

**ADOPTABILITY OF MANAGEMENT INFORMATION
SYSTEMS (MIS) IN CONSULTANCY ORGANIZATIONS
IN SRI LANKAN CONSTRUCTION INDUSTRY**

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Dissertation submitted in partial fulfillment of the requirements for the
degree Master of Science in Project Management

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DECLARATION

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Dr (Mrs) K.G.A.S. Waidyasekara

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Date

Dissertation Supervisor

ABSTRACT

Management Information systems (MIS) have been a dominant application in the era of computing due to the widespread commercial availability of computing technologies. This is the best information and communication technology (ICT) concept which performs easily and increases efficiency. MIS projects are identified for the high cost and time involved. The implementation and adoption of MIS are costly and lengthy. Many organizations in Sri Lanka are about to adopt MIS. However, it is questionable whether most firms realize the true importance of MIS. Hence, this research investigates the adoptability of Management Information Systems (MIS) in Consultancy Organizations in Sri Lanka. First, a comprehensive literature review was conducted to understand the MIS concept, types of MIS used by organizations, pros & cons of using MIS, and requirement for MIS in an organization.

Next, the convergent mixed method research design approach was adopted for data analysis. Initially, nine interviews were held over the phone, using an interview guideline with industry experts from the three specific types of consultancy companies, i.e., Quantity Surveying, Engineering, and Architecture. Simultaneously, a detailed questionnaire survey was distributed among 72 industry professionals, including Quantity Surveyors, Engineers, Architects, Project Managers, and Draughtsman, with a response rate of 69%. The study is limited to the consultants' perceptions, such as Engineering, Quantity Surveying, and Architecture consultancy firms. It was not extended to clients and contractors.

It discovered that the findings from literature were primarily appropriate to the Sri Lankan framework through the feedback provided by the experts. Additionally, it revealed that the Sri Lankan construction industry is at a preliminary phase of developing and using MIS in consultancy organizations. Further, this study found that most companies consist of a small group of employees handling small and medium-scale projects. They do not feel the requirement of working and analyzing the project progress through MIS and are used to following the traditional manual methods. In addition, it is confirmed that adopting MIS supports organizations to stay competitive or enter innovative markets and convert the business procedure system.

The research findings disclosed some significant benefits such as data sharing, providing a valuable time-saving profit to the humans, flexibility and responsiveness, integrity, entree to appropriate knowledge and reports, balancing conflicting requirements, and development in structure and division techniques. Challenges such as the high-cost factor of developing new computer systems and losing information due to website and server crashes obtained the highest frequency percentage as identified. Finally, the study provides some recommendations for better and more accurate performance for the consultancy companies adopting appropriate MIS model/s.

Key Words: MIS, Benefits, Consultancy, Quantity Surveyors, Engineers, Architects

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ABBREVIATIONS

CI	Construction Industry
CMM	Capability Maturity Model
CV	Curriculum Vitae
DSS	Decision-support systems
EMIS	Educational Management Information System
ERP	Enterprise Resource Planning
ESS	Executive support systems
FBS	Functional business system
HMIS	Health Management Information System
HRMS	Human Resource Management System
ICT	Information communication Technology
IOIS	Inter ORGANIZATIONAl Information System
IOS	Inter Organizational System
IT	Information Technology
KMS	Knowledge management system
MIS	Management Information System
MKIS	Marketing Information System
QB	Quick Book
QS	Quantity Surveying
RII	Relative Importance Index
SIS	Strategic information system
SPICE	Standardized Process Improvement for Construction Enterprises
TPS	Transaction processing systems

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1. INTRODUCTION

1.1 Research Background

With the competitive global economy in the 21st century, Management Information System (MIS) is becoming one of the most significant assets for an organization (Mishra, Kendhe, & Bhalerao, 2015). Unlike the other information systems, MIS are different because they investigate operational interests in the organization (Singh & Kaur, 2012). Businesses require various types of MIS to serve various executive levels, purposes, and business methods to support to get the most effective human decision-making for operations of the organizations (Gabriel & Obara, 2013).

The role of MIS is not only limited to collecting and managing information, but it plays a vital role in representing various formats. This is beneficial for the management to take important organizational appropriate decisions in every side, such as investments, employment, and goods, depending upon the organization (Ali, 2019). Therefore, management systems play a severe role in managing data and creating it way better for the managers to gather, integrate, and assign the knowledge and ensure effective and economical decision-making (Gupta, Kumar, & Mamdi, 2018).

Moreover, MIS helps organizations acquire the correct information to the top management effectively and efficiently, by improving the collaboration between employees, various IT systems that collect data, and the procedures it uses (Kamatchi, 2015). Therefore, this organized, diverse, and automated information system delivers essential storage of all business information which beneficial for each levels of an organization (Kamatchi, 2015).

In most construction projects, architects, engineers, and contractors are performed activities divided into functional areas according to their disciplines. Each discipline operates self-sufficiently to make decisions without reflecting the effect on others (Sari & Priantinah, 2019). Therefore, multiple re-drawing and re-keying of information should be undertaken due to incoordination of information gathering, reporting, and managing, which will waste time, incur unnecessary costs, increase errors, and cause misunderstanding (Zambare & Dhawale, 2017). The unproductive use of Information Technology (IT) in handling and collaborating information may

increase the amount of rework that happens in a project. With the rapid development of Computer Information Technology (ICT) and Internet Technology; both speediness and operation meet the desires of construction projects (Rhodes, 2010). Caixuan (2015) mentioned that construction project MIS includes commercial leaders, master strategy, prototype for investigation and consent of employees, the development fee, project management, system management, suppliers, and the demand for the organization function.

Many scholars have highlighted that an information system may be a tool that certifies data is obtainable to the higher management as per their necessity to deliver relevant data for decisions. Thus, organizational data is an essential contribution at each level within the association for deciding, implementing, planning, organizing, watching, and controlling. Ghaffarzadeh (2015) mentioned that Executives must be obliged to integrate lots of data, convert that data into information and create choices resulting in the action for business purposes. Especially for an organization, data is a necessary resource, such as cash, machinery, and personnel, and is essential for the company's survival (Gupta, Kumar, & Mamdi, 2018).

Sople and Gupta (2005) reported that LAJ is the first construction company in India to implement the MIS producing major differences in the construction industry. They have almost installed the 90% of the package for all project centers to analyze the company's total profitability. The rapid development of the construction industry in China realizes that project construction and project management information are becoming essential to highly promote the urban development process, establish a perfect management system, and use computers to assume all kinds of management work (Caixuan, 2015).

The procedure of investment explanation is the major disadvantage to executing IT in many construction firms. It makes the valuation processes burdensome because of the deficiency of responsiveness about evidence and communication technologies (Galliers & Leidner, 2014). Most construction companies encounter severe inferences in not carrying out rigorous evaluations due to the inability to quantify full implications of their investments in IT (Love & Irani, 2004). For organizational efficiency, it is very difficult to rely 100% on personal computers until it works efficiently and effectively using new advanced technological methods. Integrating them to sort data is costly unless higher management provides it to the whole staff.

Therefore, MIS automatically approached the business world (Mishra, Kendhe, & Bhalerao, 2015).

Despite some drawbacks, Raymond and Bergeron (2008) stated that MIS is very successful in satisfying users and their actual use parallel to other Information Systems. However, a fruitful MIS should have organizational impacts on project success, including a respective budget, schedule, and specifications to contribute to the project's success. Therefore, MIS played a primary position in the growing procedure and began to extant a speedy growth drive and become the inevitable development trend (Caixuan, 2015).

However, limited studies are performed in the Sri Lankan context on the MIS in the construction industry, although it has been successfully used in other sectors.

1.2 Problem Statement

As the name implies and discussed in the background study, MIS achieves complete information of an organization covering planning, control, and administration concerns by assisting the management (Rhodes, 2010). Therefore, a company can make instant decisions without any delays as the central objective is to provide information to every resource in the company (Singh, 2012). With the development of computer technology, managers can manage, store, and integrate information according to their needs and timing (Ghaffarzadeh, 2015). Several researchers highlighted that many persons use those concise, accurate, timely, well-précised, and complete information concurrently (Mishra, Kendhe, & Bhalerao, 2015).

The demand for the effective and efficient practice of IT is progressively growing (Beaumaster, 2002). The foundation in most organizations is the ability to design and implement the MIS successfully. Therefore, MIS plays a fundamental role in the business world, incorporating people, processes, and IT. As explained by Singh and Kaur (2012), it is essential to accomplish the implementation of MIS because some facts are creating the exclusive chances for MIS, such as economy of scale, sharing of data, balancing conflicting requirements, enforcement of standards, control redundancy, integrity, consistency and security of information, and flexibility and responsiveness. Thus, MIS procedures are settled synchronized to the commercial tactics, and the information is also diverse when the business grows (Tripathi, 2011).

The above findings of the background study reveal some limitations and other issues that arise in many organizations adopting MIS. The implementation process of MIS involves several problems. The approach of MIS should face ever-changing issues in every aspect of the management of information. Moreover, many important and interrelated factors will affect the success of adopting MIS (Beaumaster, 2002). According to Singh and Kaur (2012), MIS projects are identified for the high cost and time. Sometimes, organizations have even given up their adoption process after significant monetary losses. The implementation and adoption process of MIS is costly and lengthy.

Many organizations in Sri Lanka are planning to adopt MIS. Still, it is questionable whether most firms have actually realized the true importance of MIS. Also, people may not use such systems and prefer manual systems, even though they are neither effective nor efficient and time-consuming. Therefore, critical factors for a successful MIS implementation should be indicated and determined to drive successful organizations and business processes.

1.3 Aim of the research

This research investigates the adoptability of Management Information Systems (MIS) in Consultancy Organizations in Sri Lanka.

1.4 Objectives of the research

- Examine the MIS concept and its applications under global and local conditions.
- Identify the benefits of implementing MIS in Consultancy Organizations in the Sri Lankan Construction Industry.
- Investigate the challenges of using MIS in Consultancy Organizations in Sri Lanka.
- Propose suitable strategies to enhance the use of MIS in consultancy organizations in Sri Lanka efficiently and effectively.

1.5 Scope and Limitations

This research focuses on the adoptability of Management Information Systems in consultancy organizations in the Sri Lankan construction industry to enhance the organizations' performances. The study was limited to consultants' perceptions such

as Engineering, Quantity Surveying, and Architects consultancy firms and not extended to clients and contractors.

1.6 Research Methodology

Literature Review

A wide-ranging literature review was carried out using mainly journals, research papers, books, and unpublished dissertations. The review's main focus was identifying the research gap, preliminary identification of MIS, and its usage and importance to the research field.

Semi-Structured Interviews

Semi-structured interviews were held with a few professionals in the industry before the questionnaire survey. The objective was to identify key factors and current usage of MIS in the Sri Lankan construction projects and justify the relevancy of literature findings to the Sri Lankan context before conducting the detailed questionnaire survey.

Questionnaire Survey

Questionnaires were distributed among the professionals in consultancy firms in Sri Lanka. The evaluations were based on the responses received, and data were analyzed through appropriate statistical methods.

1.7 Chapter Breakdown

Chapter 01: Introduction

This chapter comprises of a concise background for the research with the problem statement, aim and objectives, scope and limitations, and research methodology.

Chapter 02: Literature Review

This chapter comprises of a broad literature survey considering the Management Information Systems, its usages, importance, opportunities and challenges, etc.

Chapter 03: Research Methodology

This chapter outlines the research methods and describes the methods utilized for data collection and data analysis.

Chapter 04: Data Analysis and Research Findings

This chapter contains a comprehensive analysis of the findings of literature reviews, the ideas collected in expert interviews, and data gathered through questionnaires.

Chapter 05: Conclusions and Recommendations

This chapter completes the study with conclusions, recommendations, and areas for further study.

1.8 Chapter Summary

Chapter One investigated the background of the MIS concept and its applications globally and locally, the different types and roles of MIS in different organizations, the impact of MIS on different personnel, the benefits and challenges of using MIS, and barriers to implementing MIS. The above findings identified research works on the adoptability of MIS internationally, but very less in the Sri Lankan situation. The research gap on the usage of MIS and its effectiveness in the Sri Lankan construction Project Consultancy field was identified, followed by the objectives of the research topic.

The next chapter presents an in-depth literature review of the Management Information Systems, their usages, importance, benefits, and challenges.

2. LITERATURE REVIEW

2.1 Introduction

A concise outline to the research was given in chapter one by identifying research background, aim, objectives, problem statement, scope and limitations. This chapter explores the existing knowledge with regards to the concepts of Management Information Systems, Objectives, model of MIS, Development of MIS and types of MIS in global and local context. Moreover, few applications of MIS, the advantages and disadvantages, the challenges of implementing MIS also discussed. Finally, this chapter indicates the role of MIS in decision making and few examples with relevant to the construction industry.

2.2 Definition and Concept of MIS

MIS is a kind of information system combined with dignified processes which deliver all of the applicable correct information at each and every stage to all of the managers (Rhodes, 2010).

MIS has been stated and defined in numerous ways. They are such Decision based and the Computer-based Information System (Tripathi, 2011). Below mentioned are some of the definitions for MIS;

- This contained system-based database for the purpose of delivering accurate and timely information to the end users in the organization (Omarli, 2017).
- It is an integrated system combining of man and machinery to provide information to assist the management to make their decisions more accurately (Yadeta, 2016, pg 84).
- “A formal method of assembling appropriate communication in a satisfactory form to accelerate operational decision making and execution, in order to carryout managerial procedures for the objective of accomplishing the managerial ambitions” (Rhodes, 2010).
- MIS is a system designed to provide selected decision-oriented information needed by management to plan, control and evaluate the activities of the corporation. It is designed within a framework that emphasises profit planning, performance planning and control at all levels (Tripathi, 2011).

According to Thierauf (1988), Management Information Systems generally known as the efficient systems which utilized for decision making at all stages of the organizations. Information systems are significantly important because it's incredible for any organization to function without any kind of IS.

MIS can translate the composed data from the user and machine exchanges into the operative information and used by the top management to make well-organized decisions according to the situation (Gupta, Kumar & Mamdi, 2018). To deliver data and information to the end users, all the resources of inner and outer are caused to enable users to take real and efficient decisions in the correct time from the view of directing, planning and controlling (Yadeta, 2016). Moreover, this is a resourceful system which provides all the essential information to the higher management where necessary (Omarli, 2017). MIS plays a major role in both managerial operations and business planning as it's an active blend of human and expertise (Lucey, 1989). That outcomes in data storage, gathering, communication, data recovery and convention to success of the business (Lucey, 1989).

Therefore, mainly these MIS are established for focus the separate requirements and necessities of the specific organization which are exclusive from each organization (Rhodes, 2010).

At the managerial levels, most of the system engineers and managers get more reputation and the consideration in the time of early 60's and in organizations, combination of human and machine are used in MIS to fulfil the demand of the information according to the appropriate levels (Wadhwa, 2006). MIS can identify as a blend of many consistent sub systems that uses the same resources for data and processing in vast organizations (Rhodes, 2010). These concepts of MIS can be considered as a fragment of all the other constant activities (Tripathi, 2011). MIS activity can be considered as important hence it furnishes the higher management with all the information of lower and middle management (Emery, 1973). It helps to maintain the flow of information throughout the organization (Emery, 1973). MIS provides the relevant information about the organizations to the owners and maintains the flow of suitable information and distribute them within different sub systems with some combined and unique functions (Sari & Priantinah, 2019). Because of these effective combination of the sub systems, whole organization is becoming a successful one (Sari & Priantinah, 2019).

