# PROJECT MANAGEMENT DASHBOARD OVER PREVAILING TOOLS AND SOFTWARE: A STUDY ON ADDRESSING NINE KNOWLEDGE AREAS

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***ABSTRACT***

*Construction projects represent unique and immensely complex array of interdependent activities that must take place to accomplish project goals. Thus, the nature of construction projects reasoned to complications and ambiguities in the construction process demands the need for Project Management (PM) to fruitful completion of projects. Construction PM uses a range of tools and software to assist the accomplishment of PM knowledge areas which define the critical constraints of a project such include the management of time, cost, quality, risk, integration, scope, communication, procurement and human resource. However, the selection of convenient PM tools and software which fulfil critical requisites in construction projects is problematic. Project Management Dashboard (PMD) is one of PM tools, which contains a variety of quality based project tracking and control metrics. Though PMD is widely practiced in other industries, a lacuna existed under the Sri Lankan construction context.*

*Hence, this study intended to assess the fulfilment of nine PM knowledge areas by PMD over prevailing PM tools and software. Thus, a hybrid survey approach, including questionnaire survey and the expert interview survey was conducted among PM professionals due to the fact that positivism in the research philosophy. The questionnaire survey analysis emphasised the ineffectiveness of most commonly used PM tools and software in fulfilling critical PM necessities and affirmed that an individual tool cannot effectively address on crucial PM needs. Subsequently, PMD was developed incorporating the essential elements (i.e. physical and financial progress, approval status, issues, risk, labour and general) based on the expert survey findings. Further, the interview survey confirmed the suitability of PMD in addressing critical PM requirements over conventional tools and software used in the Sri Lankan construction industry obtaining the results above the midpoint of the scale. Eventually, it is recommended to utilise PMD, in order to successfully manage construction projects.*

***Keywords:*** *Project Management; Project Management Dashboard; Project Management Knowledge Areas*

## 1. INTRODUCTION

A project is a solution to a problem (Winch, 2002) that has a clear beginning and end and is carried out to achieve established goals within cost, schedule and quality objectives (Haynes and Perry, 1985). In consideration of the construction projects, Walker (2007) defined it as intricate and time-consuming undertakings which have unique and multifaceted nature enhance the risk of the project. Hence, the PM approach is essential to successfully manage construction projects. Mansfield (as cited in Meng, 2012) identified the intricate nature of construction projects necessitate to manage overall critical requirements of the project, in order to successfully accomplish project objectives. PM Institute [PMI] (2008) emphasised the importance of fulfilling nine knowledge areas in PM, which offer a comprehensive guideline to manage projects.

Further, Koppelman and Fleming (2006) emphasised effective PM tools and software are indispensable to manage critical requirements of the project during the construction stage. Furthermore, PM tools and software are imperative to monitor the progress of the project. However, Young (2006) illustrated that conventional PM tools and software generally focused on planning and scheduling of the project, which are not satisfactorily addressing on critical PM requirements in construction. Aaron (2001) stated traditional

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project planning and control tools such as Task list and Gantt charts are not adequate to control large scale projects. Sole reliance on a tool such as MS project is inadequate for tracking and controlling complex and integrated projects. Hence, it is crucial to utilise appropriate PM tools or software, which is capable to address critical requirements of construction projects (Berkun, 2005).

Conventional tools and software are not adequately address critical PM desires. Thus, technically improved software and innovative PM solutions are regularly utilised in an international context. For instance, The PMD is a customised PM information system containing a variety of quality based project tracking and control metrics. The PMD enables the project manager to clearly monitor the 'vital signs' of a project, to identify problems early and to trigger corrective and proactive actions in a timely manner (Aaron, 2001).

Sri Lankan construction industry also necessitates an innovative PM tool to improve the excellence of PM through minimising poor performance. Hence, this study aims at identifying the suitability of the PMD in addressing critical PM requirements over other conformist PM tools and software under the Sri Lankan building construction context.

To achieve the above aim, it was found necessary to achieve the following objectives:

- To identify construction project management and project management knowledge areas.
- To identify the prevailing PM tools and software and its fulfilment of PM knowledge areas.
- To develop PMD, incorporating critical requisites.
- To investigate the suitability of the PMD in addressing PM knowledge areas.

The scope of the study was limited to the building construction in Sri Lanka; therefore the civil engineering construction had been excluded. The paper structure begins in the following sections with a review of literature. The next section presents the research methodology followed by data analysis. The paper finally presents discussions and conclusions of the research study.

