

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

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Abstract

This research project is primarily aimed at investigating the use of project management tools and techniques in the Sri Lankan public sector and how they affect project success. The study sample consisted of 202 public sector employees who are responsible for projects. Confirmatory factor analysis coupled with structural equation modeling (SEM) was employed as the primary statistical analysis technique. The findings reveal that the project manager's competency, top management support and affective organizational commitment facilitate project success through effective use of project management tools. Further, it was found that project complexity moderates the positive relationships between top management support and the use of project management tools, as well as affective organizational commitment and the use of project management tools.

Key words: Project management, project management tools, project success, public sector, developing countries.

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Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

Introduction

Post-conflict economic growth has resulted in a boom in the implementation of development activities across Sri Lanka. The public sector plays an important role in this development drive by implementing development projects of varying magnitude in diverse sectors. For such endeavors to be effective, it is essential that the public sector employs globally accepted, sound management practices. Adopting appropriate project management protocols assumes greater significance in this context, given the uniqueness of development projects, their magnitude and their relative importance to the national economy.

A project is defined as a temporary endeavor undertaken to create a unique product, service, or result (Project Management Institute, 2008). “Temporary” means that the project has a definite end point, while “unique” suggests that the product or service differs from all similar products or services in some distinctive way. Even though there may be certain repetitive elements present in some project deliverables, each project is fundamentally unique in some way. In contrast, any ongoing work that follows an organization’s existing procedures is a repetitive process and hence such work is not classified as a project.

The public sector in any country comprises the general government sector plus all public corporations (United Nations, 2009). The general government sector comprises the central government, the state governments/provincial councils and the local governments. The public sector is part of the economy providing basic goods or services that are either not or cannot be provided by the private sector. Public sector organizations are different from their commercial counterparts in the private sector (Boland & Fowler, 2000). In public sector organizations there is no profit-maximizing focus, little potential for income generation and, generally speaking, no bottom line against which performance can be measured. Further, the vast majority of such organizations are still funded by the state. Boland and Fowler (2000) suggest that public sector management is a complex, dynamic system involving several nominally independent stakeholders, coupled with informational and resource material flows and behaviour that is characterized by inertia and multiple feedback loops. However, the capability of the public sector is pivotal to the growth of the economy (Rwelamila, 2007 as cited in Atif, 2010). In this context, the need for project management expertise in public sector organizations has become fundamental in order to deal with the enormous responsibility of managing a number of projects

simultaneously, facilitating an organization to reduce product development time to market, utilize limited resources effectively, handle technological complexity, respond to stakeholder satisfaction and increase global market competition (Cleland, 1998, as cited in Patanakul, Iewwongcharoen & Milosevic, 2010).

In less developed countries the implementation of project management tools and techniques is still in its early phase of development. Abbasi & Al-Mharmah (2000) found that the use of project management tools and techniques in the public sector companies was considerably low, but when used efficiently would result in tangible benefits in all aspects of planning, scheduling and monitoring the time, cost and specification of projects. In recent years, public sector performance measurement and public sector project management have attracted much attention in the literature. However, most papers that have been published in academic journals have focused on the public sector in Europe, North America or Australia (Atif, 2010). Nevertheless, the use of project management in developing countries is becoming an important issue in implementing modern projects (Abbasi & Al-Mharmah, 2000). However, there is little literature available on project management in the public sector of less developed countries.

The Sri Lankan public sector is comparable to the public sector of most of the developing countries in terms of its structure and operations. Therefore, the Sri Lankan public sector also faces various issues and challenges that are common to developing countries which could ultimately affect its performance. In this context, the purpose of this research is to investigate the usage of project management tools and techniques employed by the Sri Lankan public sector and to see whether they contribute to the success of projects. In addition, the study intends to identify the factors which affect the application of project management tools in public sector organizations. Moreover such a study is important as project management has proven to be an efficient approach, which helps developing countries upgrade their management capabilities and enables them to efficiently complete projects and attain development goals (Abbasi & Al-Mharmah, 2000).

In this regard, this research seeks to narrow the empirical gap that exists due to the lack of field studies on the project management tools and techniques used by the Sri Lankan public sector, thereby providing insights to decision-makers to better plan their efforts to effectively implement project management techniques. With the end of the 30-year long internal conflict in 2009, the Government of Sri Lanka

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

intensified its mega development projects drive in strategic areas such as roads, ports, power and energy, aviation, railways, water supply and irrigation, with a view to facilitating a high economic growth momentum. The Sri Lankan government has been maintaining public investment at around 6 per cent of the gross domestic product (GDP) in the recent past (Central Bank of Sri Lanka, 2012).

However, the entirety of the public investment programme of Sri Lanka is funded by debt finance, out of which the bulk comes from foreign sources of funding (Central Bank of Sri Lanka, 2012). Hence, for each public sector development project, the government has to bear an interest cost in addition to project costs. Hence, any deviation of a project from its original plans due to ineffective application of project management practices could lead to serious long-term repercussions in the economy. Therefore, it is imperative for the policy makers to have a sound understanding of the various factors that would facilitate the successful implementation of projects through effective application of project management tools and techniques.

The next section of this paper attempts to critically review the existing body of knowledge on project management tools and techniques and the factors affecting their effective use. Subsequently, the conceptual framework for the study is presented with its operationalization. This is followed by the presentation of relevant data, findings and data analyses relating to the study. The final section consists of conclusions and recommendations.

