HOE	2,630		
M 6807	Project A	Steel Safes	HOE	1,570		
M 6808	Project A	Office Equipments	HOE	1,620		
M 6814	Project A	Blue Ray DVD Player with Speakers	HOE	284,274		
M 6815	Project A	Television	HOE	0		
M 6820	Project A	Back Office Equipment	HOE	15,030		
M 6821	Project A	Staff Furniture	HOE	92,136		

M 6821	Project A	Staff Furniture - Mattress	HOE	29,411		
M 6822	Project A	Push Cycle	HOE	17,272		
M 6823	Project A	Storage Racks	HOE	18,785		
M 6824	Project A	Yoga Mats	HOE	5,620		
M 6825	Project A	HK Pantry - Electrical	HOE	4,434		
M 6826	Project A	Rain Coat & Umbrella	HOE	3,850		
M 6830	Project A	DVD Player - 04 Nos.	HOE	1,176		
M 6833	Project A	Micro Fiber Duster	HOE	3,900		
M 6835	Project A	Wicker Cushion Box	HOE	24,673		
M 6836	Project A	Coir Door Mats	HOE	2,630		
M 6837	Project A	Guest Room Supplies	HOE	8,630		
M 6839	Project A	Caution Signs	HOE	5,610		
M 6840	Project A	Manual Cleaning Equipment Small	HOE	29,500		
M 6841	Project A	Custom Made Furniture for Staff Rooms, Tailor Rooms	HOE	5,000		
M 6842	Project A	Manual Cleaning Equipment Large	HOE	14,267		
M 6843	Project A	Toilet Aminities	HOE	36,800		
M 6843-g	Project A	Toilet Aminities - Ironing Boards	HOE	4,575		
M 6844	Project A	Ice Cube Machines	HOE	12,390		
M 6845	Project A	Bed & Bath Linen (Guest)	HOE	45,000		
M 6846	Project A	Life West	HOE	10,584		
M 6847	Project A	Ash Trays & Waste Bins	HOE	8,620		
M 6848	Project A	Out Door Coir Scraper Mats	HOE	4,630		
M 6854	Project A	Tricycle with Front Buggy - 30 Nos.	HOE	16,666		
M 6861	Project A	Custom Furniture for BV/PBV/FBV/FPBV	HOE	0		
M 6861	Project A	Custom Furniture for BV/PBV/FBV/FPBV(Moveble)	HOE	760,000		
M 6862	Project A	Custom Furniture for WV	HOE	0		
M 6863	Project A	Custom Furniture for Water Suite	HOE	0		
M 6863	Project A	Custom Furniture for Water Suite	HOE	0		
M 6864 - a	Project A	Engineering Tool	HOE	65,000		
M 6864 - b	Project A	Self-contain breathing Unit	HOE	3,890		
M 6864 - d	Project A	Cargo Tricycle	HOE	8,723		
M 6864 - e	Project A	Wood Shredder	HOE	8,211		
M 6864 - f	Project A	Garden Tool	HOE	42,300		
M 6864 - h	Project A	Compactor - Waste Disposal	HOE	12,125		
M 6864 - j	Project A	Ladder	HOE	1,350		
M 6873	Project A	Custom Furniture for Beach Villa/Pool Beach Villa/Fan	HOE	1,333,000		
M 6876	Project A	LOOSE FURNITURE - F 22 BASKET (SOILED TOWEL BIN) -	HOE	6,320		
M 6877	Project A	MATTRESS - F02	HOE	1,450		
M 6892	Project A	TELEVISION - 42" X 49" - 160 NOS + 27 NOS	HOE	74,019		
M 6893	Project A	PORTABLE SPEAKER - 190 NOS.	HOE	50,000		
M 6894	Project A	SAFE - F 29 - 160 NOS.	HOE	70,164		
M 6895	Project A	SUPER KING PILLOW - 70 NOS.	HOE	1,601		
M 6896	Project A	PILLOW CASES - 200 NOS.	HOE	22,950		
M 6897	Project A	THROW PILLOW WITH COVER FOR LOOSE BACK CUSHIC	HOE	0		
M 6898	Project A	WASTE/RECYCLING BINS FOR INSTALLATION BEHIND H	HOE	6,800		
M 6901	Project A	OUT DOOR SWING MATTRESS SEAT LOOSE - 30 NOS.	HOE	0		
M 6903	Project A	SOILED LINEN BINS - 5 NOS.	HOE	0		
M 6904	Project A	HAIR DRYERS - 200 NOS.	HOE	7,315		
M 6916	Project A	FOOT WASH & COCOUT SHELL SPOON - 180 NOS.	HOE	4,117		