## 2. LITERATURE REVIEW

### *2.1. THE CONCEPT OF PROJECT*

The projects are temporary in nature which contains a definitive start date and end date (Chaudhary, 2005). Each project is specific and unique in nature which contains a specific deliverable aimed at meeting a specific need or purpose (Mantel *et al.*, 2010). Similarly, the PMI (2008) defines a project as "A temporary endeavour undertaken to create a unique product or service".

Different authors have defined the term project in different ways. Nevertheless, there are some general characteristics, which could be identified in most of these definitions. Table 1 recapitulates general characteristics of a project identified by the different authors.

Table 1: General Characteristics of a Project

| General Characteristics | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Projects are unique | x | x | x | x | x | x | x | x | x | x |
| Projects are goal oriented. | x | x | x | x | x | x | x | x | x | x |
| Temporary in nature, | x | x | x | x | x | x | x | x | x | x |
| Defined beginning and a finish | x | x | x | x | x | x | x | x | x | x |
| Clear life cycle | x | | x | | | x | x | | | x |
| Consist with number of separate yet interdependent activities. | x | x | x | | x | x | | x | x | x |
| Require a range of resources. | x | x | | x | | x | | x | | x |
| Project delivers unique output. | x | | | x | x | x | | x | x | x |
| Projects cut across organisational lines. | | x | | x | | x | x | | | |
| Creation of new value. | | | | x | | | | x | x | x |

Note: A=Project Management Institute, 2008; B=Kerzner, 2001; C=Nicholas, 2001; D=Heyworth, 2002; E=Phillips, 2004; F=Heldman, 2005; G=Chaudhary, 2005; H=Walker, 2007; I=Winch, 2002; J=Woodward, 1997

Nicholas (2001) stated that clear identification of the characteristics of a project would be advantageous to effective management process. Therefore, management of projects is critically important in order to achieve the defined objectives of the project successfully.

### *2.2. THE CONCEPT OF PM*

PM is the planning, organising, directing, and controlling of company resources for a relatively short term objectives, which has been established to complete specific goals and objectives (Kerzner, 2001; Heldman, 2005). Further, Young (2006) defined PM as a dynamic process which utilises the proper resources of an organisation in a controlled and prearranged manner to achieve clearly distinct objectives identified as strategic needs. Furthermore, Chaudhary (2005) summarised that PM involves applying knowledge, skills, and techniques during the course of the project to accomplish the project requirements and the project manager is responsible to ensure whether PM techniques are applied and followed. Moreover, PM engages with different functions which include defining the requirement of work, establishing the extent of work, allocating the resources required, planning the execution of the work, monitoring the progress of the work and adjusting deviations from the plan (Munna and Bjeirmi, 1996).

### *2.3. PM KNOWLEDGE AREAS*

PM involves identifying project requirements, establishing project objectives, managing constraints, and prioritising the needs and expectations of the key stakeholders (Heldman, 2005). Hence, nine knowledge areas of PM are established to address the critical requirements of a project (PMI, 2008). The discussions on nine knowledge areas were tabulated in Table 2 below.

Table 2: Nine Knowledge Areas

| | |
|---|---|
| Time management | Time management involves defining and sequencing activities and estimating the duration and resource requirements for each individual task (Rosenau and Githens, 2005). Further, Heldman (2005) emphasised that successful time management leads to keep the activities on track and ensure the achievement of target completion. According to PMI (2008) emphasised on five steps in the time management process. They are defining activities, sequence activities, estimate activity resources, estimate activity duration and develop a schedule. |
| Cost management | Effective cost management is one of the core focus areas in PM since financial resource is a key constraint in a project (Winch, 2002; Kerzner, 2001). Morris *et al*, (2006) identified that cost estimating, cost budgeting, and cost control as the three foremost activities in the cost management. |
| Quality management | Quality management assures that the project meets its specified requirements (Heldman, 2005). Further, Verzuh (2003) highlighted project quality management as a continuous process throughout the project life cycle which determines quality policies, objectives, and responsibilities. Moreover, quality management, process involves three steps, including plan quality, quality assurance and quality control (Kerzner, 2001; Verzuh, 2003). |
| Risk management | Project risk management concerned with identifying, analysing, and planning potential threats and opportunities (Heldman, 2005). Further, Heldman (2005) stated that the early identification of risk and uncertainty in a project is extremely important. According to Cooke and Williams (2004), risk management process involves six major steps which follow, risk management plan, identify risk, qualitative and quantitative risk analysis, plan risk responses and monitor and control risk. |
| Integration management | Integration management involves identifying and defining the project tasks and combining, unifying, and integrating the appropriate process (Berkun, 2005). Further, Rosenau and Githens (2005) stated that the integration is basically focused on making choices to prioritise resources and effort. According to the PMI (2008), integration management comprises seven processes which include, develop project charter, |

