ENHANCING PROJECT MANAGEMENT IN SOUTH AFRICAN SMALL BUSINESSES BY FOCUSING ON PROCESS IMPROVEMENT METHODOLOGIES

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ABSTRACT

Execution of projects is important in the day to day management of any enterprise. The project management triangle, which consists of time, cost and scope, must be balanced in order to optimise project execution results. Within the project priority matrix these interrelated critical aspects can be balanced in three ways by either accepting changes to one or more of the aspects, constraining some aspects so that they don't change, or choosing to enhance an aspect by means of improvement if possible. This paper provides a framework that strives to enhance the project management decision making around the critical aspects by improving the overall balancing performance. The framework focuses on small and medium enterprises (SMEs) in South Africa that suffers from a lack of managerial and technical skills. Improvement methodologies are studied to provide tools and techniques that can increase the effectiveness, efficiency and agility of project implementation. Three methodologies were identified for consideration namely, lean thinking, the theory of constraints, and six sigma. The focus will be on the elements of these methodologies that apply to project management within skill constrained SMEs.

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1 INTRODUCTION

It is generally accepted that the nature of the modern business environment is best characterised by changing trends and events. Therefore the future success of enterprises depends on their ability to react, operate and adapt to a changing environment [1]. Evidently, a systematic approach is necessary for the successful structuring of change processes.

Project management is the process of achieving project objectives initiated by the need to change. It is a temporary group activity that has a defined beginning and end time and therefore defined scope and resources. Enterprises in South Africa are training their staff in the science of project management as the benefits of operating in a project capacity become more visible [2]. This training involves the discipline of planning, organising, motivating, and controlling resources to achieve project specific objectives.

Projects are unique and need to be performed and delivered under certain constraints or critical aspects. Traditionally, these aspects have been listed as time, cost and scope [3]. Together they form the project management triangle, which shows that these aspects are interrelated since one corner of the triangle cannot be changed without affecting the others. The project management triangle is displayed in Figure 1 below.

![Figure 1: Project Management Triangle](image)

The critical aspects represented in the project management triangle must be balanced in order to optimise the output of project execution. Within the project priority matrix these interrelated aspects can be balanced in three ways by either accepting changes to one or more of the aspects, constraining some aspects so that they don’t change, or choosing to enhance an aspect by means of improvement if possible.

1.1 Problem Statement

Enhancing each aspect of the project priority matrix, as shown in Figure 2, means that projects are executed faster and cheaper within a refined scope. This is achieved through the application of project management knowledge, skills and techniques to improve project execution results. In SMEs this opportunity is limited by a number of factors, mainly access to finance, managerial skills and technical skills [4].

The lack of financial access limits the opportunity for acquiring advance technology and outside expertise, but it is the lack of internal skills that restricts project management optimising potential. This lack of skill renders management incapable of identifying inefficient practices and therefore ignoring the need to enhance critical aspects. Above all,

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insufficient technical skills cause a shortage of project management supporting tools and methods that enables planning and execution of successful projects.

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Figure 2: Enhancing Project Priority Matrix

1.2 Objectives
The objective of this paper is to provide a framework that enhances project management decision making around the critical aspects by improving the overall balancing performance of the project management triangle in skill constraint SMEs.

A theoretical analysis is carried out to determine the connections between the critical aspects. Understanding how these aspects are related allows the manipulation of the connections to ultimately enhance their associated aspects.

1.3 Methodology
This study was done through a theoretical analysis of three commonly used continuous process improvement methodologies. These methodologies were chosen because of their relation with the project management triangle. A potential representation of how the improvement methodologies can be integrated into the project management triangle is displayed in Figure 3, after which a short explanation follows.

Figure 3: Integrated Process Improvement and Project Management Triangle
The first methodology, lean thinking, focuses on value adding activities. In other words, the primary objective is to increase value faster than accumulating cost [5].

The second methodology, theory of constraints, emphasises faster system throughput by means of constraint alleviation. The throughput is inverse proportional to the cycle time of a process. Evidently, by increasing throughput, cycle time decreases [6].

The third methodology, six sigma, focuses on improving the process quality and in affect process performance of improvement projects. These two characteristic is the results of a further refinement of the project scope [7].

2 LITERATURE REVIEW

This section explores the continuous process improvement methodologies that were identified to be integrated into the project management triangle. The focus of this literature review is on the elements that may be applied to project management within skill constrained SMEs.