To provide the proper decision making in the organizations for its all the levels, MIS should be combined and it should be available for the higher management as well as it should be companywide (Gabriel & Obara, 2013). Mainly they are playing the major role in designing, amending and conservation of the whole organization (Gabriel & Obara, 2013). With the developments of computer technology, the managers can manage the information, store, and integrate according to their needs and timing (Ali, 2019). Those concise, accurate, timely, well précised and complete information is used concurrently by many persons (Mishra, Kendhe and Bhalerao, 2015).

Data processing and presenting it in the report format at regular breaks was the initial concept of MIS. Tripathi (2011) said that these types of systems mostly trained to handle the data from a pool and process was more objective. It requires different people to pick data according to their preference and use it for the requirements (Mishra, Kendhe and Bhalerao, 2015).

2.3 Objectives of MIS

Main goal of the MIS is to help the executives of the organization to make accurate decisions which helps to improve the goal, organizational structure and dynamics to influence for a competitive benefit (Nowduri, 2011). Not as the other Information Systems, evaluation process of the MIS is separate from others (Kamatchi, 2015). This is mainly to collect data from the internal as well as the external sources of the organization and process the data and circulate that information to the decision makers to take better actions (Kamatchi, 2015).

As implies in the name, MIS achieves the whole information of an organization covering planning, control and administration concerns with providing assistance to management (Berisha-Namani, 2010). Therefore, company can take instant decision without any delays as the central objective was to provide information to every resource in the company (Yadeta, 2016).

Management is the ability of making things done across others, therefore MIS is very helpful for efficient and effective development and manage functions of the organization (Markgraf, 2017). MIS will be actively contributed to making the things done by offering speedy and suitable information to the organization. Reports produced through MIS give an understanding about the performance of human

resources, materials, equipment, capital, administration and control over the utilisation of resources employed in the organisation (Suchi, 2017). And it is very beneficial in managing costs by giving information about idle time, labour turnover, consumptions and failures and excess capacity (Nowduri1 and Al-Dossary, 2017). By getting contrast between the real performance with the specification and accounted execution, variations are brought to the notice of the management which can be corrected by taking corrective steps (Lucey, 2005). MIS brings the management strength such as strong turning points of the organization, to take the maximum benefit of the opportunities available (Namani, 2010). MIS generate the statements on manufacture figures concerning denial, imperfect and wastage and their impact on expenses and excellence of the results (Kumar, 2006).

Singh (2012) states the main objectives of MIS as follows;

- MIS deliver the most relevant information requirements of company.
- MIS analyse the position of administration and its effectiveness on information.
- It converses the decision-making process and relevancy of the role of information.
- MIS recognize the necessity of the information in usual operations of the organization.

As stated by Mishra, Kendhe and Bhalerao (2015), MIS makes a substantial distinction for the business organizations providing many edges. They are;

- Provides a valuable time-saving profit to the humans
- Effective and monetary coordination within Departments
- Use of fewer employment.
- Development in structure and division techniques
- Manage the daily activities
- Fast and consistent referencing
- Entree to appropriate knowledge and reports

2.4 Components of IS and their relationship

An information system consists of people, business process, data, hardware and software as its 5 major components and work combined to accomplish organizational aims and objectives (Kumar, Singh and Sharma, 2019) and presented in Figure 2.1.

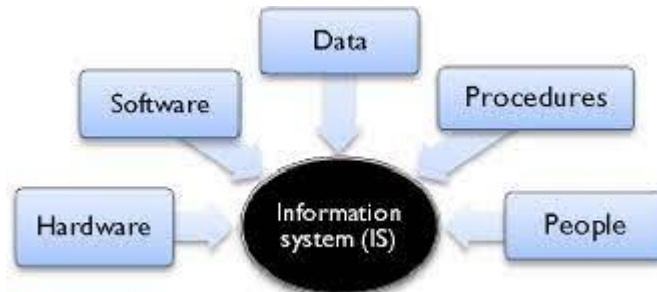


Figure 2.1: Five Components of an Information System (IS) (Source: Kroenke, 2007)

According to Kroenke (2007), five components are described as follows;

- People – The human resources who utilize information systems to do all the business transactions in day-to-day activities. In ICT departments, these skilled experts such as project managers, human resource managers, quantity surveyors, architects, accountants, etc are guiding the support staff to confirm that the system is operating accurately.
- Business Procedures – Most of procedures are established by the people according to their best practice that direct the other users and other components on how to work effectively and efficiently.
- Data – the recorded day to day organizational transactions
- Hardware – It's all about the computers, printers, routers and networking devices, etc. It provides networking and printing capabilities as well as computing power for processing data. Normally hardware speeds up the process of conversion data into information.
- Software – these are simply the programs that run on the hardware and can be categorized into two main sections called system software and applications software. System software belongs to the operating system i.e. Windows, Mac OS, and Ubuntu, etc. Applications software belongs to specific software for achieving business tasks such as a payroll program, banking system, point of sale system, etc.

2.5 Model of Management Information Systems

MIS comprises of main components, such as;

- Data Base
- Mathematical Model
- Organizational Decision Maker
- Report Writing Software

Combination of these components are mentioned in Figure 2.2.

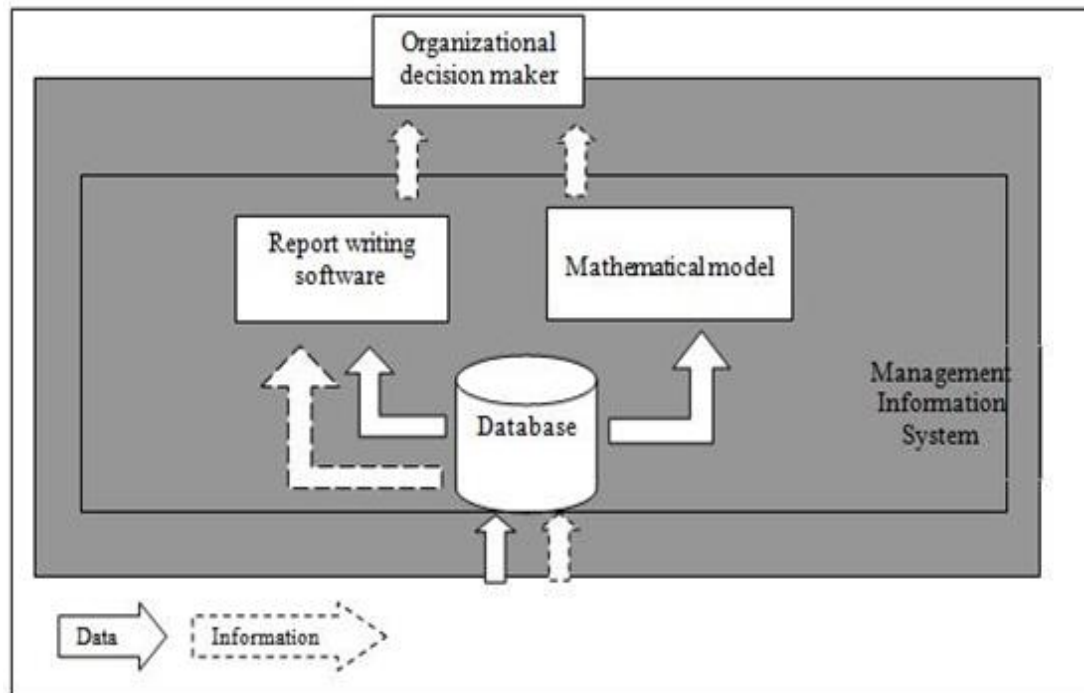


Figure 2.2 : MIS Model (Source: Mishra, Kendhe and Bhalerao, 2015)

Basically, the main function of the MIS model starts with the data and information which comes from different sources. Normally data that provided in the accounting system is stored in the data base. This data and information are transmitted to the report writing software in order to generate periodic and special reports. At the same time mathematical model is simulating the various aspects of the organization's procedures. The output from both report writing software and mathematical model sent to the managers who are responsible for solve the issues. For that purpose, effective decision making is required, hence it needs to collaborate with some people from different environment to form an Inter organizational Information System (IOIS) (Mishra, Kendhe & Bhalerao, 2015)

2.6 Development of Management Information Systems

For the development process of MIS requires the resources like capital, capacity and time with relates the long-term business plans. Informative reports will be coming as end results (Nowduri, 2011). The managers not identified information as resources but as a predictable requirement. The MIS procedures are settled synchronized to the commercial tactics and information also diverse when business grows (Tripathi, 2011).

Not only with the data processing, MIS needs proper planning to deal with management information. It should deliver support to the varying requirements of business management, management planning, decision making and action (Yaser, Alina & Nor, 2014)

According to Yuanxin (2017), MIS has to address some issues successfully in the development process. Some characteristics are presented below.

- In between the system developers and users effective communication should be there.
- Among the developers and users it should have harmonization in understanding of management processes and information technology.
- Create a single integrated system combining needs of managers from different functional areas.
- MIS increase in design complexity when including the whole organization will lead to a more efficient, speedy and more unified system.
- The MIS always cooperating with the complicated nature including all other sub-systems in the whole information system of the business and it should definitely recognize and outline the conditions of MIS according to the framework of the organization.
- It should consume quickly emerging in IT abilities in the best potential ways.
- It's very expensive and time consuming to install such advance IT based systems. But most of the time there should not be regular and main adjustments.

- It should concern of users, managers as well as the other stakeholders like employees, customers and suppliers.

Further, Tripathi (2011) has developed a process of Management Information System (MIS) Model as illustrated in Figure 2.3.

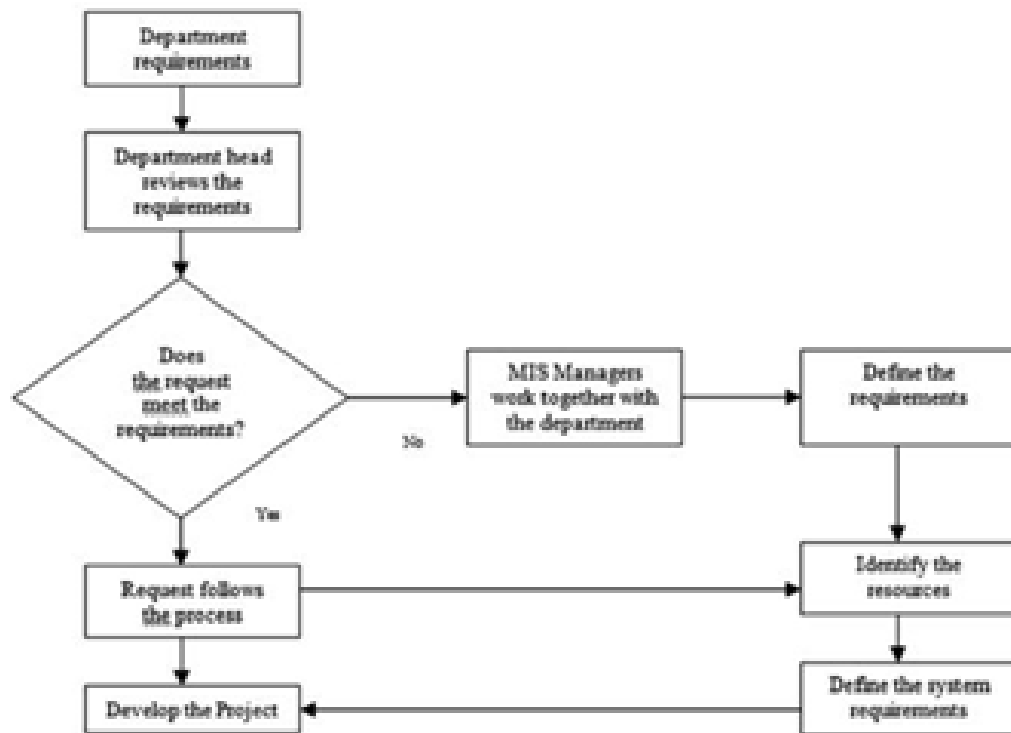


Figure 2.3 : Management Information System (MIS) Development Model (Source: Tripathi, 2011)

There are two ways of developing the MIS.

- Method 1: Prototype Method
- Method 2: Life Cycle Approach

Initial phases are developed first in prototype method. Once implemented the developed and improved system is present as per new specifications (Sari & Priantinah, 2019). This is the process which followed till the user accepted for their organization (Tripathi, 2011).

In life cycle approach, there are some different phases which MIS development is carried out (Berisha-Namani, 2010). They are feasibility study, evaluation, strategy, implementation, and analysis (Berisha-Namani, 2010). Nature of the system and its functions decide the quality of MIS and it's very advanced for business growths (Tripathi, 2011).

2.7 Types of Management Information Systems

The functions of information systems that are executed in today's commercial world can be categorized in some diverse ways. Various categories of IS can be categorized as either support of business operation or support of organizational decision making (O'Brien & Marakas, 2007).

Figure 2.4 shows the different types of MIS using nowadays and most of them rely on how tasks and responsibilities are divided within an organization.

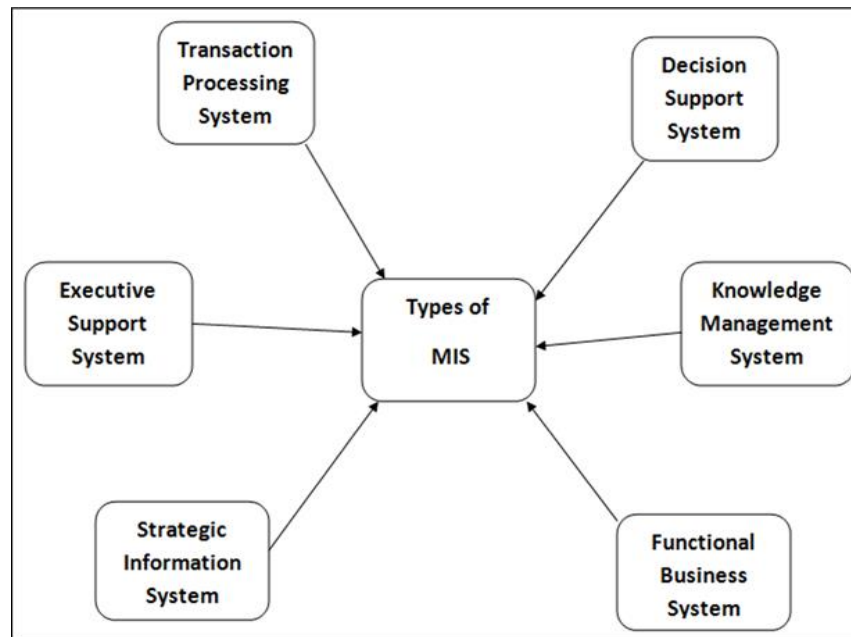


Figure 2.4: Types of Management Information System (Source: Singh and Kaur, 2012)

According to Yadeta (2011), various types of IS can be seen in the market which provides lot of advantages for companies.

Transaction Processing Systems (TPS)

- This is mainly used at the lower-level management to gather and record the usual transactions of a business. Periodic reports will be produced from the data extracted and summarized through the MIS. TPS supports mainly for middle and operational level managers in structured and semi structured decision problems. TPS can find by the least level of the managerial hierarchy that support the daily business activities (Belle, Eccles and Nash, 2001).