M 6925	Project A	Custom Furniture for Public Buildings on Land - Recre	HOE	9,997		
M 6925	Project A	Vase with Column for Custon Furniture for Public Buil	HOE	7,226		
M 6925-a	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	1,600		
M 6925-b	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	13,400		
M 6925-c	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	1,100		
M 6925-d	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	3,500		
M 6925-e	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	8,200		
M 6925-f	Project A	Custom Furniture for Public Buildings on Land - Loose	HOE	1,200		
N 6938	Project A	UV Filters for Ice Cube Machines - 10 Nos.	HOE	7,900		
N 7159	Project A	Public Area - Fabric Selection	HOE	0		
N 7187	Project A	Glassware	HOE	185,000		
N 7188	Project A	Cutlery	HOE	115,000		
N 7189	Project A	Crockery	HOE	161,816		
N 7195	Project A	Heavy Duty Bins, Crates, Bottles	HOE	16,700		
N 7202	Project A	Fabric for Guest Villa Furnitue	HOE	0		
N 7211	Project A	Electro fushion welding machine - 01 No. and PPR Soc	HOE	3,600		

N 7221	Project A	Dry Cleaning Machine - 01 No.	HOE	6,900		
N 7222	Project A	Pool Cleaning Equipment - as per attachment	HOE	3,900		
N 7223	Project A	Furniture for SPA	HOE	75,000		
N 7225	Project A	Gym Equipment as per attachment	HOE	225,000		
N 7231	Project A	Ice Buckets with Tongs - 170 Nos.	HOE	16,072		
N 7232	Project A	F&B Linen as per annexure	HOE	89,000	4,424,595	676,963,033
L 6085	Project A	Bib Taps - 01 No.	MEP	34		
L 6085 a	Project A	SANITARY WARE & ACCESSORIES	MEP	10,938		
		MEP main contract	MEP	8,480,000		
L 6085 b	Project A	Tap Fittings	MEP	605		
L 6152	Project A	Light Fittings	MEP	795,000		
L 6281	Project A	Switches and Sockets	MEP	133,000		
L 6335	Project A	Cummins 40KVA Super Silet Generator	MEP	18,375		
L 6337-D	Project A	Fabrication of Ducting & Grills for MVAC System	MEP	25,000		
L 6361 a	Project A	Sanitaryware & Fittings for Staff & Service Area Buildi	MEP	58,071		
L 6361 b	Project A	Sanitaryware & Fittings for Staff & Service Area Buildi	MEP	2,355		
L 6361 c	Project A	Sanitaryware & Fittings for Staff & Service Area Buildi	MEP	35,238		
L 6361 d	Project A	Sanitaryware & Fittings for Staff & Service Area Buildi	MEP	0		
L 6361 e	Project A	Towel Rack - 142 Nos.	MEP	4,363		
L 6361 g	Project A	Wall Hung Glass Mirror - 171 Nos.	MEP	6,422		
L 6374 (A)	Project A	Door Bells - 04 Nos.	MEP	352		
L 6375	Project A	ELV Items - Construction of 03 Nos. Mockup Villas at M	MEP	2,418		
L 6377 AC	Project A	MVAC - Construction of 3 Nos. Mock up Villas at MIR (A	MEP	8,685		
L 6377 E	Project A	Exhaust Fans & Fin Grills for 03 Mock Up Villas	MEP	2,608		
L 6378 a	Project A	Plumbing System - Construction of 03 Nos. Mock up Vi	MEP	4,436		
L 6378	Project A	Plumbing System - Construction of 03 Nos. Mock up Vi	MEP	97		
M 6426	Project A	Fire Pump with Accessory - 01 No.	MEP	20,016		
M 6759	Project A	Supply, installation & commissioning of RO Plant for S	MEP	78,860		
M 6762	Project A	Generator	MEP	874,151		
M 6763	Project A	RO Plant	MEP	629,408		
M 6764	Project A	STP	MEP	467,951		
M 6765	Project A	Kitchen	MEP	1,569,210		
