DEVELOPMENT OF A STRUCTURED APPROACH USING VM METHODOLOGY TO REDUCE PROJECT COST OVERRUNS AT SESL

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Abstract: *This paper explores the feasibility of research, design, development and evaluation of a Project Cost Control (PCC) approach using Value Management (VM) method and concepts to reduce project cost overruns at Scarlet Energy Services Limited (SESL). The study is comprised of a documentary analysis and an empirical survey. The documentary analysis entailed a review of registers, minutes of meetings, project records; confidential documents on projects, bid documents, and invoices. The conduct of the empirical survey was to acquire views from employees and senior management on project cost overrun and other relevant issues at SESL. The questionnaire was divided into three (3) sections, namely 1) Project data, 2) Project cost data, and 3) Project cost overrun data. The findings of each section were used to understand the reasons leading to and the magnitude of project cost overruns. The findings from the empirical study provided the building blocks to develop the PCC approach such as the need for proper planning, estimating, budgeting, monitoring and controlling of projects. The PCC approach comprised of a five-phase framework: 1) Policy, 2) Planning, 3) Implementation, 4) Monitoring and Evaluation and 5) Feedback. It is anticipated that the approach could provide a blueprint to reduce project cost overruns at SESL. The PCC approach would bring changes by aligning SESL's vision, mission, strategic goals, management systems and daily practices to reduce project cost overruns.*

Keywords: *Value management, project cost overruns, cost control, construction, energy, Trinidad*

1. Introduction

Scarlet Energy Services Limited (SESL) has been providing Electrical, Instrumentation, Certified Calibration, Mechanical and Building/Civil products and Engineering solutions since 2008 to the Energy (oil and gas) and public sectors. SESL is characterised as a small- to medium- sized organisation (Harris, 2000). SESL's core business operations entail services to the industrial and construction sectors (such as Mechanical and Electrical Instrumentation, building construction and road paving). They have recently adopted the use of Peachtree accounting application and become STOW-certified. However, these recent improvements have not been able to eradicate the problems and prevalence of project cost overruns. In order to compete for projects and job orders, the Company has always used a lower-price strategy as compared to their competitors, leading to a high risk of project costs overruns. The SESL management has realised the need to assure that projects are delivered in a timely and safe manner while staying within budget.

At SESL, the project management practices have relied significantly on the experience of their managers and employees. There are no structured guidelines or best practices that govern the management and execution of projects. Besides, it is not common that managers and employees would use advanced software, tools and techniques in facilitating their project management practices. Several factors are identified leading to project cost overruns are 1) bidding low in hope of securing the job, 2) no allocation for labour shortages, inflation, increase of prices for material/equipment, 3) the absence of proper scheduling or usage of Gantt charts, 4) poor budgeting and estimating and 5) lack of archives of past projects. These have resulted in SESL's inability to retain permanent staff, project budgets resulted in either reduced profits, breaking even or losses, decrease in SESL's scope of services and limited job offers from clients. The company has been experiencing protracted project cost overruns during its first five years of operation. The SESL management have expressed serious concerns on project cost overruns and the urgent need to significantly reduce its negative impact on all contracts/projects the company undertakes. This project is intended to provide SESL with a strategy forward in that regard.

Value management (VM) is a technique used for improving value in projects, products, processes and systems and has been internationally recognised for almost 40 years (Kelly et al., 2004). VM introduces value process during concept, definition, implementation and operation phases of a project. The value process incorporates a set of procedures and techniques, which are both systematic and logic to enhance project value for the entire life of the facility (Perera, et al. 2003). VM is used in many sectors: electronics, aerospace, engineering, automotive, construction and increasingly by service sectors (Smith, 2002). VM methodology focuses on total value rather than financial cost and VM seeks to attain an optimum balance among time, cost and quality as it delivers a method of integration in the project management process that no other management process procedure provides to the construction sector (Kelly et al., 2002). VM, for the cost of a mere 1% of the total project budget is documented to

significantly reduce (elimination remains elusive) cost overruns. A review of several cases reveals successful adoption of VM concepts and practices achieving budget and producing savings, hence alleviating project cost overruns. This paper is intended to develop a structured approach using VM concepts and methodology to reduce project cost overruns at SESL.