- Decision-Support Systems (DSS) - DSS are a kind of structural IS that help top management in decision making that needs demonstrating, preparation, manipulative, associating, choosing the greatest selection or forecast the circumstances. According to Heidarkhani, Khomami, Jahanbazi and Alipoor (2013), it precisely intended to help managers to get judgments in circumstances where there is indecision about the conceivable results. Most of the middle line managers use this computer program application from a broad scope to resolve issues and take timely decisions. This system is mostly benefitted for the higher-level management (Khanore, Patil & Dand, 2011).
- Executive Support Systems (ESS) - Mostly used by the divisions such as finance, human resources and operations as it is a broadcasting tool which helps to access quickly to summarize reports. This information is critical and spread in a wide range of internal & external to display managers and executives from MIS and DSS (O'Brien & Marakas, 2007). Patterson (2005) states that an ESS delivers chief managers with a system to support in getting deliberate conclusions. Shim (2000) explained that an ESS is calculated to produce the abstract information to extant the entire company process in a basic form to gratified higher management.
- Knowledge Management System (KMS) - KMS are knowledge-based IS that help the formation, association, and distribution of commercial information to workers and executives throughout a company (O'Brien & Marakas, 2007). Knowledge management is the arrangement of a wide-ranging arrangement that improves the evolution of an organization's knowledge (Salisbury, 2003).
- Strategic Information System (SIS) - This mainly involves with IT with the firm's manufactured goods, services and corporate process which assist to the

company to achieve the intentional benefit over competition. Belle, et al. (2001) states that SIS are an essential unique type of managerial information system which is utilized to maintain reliable and continue economical lead in the market place.

- Functional Business System (FBS)
- FBS are kind of IS that emphasis on functioning and administrative requests in help of basic commercial purposes and applications in accounting, finance, marketing, operations management, and human resource management which focuses an operational and managerial applications (O'Brien & Marakas, 2007). Khanore, et al. (2011) states that IS can be categorized by the precise structural task to sales and marketing systems, manufacturing and production systems, finance and accounting system and Human resource system.

2.8 Advantages of Implementing Management Information Systems

In today's world it's very difficult to enter to the businesses without the power of MIS as it directs the most of the areas like accounting, finance, management and human resources with the modern business environment (Galliers & Leidner, 2014). Simply it a kind of influence the energy of information to operate successfully and efficiently. Hence, the foundation in most of the organizations is the ability of design and implement the MIS successfully (Ali, 2019). Therefore, with the incorporation of people, process and IT, MIS plays a major role in the business world. These facts are the reasons for creating exclusive chances for MIS (Omarli, 2017).

There are so many benefits that can accomplish with the implementation of MIS (Singh and Kaur, 2012).

- **Economy of scale** – It represents to the sum of the expense of individual businesses is higher than the collective cost of several combined operations. MIS helps to combined the information and transmit within the departments very fast.

- **Sharing of data** – Through the MIS information can be distributed within several users by giving authorized entry and latest data can be simply included to the database and can be discovered effortlessly.
- **Balancing conflicting requirements** – To avoid personal conflicts within departments MIS provides combined data and supplied within all the department according to their requirement. Therefore, it facilitates to access the information in their own departments.
- **Enforcement of Standards** – MIS apply some standards for data names, usages and formats followed regularly within the organizations.
- **Control Redundancy** - To avoid repetitions of the data and control redundancy MIS integrate all the data files in to a single data base. Therefore no need to check the data repeatedly.
- **Integrity** – MIS integrates data of various places and all the departments can keep records separately. It's an opportunity for the organization as managers can easily access whole data of the organization.
- **Consistency** – MIS detects the data with the confusion as errors while feeding the data into data base. But never record it wrongly.
- **Security of information** – MIS avoids the illegal entry and define techniques to certify that only appropriate consumers can retrieve the data.
- **Flexibility and Responsiveness** – MIS facilitates to access and respond for data in much easier and more flexible way from multiple areas rather than keeping data in several files by different user areas

2.9 Challenges of using MIS

From previous studies, it was discovered and considered challenging concerns considering the IT implementation (Beaumaster, 1999). This will course for the implementation problems. The problems can be catogorized as management process issues, organizational environment issues, leadership issues, technical systems issues, and personnel issues (Brynjolfsson, Erik and Lorin, 2000).

Galliers, Robert and Leidner (2011) identified five types of issues and discussed as follows.

- Organization procedure issue - Practical operation of an group such as budgeting, personnel, and general management.
- Organizational environment issues - State as features which are less tangible such as organizational culture, change, and behavior.
- Leadership issues - Recognized as the areas which contain the communication and way of the organization decision-making.
- Technical systems issues - Mostly connected to those mentioning to the hardware and software concerns of information technologies.
- Personnel issues - Known as issues surrounding everyone in the organization.

Those issues can be arise in the each step of the development of MIS in the organization such as planning, designing and implementation (Almalki, Al-fleit and Zafar, 2019).

Management challenges

- Commitment of top management to implement the strategies is very low.
- Weak management roles in implementation
- Support of top management in creation and implementation of the system is very low.
- Frequent replacements and changes of senior management.
- Lack of coordination and sharing of responsibilities
- Poor communication.

Human challenges

- Letdown in employing specialized people.
- Complications in recruiting professional staff.
- Poor resources to contribute in user education.
- Lack of staff to implement the system
- System inability to fulfill the expectations of users

Technical Challenges

- Problems in converting and re-configuring commercial process to uniform with MIS
- Technical complications
- Poor requirement on MIS
- Progress previous system

Other Challenges

- Problems in arrangement among commercial approach and system strategy
- Incapacity to instrument the organization strategy on time
- Problems of gauging benefits
- Costs of altering a new system
- Insufficient budget for software and hardware.

To serve different organizational levels, companies need several types of MIS that fits for the functions and business processes to increase the combination within the enterprises widely. Therefore, this courses for both opportunities and challenges in the business world (Rhodes, 2010).

According to Singh and Kaur (2012), companies face various complications after used MIS;

- Most of the companies face high cost factor of developing new computer systems. Information needs to be updated according to the time as well as employees also should know the changes on the company website.
- Employees in the organization should have the ability of adopting for the new learnings, changes in the competitive environment to stay in the market.
- Sometimes information will lose due to the web site crashes and server crashes. In such situations information retrieval is resisted by the system and difficult to upgrade for new versions.
- With respect to the life of the software system it's a challenge for any organization, the implementation cost is very high because time to time the scope, time and new interventions has been occurred. To address all those issues system has to be implemented with relevant updates by paying higher cost.

2.10 Role of MIS in Decision Making

The process of decision making is very important for the organizations to take relevant actions over opportunities and threats resulted for both good and bad decisions (Berisha-Namani, 2010). It depends on the outcome of the process of decision making and successful output from the groups and individuals of the organizations can be expected from the good decision making (Al-Mamary, Shamsuddin, & Abdul Hamid, 2013). Unsuccessful, inefficient and unproductive actions can happen because of bad decision making and it results for overall loss of time, finance, labor and effort (Gabriel & Obara, 2013). It all depends on the decisions made by the higher management and success of the decision making highly depends on the availability of the information (Mishra, Kendhe and Bhalerao, 2015).

According to Nowduri (2011), the searching information can have so many views:

- There are some viewers who haven't any specific purposes to search information. They just search randomly and it's called as **undirected viewing**.
- Focused introduction with clearly identified area or information can be described in **conditional viewing**.
- For the purpose of obtaining the specific information for a definite purpose it needs to put some effort. But comparatively it's limited and unstructured. This can be called as **informal search**.
- In a **formal search** it's always have a pre-established plan, methodology and relevant procedures to search specific information for a pre identified issue.

According to Simon (1984), there are four principals in the management of decision – making. They are;

- Intelligence – find the relevant situations that need for make the decisions.
- Design- The process of understanding the problem, generate and test solutions in order to invent, develop and analyse relevant options.
- Choice- Choose an substitute from the variables
- Review- measures and investigate earlier choices

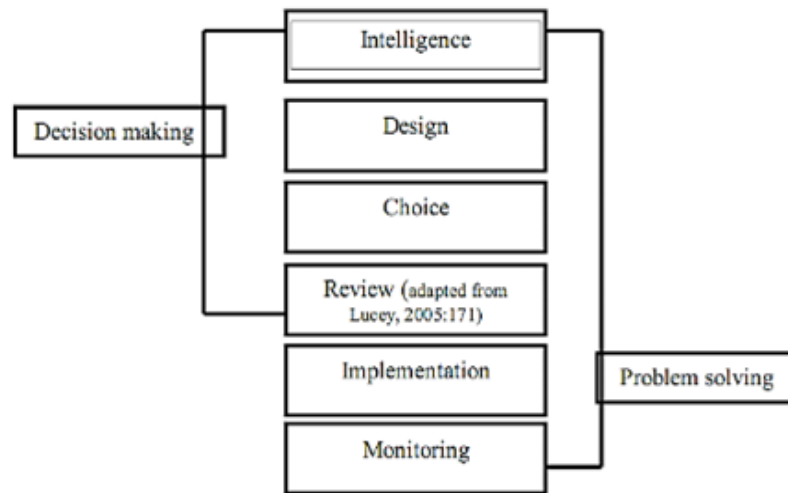


Figure 2. 5: Process of Decision Making (Source: Simon, 1984)

In decision making process MIS can be observed as a way of conversion of data (Gabriel & Obara, 2013). Through the MIS process, the data is converted to the form of information and send it to the end users for other processes. This information is used for specific purposes and provides more alternatives for make decisions accordingly (Mishra, Kendhe and Bhalerao, 2015).

MIS should choose the relevant strategy for the improvement in make decisions considering the compatibility with the system. Therefore, the correct choice can be picked and time and money will be saved. The decisions made by the organization and the strategy of MIS should be compatible (Mishra, Kendhe and Bhalerao, 2015).

Simon (1984) stated that decisions can be categorized into 2 types. They are mentioned as follows;

- In **Programmed Decisions**, the decision maker uses the standard rules, procedures and quantitative methods to make programmed decisions. The members of the organization regularly follow the problems or opportunity when the meet specifically.
- Most of the **non-programmed decisions** made responses to new issues and opportunities dealing with unusual and exceptional situations. They are mostly associated with high risk and mainly involves with people that cannot be substitute.

No matter the decision is programmed or non-programmed, it totally relies on the information that uses as inputs for MIS.

Alarm (2014) states that MIS which associates role of decision making includes some major findings. They are;

- Sometimes it's difficult to keep the principles, propositions and strategies due to the active nature of MIS.
- MIS have to face many challenges as different decisions have to be made in different situations.
- To evaluating, monitoring and programming purposed MIS needs lot of expertise that can't provide for the organizations.
- Some organizations cannot bear the cost of MIS as they are not stable financially.
- Using MIS is quite challengeable, because has to be deal with science oriented and art oriented fields.
- In order to improve the process of decision making organization should have well – defined decision making system. Otherwise, no point of having the correct MIS tools, very little can be achieved.

To overcome from those issues, well defined decision making system is more important with appropriate environment for MIS (Tripathi, 2011). But managers have to think about the cost proposal as well. The people who can think differently and intellectually are the good decision makers that can handle various kind of problems (Ali, 2019). Therefore, organization should arrange seminars, workshops to share the diverse and dynamic nature of MIS to enhance the efficiency, effectiveness and the implementation of the employees (Ali, 2019).

2.11 Applications of Management Information System

- “LAJ” (name not disclosed as requested) being the first construction company in India, which has implemented the MIS producing major differences in the construction industry. They have almost installed the 90% of the package for all project centers to analyze the total profitability of the company (Sople and Gupta, 2005).
- Along with the speedy growth of construction industry in China realizes the information of project construction and project management are becoming very significant to highly promote the process of urban development,

establishing the perfect organization system, using computer undertake all kinds of administration work (Caixuan, 2015).

- Education Management Information System (EMIS)
 - Main purpose of developing this EMIS is to increase the access, quality, effectiveness, equity and efficiency through the process of monitoring and evaluation of the Education System. There should be appropriate and consistent set of data and information, incorporation & sharing data among departments and efficient use of data in policy discussions. This facilitates teachers and students to take educational decisions at every level in the educational hierarchy (Hua and Herstein, 2003).
- Health Management Information System (HMIS)
 - This system is developed at country called Malawai, which situated in Southeast Africa. 2% per annum is the approximate growth rate whereas the population is 11 million (Chaulagai et al, 2001).

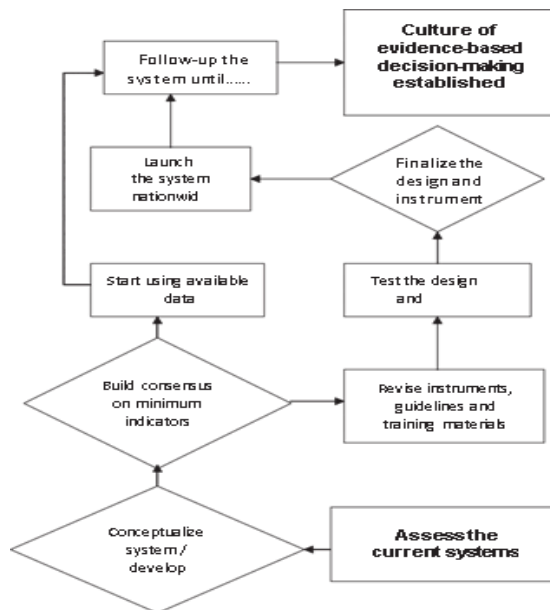


Figure 2. 6: The process through which the health management information system evolved in Malawi. (Source: Chaulagai et al, 2001)

- MKIS – Marketing Information System

Large organizations such as “Fortune 500” implement MKIS because to achieve business objectives easily, increase the visibility and the scope of the organization (Li, McLeod and Rogers, 1993).

- HRMS – Human Resource Management System

This mainly implemented to get the fast and better decisions to US managers since global competition is putting much pressure on them. To control labour cost, customer-oriented performance and motivate employees to maintain high quality is the main objectives of HRMS (Broderick and Boudreau, 1992).

2.12 MIS in Construction Industry

The environment of the construction business is fully uneven where each restraint in the business has changed self-sufficiently according to their exclusive language and way of conveying and collaborating information (Isikdag et al., 2009). It is diverse to other businesses such as the industrial or trade sector, where procedures and the operating atmosphere are well clear and measured (Gann, 1996). From the past, industries within the construction sector have been relating new approaches of working and tools to enhance efficiency and achieve excellence improvements but business has had few recognized procedures or outlines on which to base a procedure development enterprise (Love et al., 1999). The construction industry is incapable to methodically measure construction process, prioritize process developments, and direct resources properly (Sarshar et al., 2000). Figure 2.7 shows the Fragmented nature of the Construction Industry

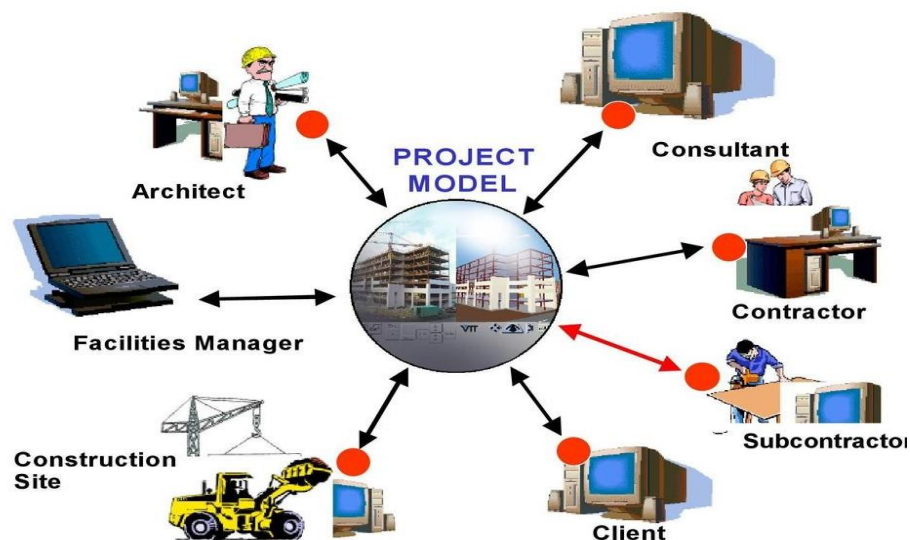


Figure 2.7: Fragmented nature of the Construction Industry (Sarshar et al., 2000)

Therefore, Irish construction industry has created an application of ICT which can overcome the challenges and it is fetching recognized that the favored communication model for handling evidence on a construction project should be founded on an essential project model, through which distributes all the information (Sarshar et al., 2000).