2.1 Lean Thinking

Lean thinking focuses on increasing the rate of value adding activities, which is pulled by the customer, by using a set of tools to continuously improve this flow. Furthermore, it is an integrated way of thinking that relies on the cooperation of the entire enterprise. It also supports continuous learning and empowerment of the front line employees. [5]

During the 1950s and 1960s Taiichi Ohno and his colleague Shigeo Shingo developed the infamous Toyota Production System (TPS), which can be visually represented by a house with three pillars. The base of the house represents operational stability through continuous improvement, standardised work, visual management and a clean, organised working environment. This forms the foundation of the three pillars that represent just-in-time, jidoka, and workforce involvement. These pillars support the final goal of rapidly providing customers with cheap, high quality product and services. The fundamental concepts will be explained later, but notice how the roof (fast, cheap, high quality) relates to the project management triangle (time, cost, scope). [5]

Jim Womack, Dan Jones and Dan Roos popularised the term lean thinking when they wrote the book entitled “The Machine that Changed the World” in 1990 [8]. In this book they claimed that lean can be applied to a wider range of industrial settings, including service industries.

Lean thinking can be summarised according to four principles. These can be stated as the 4P principles: philosophy, people & partners, problem solving and process focus [5].

2.1.1 Philosophy

Top management should commit to a vision and support an implementation strategy to sustain improvement processes. This drives long term dedication to building a learning organisation that can easily adapt to changes in the environment.

Management base their decisions on the growth and alignment of the whole enterprise towards a common purpose, even at the expense of short-term financial goals. The starting point is to generate value for the customer, society, and the economy.

2.1.2 People and Partners

An internal continuous learning and improvement culture is necessary to guides the employees through the change process towards the values of lean thinking. A stable culture with shared values and beliefs is both a result and enabler of sustainable and successful lean operations [5].
Employees operate in cross functional teams to stimulate personal and professional growth, share the opportunities of development through education, and maximise individual and team performance. These teams also provide a diverse set of skills and knowledge that support internal learning. Furthermore, employees are empowered to take responsibility and use their own judgement to make decisions within the context of best practice methods.

The external network of partners and suppliers is treated as an extension of the business. They are respected and challenged to grow and develop through improvement assistance. Suppliers need fair and honourable business relations, stable and reliable processes, clear expectations, enabling systems, and learning assistance.

2.1.3 Problem Solving

The focus of a continuous learning system is to identify root causes and problems and preventing them from occurring. This can be done by going to the source and personally observing and verifying data for better understanding and analysis of the process.

When root causes and problems are identified it is important to make decisions slowly by consensus. All options are thoroughly considered, since the process of arriving at a decision is just as important as the quality of the decision, and final decisions are rapidly implemented after all alternatives are taken into account.

Throughout the execution of decisions it is important to reflect after reaching milestones to openly identify all shortcomings of the project. Countermeasures are developed to avoid future mistakes. However, best practices are standardised to support future project.

2.1.4 Process Focus

The real challenge of lean process improvement is to know how to start. Womack and Jones specified five steps that provide a roadmap for successful implementation. These principles are: (1) identify value, (2) map the value stream, (3) create flow, (4) establish pull, and (5) pursue perfection. [8]

The first step, value analysis, is the identification of customer specific needs to define value from their perspective. This is necessary to ensure waste free processes. Taiichi Ohno identified seven forms of waste: (1) unnecessary transportation, (2) excess inventory, (3) unnecessary motion, (4) waiting times, (5) overproduction, (6) and (7) defects. Unused talent is frequently added to list of wastes.

Secondly, value stream mapping is necessary to document and analyse process detail in terms of material and information flow that brings a product or service to the customer. Value stream mapping is adapted by Mike Rother and John Shook [9] from Toyota’s material and information flow diagrams.

Thirdly, smooth flow is created to increase material movement as well as linking people and processes together so that problems surface right away. Flow is created through various methods such as standardised work, load levelling, visual management, total productive maintenance, quick changeovers and built-in error prevention.

Fourthly, pull systems are implemented to avoid overproduction and over processing. The concept of pull is to produce exactly what customers need, when they need it, in the quantity they need it, without defect at the lowest possible cost. Pull systems are usually initiated through the use of kanban cards that signals when an order is received.

The final step is to pursue perfection by repeating the all of the previous steps with constant attempt to increase the performance and quality of all business processes.
2.2 The Theory of Constraints

The theory of constraints (TOC) is an improvement approach that focuses on alleviating the constraining elements of operations in order to allow a business to perform at its optimal level. The theory purports that every business has a constraining elements that prohibit it from performing at a higher level. [10]

The method was introduced to the world by physicist and author Dr. Eliyahu M. Goldratt in his novel entitled “The Goal” which was published in 1984. [6]

One of the appealing characteristics of the TOC is that it inherently prioritises improvement activities. The current constraint is always the top priority. In environments where there is an urgent need to improve, TOC offers a highly focused methodology for creating improvement.