2. Project Cost Overruns and the VM Methodology

Project cost overruns are defined as "the amount by which a contractor exceeds or expects to exceed the estimated costs, and/or the final limitations of a contract" (Tseng et al., 2005). It is the additional percentage or dollar amount by which actual costs exceed estimates. It is further defined as the excess of expenditures incurred or expected to be incurred compared to the initial project cost estimate (Flores and Chase, 2005).

In recent years, there have been numerous studies on the identification of factors influencing project cost overruns worldwide. A study conducted in Nigeria showed that among 50 contractors, consultants and client organizations, it showed that the leading variables causing construction delays and cost overruns are poor contract management, financing and payment of completed works, changes in site conditions, design changes, labour problems, shortage of materials, imported materials and plant items (Kasimu, 2012). The major variables resulting in project cost overruns were recognised to be inaccurate estimates, price fluctuations, delays and additional work (Mansfeild et al., 1994). Kaming et al., (1997) reported that the factors influencing cost overruns on high-rise building projects in Indonesia through a questionnaire survey administered on 31 project managers, a total of seven variables (materials cost increased by inflation, inaccurate quantity take-off, lack of experience of project location, lack of experience of project type) are identified for cost overrun.

Olawale and Sun (2010) argued that the application of cost control is more overwhelming with 84% of respondents indicating that they always apply their cost control method. Among the techniques identified from the survey are value management, project cost–value reconciliation, overall profit and loss, and profit and loss at valuation dates, unit costing and earned value analysis, that have some degrees of usage.

Value management is a style of management, particularly dedicated to motivating people, developing skills, promoting synergies and innovation, all with the aim maximising the overall performance of an organisation, it provides a new way to utilise the many existing management methods (BSI, 2000). The adoption of VM philosophy and techniques would provide the required quality at optimum cost during the process of developing a project and aims to maximise project value within time and cost constraints (HM Treasury, 2013). According to Olanrewaju (2013), VM is an organised set of procedures and processes that are introduced, intentionally to enhance the function of designs, services, facilities or systems at the lowest possible total cost of effective ownership, taking into consideration the client's value system for quality, reliability, durability, conformance, aesthetic, time and cost. The opportunity to improve value of a project is at its greatest at project inception, because as the project progresses execution costs and other unforeseen costs may be committed leading to project cost overruns. Later intervention of VM tends to produce smaller proportional benefits, which have unfavourable impacts on the project and meet greater resistance. VM should be implemented at a point where approximately 35% of the design (schematic/sketch) is completed due to the fact that costing data would be more readily available in the form of estimates and savings can be more easily identified (Kelly and Male, 1993).

A VM study is the formal application of a value methodology to a project in order to improve its value and hence reduce costs (SAVE, 2007). The conduct of a VM study would follow several phases as advocated by researchers and practitioners (e.g., Norton and McElligott (1995) and Corne de Leeuw (2001). Bremmer (2010) argued that adopting VM methodology could easily produce savings of 30% of the estimated cost for manufacturing a product, constructing a project or providing a service. In order to reduce project cost overruns existence of some form of cost control is necessary. To exercise cost control one must have a budget baseline against which to compare, so that management can spot deviations in time to take corrective action (Dell'Isola, 1997). Cost control does not make any major changes to the scope and concept of a project whilst VM looks holistically at the project as a whole and scope changes are often considered when conducting a VM study. The key differences are that VM is positive. It focuses on the value rather than the cost, seeking to achieve a balance between quality, life cycle costs and time.