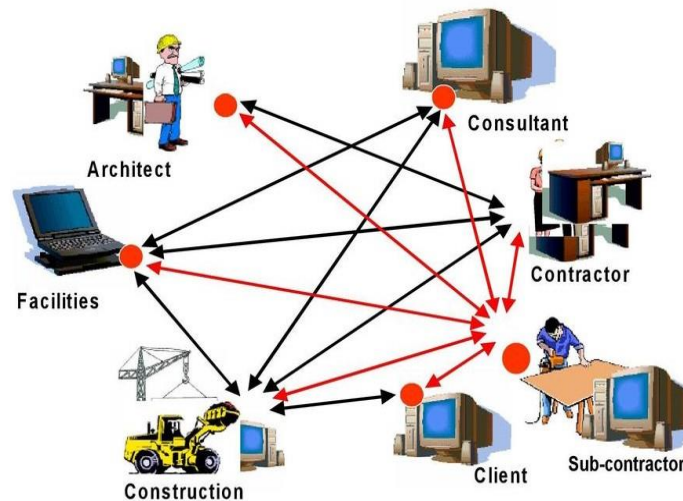


Figure 2: 8: preferred communication model for construction (Sarshar et al., 2000)

With reference to Figure 2.8, MIS should support the whole construction procedure from commencement through to the effective conservation of the structure strength (Finnemore & Sarshar, 2000). The concept of a strategy prototype that helps amended management and administration of material during the project life cycle is gained augmented gratitude (Sun & Howard, 2004). MIS is refining the competence and ability of precise features within the construction procedure (Sarshar et al., 2000).

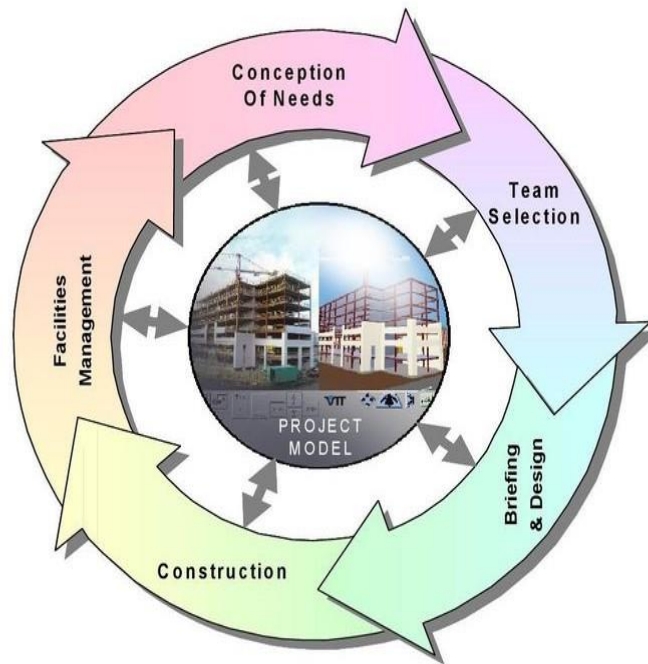


Figure 2. 9: Project Model for Construction (Sarshar et al., 2000)

Standardized Process Improvement for Construction Enterprises (SPICE) is a present research plan that is emerging a procedure enhancement outline for the construction industry. This is established on a current fruitful simulation (Paulk 1993, Saidian 1995), which was established by the US Department of Defence and is broadly used in the software industry, namely the Capability Maturity Model (CMM) (Finnemore & Sarshar, 2000). Growing indication from other sectors (Imai 1986, Paulk 1993) shows that constant procedure upgrading is based on several slight, evolutionary measures, rather than innovative processes.

The SPICE mechanism is given in Figure 2.10.

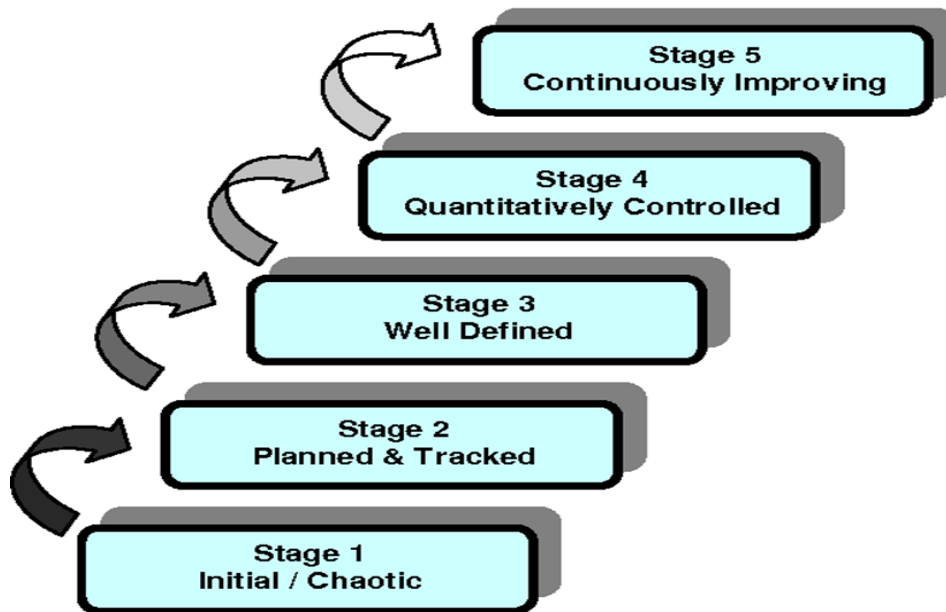


Figure 2.10: SPICE Model (Sarshar et al., 2000)

The SPICE assessment approach is shown in Figure 2.11.

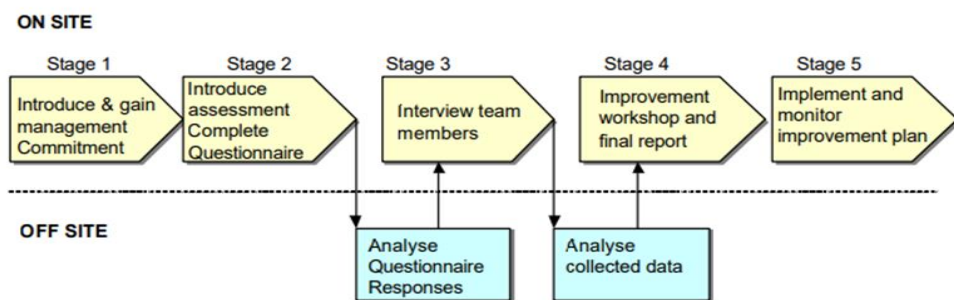


Figure 2.11: SPICE Assessment Approach (Sarshar et al., 2000)

Figure 2.11 shows the SPICE assessment approach including the five main stages within on site and analysis part in the off site.

Challenges in implementing MIS in Construction Industry (Kornkaew, 2012).

1. System is not flexible

MIS system should be adoptable and flexible according to the nature of the company, their projects and human resources. Therefore, without any expensive custom coding MIS should drive the team to manage business operations in the company.

2. Adoption prevents from internal politics

Implementing “One-time-fits-all” system for all the department is the biggest problem in implementing MIS for an organization. Everyone uses different software platforms for their workflows. Deploying MIS to an organization doesn’t integrate with the existing systems of all departments. Therefore, not exactly a gain in efficiency.

3. Lack of internal support for the system

Individuals who are working in the organization are ideal project champions for choose proper MIS. They are not willing to accept the new systems in the organization and creating the grass roots acceptance.

4. Companies don’t understand what they have

Due to the busy work schedules of the managers and executives, companies hire consultants to evaluate the capabilities of the current tools. But most of the consultants introduce fancy and expensive software platforms and services without considering the real situation and requirements of the company.

5. A company’s IT department locks down the application

Most of the IT departments over handling the tools once a company hosted MIS in their internal servers. Sometimes they delayed further customization and feature requests from users. Therefore, users have more reasons for not to use MIS.

Using the MIS, it’s very easy to achieve key processes of construction projects that heavily impacted such as tracking of business inquiries and tender, estimation of tender in time, project activity schedule preparation, contract document management, daily progress reports from projects, milestone monitoring alert, controlling material wastage at site, viewing various stock availability at various project sites for other site allocation, machinery under utilization, on-time reports from site on project status and variance in budget and actual cost in real time (Abhinav, 2021). Basically, MIS can revamped and automated the construction business operations according to the requirement of the organization.

2.13 Summary

(MIS) is a system covering with five main elements such as of people, machines, procedures, data bases and data models. Therefore, key concepts of MIS and factors affecting the effectiveness of MIS related applications has been intended to identify from this chapter. And also the critical impact due to some reasons. Further, this chapter describes the involvement of MIS in construction industry as well as the challenges of implementing the applications in various companies. Moreover, it described the need for MIS in construction industry, in order to standardize and regulate such systems in Sri Lanka. Summary of the literature review chapter indicates a beginning of a new chapter where the research methodology implemented for this study.

3. RESEARCH METHODOLOGY

3.1 Introduction

The intent of this chapter is to consider the organizational framework which adopted in accomplishing the aim and objectives of the study. The chapter outlines the issues related to the research process including research design, research approach, data collection and analysis, and summary. The research design was explained in general, and its applicability to the study was also discussed. Further, research approach has been discussed in order to have proper data collection. Finally, data analysis techniques and the research process were briefly discussed.

3.2 Research Design

In a research methodology, Research Design is an essential subdivision to develop a procedural plan which may cause to make high influence to the outcome of research study. Kumar (2011) states that researcher adopted the research design to answer the questions validity, objectively, accurately and economically. Moreover, he explained that through a research design it can be decided the method of collecting the information, choosing the respondents, evaluating the information collected and conveying the research findings with proper justifications. Further, Fellows and Lui (2005) stated that research methodology defines concepts, previous findings, connections between the trouble and techniques to find the way out. Therefore, it can be recognized as an active procedure. As stated by Yin (1994), research design is a kind of action plan which starts from the primary stage of the research and till go up to final conclusions. In addition to that Rudestam & Newton (2007) mentioned, Research Design is a combination of concepts relevant to research approach, research philosophy and research techniques. Furthermore, the author stressed stated that all the techniques used for research should be combined with each other.

3.3 Research Approach

According to Thurairajah et.al (2007), establishing research activities and illustrating data compilation of the research are the main features of research approach to reach the research aim and objectives.

Three categories of research approaches are identified as quantitative, qualitative and the mixed approach. Moreover, Creswell (2014) described the selection of the research approach is based on different reasons such as nature of the research problem, researcher's experience and respondents of the study. Major characteristics of three approaches were briefly presented in Figure 3.1.

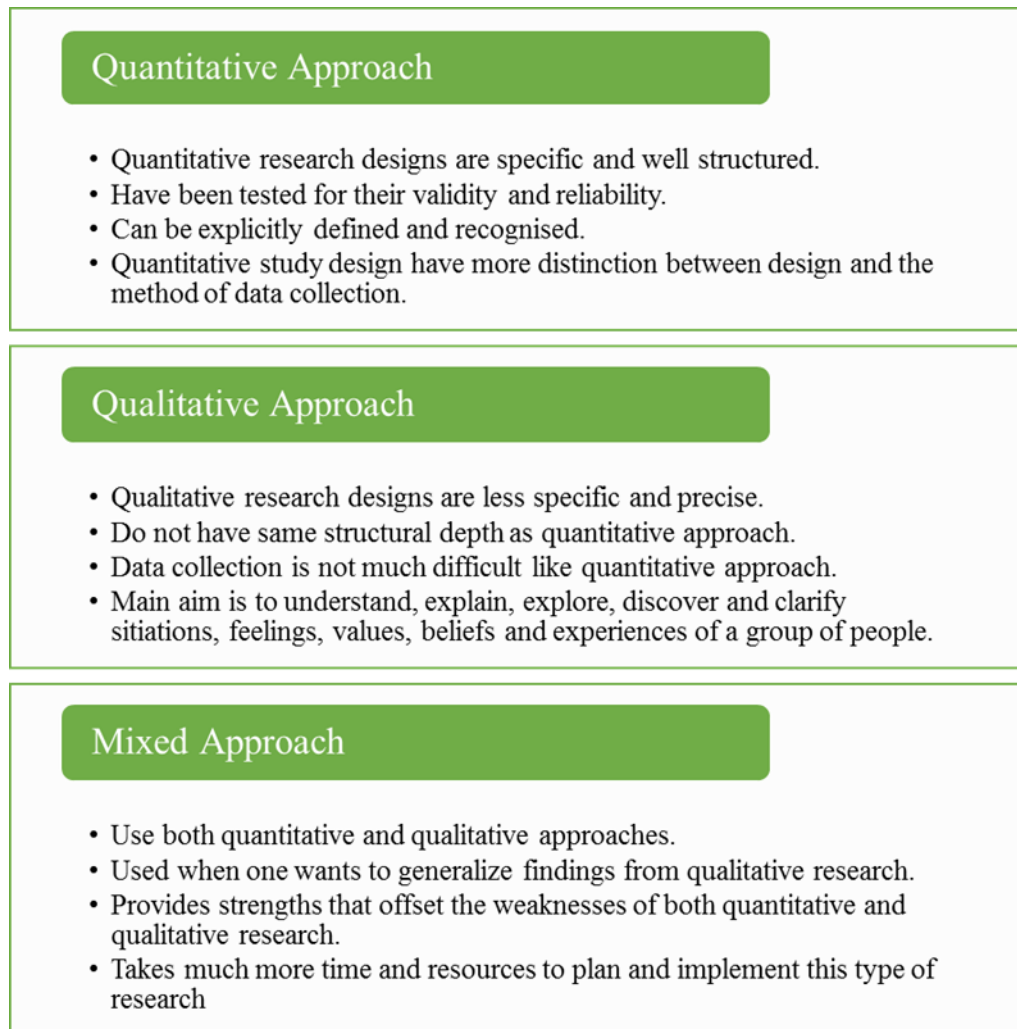


Figure 3.1: Characteristics of Research approaches

Adapted from: (Creswell, 2014; Dawson, 2002; FoodRise Resource Centre, 2016)

mentioned that survey research and experimental research can be categorized as strategies of quantitative approaches such as case study research, desk study research and action research (Fellows and Lui , 2003). They are strategies of qualitative approaches that defines the beliefs, attitudes, opinions and views of the individuals or group of people. Harwell (2011) states that, mixed approach consist of both qualitative and quantitative approaches by associating the differences of those two methods.

According to the problem statement, this study aims to find out the usage of MIS and their effectiveness in the Sri Lankan construction Project Consultancy field. Comprehensive Literature review was carried out using Journals, research papers, books, and unpublished dissertations for the identification of the research gap, preliminary identification of MIS, its usages and importance to the field of research. The semi structured interviews was carried out based on qualitative approach for this research study to collect data from the industry. To gather further data, questionnaires were distributed to employees of several consultancy firms in Sri Lanka.