Theoretical framework

Project management and project success

Project management is defined as the application of knowledge, skills, tools and techniques to project activities to meet the relevant project requirements (Project Management Institute, 2008). Project management is accomplished through the appropriate application and integration of logically grouped project management processes comprising the five process stages: initiating, planning, executing, monitoring and controlling and closing.

Project management tools and techniques (PMTT) are perceived by some authors as software for project management (Fox & Murray, 2003, as cited in Patanakul et al., 2010), while others view them as systematic procedures or practices that project managers use for producing specific project management deliverables (Milosevic,

2003, as cited in Patanakul et al., 2010). The Project Management Institute (2008) has suggested nine knowledge areas in project management. Some PMTT, e.g., return on investment (ROI), payback period, cost/benefit analysis, strengths weaknesses opportunities and threats (SWOT) analysis, flow charts, cause-and-effect diagrams and risk management, are common to both project and general management. However, other PMTT such as work breakdown structures (WBS), earned value management, critical path method (CPM), programme evaluation and review technique (PERT) and graphical evaluation and review technique (GERT) are unique to project management.

Different project success dimensions have been proposed by many authors to determine the success or failure of a project (Atif, 2010; Patanakul et al., 2010; Belassi & Tukel, 1996 and Pinto & Slevin, 1988), while recent literature on project success focuses on a multi-dimensional and multi-criteria approach, referred to as the stakeholder approach. De Wit (1988) and many other researchers draw a distinction between project success and project management success. For instance, they contend that project success is measured by comparing the project outcomes with the overall objectives of the project, whereas project management success tends to be measured against the traditional measures of performance, namely, cost, time and quality. Similarly, Munns & Bjeirmi (1996), in their study of project success, also differentiate between project success and project management success. Their definition of a project's success suggests an orientation towards longer-term goals such as return on investment, profitability and competition while project management focuses on short-term goals and a more specific context for success. Baccarini (1999) discussed the logical framework method, defining project success as the combination of project management success and product success. He suggested that time-cost-performance can be used as criteria for project management success while achieving the goal and purpose of the project (e.g., customer satisfaction and profit) should be used to measure product success. Similar findings are found in several other studies summarized in Patanakul et al. (2010).

Factors influencing project success

The Project Management Institute (2007) in their Project Manager Competency Development (PMCD) framework defines personal competency of project managers as the combined outcome of six dimensions, namely, communication skills, leadership skills, management skills, cognitive ability, effectiveness and

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

professionalism. As cited by Belassi & Tukel (1996), Sayles & Chandler (1971) and Locke (1984) identified the project manager's competency and appointment of a competent project manager respectively, as critical success factors for projects. Westerveld (2003), in his Project Excellence Model, explains that the way the project manager runs the project and how tasks and responsibilities are delegated greatly influence the overall outcome of the project. Muller & Turner (2007) from both their qualitative study and quantitative studies conclude that the project manager's leadership style influences project success. In their research the leadership style was assessed based on the competency school of leadership. Pinto & Slevin (1988), in addition, identified that the characteristics of the project team leader are important for project success while Baker, Murphy & Fisher (1983) acknowledged that adequate project team capability also leads to project success. Focusing on empirical evidence from developing countries, Olateju, Abdul-Azeez & Alamutu (2011) show that lack of project management competency is a crucial factor influencing effective project implementation in the public sector of a developing country.

H₁ - The Project manager's competency is positively related to the extent of PMTT usage.

Young & Jordan (2008) define top management support as CEO and other senior managers devoting time to review plans, follow up on results and solve management problems. Research findings of Pinto & Slevin (1988), White & Fortune (2002), Ofer (2007), Young & Jordan (2008), and Kandelousi, Ooi & Abdollahi (2011) reveal that top management support or involvement is one of the key success factors affecting project performance. According to Simonsen (2007), the lack of top management involvement is the primary challenge felt by project managers. Further, the publications of Kerzner (2000) and Tinnirello (2001) show that top and senior management support is the most important aspect of project implementation.

H₂ - Perceived top management support is positively related to the extent of PMTT usage.

Affective organizational commitment refers to the employees' identification with, involvement in, and emotional attachment to the organization out of their volition (Allen & Meyer, 1997). Moreover, affective commitment is a work-related attitude involving positive feelings regarding the organization (Morrow, 1993). Several studies have identified organizational commitment as a key factor in organizations achieving success (Allen & Meyer, 1997, Riketta, 2002). As noted in Addae &

Parboteeah (2008), such strong interest is not surprising given the relationship between organizational commitment, and many critical organizational variables such as organizational performance (Riketta, 2002), attendance and staying with an organization. Further, Bredillet & Dwivedula (2010) also noted a significant co-relationship between affective organizational and professional commitments of project workers. Moreover, Eisenberger, Fasolo & Davis-LaMastro (1990) argue that employees' general perception of being valued and cared for by the organization is positively related to: conscientiousness in carrying out conventional job responsibilities; expressed affective and calculative involvements in the organization; and innovation on behalf of the organization in the absence of anticipated direct reward or personal recognition.

H₃ - Affective organizational commitment is positively related to the extent of PMTT usage.