M 6766	Project A	Laundry	MEP	194,000		
M 6781	Project A	Portable Light Fittings in Mock-up Villas at Meedhupp	MEP	5,182		
M 6789	Project A	Design, Supply and Installation of Extra Low Voltage S	MEP	1,069,800		
M 6790	Project A	LT Power Distribution Panel Boards - MEP Works (Inte	MEP	106,200		
M 6791	Project A	Commissioning & Installation of Fuel Storage Tanks - M	MEP	148,725		
M 6792 & I	Project A	Accessories - Construction, Completion and Maintena	MEP	13,115		
M 6792 & I	Project A	Tap Fittings - Construction, Completion and Maintenai	MEP	411,375		
M 6792, M	Project A	Bip Tap	MEP	2,730		
M 6792 & I	Project A	Ceramicware - Construction, Completion and Mainten	MEP	397,080		
M 6793	Project A	Grab Bar - 50 Nos.	MEP	1,928		
M 6794-a	Project A	Sanitary ware & Accessories - Construction, Completic	MEP	30,959		
M 6805	Project A	Executive Staff Room Electrical	MEP	10,238		
M 6809-a	Project A	Sanitary ware & Accessories - Construction, Completic	MEP	37,949		
M 6827	Project A	Executive Staff Rooms Toiler Accessories	MEP	16,800		
M 6828	Project A	Toilet Accessories	MEP	4,435		
M 6834	Project A	Electrical Heavy Equipment	MEP	16,300		
M 6838	Project A	Staff Laundry	MEP	6,800		
M 6850	Project A	Switches & Sockets for Guest Villa (On Land & On Wat	MEP	351,619		
M 6850-a	Project A	Wall Boxes & Shaver Socket Boxes for Switches & Sock	MEP	1,528		
M 6853	Project A	Supply of Air Conditioning Units, Thermostats, Copper	MEP	523,000		
M 6857	Project A	Fuel Tank Protection System - Water Drenching & Forr	MEP	33,000		
M 6864 - i	Project A	Incinerator - Waste Disposal	MEP	66,409		
M 6864 - k	Project A	Plastic Crusher	MEP	5,422		
M 6864 - l	Project A	Reefer Container	MEP	46,000		
M 6864 - n	Project A	Glass Bottle Crusher	MEP	6,037		
M 6865-a	Project A	Sanitary ware & Accessories - Executive Office - Balan	MEP	5,124		
M 6866	Project A	Jacuzzi - 07 Nos.	MEP	27,662		
M 6866	Project A	Floor Standing Bath Mixer for Jacuzzi - 7 Nos.	MEP	5,229		
M 6869	Project A	Light Fittings for Guest Villas and Public Buildings (On	MEP	246,000		
M 6869-a	Project A	Wall recessed under water pool light - 63 Nos.	MEP	26,000		
M 6871-a	Project A	Sanitary ware & Accessories for Public Buildings (On V	MEP	1,460		
M 6917	Project A	SWITCHES & SOCKETS FOR GUEST VILLAS (ON LAND & (	MEP	26,000		
M 6931 - a	Project A	Mep works (internal & external) - Light fittings for gue	MEP	500,000		

N 7220	Project A	Fiber Optic Light for Swimming Pools	MEP	59,000		
N 7240	Project A	Sanitaryware & Accessories - Construction, Completio	MEP	24,100	17,654,798	2,701,184,018
M 6864 - g	Project A	Golf Buggy	Other	196,000		
M 6864 - n	Project A	Truck/Tractor with Trailer	Other	22,575		
M 6867	Project A	Tender for Proposed Coastal Modification Works	Other	1,009,615		
M 6864 - c	Project A	Fiber Glass Speed Boat	Other	62,058		
M 6742	Project A	Truck	Others	22,575		
M 6797	Project A	Supply, Transport, Replant and Maintenance of Cocon	Others	515,000	1,827,823	279,656,919
						8,279,559,799

Annexure 06 : Construction cost “Project B”

Job No	Customer	Item	Deliver	Amount	
I 2699	Project B	Bath room wall tiles aditional QTY	Civil	6,250,000	