It is obvious that the mixed approach would serve greatest to achieve the objectives when considering the nature of the study. Triangular concurrent mixed design approach was selected as the most suitable approach because to accomplish the purposes of the study the requirement of beliefs and attitudes of the industry professionals as well as the investigation of arithmetic archives and the use of mathematical rulers are most important.

Figure 3.2 illustrates the process of Triangular concurrent mixed design.

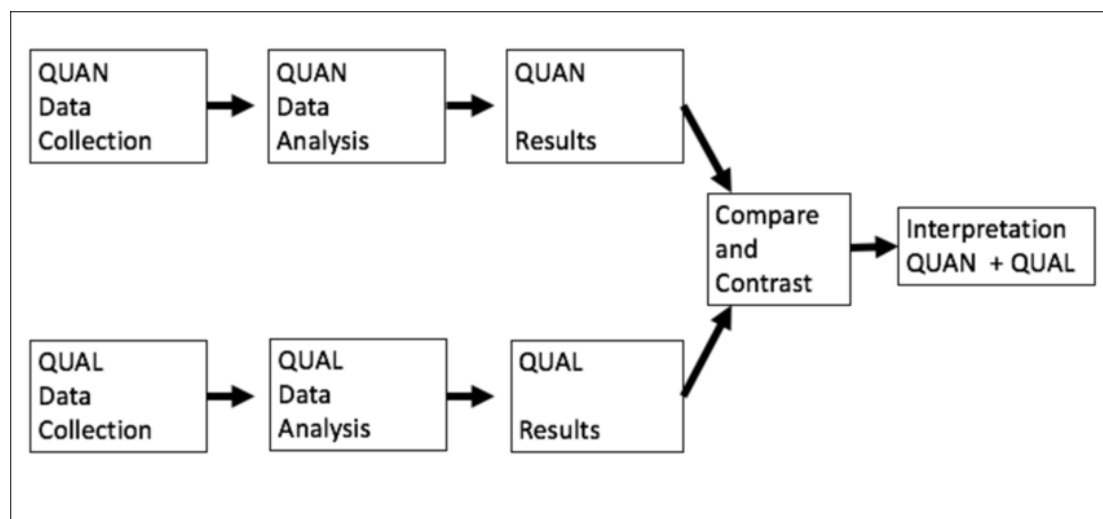


Figure 3.2: Triangular concurrent mixed design approach

Adapted from: Creswell & Plano Clark (2007, P.63)

3.4 Research Techniques

To accomplish the research aim and objectives, research techniques contain both data collection and data analysis (Thurairajah et al., 2007). Research technique provides the basic framework for data gathering and evaluation.

3.4.1 Data Collection

Based on the requirement of fulfilling the research aim and objectives data collection methods should need to be identified. According to Thomas and Brubaker (2008), to collect information concerning research problem such as literature review, interviews, observations, questionnaires various types of data collection procedures can be utilized.

Data collection techniques adopted in this study

Expert Interviews

Initially, Expert interviews were conducted with nine industry experts to identify and recognize the use of the new techniques for MIS in consultancy companies in construction industry in Sri Lanka. Applicability of the literature review to the research aim and objectives was clearly explained from this. Further it was identified that the composition for data collection and the possibility of structure with relevant to the Sri Lankan context. Interview guide is given in Appendix A.

Questionnaire Surveys

Concurrently, the questionnaire was designed. The key objective of this technique was recognizing and analyzing new technologies of MIS and usage of them in consultancy companies in construction industry. Therefore, identification of the technologies and most common methods used for MIS, were identified in detail through the questionnaire survey, which is given in Appendix B.

A questionnaire was consisted of a collection of predetermined and logically developed closed ended questions aimed at acquiring evidence from respondents. The questionnaire was developed in a google sheet and distributed among the employees at consultancy companies through emailing and other social media platforms. Even though it has been distributed among 72 employees, only 50 were responded. This is ideal for collect large amount of data within short time. Additionally, data collection through surveys can be clearly analyzed. Most of the

problems included were close ended while few questions are open ended, reducing responses to a great extent.

Therefore, to collect quantitative information with more details questionnaire survey would be more important.

3.4.2 Data Analysis

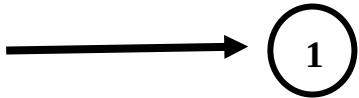
Data analysis is the next step of research methodology to analyze the collected data through semi structured interviews and questionnaire surveys. Therefore, analysis method depends on the selected research approach; quantitative or qualitative.

Content Analysis

Data collected through semi-structured interviews were analyzed using content analysis. Hence, non-statistical data gathered through qualitative approach was analyzed using this content analysis method. It helps to summarize the data collected from experts according to particular criteria.

The Relative Importance Index (RII)

Due to the lack of sophistication and understandability, RII was used to rank the questionnaire results. This technique is adopted to rank attributes based on their relative importance (Tayalan, Bafail, Abdulaal and Kabli , 2014). Equation (1) was used to rank various attributes identified through literature.

$$RII = \frac{\Sigma(W_n)}{A \times N}$$


Where,

W = Constant expressing the weighting given to each response.

A = The highest weighting.

n = The number of frequency of responses.

N = Total Number in the Responses.

As proposed by Chen et al (2010), corresponding importance level with the comparison of RII is computed from the conversion matrix. Accordingly, figure 3.3 shows the resulting significance quantities from RII.

High (H)	$0.8 < RII < 1.0$
High-Medium (H-M)	$0.6 < RII < 0.8$
Medium (M)	$0.4 < RII < 0.6$
Medium-Low (M-L)	$0.2 < RII < 0.4$
Low (L)	$0.0 < RII < 0.2$

Figure 3.3: Importance Level from RII (Sakhare and Chougule, 2019)

Percentage Frequency

Percentage value of the frequency can be used to determine the most significant MIS type, objective, benefits and challenges of MIS. For all the collected values from questionnaire survey, percentage frequency value can represent a considerable value.

It would be simple to use Formula 2 illustrated below to calculate accurate values. This formula is statistically verified and well applied formula among the researchers. It is mostly use for recognizing adequate value for discovered and stored value set.

$$P = \frac{f}{N} \times 100\% \quad \longrightarrow \quad (2)$$

Where,

P = Percentage frequency

f = Actual frequency of the responses

N = Total number of responses

3.5 Research Process

Figure 3.2 illustrates the flow of the research process adopted in this research. Initially, the research problem should be defined properly and research objectives should be developed in order to clarify the direction of the study. To identify the research gap and define some key areas, it was necessary to have an investigation from the already available knowledge relevant to the research area. Subsequently, to present the research findings clearly and effectively, appropriate information

gathering techniques and evaluation had to be established. This was done by a detailed analysis of the collected data through semi structured discussions and questionnaire surveys. Ultimately, conclusions and recommendations derived from data analysis were presented.

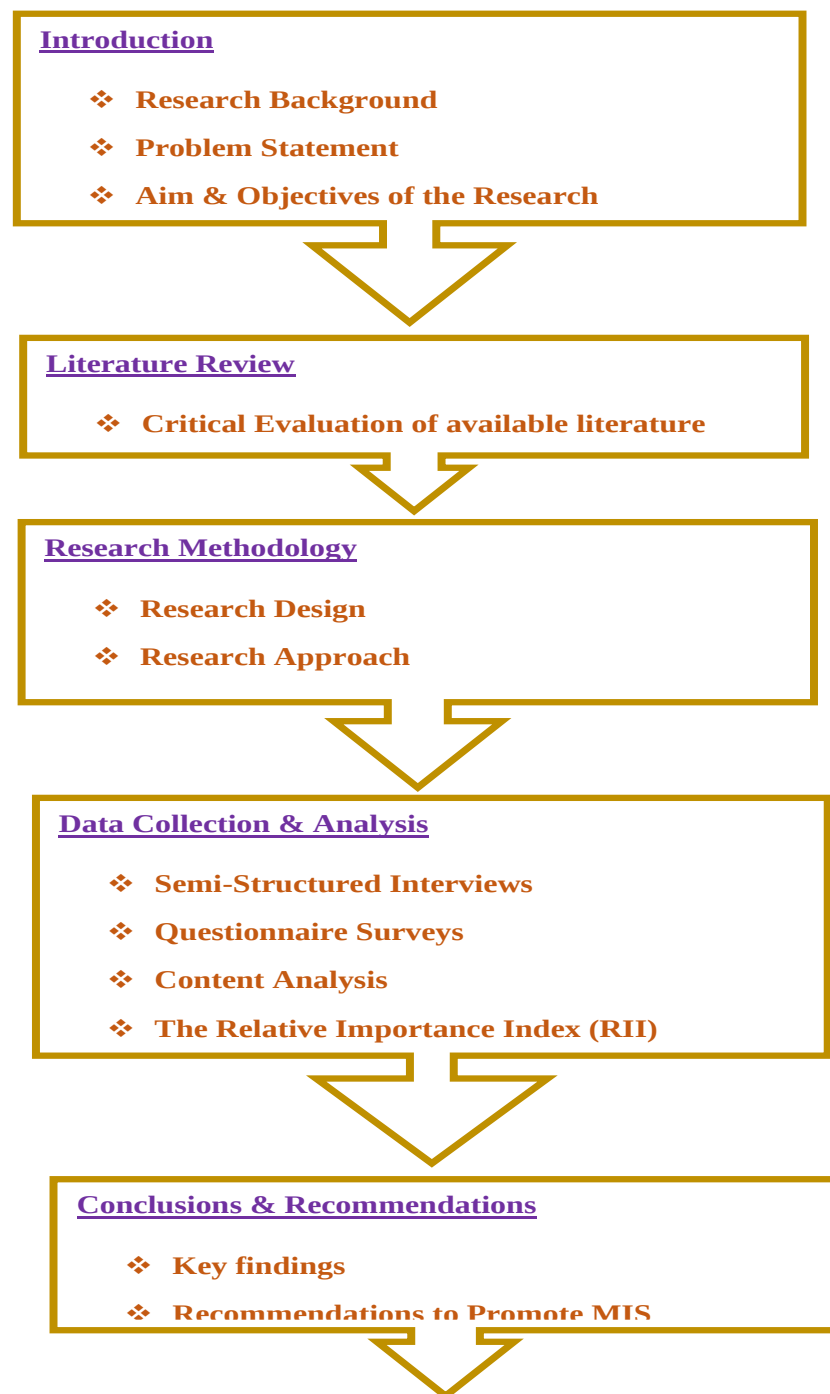


Figure 3.4: Research Process

3.6 Summary

This chapter completely covers the research methodology adopted in this research to achieve aim and objectives. Initially, research design, research approach, research method and research techniques were discussed in detail.

Afterward, data collection methods and data analysis techniques were explained with respect to qualitative and quantitative data. The triangular concurrent mixed design approach was chosen for this research. Data collection was done by means of semi structured interviews from industry experts and questionnaire surveys. To analyze qualitative data, content analysis was used while graphical tools and RII were used to analyze quantitative data. Next chapter will discuss the findings in detail.

4. DATA ANALYSIS & FINDINGS

4.1 Introduction

The previous chapter discussed the research methodology. This chapter delivers a comprehensive description of the analysis results of the expert interviews and the structured questionnaire survey based on the above methods. The study aims to identify the benefits of implementing MIS in Consultancy Organizations in the Sri Lankan Construction Industry and investigate the barriers to using MIS in Consultancy Organizations in Sri Lanka; hence the following discussion of the results focuses on this. Finally, it proposed suitable strategies to enhance the efficient and effective use of MIS in Consultancy Organizations in Sri Lanka.

4.2 Expert Interviews

Expert interviews were held with nine experienced professionals in consultancy companies as the initial step of the data collection process. They have more than 15 years of experience in the construction field. The respondents were interviewed based on the interview guidelines in **Appendix A**. Based on the literature findings, a structured questionnaire survey was developed for data collection and in-depth analysis.

4.2.1 Objectives of Expert Interviews

The primary objective is to identify critical factors and current usage of MIS in the Sri Lankan construction projects and justify the relevance of literature findings to the Sri Lankan context. The interviews helped verify the literature findings concerning the second and third objectives. These intentions were to recognize the enablers of implementing MIS in Consultancy Organizations in the Sri Lankan Construction Industry and investigate the barriers to using MIS in Consultancy Organizations in Sri Lanka. Furthermore, the interviewees provided valuable insights to propose suitable strategies to enhance the use of MIS in Consultancy Organizations in Sri Lanka efficiently and effectively, as discussed in the following sub-sections.

4.2.2 Design of the Expert Interview Guideline

The industry expert interview guidelines included seven questions (**Refer to Appendix A**), and each interview took approximately 45 - 60 minutes. The first

question was to have a brief introduction of the interviewee's organization. The second question aimed at verifying the existing MIS used in their organizations and reasons (if any) for not using such systems. The next two questions focused on the benefits compared to the manual systems, the challenges of using those systems, and the methods to overcome them. The fifth question was developed to get an idea of the current usage of MIS in consultancy companies in the construction industry. The next question is intended to get the interviewee's perspective on the approach of adapting MIS for the present situation in the local Construction Industry. The final question was designed to get any additional information related to MIS.

4.2.3 Respondents of the Expert Interviews

As mentioned earlier, industry expert interviews were held with nine interviewees with over 15 years of experience in the construction industry. Most interviewees had many years of both local and foreign expertise, and they jointly worked in several companies before starting their own practice. Table 4.1 provides elements of the interviewees of this study.

Table 4.1: Profiles of Interviewees

Interviewee Code	Type of Consultancy Company	Profession	Designation	Experience in CI (years)
I _A	Engineering	Engineer	Managing Director/CEO	22
I _B	Engineering	Engineer	Head of Program Delivery	19
I _C	Engineering	GIS Specialist	GIS Specialist	15
I _D	Quantity Surveying	Quantity Surveyor	Director	30
I _E	Quantity Surveying	Quantity Surveyor	Assistant Director	15
I _F	Quantity Surveying	Quantity Surveyor	Managing Director	20
I _G	Architecture	Architect	Chief Architect	25
I _H	Architecture	Architect	Managing Director	25
I _I	Architecture	Architect	Director	17

4.3 Analysis of the outcome of Expert Interviews

Three main categories of the consultancy sector, namely Engineering, Architecture, and Quantity Surveying companies, were selected for the semi-structured interviews. Initially, the existing Management Information Systems in the consultancy

companies were identified compared to using manual systems. Most companies are not using such systems, but they are experienced in working with unique in-built systems to fulfill the organizational requirements without disruptions. Using MIS has many benefits over the manual systems; however, experts have commented on various challenges to MIS and the methods to overcome them. All participants from the three disciplines pointed out the current usage of MIS systems (methods and techniques) in consultancy companies in the Sri Lankan Construction Industry. According to respondents' perspectives, the approach of adapting MIS is suitable for the present situation in the local Construction Industry. The opinions on current practices, benefits, challenges, and strategies of adopting MIS are discussed below.

4.3.1 The current practice of MIS in consultancy companies in the local Construction Industry

Interviews with experts revealed that currently, they are not using such standardized and centralized systems. Still, all companies use some automated types of systems and some software packages to manage company requirements and fulfill customer desires.

Considering the systems presently used at the respondent companies, it is evident that most QS companies used Cost X software for quantity surveying work (estimates and measurements). Notably, one quantity surveyor (I_D) highlighted that they use *Cubi Cost*, an advanced software package, as a measurement tool and a platform for designers and quantity surveyors.