| | |
|---|---|
| | develop a PM plan, manage project execution, monitor and control project, integrated change control and close project or phase. |
| Scope management | This engages in management of the requirements, details and processes (Kerzner, 2001). Moreover, scope management focus on defining the needs, set the expectations, manage the changes and minimise the deviations of the project (Heldman, 2005). With reference to PMI (2008), five important steps in project scope management are identified which take account of collecting requirement, define scope, create work breakdown structures, verify the scope and control scope. |
| Communication management | Field and Keller (1998) highlighted that effective communication creates a bridge between diverse stakeholders involved in a project, connecting various cultural and organisational backgrounds, different levels of expertise, and various perspectives and interests in the project execution or outcome. Further, communication management in a project team is a process which is illustrated by the PMI (2008) including identifies stakeholders, manage stakeholder expectations, plan communication, report performance and distribute information. |
| Procurement management | Procurement management processes of procuring products, services, or results externally (PMI, 2008). It is focused on establishing, maintaining and closing relationships with suppliers of goods and services for the project (Phillips, 2004). Furthermore, Project Management Institute (2008) provides four major steps of Project procurement Management, which are plan procurement, conduct procurement, contract administration and close procurement. |
| Human resource management (HRM) | Project HRM processes ensure human resources are utilised in the most effective, efficient and economical way (Kerzner, 2001) by leading the team, coaching, dealing with conflicts and performance appraisal (Heldman, 2005). According to PMI (2008) emphasises four steps in project HRM which comprising of developing an HR plan, acquiring project team developing a project team and managing a project team. |

### *2.4. CONSTRUCTION PM*

Construction projects are unique. It is heterogeneous and enormously complex (Walker, 2007). Clough, Sears, and Sears (2000) specified unique nature of the construction projects amplifies the complexity and the uncertainty. Further, Cooke and Williams (2004) suggested extensive project management techniques are essential to effectively manage construction projects due this complexity and the uniqueness.

Winch (2002) identified the construction PM as the process of controlling the accomplishment of the project objectives utilising the existing organisational structures and resources. Further, Oberlender (2000) emphasised construction PM seeks to manage the project by applying a collection of tools and techniques, without adversely disturbing the routine operation of the company. Fryer *et al.* (2004) suggested that application of PM knowledge areas into construction PM is beneficial to effectively manage the entire process. Furthermore, it is important to utilise all the extensive PM concepts and nine knowledge areas to successfully perform the duties (Oberlender, 2000).

Time, cost and the quality are the primary concerns of clients in the construction industry, which is known as the triple constraints in construction projects (Bennett and Grice, 1990). Hence, the proper project monitoring system is decisive to effectively manage time, cost and quality objectives of the project. Effective monitoring and controlling of project progress is vital as planned in the construction PM process. Harris and McCaffer (2006) described monitoring as the act of checking actual progress against planned schedule, whereas the act of taking decisions to alter the likely future outcome and bringing the project back on the planned schedule is described as controlling. According to Heldman (2005), PM utilises different tools and techniques performed by people to define, organise, and monitor the project activities.

### *2.5. PM TOOLS AND SOFTWARE*

Construction PM is a challenging task with many complex responsibilities. Modern construction PM utilises a number of tools to assist in accomplishing the tasks and executing the responsibilities (Yeung *et al.*, 2009). Some of the tools necessitate supporting computer applications and some can be used manually.

Conlin and Retik (1997) affirmed that an individual tool cannot effectively address on crucial PM needs. Therefore, selection of appropriate sets of PM tools is beneficial for effective construction PM.

PM software is beneficial to manage the project efficiently and keep a track of all the activities in the PM process (Winch and Kelsey, 2005). Further, PM tools have developed from simple spreadsheet products to sophisticated, web-based project information portals (Anbuvelan, 2005). Furthermore, Pryke and Smyth (2006) highlighted that trends in PM software are to move towards web-based systems, which integrate different systems of the project. Besides, PM software capabilities and features vary a great deal among the available packages (Kerzner, 2001). Nevertheless, the variation is more in the depth and sophistication of the features, such as its storage, display, analysis, interoperability, and user friendliness are similar for most software packages (Bayross, 2005). Hence, Tidwell (1992) demonstrated that purpose of the PM software is to make the creative process of outlining and controlling a project, from initial design to start-up, more controllable. Thus, PM software and tools ensure that project would be completed in a timely manner, within budget, and the desired level of quality.

Hence, the existing literature revealed the prevailing construction project management tools and software as tabulated in Table 3 below.