I 2823	Project B	Floor Tiles	Civil	58,000,000	
		Main civil contract	Civil	1,000,000,000	
I 2829	Project B	Client supplied items - Iron Mongery	Civil	28,900,000	
I 2829 D	Project B	Client supplied items - Tiles & Decorative light fittings	Civil	3,300,000	
I 2832	Project B	Floor Gully , Floor clean units	Civil	3,600,000	
I 2870	Project B	Public areas Tiles & Flooring - Terazzo	Civil	575,000	
I 2891	Project B	Bath Room Floor Tiles & Wall Tiles 142 Rooms	Civil	35,600,000	
I 2892	Project B	Guest Room Terazzo Floor Tiles including Skirting / Cladd	Civil	115,000,000	
I 2905	Project B	Back of the house Tiles & Floring (Floor Tile & Wall Tiles)	Civil	75,000,000	
I 2906	Project B	Public Areas Tiles & Flooring - Terazzo (10 Nos diffrent Tile	Civil	28,300,000	
I 2907	Project B	Kitchen Wall & Floor Tiles (Wall Tiles & Floor Tiles)	Civil	6,500,000	
I 2908	Project B	Swimming Pool Tiles (Floor Tiles)	Civil	10,800,000	
I 2909	Project B	Iron Mongery Public Areas	Civil	14,539,047	
I 2913	Project B	Back of the House Iron Mongery	Civil	3,900,000	
I 2919	Project B	Iron Mongery for Guest Room 143 Rooms	Civil	18,900,000	
I 2935	Project B	Civil work Banyan tree restaurent	Civil	125,000,000	
I 2937	Project B	Electronic door locks for guest rooms main doors 145 rooms	Civil	5,291,014	
I3984	Project B	GM/Admin Office Floor Tiles	Civil	890,000	
J 2964 B	Project B	Mock up rooms 4-5 - Iron Mongery	Civil	143,268	
J 2964 E	Project B	Mock up rooms 4-5 - TV Bracket 1 No	Civil	6,500	
J 2964 I	Project B	Mock up rooms 4-5 - Infrarade Door lock 2 Nos	Civil	98,000	
J 2972	Project B	Operable Partition	Civil	5,641,000	
J 3369	Project B	Supply of standard guestroom floor tiles, skirting & claddin	Civil	598,000	
J 3370	Project B	Installation of standard guestroom floor tiles, skirting & cla	Civil	690,000	
J 3399	Project B	Standard Guestroom floor & wall tiles (Bathroom area) for 1	Civil	2,630,000	
J 3654	Project B	Supply & Install of Public Area Tiles & Floring (Main Lobby/	Civil	2,361,000	
J 3655	Project B	Supply of Public Area Decorative Tiles & Floring (Main Lob	Civil	3,890,000	
K 4440	Project B	Back of the house tiles - GM appartment additional 54 nos.	Civil	124,000	
K 4454	Project B	Ironmongery Additional Requirement	Civil	59,855	
K 4456	Project B	Tender for Banyan Tree Millwork	Civil	2,400,000	
K 4719	Project B	Banquet Service Area and Corrdor Tiles 238 nos.	Civil	238,000	
K 4720	Project B	PA Floor Tiles 1191 nos.	Civil	1,786,000	
K 4721	Project B	Private Garden Floor Tiles 2781 nos.	Civil	1,390,000	
K 4828	Project B	Ironmongery Additional (2) Requirement	Civil	342,529	
K 4829	Project B	Staff Canteen Decor Wall Tiles64 nos.	Civil	128,000	
K 4972	Project B	Tiles & Flooring	Civil	368,000	
K 5198	Project B	PA Floor Tiles	Civil	895,230	
K 4072	Project B	LOBBY WATER FEATURE MOSAIC TILES for the level 16, lobby	Civil	1,650,000	
K 4077	Project B	Installation of Wall Lining in 104 Nos type I & 38 nos type II r	Civil	2,560,000	
K 4143	Project B	Public Area Tiles & Flooring	Civil	3,244,758	