3. Acquisition and Analysis of Empirical Findings at SESL

Barnes (2001) suggested five methodological options namely questionnaires, interviews, strategy charting, documentation, and ethnography) for empirical investigation of the process of formation of operations strategy. This study employed a methodology which combined the use of documentary analysis and questionnaires to determine empirically the magnitude of project cost overruns at SESL. The questionnaire was administered directly to the

Management Team. It was used to get senior management's views on project cost overrun and other relevant issues at SESL. The questionnaire was divided into three (3) sections, namely 1) Project data, 2) Project cost data, and 3) Project cost overrun data. The findings of each section were used to understand the reasons leading to and the magnitude of project cost overruns. The collation process included:

1. Tabulating data into a Microsoft excel spreadsheet.
2. The development of graphical representations such as bar charts, histograms and tables to show data collected.
3. Doubling-checking for errors and inconsistencies.
4. The drawing of conclusions from the data collected in order to determine what VM methods and concepts could be utilised for the Project Cost Control approach.

Since inception SESL has participated in approximately one hundred and thirteen (113) projects inclusive of completed and on-going projects, thus the sampling frame is one hundred and thirteen (113). The required sample size is a function of the precision of the estimates one wishes to achieve, the variability or the variance one expects to find in the population and the statistical level of confidence one wishes to use. Using a 90% confidence level and performing calculations, a sample size of twenty-two (22) projects was found to be sufficient for ensuring that the research objectives are met. Due to the lack of document control for project cost data, the questionnaires were administered to the Management Team at SESL, who are all knowledgeable on the projects conducted by SESL since inception. It is an exercise not only to arrive at project cost data, but also to find facts that the documentary analysis omits and would only be known by the Management Team. The administering was done directly by the researcher of this study for each of the twenty-two (22) projects selected; the Management Team of SESL comprised of 1) Managing Director, 2) Operations Manager, 3) Project Manager and 4) Finance/Administrative Manager. The Management Team of SESL responded to questionnaires as one unit, until the required sample size was met. Hence, twenty-two (22) valid questionnaires were completed by SESL Management Team.

It was found from the study that there have been several problems associated with project cost overruns at SESL. Specifically, these includes:

1) The inability to retain a permanent technical workforce apart from the Management staff. This escalates the budget cost of projects as technical staff has to be sourced for projects, if retained and made permanent the company overheads would be significantly reduced. When technical staff needs to be sourced the expenses are higher due to the temporary nature, and greater incentives and higher rates are often required in order to secure staff.
2) When projects exceed the budget it results in reduction of the allocated profits.
3) Once SESL signs a contract to provide services it is in the company's best interest to fulfil these contractual obligations. On occasions when SESL submits a low tender price in order to secure the jobs it has resulted in fulfilling a contract where every month there are losses until the project is completed.
4) SESL boasts about providing a wide variety of services to the industry and construction sectors. However, they no longer tender for specific jobs because it has not been profitable, thus reducing the scope of services delivered. This has resulted in a decline of job offers. Because of their pre-qualified status for many organisations, SESL usually receives calls to provide services simply by submission of a RFQ. However, when rejected by SESL, clients become unwilling to offer further jobs.
5) SESL was not able to profit from jobs that were longer than 12 months, while there was a higher success rate with shorter menial jobs. In order for the company to grow there need to be solutions to help tackle jobs of this nature.
6) With the job market in Trinidad and Tobago being unpredictable SESL has been tendering not only for jobs in the service and civil industry but also for infrastructural jobs such as road paving and maintenance jobs. Both maintenance jobs and road paving have proven unprofitable due to improper planning and the inability to retain technical workforce.
7) Jobs for Government agencies have been problematic in terms of yielding profits, because the manner in which jobs are planned and procured at SESL needs to be reviewed.

Table 1 shows the problems outlined by SESL from the data collection process and the solutions using VM methodology and tools that could be utilised in developing the project cost control (PCC) approach. It was found that cost control was severely lacking at SESL. The budgeted cost of projects was not equal to the actual cost and 59% of projects resulted in project cost overruns. There is no mechanism to monitor projects so as to remedy situations of project cost overruns. Together with using the framework of the VM Study the following tools would function as building blocks in creating the PCC approach.