2.2.1 Five Focussing Steps

TOC is based on the premises that every process has a single constraint and that total process throughput can only be improved when the flow through the constraint is improved. Therefore the constraints should be identified, and the organisations efforts should be expanded to overcome the constraint.

The TOC systems approach requires that you first understand the system, its goal and measurements before applying the five focussing steps to alleviate the constraint. These steps are: (1) Identify the constraint, (2) exploit the constraint, (3) subordinate to the constraint, (4) elevate the constraint, and (5) repeating the process. [6]

The first step, identifying the constraint, looks for the weakest link in the most used processes. Constraints may not just be physical, but can include intangible factors such as ineffective communication, restrictive company policies, or even poor team morale. Tools such as flowcharting, Pareto analysis and queuing models can be used in this step.

The second step is the exploitation of the identified constraint. Basically it means maximising throughput of the constraint, by increasing its capacity, using currently available resources. This step focuses on quick wins and rapid relief through improved utilisation of the constraint while leaving more complex and substantive changes for later.

The third step is to subordinate the other operations in the process to the constraint. By definition, all non-constraining operations have some degree of excess capacity, which enables smooth operation of the constraint by ensuring that the constraint buffer is continuously filled. A useful technique is the Drum-Buffer-Rope system that synchronise operation to the needs of constraint by releasing material according to time buffers.

The fourth step is to elevate the constraint. This implies that substantive changes are implemented to improve the capacity of the constraint. These include, changing the layout of the process, acquiring additional external sources or working overtime. This may necessitate a significant investment of time and/or money.

Finally, the cycle should be repeated to prevent inertia. The reason is that when a constraint is broken, another part of the system or process chain becomes the new constraint and the performance of the entire system must be re-evaluated. [11]

2.2.2 The Thinking Process

TOC includes a sophisticated problem solving methodology called the thinking process. This process is designed to optimised complex systems with many interdependencies or variability. This is achieved through a scientific cause-and-effect approach, that strives to first identify the root causes of undesirable effects (referred to as UDEs), and then remove the UDEs without creating new ones.
This process essentially breaks down into three questions: (1) what to change, (2) what to change to, and (3) how to initiate the change. These questions are answered through the strategy and tactic trees that have been developed by Dr. Goldratt. There are four main trees which provide a roadmap from the as-is situation to the to-be situation: (1) Current Reality Tree, (2) Conflict Resolution Diagram, (3) Future Reality Tree, and (4) Transition Tree. [12]

The Current Reality Tree (CRT) is a type of flowchart that documents the current state of a process. It depicts the cause-and-effect relationship that exists for the object of interest, starting with a list of UDEs. The contributing factors that perpetuate these effects are associated with them and listed accordingly to identify the root causes. [10]

The Conflict Resolution Diagram (CRD) evaluates potential improvements. It is a diagram that helps to identify specific changes (called injections) that eliminate UDEs. Injections are conditions or actions that occur in the future and are geared toward overcoming any underlying assumptions that prevent the achievement of objectives. The diagram is particularly useful for resolving conflict between process prerequisites and different injections.

The Future Reality Tree (FRT) documents the to-be situation of the process, which reflects the results of injecting changes into the system. Starting with the injections identified in the CRD, the purpose is to identify all possible effects of the proposed injection when applied to the current reality.

The Transition Tree (TT) is basically a project management tool that provides the detailed action plan to move from the current process state to desired process state. This tree is used as the final implementation plan when you have completed your simulation activity and are ready to go forward.

2.2.3 Throughput Accounting

Measurement is the common language for a company and communicates priorities. There are three primary indicators that Dr. Goldratt identified to measure the performance of a business: (1) throughput, (2) operating expense, and (3) inventory. [10]

Throughput is the rate at which the system generates money through sales. Mathematically it is the money generated by the system less variable costs (typically raw materials, sales commissions, freight, and labour tied to pieces produced).

Operating expense is all the expenditures a business incurs as a result of performing its normal business operations. Basically it’s all the money that the system spends in turning inventory into throughput.

Inventory, also known as investment, is all the money tied up in physical assets such as product inventory, machinery, equipment, and real estate.

2.3 Six Sigma

Six Sigma is a structured, data driven, problem solving approach for improving processes. Its strength lies in the advance statistical tools that are implemented within a formal organisational structure. [7]

Originally pioneered by Bill Smith at Motorola in 1986, six sigma was popularised by Jack Welch, former CEO of General Electric, in 1995. It was designed as organisational initiative that strives to produce no more than 3.4 defects per million opportunities. This quantity is based on the assumption of a 1.5 sigma shift in mean.