K 4372	Project B	Supply of staff dining kitchen wall mounted sink units - 1 ur	Civil	5,600	
K 5492	Project B	CT 06 FLOOR TILES - 322 NOS.	Civil	64,500	
K 5495	Project B	Iron Mongery	Civil	617,263	
K 5514	Project B	SWIMMING POOL STEP NOSING TILES - MOISAC/ GREEN	Civil	498,000	
K 5551	Project B	POOL BAR FLOOR & WALL TILES	Civil	796,000	
L 5683	Project B	BRONZE CASTED HAND RAIL FOR MAIN ENTRANCE STEPS	Civil	4,560,000	1,578,130,564
I 2700	Project B	Shower curtain rod with rongs	FF&E	265,000	
I 2839 A	Project B	MBR Mock up room type 3 Revised Fixed furniture & Light fi	FF&E	156,000	
I 2839 B	Project B	MBR Mock up room type 3 Revised Fixed furniture & Light fi	FF&E	354,000	
I 2859	Project B	Fixed Furniture Public Area & Presidential Suite	FF&E	65,000,000	
I 2904 (b)	Project B	Glass Shelf/ Shower Curtain	FF&E	450,000	
J 2964 C	Project B	Mock up rooms 4-5 - Fixed Furniture	FF&E	1,300,000	
J 2964 G	Project B	Mock up rooms 4-5 -Curtain Railings	FF&E	25,460	

J 3078	Project B	Guest room ceiling fan Total order 143 Nos	FF&E	1,358,500	
J 3349	Project B	Mockup Room 6 & 7 - fixed furniture	FF&E	1,260,000	
J 3400	Project B	Presidential Suite Ceiling Fans - 2 Nos.Public Area Fans Ceili	FF&E	125,000	
J 3802	Project B	Guest Room built-in furniture (Millwork) - For 142 Guest Rc	FF&E	156,000,000	
J 3803	Project B	Room Furniture as per the RDM FFE Schedule & the Finishin	FF&E	98,000,000	
K 4535	Project B	Ceiling Fans for the Banyan Tree - 4 nos.	FF&E	48,000	
K 4766	Project B	Guest Room Curtain & Curtain Railing System	FF&E	35,750,000	
K 4073	Project B	Mill work for the construction of Mock up room VI & VII	FF&E	987,634	
K 4079	Project B	Staff Rooms Orbit Ceiling Fans	FF&E	760,000	
K 4145	Project B	Type II Bead Head Reading Light for new Mock Up	FF&E	171,114	
K 4146	Project B	Type II Bead Head Reading Light for new Mock Up	FF&E	34,600	
K 4270	Project B	STORAGE RACKS & CUPBOARDS	FF&E	465,000	
K 5204	Project B	Cushions,Curtain Set,Rugs	FF&E	825,000	
K 5288	Project B	Monsoon Blinds for Sunset Bar	FF&E	5,600,000	
K 5456	Project B	Spa Curtains	FF&E	654,000	
K 5561	Project B	MILL WORKS - PACKAGE 1	FF&E	38,938,673	
K 5564	Project B	MILL WORKS - PACKAGE 4	FF&E	1,650,000	410,177,981
I 2145	Project B	Digital Camera 1 No	HOE	13,775	
I 2185	Project B	Kitchen Light Equipment	HOE	25,890,000	
I 2319	Project B	Multimedia Projector 1 No	HOE	96,969	
I 2357	Project B	Movable Furniture Public Area	HOE	56,000,000	
I 2643	Project B	Digital Voice recorder 1 No	HOE	14,500	
I 2675 (a)	Project B	Housekeeping equipment (Refer Capex Attachment)	HOE	359,000	
I 2675 (b)	Project B	Housekeeping equipment (Refer Capex Attachment)	HOE	486,922	
I 2675 (c)	Project B	Housekeeping equipment (Refer Capex Attachment)	HOE	1,893,740	
I 2676 A	Project B	Hand Dryer 20 Nos	HOE	645,000	
I 2676 B	Project B	Soap Dispenser 30 Nos	HOE	126,000	
I 2676 C	Project B	Sanitory Bins 30 Nos	HOE	98,000	
I 2676 K	Project B	High Pressure washer 2 Nos	HOE	125,000	
I 2677	Project B	Insulatation Flask 20 Nos	HOE	42,000	
I 2678	Project B	Trolle & Cart	HOE	1,230,000	
I 2829 B	Project B	Client supplied items - Movable furniture	HOE	6,542,311	