Table 1. Findings, VM method and concepts and respective source

Problems	VM Methodology and Tool	Source
Lack of experience, labour shortages, dealing with long term projects	(Kaming, et al., 1997), (Mansfeild, et al., 1994), (Olawale & Sun, 2010)	Value Planning
Inaccurate estimates, price fluctuation, dealing with long term projects.	(Kaming, et al., 1997), (Mansfeild, et al., 1994), (Kasimu, 2012), (Olawale & Sun, 2010), (Ashworth, 2004)	Cost/Worth Model, LCC Technique, Cost-benefit Analysis
Weak regulation and control, inaccurate evaluation of projects time/duration	(Olawale & Sun, 2010)	Earned Value Analysis

This approach needs to have methods or concepts that would provide proper estimates at the start of the project, determine whether or not the project is feasible and monitor the performance of the project. The diagnosis of problems in line with various phases of VM Job Plan at SESL is elaborated as follows:

1) Pre-study phase

The objective of this phase is to ensure that the study has clear objective, sufficient information and all stakeholders are involved. The most important aspect of this phase to help in alleviating project cost overruns at SESL is the cost estimate verification, 41% of jobs at SESL resulted in project cost overruns and one of the major reasons leading to project cost overruns was 'Poor estimating and budgeting.' In this phase there is a conceptual view as to what the project entails and what may be needed. There is an idea of the budget, materials/equipment and staffing requirements and planning begins so that this would not become a problem into the project which can lead to cost overruns.

2) Information phase

An important part of this first phase should be spent on coming up with answers to the questions: 'what does it do?' and 'what else does it do?' A FAST diagram is a tool used to answer and structure these questions above. In this phase tools and techniques to aid in cost control are applied. At SESL, a common practice is 'Bidding low to secure the job', Besides, SESL would undertake projects that they might not well understood or they do not have the expertise, such as RTU installation. This phase helps SESL to remove any doubts or questions about the project being undertaken (such as design changes that have been proven to be a major contributor of project cost overruns).

3) Creative phase

The objective of this stage is to give all the team members the opportunity to put forward their suggestions for beneficial change without fear of recrimination or criticism. The team develops a broad array of ideas that provide a wide variety of possible alternative ways to perform the function(s) to improve the value of the project. A technique predominantly used in this stage is that of Brainstorming. One of the many advantages of this group brainstorming is that it provides synergy which basically means that the productivity of the group is higher than the sum of all the results of the members in the team. At SESL the Management Team makes all the decisions and valuable employees such as Technicians are not involved, their input can be very important as they are the people onsite who would know the real issues faced on a day-to-day basis. This phase is important in reducing project cost overruns as different ideas, views and perspectives can result in unlimited possibilities showing the importance of VM as a tool to solve project cost overruns.

4) Evaluation Phase

The team would conjointly evaluate and prioritise the ideas that they think is worthwhile and can add value and where they dismiss those ideas that are not likely to add value to the project. The judgement that was gathered during the creativity phase is now released. The typical technical criteria utilised are: (i) Cost - savings potential like initial capital cost savings, maintenance cost savings, staffing costs, (ii) Function - security, future expansion possibilities, safety during, occupancy, (iii) Time - impact on design time, impact on the durability, reliability and service lives of components, and (iv) General - the constructability of the idea, safety issues, political factors and jurisdictional matters to be considered. Each factor in the project is weighed as to what positive benefits it would bring if implemented. This phase would appraise these ideas and develop those that bring the most rewards.

5) Development Phase

The acknowledged ideas selected for further development are investigated and considered in detail for their technical feasibility and economic viability. Outline designs would be worked out and costs should be realised. Comprehensive proposals are formulated in this phase which provides an extension to the evaluation process.

6) Presentation phase

The objective of this final phase is to assist the communication of the results of the VM study to the decision makers and the original design team. The refined ideas supported by drawings, calculations and costs are presented by the team to the body that commissioned the VM workshop.

7) Post-Study phase

The post study phase can be divided into the following three phases, namely: (i) Report preparation and review phase, (ii) Implementation phase, and (iii) Follow up phase.