Baccarini (1996) described project complexity as “consisting of many varied interrelated parts” and operationalized this concept in terms of differentiation and interdependency mainly focusing on two types of complexities, viz., organizational and technological. Baccarini (1996) found project complexity to be a key factor affecting project performance in construction projects. Furthermore, Baccarini (1996) argues that project complexity influences the selection of appropriate project inputs and project organizational form. Furumo, Pearson & Martin (2006) found in their research on project management tools and outcomes in organisations of varying size and sector that projects carried out in public sector organizations were more likely to be delivered late. Moreover, Furumo et al. (2006) identified that increased oversight and the numerous constituencies involved in public sector projects were the main reasons for projects carried out in public sector organizations being delivered late. Boland & Fowler (2000) note that public sector management is a complex, dynamic system involving several nominally independent stakeholders, coupled with information and resource material flows and behaviour that is characterized by inertia and multiple feedback loops. According to Morris & Hough (1987), complex projects demand an exceptional level of management and so the application of conventional systems developed for ordinary projects have been found to be inappropriate for complex projects.

H₄ – The relationships between project manager's competency, perceived top management support, affective organizational commitment and the extent of PMTT usage are moderated by project complexity.

Usage of project management tools and its mediating effect on project success

As cited by Patanakul et al. (2010), several studies have suggested that the effective use of project management tools and techniques impacts the success of a project (Might & Fischer, 1985; Pinto & Slevin, 1988; Cash & Fox, 1992; Hatfield, 1995; Thamhain, 1996; Coombs et al., 1998; Milosevic et al., 2001 as cited in Patanakul et al., 2010). Likewise, the inappropriate use of tools and techniques can be counterproductive to project management outcomes (Thamhain, 1996; Kerzner, 2000; Patanakul et al., 2010). Patanakul et al. (2010) propose that by using appropriate tools and techniques in the right way (utilizing the PMTT that matches the characteristics of the project phases) will have a direct impact on the delivery of a successful project. White & Fortune (2002) examined the current project management practice in the public sector in the UK, by collecting data from 236 project managers in public institutions. The study asked the respondents to judge the effectiveness of the project management methods, tools, and techniques they had adopted in relation to project success. The result of the study revealed that 41 per cent of the reported projects were judged to be completely successful (using time, budget and specification), though some drawbacks were reported. Similarly, Abbasi & Al-Mharmah (2000) explored the project management tools and techniques used by the public sector in Jordan by surveying 50 industrial public firms. The study found that even though the use of such tools was considerably less in the public sector, that once practised tangible benefits in all aspects of planning, scheduling and monitoring, time, cost and specifications of projects could be achieved.

H₅ - The extent of PMTT usage is positively related to project success.

Even though separate studies have been carried out to analyze the relationship between critical success factors and overall project success as well as PMTT usage and overall project success, there is a lack of theoretical and empirical evidence of the mediating effect of PMTT usage on the relationship between critical success factors and overall project success. Belassi & Tukel (1996), in their new framework for determining critical success/failure factors in projects, do not show a direct relationship between success factors and overall project success. Instead, factors related to the project, project manager and team, and organization first influence the project manager's performance on the job in terms of effective planning and scheduling, effective coordination and communication, effective control and monitoring and so on which then relates to overall project success. Similarly, in the

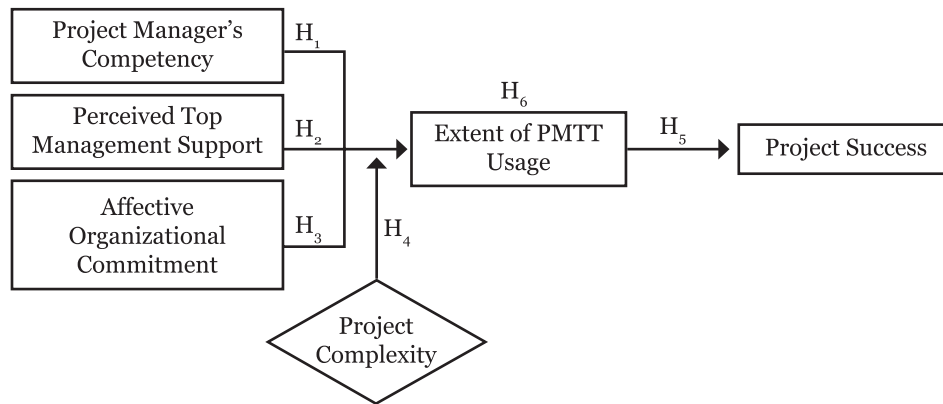
Project Excellence Model of Westerveld (2003), various organizational areas such as leadership and team work, stakeholder management and resources are first linked to project management practices, which are then associated to project results.

H₆ - The extent of PMTT use mediates the effect of project manager's competency, perceived top management support and affective organizational commitment on project success.

Study framework

The conceptual framework, as depicted in Figure 1, has been developed based on the hypotheses discussed in the previous section. 'Project Manager's Competency', 'Perceived Top Management Support' and 'Affective Organizational Commitment' are treated as independent variables while 'Project Success' is the dependent variable. Further, the relationship between the independent variables and the dependent variable is assumed to be mediated by the 'Extent of PMTT Usage'. Meanwhile, the relationship between the independent variables and the 'Extent of PMTT' usage is assumed to be moderated by 'Project Complexity'.

Figure 1: Conceptual framework



Source: Conceptualized by the Authors

Methodology

The research was carried out as a broad-based study covering various public sector institutions. Accordingly, the analysis includes government ministries, departments, provincial councils as well as statutory boards such as the Central Engineering

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

Consultancy Bureau (CECB) and the Civil Aviation Authority of Sri Lanka and public corporations like the Ceylon Electricity Board (CEB) and the Sri Lanka Insurance Corporation. Project team members were selected from the above broad-based population covering projects of varying durations, varying magnitudes in terms of costs, and projects with both foreign as well as domestic sources of funding.