Table 3: Project Management Tools and Software

| Project Management Tools | | Project Management Software | |
|---|---|---|---|
| Work Breakdown Structure | Earned value management | MS Project | MS Excel |
| Gantt Charts | Scenario Planning | Primavera (P6) | Cost Track |
| Critical Path Method | Project Reports | Primavera Earned Value Management | American Contractor |
| Program Evaluation Review Technique | Project Management Dashboard | Primavera Contract Management, Business Intelligence Publisher Edition | Basic Builder |
| Six Sigma | | | Construction Manager |
| Source: Cooke and Williams (2004); Kerzner (2001); Morris and Pinto (2007) | | Source: Oracle (2013); Kerzner (2001) | |

### *2.6. PROJECT MANAGEMENT DASHBOARD*

The PMD has been identified as one of the project management tools in Table 3. PMD is a customised PM information system containing a variety of quality based project tracking and control metrics which enables the project manager to identify the "vital signs" of a project for early identification of issues and to prompt proactive actions in a sensible approach (Aaron, 2001). Further, Kerzner (2001) highlighted that the main purpose of the PMD is to provide accurate information to the right person at the right time using the correct medium in a cost effective approach. Furthermore, Rahman *et al* (2011) affirmed that PMD is advantageous to dramatically reduce the need for financial and operational reports. Thus, it is useful for decision making and improves the performance. Moreover, Aaron (2001) recognised three major advantages of PMD, i.e. concentrating on vital activities of the project, identifying the true status of the project and provides a weekly report on key dimensions of the project. Besides that, the developments of PMD in MS Excel spreadsheets allow users to adopt into the system with a less effort. Hence, the graphical presentation approach is supportive to express the actual status of the project to key stakeholders, including the layman clients (Rahman *et al.*, 2011).

## 3. METHODOLOGY

An extensive literature review was carried out to investigate concepts of construction PM and theoretical overview of PM knowledge areas. In the consideration of the research philosophy, to a certain extent it is believed that the research is more towards to the positivism end. It is a fact that, the existing theory is used to develop a hypothesis on the determination of nine knowledge areas through PMD. Hence, it is subsequently tested in whole or part, or refuted, leading to the further development of the theory (Saunders

*et al*., 2009). Moreover, positivists believe that the reality is stable and described from an objective point of view (Levin, 1988). Hence, the taxonomy of research methodologies has identified that survey approach is suitable for the positivism (Galliers, 1991).

Thus, a questionnaire survey was then carried out among a sample (50) of PM professionals in the Sri Lankan construction industry. This was intended to identify commonly used PM tools and software in the Sri Lankan building construction industry and the fulfilment of nine knowledge areas. Respondents' self-assessment was rated according to the Likert scales given below.

Likert scale 1: Frequency of Using the Tool or Software in Sri Lankan Construction Context

| **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|
| Rarely | Occasionally | Sometimes | Often | Every time |
| 1-20% | 21-40% | 41-60% | 61-80% | 81-100% |

Likert scale 2: Fulfilment of Nine Knowledge Areas

| **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|
| Strongly Agree | Agree | Intermediatel | Weakly Agree | Very Weakly |

Thus, Likert-type data analysis was based on the significant measurement by using the Relative Importance Index (RII) to rank the frequency of using the tools or software in construction PM and the fulfilment of nine knowledge areas. Further, Mode and Median were individually calculated for each knowledge area for the validation of RII results. The following formula was used to compute RII from the data where the RII shall change from 0% to 100%. Weightage was as per the Likert scale weighting 0 being the least and 5 being the highest.

$$RII = [(W.n) \times 100] / A.N \quad \text{(Eq.01)}$$

Where, W = Constant expressing the weighting given to each response, A = the highest weighting, N = the frequency of responses, N = Total number of the responses.

Subsequently, the PMD was developed incorporating the main elements generated from the expert survey analysis. The respondents were those who retained the experience of using the PMD in the foreign construction projects. Finally, an interview survey was carried out among a sample (10) of PM experts to identify the suitability of PMD in fulfilling critical PM requirements over conventional tools and software. Mode value is used to analyse the frequency of responses to conclude the suitability of introducing the PMD to the Sri Lankan building construction industry.

## 4. QUESTIONNAIRE SURVEY DATA ANALYSIS

A preliminary questionnaire survey was carried out among 50 individuals in the construction industry and only 43 questionnaires were responded. Hence, this analysis is based on the responses of 43 respondents and the rest of the 7 considered as non-respondents. Hence, the response rate for this preliminary questionnaire survey was 86%. Questions were mainly distributed among the project managers, site engineers, chartered engineers, quantity surveyors, chartered quantity surveyors practicing in the Sri Lankan construction industry. The minimum experience requirement for the respondents was 3 years in the construction industry. 56% of the respondents had more than ten years' experience. 31% of the respondents had 5-10 years' experience and 13% of them were in the category of 3-5 years' experience.