I 2856	Project B	Movable Furniture Presidential Suite	HOE	2,630,000	
I 2857	Project B	Swimming Pool Furniture	HOE	7,890,000	
I 2858	Project B	Public Area Movable Furniture	HOE	4,580,025	
I 2871 (a)	Project B	Equipment for Gymnasium	HOE	54,452,122	
I 2871 (b)	Project B	Wicker- Towel Bins/ Waste Basket	HOE	1,358,000	
I 2889	Project B	Wash Basin for Mock up Room Type 2	HOE	54,000	
I 2901	Project B	Steel Locker cupboards 164 Nos	HOE	3,690,000	
I 2911	Project B	Cutlery Crokery etc for Staff	HOE	469,000	
I 2916	Project B	Supply of Bar Equipments	HOE	3,680,000	
I 2917 A	Project B	Supply of Banquet Furniture & related Equipments	HOE	6,580,000	
I 2917 B	Project B	Supply of Banquet equipments - Coffee machine 1 No	HOE	75,000	
I 2917 C	Project B	Supply of Banquet equipments - safe for laptop 1 No	HOE	22,500	
I 2917 D	Project B	Supply of Banquet equipments - Arial Work Flatform 1 No	HOE	1,350,000	
I 2917 E	Project B	Supply of Banquet equipments - Table no stand 50 Nos	HOE	56,000	
I 2917 F	Project B	Supply of Banquet equipments - Mobile Bar 1 No	HOE	358,000	
I 2917 G	Project B	Supply of Banquet equipments - Conference Flip chart 2' x	HOE	45,600	
I 2920	Project B	Office Furniture	HOE	8,500,000	
I 2930 A	Project B	Executive Staff accomadation Movable furniture & fittings	HOE	7,500,000	
I 2930 B	Project B	Executive Staff accomadation Beds & bed side table lamp, C	HOE	3,600,000	
I 2930 C	Project B	Executive Staff accomadation TV with brackets	HOE	1,500,000	
I 2930 D	Project B	Executive Staff accomadation Wall mounted rod type towel	HOE	65,000	
I 2930 E 3	Project B	Executive Staff accomadation - iron & iron board	HOE	560,000	
I3982	Project B	Banquet Panel Table with Half Front Panel 72" x 15"	HOE	1,200,000	
I3983	Project B	Banquet, Meeting Room, Lobby, Presidential Suite Carpets	HOE	75,000,000	
I3988	Project B	Safe Deposit Box 138 nos.	HOE	3,450,000	
I3989	Project B	Hair Dryers - 138 nos.	HOE	2,070,000	
I3991	Project B	Mini Bar Fridge 136 nos.	HOE	2,550,000	
L 5583	Project B	ROOM LINEN/ BEDDING 143 GUEST ROOMS	HOE	56,000,000	

J 2964 H	Project B	Mock up rooms 4-5 - Movable Furniture	HOE	750,000	
J 3350	Project B	Mockup Room 6 & 7 - Moveble furniture	HOE	590,000	
J 3401	Project B	40" LED Tv - 2 Nos.	HOE	156,000	
J 3831	Project B	Guest Room Beds & Mattress - 79 nos. King & 120 nos. Sgl - D	HOE	8,008,000	
J 4013	Project B	Room Linen/ Bedding 143 Guest Rooms (HK)	HOE	25,600,000	
K 4534	Project B	BOQ of the mrble Furniture	HOE	4,562,000	
K 4716	Project B	Staff Acoomodation Furniture - 12 nos.	HOE	780,000	
K 4722	Project B	Supply of Staff Dinind Furniture 80 chairs	HOE	360,000	
K 4723	Project B	Trolley & Carts	HOE	3,600,000	
K 4791	Project B	Motorized Flatform Carts 2 nos.	HOE	2,300,000	
K 4792	Project B	Kitchen Floor Bucket Gullies 3 nos.	HOE	24,000	
K 5046	Project B	38 Floor Standing Rotatable TV Stand, 94 Wall Mounted TV E	HOE	1,250,000	
K 5047	Project B	I Home Lighting Connector 145 nos.	HOE	6,435,000	
K 5048	Project B	BOQ for the Lobby Furniture as per the RDM FFE Shedule.	HOE	3,600,000	
K 5197	Project B	Guest Room BedCushions & Bed Vallace 139 Guet Rooms	HOE	15,680,000	