A questionnaire was the main survey instrument adopted in the study. Approximately 350 questionnaires were distributed and 251 were returned of which 202 were used in the model fitting exercise (49 questionnaires were discarded due to the large volume of missing data). The sample population of the study comprised public sector project workers: 82 project managers and 120 senior project officials.

In selecting participants for the study, special attention was paid to choosing only one participant from each project. Hence, each participant in the survey represented a distinct project carried out in the Sri Lankan public sector. Further, the researchers ensured that only senior project officials were selected for the study as it was vital that the participants had a holistic view of the projects under consideration.

The measures used in the quantitative study were derived based on the relevant literature. Each construct was measured using a series of 5-point Likert scale questions. Accordingly, the project manager's competency was operationalized using the Project Manager Competency Development (PMCD) framework of the Project Management Institute (2007). PMCD has two broad dimensions, of which the second broad dimension of personal competencies is taken into consideration in this study since the first broad dimension of project management knowledge/performance competencies overlaps with the PMTT usage construct. Accordingly, the project manager's competency was measured through a series of questions such as "I/Project manager actively listens, understands and responds to stakeholders" and "I/Project manager takes a holistic view of the project". Perceived top management support is operationalized through measures employed by Esteves & Pastor (2001), while organizational commitment is measured using the affective commitment scale of Allen & Meyer (1990). The measure for project complexity is adapted based on Camci (2006) and covers four dimensions of project complexity: organizational complexity, product complexity, methods (process) complexity and goal complexity. The construct 'Extent of PMTT Usage' is operationalized using the measures employed by Shahin & Sulaiman (2011), coupled with a comprehensive list of commonly used PMTT. Statements such as "Realistic project milestones and end

dates were defined and set with measurable results” and “The responsibility for all parts of project implementation were defined and assigned” were used to measure the extent of PMTT usage. Measures for project success are adapted from Patanakul et al. (2010) where success measures are identified using the stakeholder approach, representing both internal and external perspectives. Accordingly, project success was measured through a series of questions such as “Project completed on time or faster” and “The intended customers of the project were satisfied with the outcomes of this project”.

The content validity of the questionnaire was examined by a group of eleven project management experts who are qualified Project Management Professionals (PMPs). Each expert was asked to mark on the scale, whether a question was “essential” (assigned 2 points), “useful” (assigned 1 point) or “not necessary” (assigned 0 points). The final decision on validity was based upon the computation of the Content Validity Ratio defined by Lawshe (1975). All the questions in the final questionnaire recorded a Content Validity Ratio of 0.5 or above.

In addition to the content validity test, a pilot study was carried out with several selected participants to analyze the level of comprehension of the questionnaire. Based upon the inputs of the pilot study, the wording of certain questions was slightly altered to ensure that the participants could easily understand the questions and also to eliminate possible ambiguities in certain questions. For example, the question “Project came in on time or faster” was altered to “Project completed on time or faster”. This process ensured that the statements could be understood by all respondents involved in the survey.

Data analysis and findings

Descriptive analysis

The majority of participants were males accounting for 66 percent of the study sample. Even though there was an equally fair representation of age categories of 20 – 29 (35 percent), 30 – 39 (33 percent) and 40 – 49 (25 percent), there was only a relatively small participation rate in the age category 50 and above (7 per cent). The majority of the participants (75 percent) had served in 1 - 10 projects with 12 percent of the participants having served in 11 - 20 projects, and the balance 13 percent in more than 20 projects.

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

In terms of participants' educational qualifications, the majority (94 percent of the study sample) of project workers in the public sector possessed at least a bachelor's degree. However, they lacked reputed project management qualifications such as PMP (Project Management Professional), CAPM (Certified Associate in Project Management), PRINCE2 (Projects in Controlled Environments) training; only around 10 percent of the study sample had obtained such qualifications.

Among the various types of project management tools and techniques, physical check lists were found to be the most popular tool as it was used by almost 80 percent of the participants. Flow charts, cost benefit analysis, Gantt charts and milestone charts were the other popular tools used by 54 percent, 47 percent, 41 percent and 32 percent of the participants, respectively. Meanwhile, Results Based Framework (RBF), PRINCE2 and Delphi were identified as the least popular project management tools in the Sri Lankan public sector.

Hypothesis Testing

Structural equation modeling (SEM) was employed to identify the relationship between latent constructs that were indicated by multiple measures. "SEM takes a confirmatory (hypothesis testing) approach to the multivariate analysis of a structural theory, one that stipulates causal relations among multiple variables" (Lei & Wu, 2007). IBM SPSS AMOS version 20.0 was employed to see how the hypothesized theoretical model is consistent with the data collected. 202 responses (178 full responses and 24 partial responses treated with mean imputation) were used for the model fitting exercise.

A normality test was conducted for examining the distribution of each observed variable for skewness and kurtosis. All the variables fell within the acceptable ranges of skewness and kurtosis (skewness < 3 and kurtosis < 10, according to Chou & Bentler, 1995) suggesting that univariate normality exists in the sample data. Further, a multicollinearity diagnostic was carried out for all independent variables including the moderator variable. According to the collinearity statistics, the Variance Inflation Factors (VIF) were well below the threshold level of 5 for all scenarios, indicating that the issue of multi-collinearity was not existent among the independent variables in the sample data set. In addition, Cronbach's Alpha was used to measure internal consistency as the questionnaire includes multiple Likert scale questions to measure a single construct. Accordingly, the reliability of each of the constructs was checked using Cronbach's Alpha for the entire data set. The results for each construct were

well above the threshold level of 0.8 indicating a high level of internal consistency in the scales.