4. Development of a Proposed Project Cost Framework

Incorporating the VM concepts and methodologies with the empirical findings, a PCC approach was derived for SESL. The approach has five categories of criteria. The empirical data collected unveiled elements of each criterion were lacking which would be described in detail in the ensuing sections including 1) Policy, 2) Planning, 3) Implementation, 4) Monitoring and Evaluation and 5) Feedback. A diagrammatic representation of the PCC approach is given in Figure 2. It would produce a data-driven approach to understanding, comparing and cross-examining costs for each phase and facet of the life-cycle of projects to be executed by SESL. It would promote a change in organisational culture, seeing that the use of VM concepts and methods is new to SESL. The aim is for the concept of value to drive the organisation's strategic objectives and inform its cost reduction strategy. This will avoid inadvertent cuts to high-value, low-cost services, in turn reducing project cost overruns.

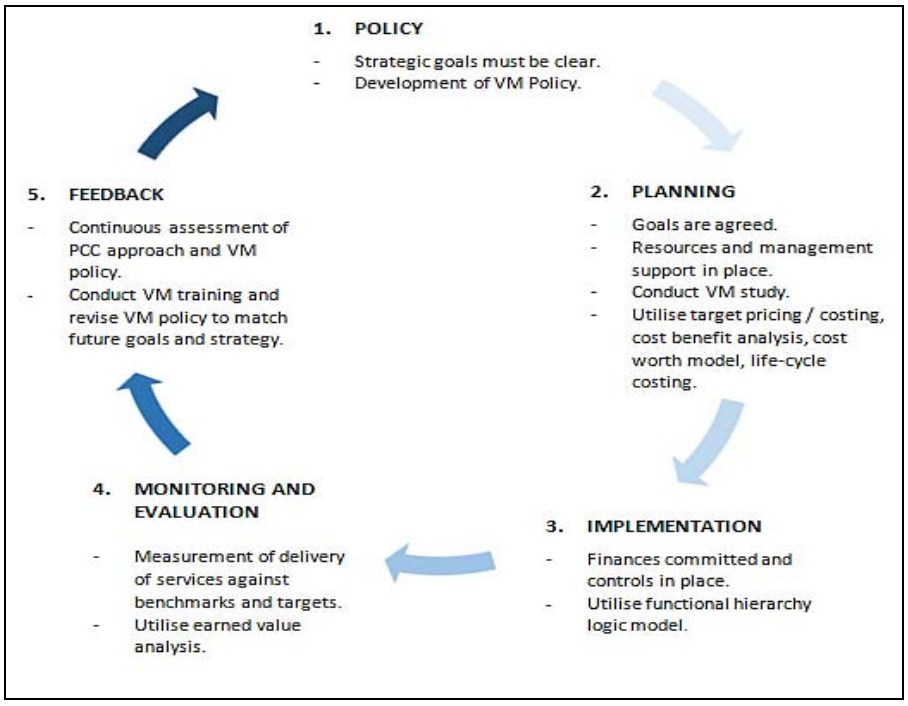


Figure 2. PCC approach

The five phases combine to form the PCC approach, which can be seen diagrammatically in Figure 3, using generic project phases, issuing responsibilities and showing VM tools and techniques to be used in the respective phases to form a project implementation plan. All cost reduction programmes must focus on realising the savings through identifying, quantifying, delivering and measuring the real cost reductions. The PCC approach entails an analytical framework for assessing opportunities to reduce costs. It has an understanding of the drivers of cost (people, processes, technology, procurement, capital assets) and how to influence demand (activity levels, smoothing demand patterns). The approach provides an analysis of the cost/value ratio, this is important as the understanding of costs (inputs) should be linked to an understanding of value (outputs and outcomes).