The purpose of this methodology is to align all business processes with the needs of the customer. To achieve this purpose, six sigma seeks to find and eliminate causes of variation and defects in business processes by focussing on outputs that are of critical importance to
customers. Furthermore, it required extensive training of employees since project members are selected according to their knowledge of statistical tools and improvement experience.

A five step model is implemented for reaching project objectives: (1) define, (2) measure, (3) analyse, (4) improve, and (5) control. This is called the DMAIC model [7]

The first phase, define, involves top management to define the problem and scope of the project according to customer feedback and the strategy of the company. The first step is to identify the critical needs of the customer. Thereafter, for each need, you identify its quality drivers which are the factors that the customer will use to evaluate the quality of the product. Finally, identify measurable performance goals that each driver must satisfy if you’re to actually provide a high quality product to your customers. Useful tools include the SIPOC diagram that identifies the suppliers, inputs, process steps, outputs, and customers of the studied process, while the Critical-to-Quality Tree translate broad customer needs into specific, actionable, measurable performance requirements. [13]

The second phase, measure, involves the development and implementation of a data collection plan. Firstly, all the aspect that is critical to quality is operationally defined. Secondly, a repeatability and reproducibility study is performed to determine the validity of process measures. Finally, the collected data is used to develop a baseline for process capability and performance.

The third phase, analyse, determines the underlying cause of problems by converting raw data into information that that provides insight into the process. In this phase, the project team uses data analysis tools and process analysis techniques to identify and verify root causes of the problem. A good place to start is with non statistical Root Cause Analysis tools such as Pareto analysis and Ishikawa diagrams. Thereafter more advance tools are used such as linear regression, correlation analysis and analysis of variance.

The fourth phase, improve, entails the generation and selection of solutions that will eliminate the identified problems and reduce process variation. It requires improving or optimising the process based upon data analysis techniques like Failure Mode and Effect Analysis (FMEA) and Design of Experiments (DOE). FMEA is a analytical approach directed toward problem prevention through which every possible failure mode is identified and risk rated, while DOE looks at multiple levels of multiple factors simultaneously and make decisions as to what levels of the factors will optimise output. [13]

The fifth and final phase, control, involves the evaluation of the implemented solutions by controlling the process to ensure that any deviation from the target is corrected before they result in defects. The objective is to maintain improvement by measuring process performance and capability. Two primary tools of this phase are control charts, which presents a graphical display of process stability or instability over time, and process capability analysis.

3 INTEGRATED PROJECT MANAGEMENT FRAMEWORK

The focus of this section is the development of an integrated project management framework that strives to enhance project management by improvement the overall balancing performance of the critical aspects of the project management triangle in skill constraint SMEs.

The focus of the framework is not on the direct improvement of each critical aspect, but rather on overall improvement. Therefore connections between these aspects were identified to improve the understanding of their interrelatedness. The three connections are the focus of project improvement in terms of (1) effectiveness, (2) efficiency, and (3) agility. These connections are shown in Figure 4.
Effectiveness connects cost and scope. It is defined in terms of how successful a process is in producing a desired or intended result. Being effective is about doing the right thing. In other words it is to create value from the customer’s perspective.

Efficiency connects time and scope. In short it is to perform or function in the best possible manner with the least amount of waste and effort. Being efficient is about doing things in the right manner. Basically it describes the quality of the process.

Agility connects cost and time. It is defined as the ability of a system to adapt rapidly and cost efficiently in response to changes in the business environment.

3.1 Effectiveness

Effective project managing is to ensure that the intended or desired project objectives should be successfully achieved. This means that the right processes must be done in scope with the objectives to create value for the customer. Therefore the source of effectiveness can be seen as the initiation and planning phases of project management. The reason for this statement is that these phases determine why the project is initiated, how it will be executed, and what the intended or desired results will be. [3]

When planning a project, top management must identify the person, problem or opportunity that initiated the need for the project. Thereafter, customer related information is analysed and translated into defined requirements. The customer definition of value is important for refining the refined project scope and to ensure waste free projects. Goals are then set according to customer feedback and the company’s strategy and mission statements.

The SIPOC analysis identifies the suppliers, inputs, process steps, outputs, and customers related to the process within the project scope. The suppliers are the sources of the inputs, such as material, tools, knowledge and skills, necessary for project completion. Furthermore, process steps are the activities related to the project. Finally, outputs are the intended or desired results that will satisfy the defined customer’s requirements.