According to I_D, I_E, and I_F, the current usage is very low because most QS consultancy firms prefer not to invest money for such things as they do not have sufficient staff. Besides, they have unique systems built on their own. Some use packages for cost-benefit analysis, measurements, data reports preparation, databases, document control, human resource control, accounting purposes, and quantity surveying-related work. I_D highlighted that some leading companies use Enterprise Resource Planning (ERP) Systems to accomplish regular business activities such as finance, purchasing, project management, risk management, and supply chain operation.

The Engineering Consultancy Companies have unique in-built systems which accomplish the company goal. At present, they have ISO 9001: 2015 quality management system for their internal processes in the company, especially for the

business development process. Hence, companies strictly follow the ISO quality manuals and guidelines to provide high-quality products and services. For that, they have developed internal systems with user-friendly interfaces to maintain daily work records, project plans and drawings, project staff and sub-work activities, and a Curriculum Vitae (CV) database for the consultants who can sort the required CVs according to the profession, years of experience, age, and professional & academic qualifications.

IA, IB, and IC pointed out that it is an indescribably small use because the situation in the country is gradually deteriorating. Most consulting firms know how to get their maximum profit without quality jobs. At the end of the work, if they have the expected profit and the management is happy with the outcome. Therefore, most company managements are not concerned about those systems.

The information related to the Architecture Companies revealed that most use AutoCAD software as a drafting tool and not specific internal systems as they are more on the design-oriented aspect. Nevertheless, IG emphasized that they have some in-house systems for contract management, structural designs, and other organizational activities. They manage all the technical information, survey plans, design guideline specifications, client information, wish list, market data, project progress review, post-project evaluation, performance monitoring, financial analysis, and make training and development plans through these systems. The architect stated that Revit Software is used for modeling purposes.

The interviews revealed that Architectural companies highlighted the same information that the other two categories expressed regarding the current usage of MIS. It was noted that most companies use some unique systems and do not select such expensive systems due to the cash flow issues and low profits.

Further, respondents revealed that their finance divisions used Quick Book (QB) software and have a separate in-house developed system that can categorize the rates, sample agreements, prices, profits, revenues, etc.

Nevertheless, the answers given by the experts prove that they are not using MIS for the overall administration process of the company. However, they are comfortable with the current unique inbuilt systems. Since most companies consist of a small

group of employees, they do not feel the requirement to work and analyze the project progress through MIS; hence they follow the traditional manual methods.

4.3.2 Benefits of using Management Information Systems compared to the Manual Systems

Having identified the benefits of using MIS, some main factors are highlighted through the interviews. The respondents stated that it is easy for good decision-making at the right time while minimizing the risk. Due to high accuracy and low time consumption, a company can use minimum staff to get the maximum work. Also, it will help enhance the company's performance and provide accurate information and quality products and services according to the clients' requirements.

Further, I_C stressed that top management could quickly review the overall project progress and financial progress in all projects. The urgently needed decisions in the field could be communicated directly to top management, and this helps reduce decision-making time through middle management. As stated by I_A, I_B, I_D, I_E, and I_F, the company can use its resources, especially human resources, more effectively and efficiently than manual systems.

Respondents I_A and I_B highlighted that it is convenient to manage and judge the information, especially during work-from-home. Managers can review and monitor their employees' progress and make decisions about where they are. It will reduce the time waste and conflicts between the consultant and the client due to the high accuracy and quick results.

From all respondents' perspectives, it is beneficial to introduce such systems to the consultancy companies in the construction industry at an affordable price because every industry should digitalize with the world and be keen on those MIS to meet client requirements. For example, I_D highlighted that it would be a good investment in the present pandemic since employees can do their work from home. I_D further mentioned that it would be beneficial for the newly-recruited staff who are often unaware of the past projects, project scope, staff, and consultants. With a proper MIS, they can prevent many drawbacks.

It is practical to have MIS for consultancy companies, clients, and contractors because now, most tenders arrive as designed & built, not separately as earlier as 'design for the consultancy companies' and 'build for the Contractors.' Therefore, if

both have adopted the MIS, the quality of the work can be maintained at a high standard. Additionally, correct decision-making is helpful for market changes. As per I_A, some companies outsource the services according to the requirements. If they have proper, specifically designed MIS, it is very easy to provide the services effectively and efficiently.

4.3.3 Challenges of using Management Information Systems and methods to overcome

From a Quantity Surveyor's point of view, the main challenge was Quantity Surveying is a small category in the Sri Lankan construction industry compared to other countries. Most companies are unwilling to use such MIS, mainly because of the cost. The initial cost for the establishment will be very high, and frequent updates are also necessary. Therefore, companies are reluctant to invest in MIS. However, it is beneficial to adopt and implement the MIS if companies have sufficient work and good economic conditions.

The volatile market and financial status may not be stable as expected. Sometimes companies face software crashes and have to bear the maintenance cost. Also, all parties (client and contractor) should be aware if a consultant is using those MIS. They highlighted that those systems might collapse due to various reasons such as virus attacks, cyber-attacks, and technical issues. Therefore, backup systems may need to be managed constantly to avoid such problems. Besides, the possibility of reliability issues could totally change the output as it is based on our input data. A mistake in data feeding would lower the accuracy of the output and reduces the work quality.

I_C, an interviewee from the Engineering consultancy company, stressed that MIS should be a cross-platform that users can access anytime from anywhere in the world. Therefore, cyber security, the threat of unauthorized access, and the weak responsibilities of users need special attention. In general, management may not be interested in MIS due to the development costs and will think twice before investing in MIS. Therefore, a clear explanation of the benefits of using MIS has been identified.

Architect consultancy companies highlighted in this interview that companies should train people to adopt these MIS. However, most employees may leave the company at the end of the period. Hence, employee retention is a big challenge, and it is

difficult to find skilled people. Implementation cost is high for such systems. Further, most MIS may not be up to the required standard when they use after purchasing the software from the agent.

Regarding the possible ways of overcoming challenges, it is highlighted that helping employees develop IT practices by implementing suitable policies and procedures, rewarding good practices, and conducting simulations. Top management should understand the real versus using MIS and train people to bridge the gap. They must always communicate appropriately with employees and allocate their time to maintain compliance and efficiency. It is always advisable to engage a qualified and well-experienced service provider to support, respond to, and solve inquiries.

Regarding the respondents' opinion on the challenges of using MIS and methods to overcome them, it is apparent that MIS is perfect for highly structured companies but not for small-scale companies. Also, it is more suited for large-scale projects. Therefore, it will be better to have an MIS that fits both small-scale and large-scale consultancy companies according to their requirements. Many respondents highlighted that purchasing such systems is pointless because it will make things more complicated than the standard company operating system.

4.4 Questionnaire Surveys

The final step of data collection is a questionnaire survey, described in this research section. A detailed questionnaire was developed using the literature findings, and the survey involved several professionals in the consultancy companies in the construction industry. The questionnaire was distributed online among 72 professionals. Of those 72 professionals, 50 professionals responded, and 22 did not respond.

The detailed questionnaire contained of three main sections: the initial section composed general information from the respondents, the second section gathered awareness and use of MIS, and the third section collected data on the benefits and challenges of MIS (**Refer to Appendix C**).

4.4.1 Aims of the Questionnaire Survey

The main aims of the questionnaire survey are to analyze the percentage of awareness and usage of MIS in consultancy companies, the benefits and challenges,

and identify suitable strategies to enhance the efficient and effective use of MIS to implement consultancy organizations in Sri Lanka.

4.4.2 Details of questionnaire respondents

The initial section of the comprehensive questionnaire survey collected respondents’ general information. Those details contained their professional background and experience. Accordingly, the response rate of the questionnaire survey was identified as below.

Rate of Response

Among the construction industry professionals, 72 questionnaires were distributed, and 50 professionals responded. As illustrated in Figure 4.1, the response rate of the research is 69%.

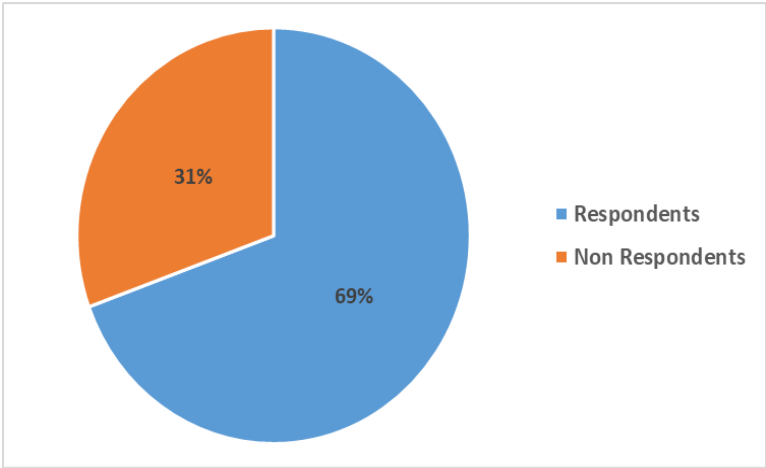


Figure 4.1: Response rates of the questionnaire survey

Questionnaires were distributed among the professionals in consultancy companies such as Engineers, Quantity Surveyors, Project Managers, Architects, Draftsman, and Project Officers. As illustrated in Figure 4.2, 30% of respondents were Quantity Surveyors, 20% of respondents were Engineers, 10% of respondents were Project Managers, 10% of respondents were Architects, 8% of Draftsman, and 12% of respondents were Project Officers. The other portion represents 10% of the respondents.

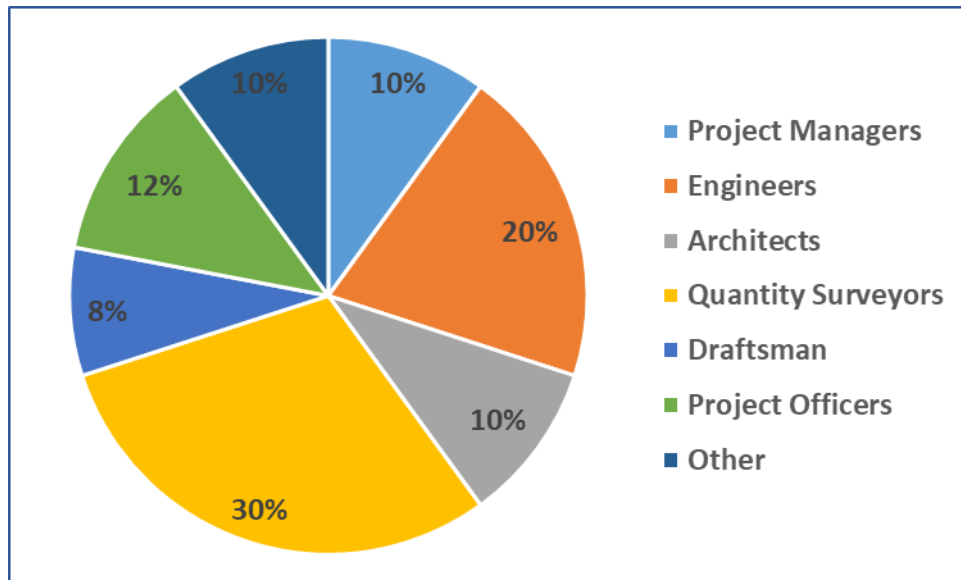


Figure 4.2: Professional Background of Respondents

Figure 4.3 illustrates the percentage of respondents according to their level of work experience. Accordingly, 40% of respondents have experienced between 6 to 10 years, 24% of respondents have experienced between 0 to 5 years, 16% of respondents were experienced between 11-15 years, 10% of respondents have experienced between 16-20 years, 6% of respondents have experienced between 21-25 years, and 4% of respondents have more than 25+ years of experience in the construction industry.

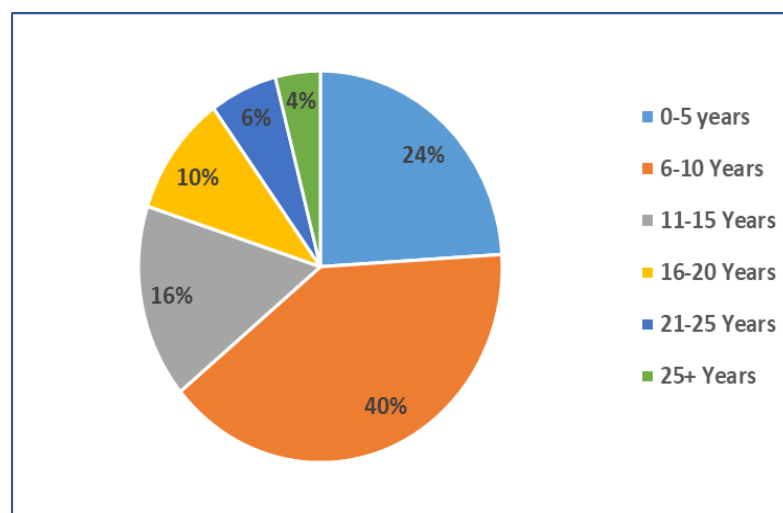


Figure 4.3: Working Experience of Respondents

4.5 Findings of the Questionnaire Survey

The questionnaire survey helped rank the awareness level of common MIS types associated with consultancy companies and identify the current MIS type used to handle information. Questionnaire survey data were also beneficial to realizing the second, third, and fourth objectives of the research. It identifies the benefits of implementing MIS in consultancy organizations in the Sri Lankan Construction Industry, investigates the barriers to using MIS in consultancy organizations in Sri Lanka, and proposes suitable strategies to enhance the use of MIS in consultancy organizations in Sri Lanka, efficiently and effectively.

4.5.1 Awareness of common MIS types in consultancy companies

Awareness of common MIS types was recognized through literature review and expert interviews. The detailed questionnaire survey helped rank the awareness of MIS types giving to their level of significance to fulfill the second research objective. The MIS types in consultancy companies were determined using the five-point Likert scale, and they were categorized and ranked according to the Relative Importance Index (RII) value. Table 4.2 summarizes the questionnaire survey findings.

Table 4.2: Awareness of Common MIS types

MIS Type	Level of Awareness					RII	Rank
	5	4	3	2	1		
Decision-support systems (DSS)	4%	6%	22%	42%	26%	0.440	1
Knowledge management systems (KMS)	6%	4%	22%	26%	42%	0.412	2
Transaction processing systems (TPS)	2%	10%	14%	28%	46%	0.388	3
Strategic information systems (SIS)	4%	8%	12%	24%	52%	0.376	4
Executive support systems (ESS)	4%	6%	12%	20%	58%	0.356	5
Functional business systems (FBS)	0%	8%	12%	14%	66%	0.324	6
5 - Very Good; 4 - Good; 3 - Moderate; 2 - Poor; 1- No idea							

The questionnaire survey results easily identify that most consultancy companies are not aware of the MIS. According to Table 4.2, the majority of the companies have

very poor awareness regarding the type of MIS as they are not used for that. Only less than 10% of the companies have some awareness regarding the MIS types, while 20% of companies have a moderate understanding. Among those six types of MIS, most companies have poor awareness of Decision-support systems (DSS). They have no idea about the other five types, namely, Knowledge management system (KMS), Transaction processing systems (TPS), Strategic information system (SIS), Executive support systems (ESS), and Functional business systems (FBS).

As per the RII values calculated, DSS and KMS are in the medium importance level with values of 0.44 and 0.412, and the other four types belong to the low importance level category. Therefore, it highlighted that no significant type of MIS is associated with consultancy companies in the construction industry.