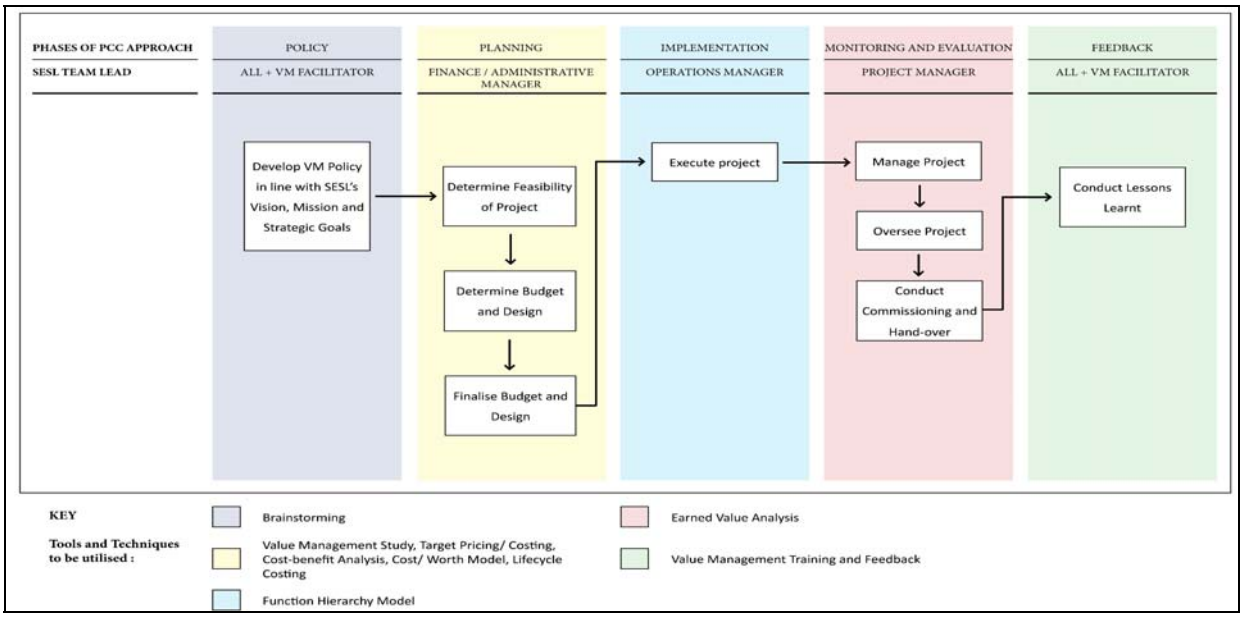


Figure 3. Implementation plan

5. Evaluation of Project Cost Control (PCC) Approach

5.1 Problems/Issues and Approach to Reducing Effect

The PCC approach was developed using the findings from the empirical study, the documentary analysis and the VM methods and concepts derived from the literature review which acted as the pillars of this approach. It was important to note whether or not the PCC approach took into consideration all the problems/issues found in the empirical study and documentary analysis. Table 2 highlights all the findings and the method or concept which would be used to reduce the effects of that particular problem/issue.

Table 2. Findings of associated problems and effect of adopting the PCC approach

FINDINGS FROM EMPIRICAL STUDY	ASSOCIATED PROBLEMS	PCC APPROACH METHODOLOGY TO REDUCE EFFECT
Low range of profitable services, limited job scope.	Poor planning, poor budgeting and estimating, lack of use of cost models.	VM study – 7 phased framework. Use of cost models such as target costing, cost-benefit analysis, cost/worth model, life cycle costing.
Inability to be successful outside of private sector.	Poor planning, poor estimating and budgeting.	VM study – 7 phased approach.
Poor performance in long term jobs.	Poor planning, poor estimating and budgeting, lack of monitoring and scheduling.	VM study – 7 phased approach, use of Earned Value Analysis (EVA).
Project cost overruns	Poor planning, poor estimating and budgeting, lack of monitoring and scheduling.	VM study – 7 phased approach, use of functional hierarchical model, use of use of Earned Value Analysis (EVA).

5.2 A Pilot Study – PCC Approach

SESL is required to provide tools, labour and equipment for the maintenance of a tank farm at Trinmar. This is a three-year contract with a consistent monthly fee of $35,970 which is $5,970 above the budgeted cost. Therefore every month SESL's expense for tools, labour and equipment for this job is 19.91% above the budgeted cost. This project was used as a pilot study to evaluate the effectiveness of the PCC approach. The pilot study comprised of a one (1) day session held at SESL's head office with their Management Team. The major finding after this session is SESL had under-budgeted for this project by 6.29% in terms of market value. This was found during the seven (7) phases VM study session using target pricing/costing after forming a proper project plan for the study. The earned value analysis projection established during the session showed that current estimation to completion would be $1,295,000 which was initially budgeted as $1,080,000 and if the PCC approached was utilised that would be some

$1,213,540, which can be seen in Figure 4. Therefore, if SESL had the use of the PCC approach their cost overruns could have been reduced by at least 6.29%.