### *4.1. RANKING PM TOOLS AND SOFTWARE WITH THE RII*

The most commonly used PM tools and software in the Sri Lankan building construction industry is tabulated in Table 4. MS project has gained 93% of relative importance and marked as the mostly used software in the Sri Lankan building construction industry.

Table 4: Mostly Practiced Tools and Software

| PM Tools/Software | RII | RANK | % of respondents |
|---|---|---|---|
| MS Project | 93% | 1 | 100% |
| Project reports | 83% | 2 | 100% |
| Critical path method (CPM) | 75% | 3 | 100% |
| Spreadsheet schedules | 73% | 4 | 100% |
| Gantt charts | 69% | 5 | 100% |
| MS Excel | 61% | 6 | 100% |
| Earned value management (EVA) | 55% | 7 | 95% |
| Work breakdown structure | 51% | 8 | 100% |
| Program evaluation and review technique | 50% | 9 | 86% |
| Primavera (P6) | 41% | 10 | 88% |

However, Primavera (P6) has gained 41% relative importance and ranked as 10. The Relative importance of top 10 tools and software diverges between 52% range. Project reports are the most commonly used PM tools in the Sri Lankan building construction industry, gaining a relative importance of 83%. An overall ranking of the Project report is 2. The difference between top 2 ranks is 10%. CPM is ranked as the 3 where the difference of RII between rank 2 and 3 is 8%. Relative importance of seven tools and software has dispersed between 25% range, which is from 75% to 50%.

On the other hand, Primavera Sure Track, Primavera, EVA, PMD, Primavera (P3), Six Sigma, Scenario planning, Primavera Contract Management, Cost Track and Basic Builder ranked as the least practicing PM tools and software in the Sri Lankan construction context. Primavera Sure Track has gained 5% relative importance and Primavera EVM has gained RII about 4%, where the percentage of respondents practiced is 19% in both the software while other tools and software has gained negligible values.

### *4.2. FULFILMENT OF NINE KNOWLEDGE AREAS BY THE PM TOOLS AND SOFTWARE*

Mostly practiced tools and software identified in the section 1 were selected for the further analysis. Therefore, top ten PM tools and software were individually analysed to identify the fulfilment of nine knowledge areas according to the Likert scale 2.

According to the analysis Primavera (P6) has the highest influence on ***time management*** over other tools and software gaining the highest RII which is 90%. Mode and the Median indicate "high effect". Secondly, MS Project has gained 84% RII for time management and the Mode and the Median value of indicate a "moderate effect". Project reports, critical path method, spreadsheet schedules, Gantt charts and PERT have a significant effect on time management of construction projects where all the tool have gained more than 70% RII. EVA has the highest RII for ***cost management***, which is 73%. Mode and the Median indicate a "moderate effect". Project reports have gained the highest RII for ***quality management***, which is 46%. Mode and the Median of other tools and software vary in between "No effect" to "Minor effect. Gantt charts and project reports have gained the highest RII for ***integration management***, which is 51%. Mode and the Median of all tools and software indicate a "Minor effect". Gantt charts have the highest RII for ***scope management***, which is 65%. Project Reports have gained the highest RII for ***HRM***, which is 44%. Mode and the Median of all tools and software indicate a "Minor effect". Primavera (P6) has the highest effect on ***communication management***, gaining 55% of RII and Mode and the Median indicate a "Neutral effect". Critical path method has the highest effect on ***risk management***. It has gained 44% relative importance and Modes and the Medians of all the tools and software vary in between "No effect" to "Minor effect. MS Project has the highest effect on ***procurement management.*** RII of MS Project for procurement management is 40% and Mode and the Median indicate a "Minor effect". The results are then summarised in Table 5, ranking the best five PM tools and software which fulfil knowledge areas comparatively.

Table 5: Top Five PM Tools and Software Fulfilling Each Knowledge Areas

| PM Knowledge areas | Best PM tools and software | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Time | Primavera (P6) | MS Project | CPM | Gantt Charts | PERT |
| Cost | EVM | Primavera (P6) | MS Excel | Project reports | PERT |
| Quality | Project reports | Spreadsheet | MS Excel | Primavera (P6) | WBS |
| Risk | CPM | Primavera (P6) | PERT | MS Project | EVM |
| Integration | Project reports | Gantt Charts | CPM | WBS | Spreadsheet |
| Scope | Gantt Charts | Primavera (P6) | MS Project | CPM | Project reports |
| Communication | Primavera (P6) | Project reports | MS Project | CPM | Gantt Charts |
| Procurement | MS Project | Spreadsheet | CPM | MS Excel | Primavera (P6) |
| HR | Project reports | Primavera (P6) | CPM | Gantt Charts | WBS |