4.5.2 Current MIS types used in the organization while handling information

When considering the current MIS types used in organizations, it has been identified that most companies are not using MIS while only a few companies use it. Out of 50 respondents, above 43 mentioned that their companies are not using MIS, and seven respondents and fewer said they use MIS. Accordingly, it revealed that only a few companies are currently using MIS, and most consultancy organizations are not using that. It also disclosed that most organizations have unique systems developed on their own, according to their company requirements. Figure 4.5 illustrates the numerical value of current usage in consultancy companies.

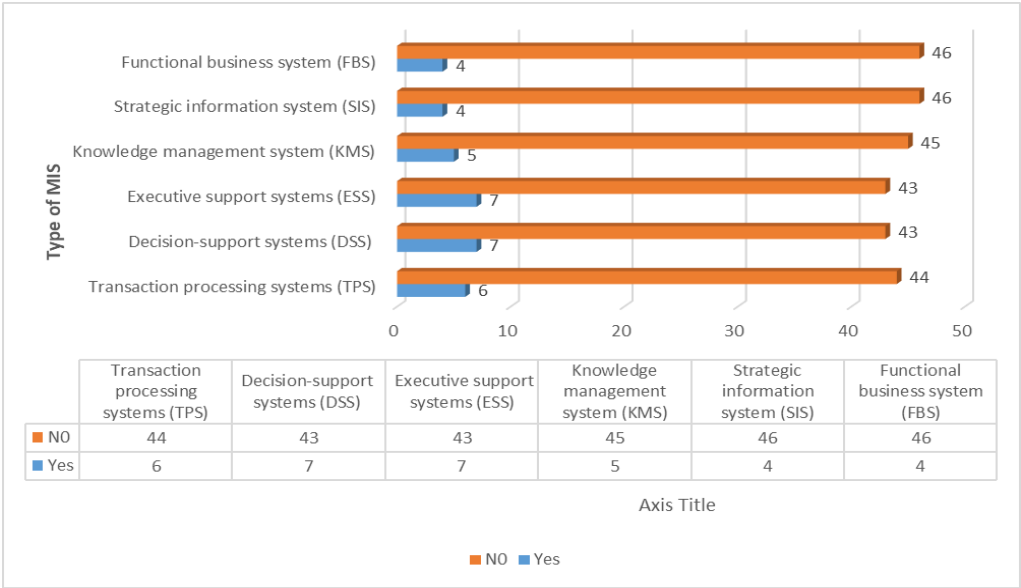


Figure 4.1: Current usage of MIS in Consultancy Companies

4.5.3 Main objectives of using MIS for a consultancy company

The detailed questionnaire survey included the identified objectives associated with MIS through the literature review to select the most significant objectives. The equal five-point scale was used to identify the most significant objective of the consultancy companies in the construction industry. According to the Relative Importance Index (RII) value, the objectives were sorted and ranked. Table 4.3 presents the findings of the questionnaire survey.

Table 4.3: Main objectives of using MIS

Objective of the Company	Level of Agreement					RII	Rank
	1	2	3	4	5		
Deliver the most relevant information requirements of the company	0%	0%	2%	16%	82%	0.960	1
Analyze the role of management and its effectiveness on information	0%	0%	0%	26%	74%	0.948	2
Converse the decision-making process and relevancy of the role of information	0%	0%	6%	16%	78%	0.944	3
Recognize the necessity of information in the usual operations of the organization	0%	0%	6%	20%	74%	0.936	4
1- Strongly Disagree, 2 - Disagree, 3 - Moderate, 4 - Agree, 5 - Strongly Agree							

The questionnaire survey results disclosed that all employees in consultancy companies agree with the given objectives. According to the results, more than 80% of employees strongly agreed with the objectives related to MIS. Even though most companies are not using MIS, they have agreed with the objectives of using MIS.

The calculated RII values clearly indicate very few differences between the four objectives. Still, all four values are in the range of $0.8 < \text{RII} < 1.0$, conveying that all four objectives carry a high importance level. Therefore, it is highlighted that all four objectives are the most significant associated with consultancy companies in the construction industry.

4.5.4 Benefits of using MIS for a consultancy company

Benefits identified from the literature were categorized into sixteen types. For those identified benefits, it is essential to find the agreement level between the consultancy companies. This part focuses on finding the most significant benefits of using those MIS over manual systems to fulfill the second research objective. Therefore, to achieve the objective, the respondents were required to rank all benefits based on a five-point Likert scale. Table 4.4 summarizes the findings based on benefits.

Table 4.4: Benefits of using MIS

Benefit	Level of Agreement					RII	Rank
	1	2	3	4	5		
Sharing of data	0%	2%	6%	8%	84%	0.948	1
Fast and consistent referencing	0%	4%	14%	8%	74%	0.944	2
Manage daily activities	0%	6%	8%	18%	68%	0.94	3
Consistency	0%	2%	10%	10%	78%	0.936	4
Provides a valuable time-saving profit to the humans	0%	4%	6%	8%	82%	0.932	5
Flexibility and Responsiveness	0%	2%	12%	6%	80%	0.928	6
Integrity	0%	4%	6%	10%	80%	0.924	7
Entree to appropriate knowledge and reports	0%	4%	6%	8%	82%	0.924	7
Use of few employment	0%	4%	14%	4%	78%	0.912	8
Security of information	0%	4%	10%	16%	70%	0.908	9
Balancing conflicting requirements	0%	2%	6%	12%	80%	0.904	10
Development in structure and division techniques	0%	2%	6%	10%	82%	0.904	11
Enforcement of Standards	0%	4%	6%	14%	76%	0.896	12
1- Strongly Disagree, 2 - Disagree, 3 - Moderate, 4 - Agree, 5 - Strongly Agree							

The questionnaire survey results easily identified that all employees working in the consultancy companies have agreed with the given benefits. According to the results analyzed, more than 80% of the employees strongly agreed with the benefits of using MIS. Even though the majority of the companies are not using MIS, they agree with

the benefits of using MIS. Few benefits have more than 80% frequency percentage: *sharing data, providing a valuable time-saving profit to the humans, flexibility and responsiveness, integrity, entree to appropriate knowledge and reports, balancing conflicting requirements, and development in structure and division techniques.*

The calculated RII values ascertain very few differences between the fifteen benefits. However, all fifteen values are in the $0.8 < \text{RII} < 1.0$ range, conveying that all fifteen benefits carry a high importance level. This confirms that all fifteen benefits are the most significant and are highly appropriate for MIS users.

4.5.5 Challenges of using MIS in a consultancy company

Challenges identified in the literature were categorized into six types. For those identified challenges, it is important to find the level of agreement of the consultancy companies. This part focused on finding the most significant challenge of using those MIS over manual systems to fulfill the third research objective. Therefore, the respondents should rank all challenges based on a five-point Likert scale to attain the objective. Table 4.5 summarizes the findings of the challenges.

Table 4.5: Challenges of using MIS

Challenge	Level of Agreement					RII	Rank
	1	2	3	4	5		
The high-cost factor of developing new computer systems.	0%	2%	8%	26%	64%	0.904	1
Implementation cost is very high because, from time to time, the scope, time, and new interventions occur.	0%	2%	8%	34%	56%	0.896	2
Loss of information due to website crashes and server crashes.	0%	6%	8%	18%	68%	0.888	3
Information retrieval is resisted by the system, and it is difficult to upgrade to new versions.	0%	6%	10%	30%	54%	0.888	3
Employees in the organization should have the ability to adopt to the new learnings and changes in the competitive environment.	0%	4%	6%	32%	58%	0.864	4
Implement with relevant updates by paying a higher cost.	0%	4%	12%	32%	52%	0.864	4
1- Strongly Disagree, 2 - Disagree, 3 - Moderate, 4 - Agree, 5 - Strongly Agree							

Results from the questionnaire survey easily identified that most professionals in consultancy companies have agreed with the given challenges. According to the results, 65% of respondents strongly agreed, 35% agreed with the challenges of using MIS, and 0% strongly disagreed. Even though the majority of the companies are not using MIS, they have some kind of idea about the challenges of using MIS. Among those challenges, ***the high-cost factor of developing new computer systems and losing information due to website crashes and server crashes obtained the highest frequency percentage.***

The calculated RII values signify very few differences between all six challenges. All six values are in the $0.8 < \text{RII} < 1.0$ range, conveying that all six challenges carry a high importance level. Therefore, it is highlighted that all six factors are most challenging for the companies using MIS.

4.5.6 Suitable strategies can process to implement MIS in a consultancy company

According to the questionnaire survey, many respondents highlighted that it is very good to implement MIS for companies undertaking large-scale projects. They stated that a few steps had to be followed when implementing MIS: implementation plan, establishing the MIS department, collection and purchasing of hardware, obtaining of software, designing the database, training of users, creating physical infrastructure, and transition to the new system.

Further, they highlighted that using MIS generally involves six main strategic objectives: ***operational excellence, new products, services, business models, client and supplier intimacy.*** Figure 4.5 demonstrates the 12 main phases of the life cycle approach to the development of MIS:

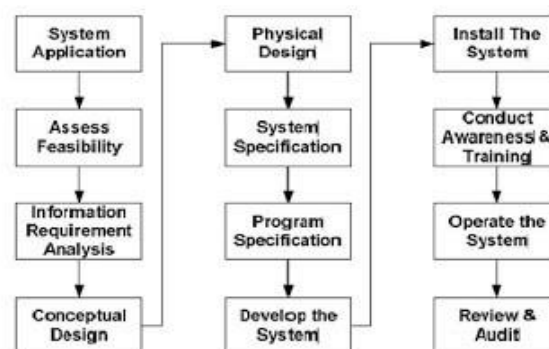


Figure 4.5: Life-cycle approach to the development of MIS

Finally, MIS play the vital position of providing a comprehensive range of modernized options to the management for decision-making to get their preferred choices. This guarantees that the outcome becomes positive whatever selections are made by decision-makers.

4.6 Discussion of Findings

With reference to the literature findings, expert interviews, and questionnaire surveys, most consultancy companies in the construction industry are not using MIS for the overall process of the company, but all use some type of in-house-built system according to the company requirements. Most companies use manual systems, and they are comfortable with that because most of them belong to small- and medium-scale categories, which consist of a small group of employees. Therefore, they do not feel the requirement of adopting MIS than using their traditional manual methods.

Compared to the global context, the use of MIS in Sri Lankan industries is indescribably small and deteriorating gradually. Most companies are not willing to invest in such things as they focus much on their profit. Nevertheless, all companies agreed that MIS is a good concept and implementation will benefit all.

According to the literature, there are six MIS types, namely DSS, KMS, TPS, SIS, ESS, and FBS. The questionnaire survey results identified that most companies are not aware of the available MIS types. Moreover, it has been highlighted that only a few companies are currently using MIS, and a majority of consultancy organizations are not using them. It also revealed that 80% of the consultancy companies have strongly agreed with the objectives of MIS, such as delivering the most relevant information requirements of the company, analyzing the character of organization and its effectiveness on information, converse the decision-making process and relevancy of the role of information, and recognize the necessity of the information in usual operations of the organization.

Having identified the benefits of using MIS, the following main factors were highlighted through the interviews and questionnaire surveys: sharing of data, providing a valuable time-saving profit to humans, flexibility and responsiveness, integrity, entree to appropriate knowledge and reports, balancing conflicting requirements, and development in structure and division techniques. The respondents' opinion reveals the significant challenges, such as the high-cost factor

of developing new computer systems and losing information due to website crashes and server crashes.

Some strategic ideas emerged for developing MIS after considering all findings. These maximize the organizations' ability to achieve their agreed objectives and provide the best service according to client requirements. Accordingly, the opportunities and needs of MIS should be identified and prioritized. Consideration is focused on the need to remove surplus information systems.

Within this context, the study can recommend the following:

- to design and determine a appropriate strategy to create MIS in consultancy companies in the Sri Lankan construction industry,
- to improve the philosophy of utilizing computers and communication techniques on every scale of the projects,
- to provide a comprehensive plan before using MIS, and
- to form an MIS committee from the beginning of using MIS in the business.

The purpose of this section was to present main research findings, and triangulating, literature, interviews, and questionnaire survey findings.

4.7 Chapter Summary

This chapter consists of analysis and research findings to achieve the research objectives and the research aim. Content analysis was used to analyze the expert interview findings to achieve objectives two, three, and four by identifying the benefits of implementing MIS in consultancy organizations in construction industry in Sri Lanka and investigating the barriers to using MIS in consultancy organizations in Sri Lanka. It also proposes suitable strategies to enhance the use of MIS in consultancy organizations in Sri Lanka, efficiently and effectively.

RII method was used to analyze the questionnaire survey findings to accomplish the second, third, and fourth research objectives by ranking the awareness of common MIS types in consultancy companies, the main objective of using MIS, and the agreement level on the importance of using them, benefits of using MIS to a consultancy company, challenges of using MIS in a consultancy company, and finally, propose suitable strategies for enhancing the usage of MIS in consultancy companies in the Sri Lankan Construction Industry.

5. CONCLUSIONS AND RECOMMONDATIONS

5.1 Introduction

The main intention of this chapter is to provide a wide-ranging description of the final outcomes of the research findings elaborated in Chapter Four. Conclusions derived from research findings described in the previous chapters were also encompassed in finalizing the research. Similarly, this chapter discusses the conclusions derived from each research objective.

This research investigated the adaptability of Management Information Systems (MIS) in Consultancy Organizations in Sri Lanka. In this regard, recommendations have been provided for developing MIS in consultancy companies in the Sri Lankan construction industry. Therefore, this section demonstrates how fruitfully accomplished those initially established objectives with the research discoveries.

5.2 Conclusions

This research aimed to investigate the adoptability of MIS in Consultancy Organizations in Sri Lanka. Hence, this study started with a brief literature review in which the definition and concept of MIS, objectives of MIS, models of MIS, development of MIS, types of MIS, advantages of implementing MIS, challenges of using MIS, the role of MIS in decision-making, and application of MIS in the construction industry were recognized, and the research gap was recognized. While identifying those details from the literature review, the research study was conducted with a triangular concurrent mixed design approach. Semi-structured interviews and a questionnaire survey were employed as data collection techniques. At the end of this study, the aim and objectives were fulfilled using the findings derived from analyzing the collected data. The conclusions of each objective, fulfilled throughout the first four chapters, are mentioned in the following subsections.

5.2.1 Achievement of Objective One - Examine the MIS concept and its applications globally and locally

According to the literature synthesis, MIS can be defined and stated in various ways. However, it is generally known as a ‘group of structures and events that collect data

from a variety of sources, accumulate, and present it in a readable format.’ It was highlighted that the initial concept of MIS is ‘data processing and presenting in a report format at regular breaks.’ Therefore, these information systems are mainly developed to focus on separate needs and requirements of the specific organizations that are exclusive from other organizations. It is highly emphasized that the primary goal of MIS is to help the top management of the organization to make accurate decisions ranging from minor details to top-level strategy.

There are six MIS types identified through literature findings: Transaction Processing Systems (TPS), Decision-Support Systems (DSS), Executive Support Systems (ESS), Knowledge Management Systems (KMS), Strategic Information Systems (SIS), and Functional Business Systems (FBS). However, it was pointed out that using those MIS involves advantages as well as disadvantages, especially in consultancy companies in the construction industry. Chapter Two and Chapter Four provided a detailed discussion on these aspects.