The Critical to Quality Tree translate customer related information into specific project objective. Feedback from the customer is documented to determine the critical drivers of the project. Thereafter, the requirements of these drivers are identified and replaced with requirement in a measurable form. The final part of this analysis is to set target values for these requirements.

When the target objectives for the project is set, the TOC thinking process can be implemented to optimise the project planning approach, even when it consist of a complex system with many interdependencies and variability. The scientific cause-and-effect
approach is effective at identifying the possible outcomes of different actions that may form part of the project. Using the tactical trees it is possible to identify the requirement to reach certain objectives, along with their prerequisites. Assumptions can then be made why these prerequisites may be conflicting with each other. Finally injections (actions) can be initiated in order to prevent conflict.

3.2 Efficiency

Efficiency is a measurable characteristic that evaluates the performance and quality of activities. Therefore, the focus of project efficiency is on the execution and monitoring phases of project management. [3]

While executing project activities it is necessary to be able to identify non value adding activities so that they can be eliminated. A good start is seven types of waste defined by Taiichi Ohno. The wastes that can be best applied to project management are unnecessary transport, excess inventory, waiting times, over processing and non-conforming activities (defective work).

The flow of sequential activities is also important to shorten execution time. Smooth flow can be created by effective communication between the people responsible for activities. Communication is important to initiate time buffers between activities. Also, the right inputs for each activity should be provided at the right time at the right amount.

Measurement is a critical aspect to determine project efficiency. The goal of measurement is to compare activities, either against historical data or the target objectives. It can also be used to determining the efficiency of similar processes. Furthermore, it can be used to set benchmarks for future activities. For effective measurement an appropriate data collection plan is necessary to measure relevant aspects of the current activities. This requires the development of operational definitions which establish a better understanding of the necessary activities.

Throughput accounting provides three key performance indicators that can be used to measure the efficiency of activities if they’re aligned to project management. These indicators communicate the performance of an activity. They may not always be relevant or even measurable, but they provide a starting point when developing a data collection plan. Throughput is the rate at which value is added to an activity relative to cost. Operating expense is the cost of skill and knowledge that are needed for the execution of an activity. Inventory is the money that is invested in the physical resources required for an activity.

3.3 Agility

Agility ensures flexibility in an environment with high variance by adapting rapidly and cost effectively to unexpected change. This is an important aspect primarily of the planning and execution phases of project management. The reason is that possible changes and different scenarios should be taken into account during planning of a project. Furthermore, when changes occur during execution the people involve should be able to rapidly adapt to the changes without adding unexpected costs. [3]

During the planning phase, the TOC thinking process can be used to detect different prerequisites with potential for future conflict. Furthermore, potential external conditions can be identified for different scenarios. Assumptions are made to include various different possible situations. When these situations are identified, injections can be developing to prevent them from escalating when they would happen.

Additionally, an FMEA can be made to identify different failure modes that may be related to project execution. Each failure mode is than rank according to the risk they pose to successfully completing a project. Furthermore, precaution can be implemented to decrease the possible of failure or to the decrease the severity should a failure occur.
During the execution phase, it is important that a flexible team is available that deal with changes in the project scope or if an activity deviates from the project plan. One way of instantly increasing team flexibility is by selection a cross functional team. These teams implement members from various departments and functions inside a company. This ensures a diverse set of skills and knowledge inside a team. Members must be empowered to use their own judgement for rapid decision making when necessary while taking responsibility for their actions.

Moreover, establishing a culture of continuous learning encourage teams members to expand their and improve their knowledge. Activity rotation can also be implemented to widen employee perspective on each function in a project. Knowledgeable team members that have perspective form areas and understand the full extent of a project improve decision making processes.

Finally, after each activity or milestone, it is important to reflect to openly identify all shortcoming of the project. Thereafter, countermeasures are developed to avoid future mistakes. However, best practices are standardised for future projects.

4 CONCLUSION

Based on the literature study, certain element of different process improvement methodologies can be applied to project management. Three connections were also identified between the critical aspects (time, cost, scope) of the project management triangle: (1) effectiveness, (2) efficiency, and (3) agility. These connections are the focus of improvement since they comprehend the interrelatedness of the critical aspects.

A framework was developed that potentially enhances decision making around the critical aspect by improving the overall balancing performance of the project management triangle in skill constraint SMEs. The framework consists of three connections, along with traditional process improvement elements, that are specifically related to certain parts of the project management process. The framework is concluded in Figure 5.

![Figure 5: Integrated Project Management Framework](image-url)
5 REFERENCES