According to the Table 2, Primavera (P6) has the highest influence on time management and communication management, over another mostly practiced PM tools and software. Further, Primavera (P6) also gained the second highest RII for cost management, risk management, scope management and HRM. Furthermore, Primavera (P6) attained the fourth highest RII for quality management and fifth highest RII for procurement management. Hence, Primavera (P6) fulfils most of knowledge area over other tools and software. EVM is the best solution for the cost management of the project. Project reports have a significant effect on quality, integration, and human resource management of the projects, which was identified as the best solution for the above mentioned three knowledge areas. Gantt charts are a perfect solution for the scope management where CPM is finest for management of risk compared with the other tools and software. MS Project, which was identified as the most commonly used PM software, is the best solution for the procurement management of the project.

## 5. DEVELOPMENT OF THE PMD

A structured questionnaire was developed based on the literature findings and existing dashboards used for international projects. Structured questionnaire was distributed among three experts for construction PM, who have used PMD for the international projects. The data generated from the expert survey revealed the most important elements which should be displayed in the PMD under the six headings such as, physical and financial progress, approval status, issues, risk, labour and general.

The mode was used to analyse the data collected through the expert survey. The results generated through the analysis, concluded that more than 67% of the respondents marked the tabulated elements under 6 categories as “Necessary” and “Usually used” in the PM. Thus, concluded the proposal of PMD and its requisite features to be incorporated into the dashboard under the Sri Lankan context. Subsequently, PMD was developed in a MS Excel format based on the above information and illustrated in Table 6.

Table 6: Analysis of Expert Survey

| Group | | Information | Degree of Necessity | | | Extent of Use | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unnecessary | Optional | Necessary | Not Used | Sometimes | Usually Used |
| Physical and Financial Progress | 1 | Summary of the physical progress of the project. | | | 100% | | | 100% |
| | 2 | Graphs comparing planned progress with the actual. | | | 100% | | | 100% |
| | 3 | Summary of the financial progress. | | | 100% | | | 67% |
| | 4 | Summary of the project payment status. | | | 100% | | | 100% |
| Approval Status | 5 | Summary of the material submittals of the project. | | | 67% | | | 67% |
| | 6 | Summary of the shop drawings submissions. | | | 67% | | | 100% |
| | 7 | Summary of the method statements submissions. | | | 67% | | | 67% |
| Issues | 8 | Summary of the current project issues. | | | 100% | | | 100% |
| | 9 | List of issues significantly impact on critical activities. | | | 100% | | | 100% |
| | 10 | List of issues highly impact on next week construction. | | | 100% | | | 100% |
| | 11 | Identification of responsible parties for project issues. | | | 100% | | | 100% |
| Risk | 12 | Summary of major risks of the project. | | | 100% | | | 100% |
| | 13 | Impact on time and cost due to the major risk factors. | | | 100% | | | 67% |
| Labour | 14 | Summary of the labour productivity. | | | 100% | | | 100% |
| | 15 | Comparison between planed labour force with actual. | | | 100% | | | 100% |
| | 16 | Indication of a labour shortage. | | | 100% | | | 100% |
| General | 17 | Summary of earned value analysis. | | | 67% | | | 100% |
| | 18 | Photographs indicating the actual status of the project. | | | 100% | | | 100% |
| | 19 | Summary of the next week major activities. | | | 100% | | | 100% |

### *5.1. OVERVIEW OF THE PMD*

PMD contains a number of data input sheets and summarised data are displayed in the dashboard under key sections as illustrated in Figure 1. The dashboard provides a high quality user interface that displays the information in a graphical form using a variety of elements including charts, tables and gauges. These elements improve the effectiveness and efficiency in decision making process where time spent on data analysing would be reduced (Malik, 2005). Therefore, PMD necessitate a certain number of supporting data entry sheets in order to provide summarised information to the dashboard sheet.