The maximum likelihood estimation (MLE) method was employed to estimate the model parameters. Research has demonstrated that MLE produces efficient and reliable estimates compared to the alternative methods of estimation such as Generalized Least Squares (GLS), Unweighted Least Squares (ULS), and Asymptotically Distribution Free (ADF) discrepancy function (Hair et al., 2010, p663, as cited in Groenland & Stalpers, 2012).

Measurement model

The measurement model of SEM incorporating Confirmatory Factor Analysis (CFA) depicts the pattern of observed variables for the latent constructs in the hypothesized model. It is important to first examine the quality of the constructs, before using these constructs in the analysis of the structural model. Marsh & Hau (1999) recommended having a minimum of 4 or 5 indicators with factor loadings exceeding at least 0.6 in confirmatory factor analysis. Accordingly, only the indicators with factor loadings in excess of 0.6 were retained in the model. Consequently, the average factor loading for each latent variable in the model is at a level above 0.6.

The measurement model contains all the latent constructs in the model and specifies the indicators for each construct. That is, the relationships between each model construct for the project manager's competency, perceived top management support, affective organizational commitment, project success and the extent of PMTT usage and its respective sets of indicators. The latent constructs themselves were supposed to co-vary. Meanwhile, the degrees of freedom of the measurement model, which is calculated as the difference between the number of distinct sample moments and the number of distinct parameters, amounted to 1,232. Accordingly, the model is said to be identified as the degrees of freedom meets the counting rule of being greater than or equal to zero (Kaplan, 2009).

Chi-Square value is the traditional measure for evaluating overall model fit and it assesses the magnitude of discrepancy between the sample and fitted covariance matrices (Hu & Bentler, 1999: 2, as cited in Hooper, Coughlan & Mullen, 2008). However, Chi-Square statistics nearly always rejects the model when large samples are used (Bentler & Bonnet, 1980; Joreskog & Sorbom, 1993). Due to the restrictiveness of the model Chi-Square, several authors recommended relative/

**Effectiveness of Project Management Tools
used in the Sri Lankan Public Sector**

normed Chi-Square (χ^2/df – a value between 2 and 5) as an alternative measure to evaluate fit (Wheaton et al, 1977 as cited in Hooper et al, 2008; Marsh & Hocevar, 1985). Holding the value of 2.26 as the relative/normed Chi-Square, a good absolute fit is indicated in the measurement model adopted in this study.

It is generally recommended that multiple indices should be considered simultaneously when overall model fit is evaluated. For instance, Hu & Bentler (1999), as cited in Lei & Wu (2007), proposed a 2-index strategy, that is, reporting Standardized Root Mean Squared Residual (SRMR) along with one of the fit indices (e.g., Relative Noncentrality Index - RNI, Comparative Fit Index - CFI, or Root Mean Square Error of Approximation - RMSEA). A number of authors have suggested the following criteria for a good model fit: RNI (CFI) or Tucker-Lewis Index (TLI) values closer to 1 (>.90), RMSEA or SRMR values less than 0.08 and Parsimonious Normed Fit Index (PNFI) or Parsimony Comparative Fit Index (PCFI) closer to 1 (Hooper et al, 2008; Lei & Wu, 2007; Hair et al. 2006, as cited in Groenland & Stalpers, 2012). Model fit parameters based on the survey data - CIF - 0.804, TLI - 0.789, PCFI - 0.747, SRMR - 0.049 and RMSEA - 0.079 - suggest a reasonable fit in the measurement model.

Table 1 presents the inter-correlations among the four exogenous variables (Top Management Support, Project Complexity, Affective Organizational Commitment and Project Manager’s Competency) and the two endogenous variables (Extent of PMTT Usage and Project Success).

Table 1: Correlation matrix, mean, and standard deviation for the model

Variables	Variables					
	PS	EPU	TMS	PC	AOC	PMC
PS	1.000					
EPU	.824	1.000				
TMS	.570	.706	1.000			
PC	.290	.230	.235	1.000		
AOC	.403	.460	.479	-.197	1.000	
PMC	.689	.809	.658	.258	.371	1.000
Mean	3.660	3.289	3.498	3.805	3.739	3.795
SD	0.803	0.607	0.670	0.645	0.724	0.720

Source: Calculated based on survey data

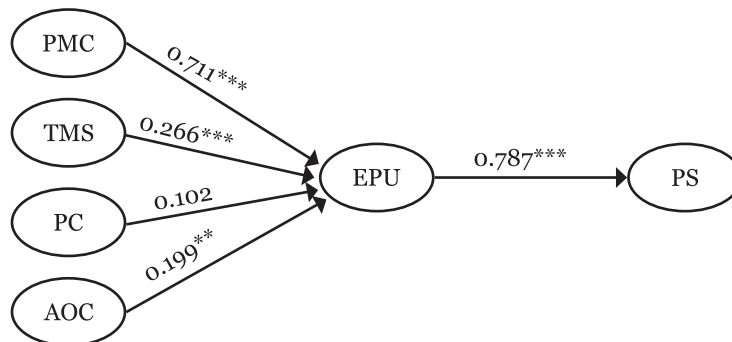
Notes: PS - Project Success; EPU - Extent of PMTT Usage; TMS - Top Management Support; PC - Project Complexity; AOC - Affective Organizational Commitment; PMC - Project Manager's Competency

A comparison of competing measurement models was carried out using a series of multiple factor models. In the one-factor model all indicators were specified under a single latent construct. The six-factor model is the same as the measurement model used in the preceding sections of the analysis. Alternative models were specified by nesting factors coming under separate constructs into one latent construct. The results of the analysis of the multifactor measurement models indicated that all of the fit measures improved as the model progressed from a one-factor model to a six-factor model. Therefore, by taking all the fit indices into account it could be stated that the six-factor model fits significantly better than any of the more parsimonious nested models.