I 3983	Project B	BANQUET, MEETING ROOM, LOBBY, PRESIDENTIAL SUIT CARI	HOE	236,000	
K 4107	Project B	Amended Furniture Public Area & Presidiential Suite 15 iter	HOE	3,560,000	
K 4138	Project B	Electric Boiling Pam/Rice Cooker 80 LT Tilting 1 nos.	HOE	890,000	
K 4139	Project B	Masala Grinder - Floor Standing - Medium 1 nos.	HOE	84,000	
K 4140	Project B	Industrial Coconut Scraper 1 nos.	HOE	65,000	
K 4141	Project B	Meat Saw - Vertical 1 nos.	HOE	456,000	
K 4142	Project B	Floor Cleanout Units	HOE	56,000	
K 4151	Project B	Single Line Analog "V tech" corded Phone A 2210	HOE	2,359,000	
K 4227	Project B	138 NOS. GUEST ROOM KETTLES	HOE	550,500	
K 5287	Project B	Food & beverage Linen	HOE	1,800,000	
K 5496	Project B	Staff Linen	HOE	3,650,000	
K 5498	Project B	Guest Request Items	HOE	2,365,000	
K 5499	Project B	Laundry Room Accessories	HOE	890,000	
K 5501	Project B	Bed Linen	HOE	645,222	
K 5513	Project B	FURNITURE FOR THE UTILITY BULDING / DRIVERS QUARTERS	HOE	975,000	
K 5515	Project B	F & B OUTLET EQUIPMENT	HOE	2,600,000	
K 5516	Project B	F & B FLATWARE/ HOLLOWARE	HOE	2,687,000	
K 5559	Project B	MOVABLE FURNITURE - PUBLIC AREA	HOE	25,689,000	
K 5560	Project B	MOVABLE FURNITURE - PRESIDENTIAL SUITE	HOE	3,600,000	
L 5582	Project B	SUPPLY OF CROKERY	HOE	2,300,000	
L 5583	Project B	ROOM LINEN/ BEDDING 143 GUEST ROOMS	HOE	3,600,000	
L 5624	Project B	BANQUET, MEEING ROOM, LOBBY, PRESIDENTIAL SUIT CARP	HOE	4,654,645	
L 5684	Project B	GUEST ROOM AND BR AMINITIES	HOE	5,142,552	485,398,383
		MEP contract	MEP	750,000,000	
I 2127	Project B	Tender for AV	MEP	10,700,000	
I 2186	Project B	Kitchen Heavy Equipment	MEP	232,500,000	
I 2187	Project B	Laundry	MEP	135,000,000	
I 2190	Project B	Light Fitting	MEP	98,500,000	
I 2194	Project B	Elevators 9 Nos	MEP	55,999,774	
I 2355	Project B	Insttalation of Audio Visual System	MEP	10,473,490	
I 2640	Project B	Supply & Installation of Split type AC Units 2 Nos	MEP	150,000	
I 2812	Project B	Installation of PABX Telephone System	MEP	5,600,000	
I 2829 C	Project B	Client supplied items - Sanitory Fittings	MEP	38,500,000	
I 2840	Project B	Shower outlet /Bath Mixtures / Shower system 147 Nos	MEP	6,615,000	
I 2860	Project B	AC Unit 18000 BTU split type 1 No shifting	MEP	68,000	
I 2869	Project B	LED Feature wall & swimming pool light sample	MEP	560,000	
I 2893	Project B	Sample LED Light fittins 18 Nos Area (Entire Hotel)	MEP	895,000	
I 2895	Project B	Lotus Light fitting devolopment 1 No Sample	MEP	919,278	
I 2903	Project B	Urinal concealed bodies 13 Nos	MEP	365,000	
I 2904 (a)	Project B	Bath Room Fittins & Accessaries for Public Area	MEP	16,500,000	
I 2910	Project B	Back of the house light Fittings	MEP	11,162,665	
I 2912	Project B	Bath Room Fittngs & Accessaries	MEP	8,900,000	
I 2914	Project B	Bath Room fittins & Accessariees for back of the House	MEP	4,620,000	
I 2915	Project B	Decorative Light Public Areas	MEP	25,635,000	
I 2918 A	Project B	Decorative Light fitting for Guest rooms 143 Nos (Bulk order	MEP	433,796	

I 2918 B	Project B	Decorative Light fitting for Guest rooms 143 Nos (Light fittin	MEP	86,427	