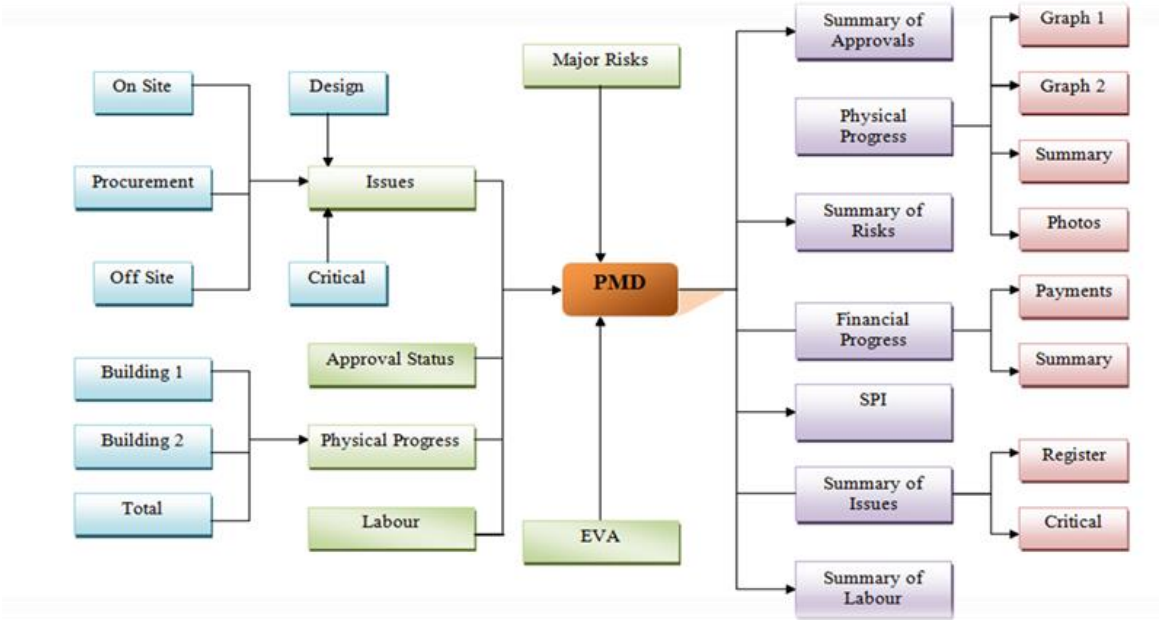


Figure 1: Basic Structure of PMD

## 6. INTERVIEW SURVEY ANALYSIS

### *6.1. SUITABILITY OF PMD IN ADDRESSING CRITICAL PM REQUIREMENTS*

The summarised responses for the suitability of PMD in addressing critical PM requirements of construction projects together with other merits of PMD, is tabulated in Table 7.

Table 7: Analysis of the interview survey- Suitability of PMD

| | Description | Strongly Agree | Agree | Intermediately Agree | Weakly Agree | Very Weakly Agree |
|---|---|---|---|---|---|---|
| **Time Management** | | | | | | |
| 6 | Managing the time of the project compare to commonly used scheduling software (i.e. Ms.Project). | 90% | 10% | - | - | - |
| 7 | Identifying key stakeholders' responsibilities to avoid delays. | 10% | 90% | - | - | - |
| 8 | Identifying the causes for time delays in advance. | 50% | 50% | - | - | - |
| 9 | Avoiding time delays by setting up proactive actions | 70% | 30% | - | - | - |
| **Cost Management** | | | | | | |
| 10 | Indicating the cost overruns of the project. | - | 50% | 50% | - | - |
| 11 | Assisting to manage the cost of the project. | - | 80% | 20% | - | - |
| 12 | Proactive decision making by Project managers to avoid cost overruns due to the early identification of the issues. | - | 70% | 30% | - | - |
| **Quality Management** | | | | | | |
| 13 | Assisting to identify project quality issues. | | 80% | 20% | - | - |
| 14 | Proactive decision making by Key stakeholders to avoid quality related problems due to early identifications of issues. | 30% | 70% | - | - | - |
| **Risk Management** | | | | | | |
| 20 | Quantifying the major risk factors of the project. | 10% | 90% | - | - | - |
| 21 | Noticing the major risks in advance. | - | 80% | 20% | - | - |
| 22 | Managing the major risk factors of the project. | - | 90% | 10% | - | - |

| | Description | Strongly Agree | Agree | Intermediately Agree | Weakly Agree | Very Weakly Agree |
|---|---|---|---|---|---|---|
| **Integration Management** | | | | | | |
| 23 | Assisting to combine and integrate different processes. | - | 40% | 60% | - | - |
| 24 | Prioritising the resources utilisation effectively. | 20% | 70% | 10% | - | - |
| 25 | Assisting to monitor and control the project. | 10% | 90% | | - | - |
| 26 | Integration management of the project. | - | 50% | 50% | - | - |
| **Scope Management and Communication Management** | | | | | | |
| 27 | Identifying and managing the project scope. | 10% | 50% | 40% | - | - |
| 28 | Distributing and sharing information among stakeholders. | 20% | 80% | - | - | - |
| 29 | Collecting, storing and retrieving information of the project. | 10% | 90% | - | - | - |
| **Procurement Management and Human Resource Management** | | | | | | |
| 30 | Identifying supplier related issues in advance. | - | 70% | 30% | - | - |
| 31 | Assisting the procurement management of the project. | - | 70% | 30% | - | - |
| 32 | Assisting to manage the labour requirements of the project. | - | 80% | 20% | - | - |
| 33 | Proactive decision making to avoid HR issues. | 10% | 90% | - | - | - |

At the first instance, the overall picture of Table 4 possesses an optimistic conclusion of the suitability of the PMD under the Sri Lankan building construction industry which illustrated the responses ranged between strongly agree and intermediately agree. Hence, the testing of the hypothesis on the determination of fulfilling the nine knowledge areas through PMD has been certain.