Structural model

The structural model specifies both the constructs with their indicators, and the causal relationships between the constructs. Figure 2 represents the structural model of the research under consideration. The single arrowhead denotes the corresponding direct effect, whereas the statistical estimates of direct effects are given by path coefficients.

Figure 2: Structural model with standardized parameter estimates



Source: Constructed based on survey data

Notes: (1) PMC - Project Manager's Competency; TMS - Top Management Support; PC - Project Complexity; AOC - Affective Organizational Commitment; EPU - Extent of PMTT Usage; PS - Project Success

(2) *** - Significant at 0.1% level; ** - Significant at 1% level

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

The structural equation modeling results revealed that the proposed model had an acceptable fit. Even though the Chi-Square (χ^2) value was significant, the χ^2 to degrees of freedom ratio recorded a value of 2.4 indicating an acceptable fit between the hypothetical model and the sample data (Carmines & McIver, 1981). RMSEA recorded a value of 0.08 indicating a reasonable error of approximation (Browne & Cudeck, 1993). Several other absolute fit indices (RMR=0.064 and SRMR=.1766) also indicated a good model fit. Meanwhile, the incremental fit indices related to the structural model exhibited values close to 0.9 indicating a tolerable fit between the hypothetical model and the sample data.

According to the path coefficients of the structural model, there is a significant association (path coefficient = 0.711, $p < .001$) between the project manager's competency (PMC) and PMTT usage (EPU). Therefore, Hypothesis 1, which states that the project manager's competency is positively related to the extent of PMTT usage, can be accepted. In addition, a significant association (path coefficient = 0.266, $p < .001$) can be noted between top management support (TMS) and PMTT usage (EPU). Therefore, Hypothesis 2, which states that perceived top management support is positively related to the extent of PMTT usage, can also be accepted.

Even though the level of significance in the relationship between affective organizational commitment (AOC) and PMTT usage (EPU) is not as large as the previous two relationships, there is a reasonable association (path coefficient = 0.199, $p < .01$) between the variables, allowing for accepting the third hypothesis: organizational commitment is positively related to the extent of PMTT usage. However, no significant association was witnessed (path coefficient = 0.102, $p > .05$) between project complexity (PC) and PMTT usage (EPU), supporting the placement of project complexity as a moderating variable in the conceptual framework. Meanwhile, PMTT usage (EPU) and project success (PS) exhibited a considerable association (path coefficient = 0.787, $p < .001$) indicating a possible mediating effect between the exogenous variables and project success. Consequently the fifth hypothesis, which states that the extent of PMTT usage is positively related to project success, can be accepted.

It was hypothesized that the causal effect between top management support (TMS), affective organizational commitment (AOC), project manager's competency (PMC) and project success (PC) was mediated by the extent of PMTT usage (EPU). Accordingly, a mediator analysis in terms of a Chi-Square difference test was

conducted by analyzing the full model, the mediated model and the direct path model (based on Williams and Anderson (1994)). Table 2 illustrates the results of this Chi-square difference test.

Table 2: Model comparison for mediator analysis

Model	χ^2	df	$\Delta\chi^2$	Δdf	Significance
Full	2956.545	1238			
Mediated	2961.858	1242	5.313	4	0.257
Direct path	3183.696	1243	227.151	5	0.000

Source: Calculated based on survey data

The Chi-Square difference test between the full model and the direct path model resulted in a significant $\Delta\chi^2$ value. If the $\Delta\chi^2$ value is statistically significant, the larger model with more freely estimated parameters fits the data better than the smaller model in which the parameters in question are fixed. According to Table 2, the full model is better than the direct path model: clearly, it is more meaningful then to estimate the additional parameters and to prefer the larger model. Meanwhile, the Chi-Square difference test between the full model and the mediated model returned a non-significant $\Delta\chi^2$ value. In case the $\Delta\chi^2$ value is not statistically significant, both models fit equally well, so that the parameters in question can be eliminated from the model and the smaller model can be accepted. Therefore, it can be determined that the mediated model is as good as the full model. Accordingly, based on the statistical results, the sixth hypothesis which states that the extent of PMTT usage (EPU) mediates the effect of project manager's competency (PMC), top management support (TMS) and affective organizational commitment (AOC) on project success (PS), can be accepted.

At the conceptualization stage it was assumed that there is a moderating effect from project complexity (PC) towards the relationship between project manager's competency (PMC), top management support (TMS), affective organizational commitment (AOC) and the extent of PMTT usage (EPU). Accordingly, moderator tests based on Jaccard and Wan (1995) were carried out to assess the level of significance of these interactions. According to Table 3, the regression weight is not significant for the interaction between project manager's competency (PMC) and project complexity (PC), whereas it is significant for the interactions of top management support (TMS) and affective organizational commitment (AOC) with project complexity (PC).