The usage of MIS in consultancy companies in the Sri Lankan construction industry is very low compared with the global construction industry. Most consultancy companies use in-house implemented unique systems and are not much interested in MIS. Still, all companies use some kind of software package to manage the company requirements and fulfill customer desires. Findings from the expert interviews clearly emphasized that all companies of quantity surveying, engineering, and architecture are not using MIS for the overall administration process of the company, but they are comfortable with their current unique in-built systems. Since most companies consist of small groups of employees handling small- and medium-scale projects, they do not feel the requirement of working and analyzing the project progress through MIS—hence they follow the traditional manual methods.

5.2.2 Achievement of Objective Two - Identify the benefits of implementing MIS in Consultancy Organizations in the Sri Lankan Construction Industry

This objective is accomplished through expert interviews, a detailed questionnaire survey, and supportive literature findings. In this research, overall benefits were identified and analyzed through a five-point Likert scale. Awareness of the common types of MIS was recognized, and it was pointed out that most companies are less

aware of such types. Many companies have some ideas regarding the Decision Support System.

The same five-point Likert scale was used to identify objectives associated with MIS. After analyzing data, it revealed that the most significant objective is to deliver the most relevant information requirements of the company.

The benefits of using MIS are the primary part of this research. According to the RII values, it was identified that data sharing, fast & consistent referencing, and managing daily activities received the highest ranks. From the consultants' viewpoint, using MIS helps enhance company performance by better decision-making while minimizing the risk. The high accuracy and low time consumption provide accurate information and quality products and services to enhance company performance. Therefore, top management can review the overall project progress very quickly and easily. The high accuracy and quick results reduce the time wastage and conflicts between clients and consultants.

Finally, it confirmed that those benefits help organizations to enter new markets, remain competitive, and transform according to the way of doing the business.

5.2.3 Achievement of Objective Three - Investigate the barriers to using MIS in Consultancy Organizations in Sri Lanka

For the third objective, many barriers were identified through literature findings, expert interviews, and questionnaire surveys. The barriers identified through the literature survey were analyzed in this research through a questionnaire survey using a five-point Likert scale. The outcomes highlighted (1) high-cost factors in developing new computer systems, (2) losing information due to website crashes and server crashes, (3) high implementation costs because the scope, time, and new interventions occur periodically, and employees in the organization must be able to adopt the new learnings, and (4) changes in the competitive environment as the most challenging factors when implementing MIS in consultancy companies in the Sri Lankan construction industry.

During expert interviews, most interviewees pointed out that the initial cost and the maintenance cost of implementing the MIS are very high. They mentioned that systems might collapse due to software crashes, virus attacks, cyber-attacks, and technical issues. Backup files have to be managed constantly to avoid such situations.

They further highlighted that employee retention is another important barrier in implementing the MIS.

These results strongly indicate that a considerable number of barriers affect implementing MIS in consultancy companies in the Sri Lankan construction industry.

5.2.4 Achievement of Objective Four - Propose suitable strategies to (efficiently and effectively) enhance the use of MIS in consultancy organizations in Sri Lanka

Several strategies were identified to enhance the use of MIS by considering all responses. MIS strategy is an idea for emerging management information systems. It enhances the capacity of an business to accomplish its approved objectives and provide the best service according to client requirements. Typically, a strategy provides the context for the organization to ensure competencies between systems and prioritizes development. That framework boosts eliminating surplus information systems.

The following strategies will help to develop and boost the use of MIS in an organization:

1. Create an enterprise-wide MIS with a high-level professional in charge.
2. Carrying an audit of the information of the company to detect the origin of the costs and blockages.
3. Remove redundant storage space.
4. Use enterprise content management to drop light on 80% to 90% of the formless data.
5. Apply big data analytics to the evidence of the company to commercial developments and make forecasts.

5.3 Limitations of the Research

Conducting this research was limited to the consultancy companies of engineering, quantity surveying, and architecture, and only nine industry expert interviews were held, and the questionnaire survey was limited to 50 respondents working in consultancy companies in the construction industry. Moreover, this research was done to the consultants' perception and not extended to clients and contractors.

The study focused on the adoptability of Management Information Systems in consultancy organizations in the Sri Lankan construction industry to enhance the

performance of the organizations. However, many more areas have to be considered, such as communication, security, cost, and accuracy, when implementing MIS for any industry.

5.4 Recommendations for the Industry

These research findings precisely pointed out that implementing MIS for consultancy companies in the Sri Lankan industry would be beneficial and essential for the future. Especially, engineers, quantity surveyors, and architects will have to play a prominent role in mega-scale construction projects by adopting MIS. Consequently, the research can recommend the following endorsements for better performance in consultancy companies.

Following are some suggestions/recommendations:

- The organization must work to provide the required provision of appropriate technology for implementing MIS.
- Training people to deal with MIS and grow the philosophy of using computers and information systems; should not limit this to large-scale companies.
- Accurately determining the cost for implementing MIS within the company budget to provide certain requirements for system implementation.
- Scheming and defining an appropriate strategy to develop MIS in consultancy companies in the Sri Lankan construction industry.
- Organizing appropriate discussions at local and global levels to improve the use of MIS in consultancy companies in the Sri Lankan construction industry.
- Throughout the layout, organization, and product process of MIS in the business, the administrators should be concerned about the developmental qualities of the organization personnel.
- Absorbing the efficient and skillful employees and creating suitable reasons for the strength of the remaining personnel.
- Establishing an MIS committee from the beginning using MIS in the organization.

5.5 Areas for further study

- Create an MIS model representing the relationship between the client, consultant, and contractor.

- The current study was limited to consultancy companies in the construction industry. Thus, it can be further developed for other industries such as education, health, banking, and finance.
- Conducting case studies for large-scale projects through implementing and validating a framework.

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Appendix A - SEMI STRUCTURED INTERVIEW GUIDELINE

Semi Structured Interview Guideline

Dissertation – MSc in Project Management

Dear Sir/Madam,

I am Miyuru Prabhashi Galgamuwa, following MSc in Project Management at Department of Building Economics, University of Moratuwa. Presently, I'm involved a research which is incorporated in the dissertation to be prepared and submitted at the end of the course of study.

The topic of my dissertation is “**Adoptability of Management Information Systems (MIS) in Consultancy Organizations in Sri Lankan Construction Industry**”. I have identified you/your organization as a potential participant who could provide valuable information for my research.

The interview will be carried out only for the purpose of fulfilling the requirements of the dissertation. Through this interview I'm hoping to validate the findings of literature synthesis and check on the applicability of the findings towards Management Information System. The information shared and the time dedicated despite the busy schedule is highly appreciated.

Thank you.

Yours faithfully,

Miyuru Prabhashi Galgamuwa,
Student – MSc in Project Management,
Department of Building Economics,
University of Moratuwa.

Personal information

1. Name and designation of respondent (optional): -
2. Name of the organization:-
3. Number of years of experience in the construction industry: -

Questions

1. Can you give a brief introduction to the Organization?
2. a) What are the existing Management Information Systems (MIS) that using in your Organization? Please give a brief introduction regarding such systems.

b) If your organization is not using MIS, please state the reasons.
3. What are the benefits of using such systems compared to the manual systems?
4. What are the challenges of using those systems and how to overcome from them?
5. In your opinion, how is the current usage of MIS systems (methods and techniques) in consultancy companies in Sri Lankan Construction Industry?
6. According to your perspective, approach of adopting MIS is, good or bad for the present situation in local Construction Industry? Explain with suitable examples.
7. Do you have any additional things to say?

Thank you

APPENDIX B – INTERVIEW TRANSCRIPT

Personal information

1. Name and designation of respondent (optional): (ManaginDirector/CEO)
2. Name of the organization:- ABC
3. Number of years of experience in the construction industry: - 22 +

Questions

1. Can you give a brief introduction to the Organization?

We at ABC are committed to provide engineering consulting services in different fields in the world of Engineering by using the state of art technology and knowhow in order to exceed the customers' expectations and to enhance everyone's lifestyle truly comfortable.

To deliver the best services to all of our clients, we comply with all the applicable requirements including legal and statutory requirements and organizational values including quality, reliability, accountability, sustainability, integrity, creativity and success. In doing so, all business functions are managed through a well-defined process in efficient and effective manner assuring continual improvements to quality management system of the Company while achieving its corporate goals and objectives.

2. a) What are the existing Management Information Systems (MIS) that using in your Organization? Please give a brief introduction regarding such systems.

Currently we have ISO 9001: 2015 quality management system for our internal process in the company, especially for the business development. Therefore, we'll be able to provide the high quality products and services according to the client's requirement. We are strictly follow the ISO quality manuals and guidelines for our services. Apart from that we are using an in-house developed CV database for the consultants and can sort the required CVs according to the profession, years of experience, Age, professional & academic qualifications, etc. And also our finance division has same kind of in-house developed system which can categorize in to rates, sample agreements, prices, profits etc. For the accounting purposes we are using

quick book software. We limit the access to the confidential data and relevant authority have the permission to when necessary.

At the moment we are trying to develop our internal systems using user friendly interfaces through visual basic with the help of our internal IT staff.

b) If your organization is not using MIS, please state the reasons.

3. What are the benefits of using such systems compared to the manual systems?

There is no time consuming and accuracy is very high. Can do more work when comparing to the manual systems. No need more staff to do the work. Can do business decision making very quickly while minimizing the risk.

4. What are the challenges of using those systems and how to overcome from them?

Capital cost will be high at the initial stage. Have to choose the right MIS according to the type of the organization.

5. In your opinion, how is the current usage of MIS systems (methods and techniques) in consultancy companies in Sri Lankan Construction Industry?

According to my view, I think current usage is low. Most of the companies are not focus to have or implement such systems because somehow they want to do the work. At the end of the work, if they have the expected profit the management are fine with that. Therefore, most of the management in the companies are not very much worry about those systems.

6. According to your perspective, approach of adopting MIS is, good or bad for the present situation in local Construction Industry? Explain with suitable examples.

It's very good to adopt MIS for the present situation in local Construction Industry. It's useful to get correct decision making according to market changes. Some companies are outsource the services according to the requirements. If they have in-house MIS it's very easy to provide the services effectively and efficiently.

7. Do you have any additional things to say?

It's good to have MIS for consultancy companies as well as for the clients and contractors because now most of the tenders are coming as design & built. Not the separate as earlier as design for the consultancy companies and

built for the Contractors. Therefore if both have adopt to the MIS, quality of the work can be maintained up to standard.

Thank you

APPENDIX C - QUESTIONNAIRE GUIDELINE

Questionnaire Guideline

Dissertation – MSc in Project Management

Dear Sir/Madam,

I am Miyuru Prabhashi Galgamuwa, following MSc in Project Management at Department of Building Economics, University of Moratuwa. Presently, I'm involved a research which is incorporated in the dissertation to be prepared and submitted at the end of the course of study.

The topic of my dissertation is “**Adoptability of Management Information Systems (MIS) in Consultancy Organizations in Sri Lankan Construction Industry**”. I have identified you/your organization as a potential participant who could provide valuable information for my research.

The questionnaire will be carried out only for the purpose of fulfilling the requirements of the dissertation. Through this questionnaire I'm hoping to validate the findings of literature synthesis and check on the applicability of the findings towards Management Information System. The information shared and the time dedicated despite the busy schedule is highly appreciated.

Thank you.

Yours faithfully,

Miyuru Prabhashi Galgamuwa,
Student – MSc in Project Management,
Department of Building Economics,
University of Moratuwa.

Section 1 – General Information

1.1 Name of Organization: (Optional)

.....

1.2 Name of Respondent: (Optional)

.....

1.3 Designation of the Respondent:

.....

1.4 Experience in Construction Field:

0-5 Years ☐ 6-10 Years ☐ 11-15 Years ☐ 16-20 Years ☐ 21-25 Years ☐

Section 2 – Awareness and Use of Management Information System

2.1 Common MIS type/s are listed below. Please state the level of awareness of such systems.

MIS Type	Level of Awareness				
	Strong	Good	Moderate	Poor	No Idea
Transaction processing systems (TPS)	☐	☐	☐	☐	☐
Decision-support systems (DSS)	☐	☐	☐	☐	☐
Executive support systems (ESS)	☐	☐	☐	☐	☐
Knowledge management system (KMS)	☐	☐	☐	☐	☐
Strategic information system (SIS)	☐	☐	☐	☐	☐
Functional business system (FBS)	☐	☐	☐	☐	☐
Other (Please Specify.....)	☐	☐	☐	☐	☐

2.2 What are the current MIS type use in your organization while handling information.

Current MIS Type	Yes	No
Transaction processing systems (TPS)	☒	☐
Decision-support systems (DSS)	☐	☐
Executive support systems (ESS)	☐	☐
Knowledge management system (KMS)	☐	☐
Strategic information system (SIS)	☐	☐
Functional business system (FBS)	☐	☐
Other (Please Specify.....)	☐	☐

2.3 In your opinion, what are the main objectives of using MIS in Consultancy Company?

Objective	Yes	No
Deliver the most relevant information requirements of company	☐	☐
Analyse the role of management and its effectiveness on information	☐	☐
Converse the decision making process and relevancy of the role of information	☐	☐
Recognize the necessity of the information in usual operations of the organization	☐	☐
Other (Please specify)	☐	☐

Section 3 – Benefits & Challenges of Management Information System

3.1 Please indicate benefits of using MIS in Consultancy Companies in Sri Lankan Construction Industry?

No	Benefit	Level				
		1. Strongly Disagree	2. Disagree	3. Moderate	4. Agree	5. Strongly Agree
1	Economy of scale	☐	☐	☐	☐	☐
2	Sharing of data	☐	☐	☐	☐	☐
3	Balancing conflicting requirements	☐	☐	☐	☐	☐
4	Enforcement of Standards	☐	☐	☐	☐	☐
5	Control Redundancy	☐	☐	☐	☐	☐
6	Integrity	☐	☐	☐	☐	☐
7	Consistency	☐	☐	☐	☐	☐
8	Security of information	☐	☐	☐	☐	☐
9	Flexibility and Responsiveness	☐	☐	☐	☐	☐
10	Provides a valuable time-saving profit to the humans	☐	☐	☐	☐	☐
11	Effective and monetary coordination within Departments	☐	☐	☐	☐	☐
12	Use of fewer employment	☐	☐	☐	☐	☐

13	Development in structure and division techniques	☐	☐	☐	☐	☐	
14	Manage the daily activities	☐	☐	☐	☐	☐	
15	Fast and consistent referencing	☐	☐	☐	☐	☐	
16	Entree to appropriate knowledge and reports	☐	☐	☐	☐	☐	
17	Any Other	☐	☐	☐	☐	☐	

3.2 Please indicate the challenges of using MIS in Consultancy Companies in Sri Lankan Construction Industry?

No	Challenge	Level					
		1. Strongly Disagree	2. Disagree	3. Moderate	4. Agree	5. Strongly Agree	
1	High cost factor of developing new computer systems.	☐	☐	☐	☐	☐	
2	Implementation cost is very high because time to time the scope, time and new interventions has been occur.	☐	☐	☐	☐	☐	
3	Information will lose due to the web site crashes and server crashes	☐	☐	☐	☐	☐	
4	Information retrieval is resist by the system and difficult to upgrade for new versions	☐	☐	☐	☐	☐	
5	Employees in the organization should have the ability of adopting for the new learnings, changes in the competitive environment	☐	☐	☐	☐	☐	
6	Implement with relevant updates by paying higher cost	☐	☐	☐	☐	☐	
7	Any Other.....	☐	☐	☐	☐	☐	

3.3 What are the strategies and recommendations can propose to implement MIS in Consultancy Companies in Sri Lankan Construction Industry?

I greatly appreciate your valuable time and efforts that you have spent in filling out this questionnaire.