Further, most of the interviewees strongly agreed about the capability of PMD to manage the time of the project. This is advantageous for key stakeholders of the project to identify their responsibilities in order to avoid time delays. Furthermore, PMD addresses on cost and quality management aspects of the project in a better way. Moreover, PMD is capable to identify the critical issues of the project at the earliest stage and subsequently proactive decisions can be implemented. Especially, key stakeholders can determine their responsibilities in each of project issues and corrective decisions can be taken. Besides, PMD accomplishes critical requirements of the integration, scope, risk communication, human resources and the procurement management of the project. These critical areas were not addressed appropriately by the commonly used PM tools and software of the Sri Lankan building construction industry.

Beyond the consideration of assessing the knowledge area fulfilment, the questionnaire is extended in assessing the general merit of using PMD under the Sri Lankan context. As a progress monitoring tool, 70% of the respondents have agreed that PMD delivers a clear snapshot of the project status. Further, 60% have agreed that the PMD is a decision making tool which highlights the relevant information. Furthermore, PMD is beneficial to monitor the physical and the financial progress of the project, which is vital to identify the exact status of the project. At the point of view of user friendliness, the format of the PMD is simple and easy to use without specific knowledge. In emphasis, 70% of the respondents have strongly agreed that simplicity inherent in the PMD due to the use of MS. Excel interface. It is often alleged that, the PMD identifies project issues in advance. Subsequently, PMD determines the responsibility of key stakeholders in each of project issues, identifying issues with higher impact. Besides this, over 90% of the respondents have agreed that PMD is a feed forward PM tool. However, it is commonly agreed the need of a separate operator in order to collect data from different parties and the contemporary review to the PMD. Finally, analysis of the interview survey emphasised the applicability of the PMD in the Sri Lankan context which has derived the 60% strong agreement to the introducing of PMD in the Sri Lankan construction context fulfilling the most of PM knowledge areas over conventional tools and software use in Sri Lankan construction context.

## 7. CONCLUSIONS AND RECOMMENDATIONS

The PM is a dynamic process which utilises the project resources in a controllable and prearranged manner to accomplish the project objectives. Critical requirements defined in the nine knowledge areas of the PM must be considered for the achievement of project objectives, such include management of time, cost, quality, risk, integration, scope, communication, procurement and HR. Since the construction PM concepts are derived from the general PM concepts, construction PM accomplish the project objectives by utilising the existing organisational structures and resources. However, the unique nature of the construction projects amplifies the complexity and the uncertainty. Therefore, extensive PM techniques which covered the critical project requirement are essential to successfully manage construction projects.

The questionnaire survey analysis revealed that MS Project as the most popular PM software in the Sri Lankan construction industry. However, in terms of fulfilling PM knowledge areas Primavera (P6) had superseded other mostly practicing PM tools and software. Yet, the results revealed that, neither PM tools nor software in the Sri Lankan construction industry effectively addressing all the nine knowledge areas of the PM. Most of the tools and software concentrated only time and cost parameters. Thus, Sri Lankan construction industry necessitates an innovative PM tool or software to improve the excellence of PM through addressing all critical requirements. Afterwards, the proposal of PMD is built incorporating the important elements under the six headings such as, physical and financial progress, approval status, issues, risk, labour and general. Next, PMD was developed in an MS. Excel format based on the above information with a number of supporting data entry sheets in order to provide summarised information to the dashboard sheet. The PMD provides a high quality user interface that displays the information in a graphical form using charts, tables and gauges.

Finally, the expert survey results derived the suitability of the PMD to accomplish the nine PM knowledge areas where the respondents possessed the optimism for PMD. Mainly, PMD has contributed to the time management. Moreover, the other entire PM knowledge area fulfilment through PMD had been agreed. Thus, the initial hypothesis under this research study has become certain. Moreover, PMD is beneficial for the physical and financial progress monitoring of the project, managing approval status, and identification of project issues. Hence, it cannot be denied that the PMD is recommended to use for construction PM, which is capable to execute the critical PM requirements. However, the inadequacy of knowledge on the PMD would be a barrier under the Sri Lankan context. Therefore, it is important to promote the concept among the PM professionals through CPD programmes and by other means of knowledge sharing sessions.

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