**Effectiveness of Project Management Tools
used in the Sri Lankan Public Sector**

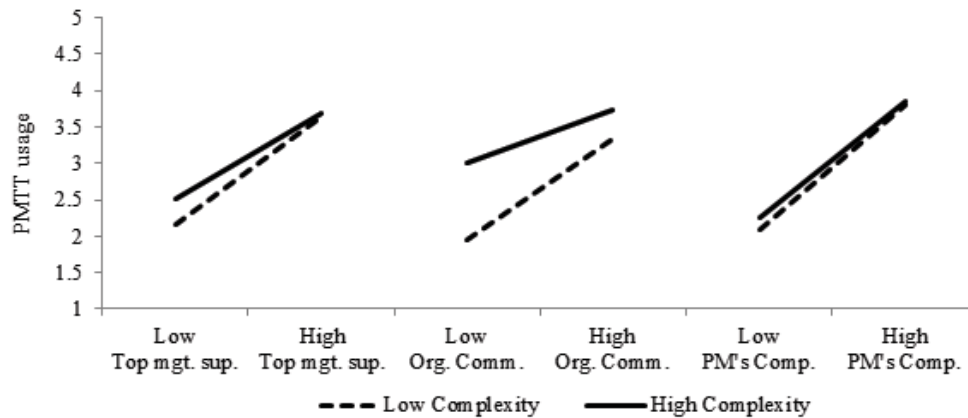
Table 3: Regression weights for moderator effect analysis

	Estimate	S.E.	C.R.	P
Zscore(PMC) *Zscore(PC) → Zscore(EPU)	-0.030	0.025	-1.173	0.241
Zscore(TMS)* Zscore(PC) → Zscore(EPU)	-0.078	0.035	-2.216	0.027
Zscore(AOC)* Zscore(PC) → Zscore(EPU)	-0.165	0.258	-2.864	0.004

Source: Calculated based on survey data

Figure 3 summarizes the moderating effect of project complexity on all three predictor variables. With these observations the fifth hypothesis can be accepted with an alteration. Accordingly, the fifth hypothesis can be restated as “project complexity moderates the relationship between top management support and the extent of PMTT usage, as well as affective organizational commitment and the extent of PMTT usage”.

Figure 3: Moderating effect of project complexity on the predictor variables



Source: Survey data

Discussion

This research focused on investigating the use of project management tools and techniques in the Sri Lankan public sector, and on gaining an understanding of whether such use actually leads to project success. In addition, the study attempted to analyze the factors which affect the application of project management tools in

public sector organizations. Thus, this research contributed to filling an empirical gap that existed due to the lack of field studies on project management tools and techniques used in the Sri Lankan public sector. The empirical analysis, which was predominantly of a quantitative nature, and was backed by structured interviews, gave rise to several interesting relationships relating to project management practices that exist in the Sri Lankan public sector. Even though these findings were primarily based on hypothesis testing, the analysis of descriptive statistics as well as structured interviews helped to broaden the findings of the research.

The project manager's competency emerged as the most important factor determining the level of PMTT usage as well as project success. The statistical analysis of empirical data revealed that among the independent variables, the project manager's competency showed the largest path coefficient with PMTT usage as well as project success, meaning that it is the most important item in explaining the variation in PMTT usage. This signifies the importance of having competent project managers in public sector organizations in the country in order to facilitate successful project completion.

The relationship between project manager's competency and project success also confirms the research findings of Baker et al. (1983), Pinto & Slevin (1988), Belassi & Tukel (1996), and Muller & Turner (2007). However, all the aforementioned researchers conducted their research on private sector organizations in developed countries. Moreover, research outcomes are in line with the findings of Olateju et al. (2011) whose research work was based on project management in a developing country. Further, the mediator impact of PMTT usage confirms the project management frameworks of Belassi & Tukel (1996) and Westerveld (2003).

Top management support emerged as the second most important factor in determining the level of PMTT usage as well as project success. It recorded the second highest path coefficient among the independent variables in the analysis. Hence, it is noteworthy that top management support is another key ingredient that facilitates successful project completion through effective application of the body of knowledge relating to project management.

The relationship between top management support, the extent of PMTT usage and project success can be jointly compared against the findings of previous research work. White & Fortune (2002) in their study stated that out of the three critical success factors mentioned most frequently by respondents to their survey, support

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

from senior management emerged as the second most frequently mentioned critical factor. In addition, the results confirm the research findings of Pinto & Slevin (1988), Ofer (2007), Simonsen (2007), Young & Jordan (2008), and Kandelousi et al. (2011) which revealed that top management support or involvement is one of the key success factors for project performance. However, none of the above researchers analyzed the mediating effect of PMTT usage on the relationship between top management support and project success. Westerveld (2003), on the other hand, in his Project Excellence Model mentioned that organizational leadership is first linked to project management practices, which is then associated to project results.

Affective organizational commitment emerged as the third most important factor determining the level of PMTT usage as well as project success in the Sri Lankan public sector. However, its significance is not as high as that of the project manager's competency and top management support. This confirms the results of previous studies (Sinclair, Tucker, Cullen & Wright, 2005; Vandenberghe, Bentein & Stinglhamber, 2004; and Gong, Law, Chang & Xin, 2009) which stated that affective organizational commitment has a positive relationship with individual and organizational performance. However, to the knowledge of the researchers there are no previous studies that have unveiled the mediating effect of PMTT usage on the relationship between affective organizational commitment and project success.

In addition, the empirical data revealed that project complexity moderates the positive relationship between top management support and the extent of PMTT usage, as well as affective organizational commitment and the extent of PMTT usage. However, it also revealed that project complexity does not significantly moderate the relationship between the project manager's competency and the extent of PMTT usage. The empirical findings confirm that project complexity influences the selection of project inputs and project organizational form (Baccarini, 1996), while supporting the argument of Furumo et al. (2006) which states that project complexity is a key factor hindering project performance.