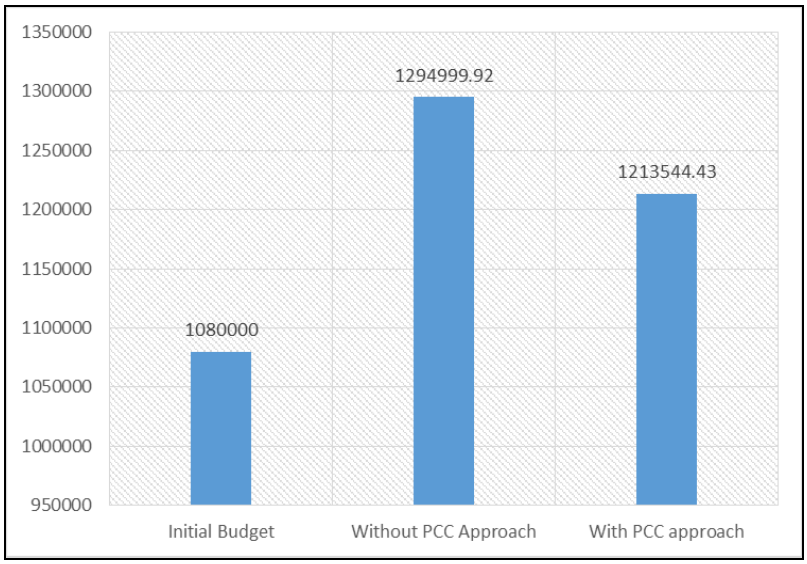


Figure 4. Estimation to completion of pilot study

6. Conclusion

With respect to project cost overruns at SESL, the empirical findings revealed that there were numerous factors leading to project cost overruns at SESL. Some key factors being: 1) bidding low in hope of securing the job, 2) no allocation for labour shortages, inflation, increase of prices for material/equipment, 3) the absence of proper scheduling or usage of Gantt charts, 4) utilising - poor budgeting and estimating techniques and 5) lack of documentation and records management of past projects and lessons learnt at the company. These factors have resulted in SESL's inability to: retain permanent staff, attaining deficient project budgets that result in reduced profits, breaking even or in losses, decrease in SESL's scope of services offered to clients, and reduction in the number of contract secured - limited job offers from clients. The empirical part identifies the magnitude of challenges faced by SESL and shows the need for a mechanism to control costs. Together with the literature, this study adds new dimensions on areas of cost control using VM methodology.

The uniqueness of this study is to 1) identify the factors affecting project cost overruns, and 2) develop and evaluate the efficacy of the PCC approach in reducing cost overruns at SESL. This involves continuous refinement through feedback and project experience. The approach comprises of a five (5) phase approach including 1) Policy, 2) Planning, 3) Implementation, 4) Monitoring and Evaluation and 5) Feedback. This five phase approach can assist SESL to:

1) Align the integration process with corporate vision, mission and strategic goals, through the development of a Policy,
2) Establish a stage for merging organistional strategies, plans and actions,
3) Ensure projects are properly planned and budgeted,
4) Control, monitor and evaluate progress and project performance,
5) Maintain performance goals and raise continous improvement.

It is anticipated that the adoption of the PCC approach would bring changes by aligning SESL's vision, mission, strategic goals, management systems and daily practices to reduce project cost overruns. The approach would not be limited to its proposed design, however with ideas for cost reduction and continuous improvement encouraged, tested, implemented and evaluated on an ongoing basis. SESL management would identify and implement strategies for long-term value for money. Cost management, regular benchmarking, and the adoption of wider good practice would be part of the core business and sustained by strong leadership and good quality information, using this approach as the backbone for any further development. Furthermore, the PCC approach could be refined to suit similar companies in both construction and energy sectors in Trinidad and Tobago.

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