I 2918 C	Project B	Decorative Light fitting for Guest rooms 143 Nos (Presidenti	MEP	74,530	
I 2921	Project B	Light Fittings total order for 143 Nos Guest rooms,Public are	MEP	75,000,000	
I 2921 B	Project B	Light Fittings (LED) Garden	MEP	8,900,000	
I 2923	Project B	Swimming Pool Light 23 Nos	MEP	695,000	
L 5581	Project B	BATHROOM FITTINGS AND ACCESORIES FOR DRIVER QUART	MEP	756,000	
J 2964 D	Project B	Mock up rooms 4-5 - Decorative Lights	MEP	162,149	
J 2964 F	Project B	Mock up rooms 4-5 -Sanitory Fittings	MEP	365,000	
J 2964 J	Project B	Mock up rooms 4-5 - LED Lights	MEP	254,000	
J 2964 J	Project B	Mock up rooms 4-5 - LED Lights	MEP	32,555	
J 2964 J i	Project B	Mock up rooms 4-5 - LED Lights	MEP	325,414	
J 3338	Project B	Banyan Tree Complex - MEP Works	MEP	56,000,000	
J 3515	Project B	Public Area DEcorative LIghts - Lobby Pond Lotus LOght Cop	MEP	919,278	
K 4536	Project B	Deorative Lights for the Banyan Tree Complex	MEP	2,350,000	
K 4537	Project B	Kitchen Equipment - 76 nos.	MEP	568,000	
K 4543	Project B	2 Sets of Public Toilets	MEP	763,000	
K 4827 (a)	Project B	Light Fittings & Fans driver quarters	MEP	1,190,962	
K 4923	Project B	Liight fittings partial order	MEP	654,411	
K 4971	Project B	Shaving Mirror 145 nos.	MEP	2,280,000	
K 4973	Project B	Electrical & Sockets	MEP	325,522	
K 4075	Project B	Sample Light Fitting Landscape and exterior	MEP	986,829	
K 4075	Project B	Sample Light Fitting Landscape and exterior	MEP	75,000	
K 4089	Project B	Bronze Garden taps	MEP	450,000	
K 4228	Project B	LIGHT FITTINGS ARCHITECTURAL TOTAL ORDER	MEP	8,500,000	
K 4271	Project B	INSTALLATION OF AUDIO VISUAL & DJ SYSTEM	MEP	3,560,000	
K 4369 (a)	Project B	Table Lamp	MEP	2,145,000	
K 4369 (b)	Project B	SIDE TABLE	MEP	3,600,000	
K 4370	Project B	DIGILIN FIBRE OPTIC LIGHT SYSTEM 2 NOS.	MEP	5,600,000	
K 4373	Project B	Public area decorative lights 32 nos.	MEP	465,220	
K 4827 (b)	Project B	Light Fittings & Fans driver quarters	MEP	894,500	
K 5303	Project B	Landscape & exterior light fittings	MEP	22,306,528	
K 5304	Project B	Architecture light fittings Banyan Tree Restaurent	MEP	3,500,000	
K 5324	Project B	Walk in freezer wtith shelving 100 mm walls	MEP	4,500,000	
K 5493	Project B	Soap Tray with Fixing Acceessories	MEP	514,800	
K 5497	Project B	Guest Room and Bathroom Amenities	MEP	2,460,000	
K 5500	Project B	GUEST TOILLETS	MEP	4,652,222	
K 5541	Project B	WC WITH P TRAP & ACCESORIES FOR STAFF AREA	MEP	8,900,000	
L 5581	Project B	BATHROOM FITTINGS AND ACCESORIES FOR DRIVER QUART	MEP	750,000	
L 5718	Project B	GROHE GRAB BAR FOR BATHROOM - 135 NOS.	MEP	2,230,000	1,641,889,350
I 2191	Project B	Garden	Other	50,000,000	
J 2971	Project B	Total Rooms Type 1 & 2	Other	5,370,079	
J 4014	Project B	Public Area Sculptures & Decorations	Other	3,560,000	
K 4067	Project B	Public Area sculptures & Decorations (120nos of Fibre glass	Other	1,200,000	
K 4374	Project B	Public area sculptures & decorations as per 3G + Supervisior	Other	2,650,000	
L 5941	Project B	7.5M3 RIVER PEBBLES TO PLACE IN THE GARDEN AS PER THE I	Other	1,350,000	64,130,079
					4,179,726,357