Implications for theory and practice

Implications for theory

The study empirically confirmed the significant association between project manager's competency and project success discovered by previous researchers (Baker et al., 1983; Pinto & Slevin, 1988; Belassi & Tukel, 1996; Muller & Turner, 2007)

in the context of the public sector of a developing country. In addition, the results coincide with the research findings of Pinto & Slevin (1988), Ofer (2007), Simonsen (2007), Young & Jordan (2008), and Kandelousi et al. (2011) which revealed that top management support or involvement is a primary input for project performance. Confirming the previous studies of Sinclair et al. (2005), Vandenberghe et al. (2004) and Gong et al. (2009), the study findings reinstated the importance of organizational commitment towards individual and organizational performance.

Testing the previously empirically unproven mediator effect of the extent of PMTT usage on project success is one of the key contributions to theory. Thus, the study can be used to verify the project management framework proposed by Belassi & Tukul (1996) and the Project Excellence Model of Westerveld (2003). Further, providing empirical evidence of the moderating effect of project complexity on factors affecting project success is another important dimension of the findings, as such moderating effects have so far been little discussed in the literature.

Implications for practice

Abbasi & Al-Mharmah (2000) found that the use of project management tools and techniques among public sector companies was considerably low, but when practised efficiently would result in tangible benefits in all aspects of planning, scheduling and monitoring the time, cost and specifications of projects. In the above context, several recommendations could be made based on the findings of the study that would help the public sector organizations to become more effective in terms of applying project management tools and techniques, enabling them to deliver a better project outcome. These recommendations mainly target the three critical success factors derived from the study, which are the project manager's competency, top management support and affective organizational commitment.

Infusion of private sector project management knowledge to the public sector through the recruitment of competent, experienced project managers from the private sector is suggested, as such an initiative would facilitate a quick transformation in the project culture of the public sector. Similarly, it is also encouraged that senior private sector professionals be hired for top management positions in public sector institutions, since that would ensure better top management support for the projects carried out by those respective institutions. Developing countries seeking to enhance the implementation of project management might capitalize on the experience gained

Effectiveness of Project Management Tools used in the Sri Lankan Public Sector

in developed countries, and adapt these to their needs (Abbasi & Al-Mharmah, 2000). During this transfer of technology process, developing countries must work on improving management skills, and cultural and behavioral habits. In this line of thought, encouragement of public-private partnerships (PPPs) is another option that the public sector policy makers could consider. This is a common approach followed by many developing countries to transfer certain competencies in the developed countries/private sector to the public sector organizations, by way of joint implementation of projects.

Carlos, Mahmoud & João (2008) emphasized the transition needed in public sector organizations - from closed to more open systems - through the effective utilization of management and project management know-how. Further, Carlos et al. (2008) argued that public sector organizations should invest to re-invent and modernize their information systems. Accordingly, the encouragement for acquisition of internationally recognized project management qualifications, increased project management related training, enhancement of general management skills, competitive interview based selection of project managers, establishment of a central unit for project management knowledge enhancement, minimizing political involvements in internal project decisions, and encouragement of performance recognition and performance based incentives, are certain other key recommendations that could be made based on the findings of this research.

Limitations and directions for future research

The general limitations of a quantitative study are applicable to this research since the analysis was predominantly based on the deductive method. Even though several structured interviews were conducted with the objective of confirming the findings of the quantitative study, they were not carried out systematically to the extent of an exploratory qualitative study. Accordingly, certain context specific factors may not have been captured in the analysis. Single Source Bias (SSB) which arises when overlapping variability is due to data collected from a single source (Campbell & Fiske, 1959), could be considered another limitation in this analysis.

The research under consideration was conducted as an across the board study of the Sri Lankan public sector. However, future work could be done by further breaking down the public sector into its constituents such as the central government (Ministries and Departments), public corporations and statutory bodies. The same

study could also be replicated as a sector-wise study to analyze projects carried out by different sectors. Further, the research can be redesigned with the same theorization as a predominantly qualitative study. This would enable a more in-depth analysis on causal factors affecting PMTT usage. In addition, the same study can be replicated in other developing countries as well as in the Sri Lankan private sector with minor alterations. Meanwhile, future studies can also address the issues that may arise due to data construction through perceived measures from senior project officials rather than through independent evaluations.

Conclusion

This research gave rise to several interesting relationships that exist in the Sri Lankan public sector with regard to project management practices. Research outcomes suggest that the project manager's competency is the most important factor determining the level of PMTT usage, followed by top management support and affective organizational commitment. The study also found that project complexity moderates the positive relationships between top management support and the usage of project management tools, as well as affective organizational commitment and the usage of project management tools. Further, it was observed that PMTT usage acts as a mediator for the relationship between project manager's competency, top management support, organizational commitment and project success. The research findings reveal that the Sri Lankan public sector needs to focus more on enhancing the competency levels of project management staff, improving the level of support and cooperation extended by the higher level authorities, as well as to take measures to improve the project worker's emotional attachment to the organization. Addressing these factors in an effective manner will lead to successful project implementations, enabling the public sector to emerge as the primary engine in the development drive of the country.

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Vol. 18, Nos. 3 & 4, July - December, 2013

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Sri Lankan Journal of Management

Vol. 18, Nos. 3 & 4, July - December, 2013

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