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21 March 2019
ABSTRACT

The aim of this dissertation is to review and analyse the existing strategies and methodologies of project management relating to management, organisation structures and more specifically their impact on project management itself.

The dissertation will start by doing basic research on project management and the two major institutes that have generated an international standard, namely PRINCE and PMBoK. From here the dissertation will move to explore the different organisational structure how projects are managed in these structures. Next the dissertation will review some of the most basic management principles, and management strategies as well as how they are focussed on projects. Research will consist of various books, journal articles and seminar presentations being summarised and combined to form the basis of this paper.

The final stage of the dissertation will propose a combined management strategy that assesses the information gathered in the research portion of all sections. The idea behind this proposal will be to allow Engineering Managers to for a basis for managing projects in their organisation. This proposal will in no means be complete as no single set of standards apply to all industries, only guidelines that can be moulded to suit.

The dissertation closes by making basic recommendations to the organisation considered in the case study with regards to all three focus areas as well as a general recommendation. In conclusion the dissertation identifies that there is a need for combining organisational structures and new management styles and principles into organisational structures.
ACKNOWLEDGMENTS

From a professional perspective, I would like to thank my supervisor, my previous organisations and especially Roytec Global for the insights and experiences received over the past few years that has guided me to the views and insights expressed throughout this paper.

In my personal life I would like to thank my wife Christelle and my daughters Danelle and Micke for the love, motivation, support and tremendous patience shown over the duration of this minor dissertation. Without their support and understanding this would not have been possible.
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<th>Full Form</th>
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<tbody>
<tr>
<td>Project Management</td>
<td>PM</td>
</tr>
<tr>
<td>Project Management Office</td>
<td>PMO</td>
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<tr>
<td>Project Management Institute</td>
<td>PMI</td>
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<tr>
<td>Office of Government Commerce</td>
<td>OGC</td>
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<td>Project Management Body of Knowledge</td>
<td>PMBoK</td>
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<td>PCA</td>
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<td>Engineering Management</td>
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<tr>
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<td>Contract Engineer</td>
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<td>Contract Manager</td>
<td>CM</td>
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<tr>
<td>Head of Department</td>
<td>HOD</td>
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<tr>
<td>Contracts Department</td>
<td>CD</td>
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<tr>
<td>Purchase Order</td>
<td>PO</td>
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<td>Scope of Work</td>
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<tr>
<td>General Arrangement</td>
<td>GA</td>
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<tr>
<td>Process Flow Diagram</td>
<td>PFD</td>
</tr>
<tr>
<td>Request for Quotation</td>
<td>RFQ</td>
</tr>
<tr>
<td>Factory Acceptance Test</td>
<td>FAT</td>
</tr>
<tr>
<td>Technical Specification</td>
<td>Tech-Spec</td>
</tr>
<tr>
<td>Business Case</td>
<td>BC</td>
</tr>
<tr>
<td>Term</td>
<td>Abbreviation</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Capacity for Engineering Systems Thinking</td>
<td>CEST</td>
</tr>
<tr>
<td>Rate on Investment</td>
<td>ROI</td>
</tr>
<tr>
<td>Earned Value Performance Management</td>
<td>EVPM</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

1.1 Research Topic

The main theme of the dissertation will be Engineering Management with a focus on Project Management in Organisational Structures.

1.2 Research Introduction and background

From industry experience it has been identified that there exists a large need in various engineering industries for incorporating Project Management into the organisation structure as well as the management style of these organisations. This is due to a disconnect between organisations that are mainly focussed on using projects as a main income stream and the fact that the organisational management style and structure is not project orientated.

The aim of this dissertation is to research a management styles and organisational structures to assist and / or incorporate projects into the everyday organisational operation to improve the success rate of said projects.

1.3 Research Problem Statement

There is a large disconnect in most organisations between how the structure allows projects to be run and what the projects require to be completed successfully. A lot of firms have no dedicated methodology with regards to project management and mostly leave it open to interpretation for the Project Manager to deliver to expectation, although sometimes the organisation does require a predefined set of Checks and / or Controls.

The inverse is also true, where the organisation will have a defined methodology for projects based on historical experience from the 80’s and 90’s that is no longer relevant, practical or best practice in the industry with regards to today’s technology and innovations.

1.4 Research Objectives

The following objectives will be considered and aimed for the reach a successful study:

1. Review and compare the two main stream PM methodologies
2. Review and examine the existing basic organisational styles to consider the best approach for effective PM
3. Review and examine the existing management principles to consider the best approach with regards to PM
1.5 Research Questions

The main questions considered for this proposal is as follow:

1. What is the relevance and impact the two main stream standards, namely PRINCE2 and PMBoK, in existing project organisations?
2. What are the basic organisational structures and are they relevant in project orientated organisations?
3. Can organisational methods be adapted to a more project-based style?
4. What Engineering Management principles can assist managers with the proposed changes?

1.6 Research Rationale

The main body of research will consider the two international PM methodologies along with the three major types of organisational structures as well as the basic Engineering Management principles.

Relevant books, research dissertations, journals and their articles will be considered in each of the main topics to ensure a broad an accurate understanding and application can be used to create a solid foundation for the proposed Management approach in section 5.

After the research has been completed a Cases study will evaluate an existing engineering firm and evaluate the research results with the findings and make basic recommendations accordingly.

1.7 Research Design

Research will be conducted by focussing into each primary area as a starting point, including relevant articles will be reviewed an assessed through the various disciplines. From here the dissertation will consider articles that are more cross bordered to assist in creating the management approach.

The dissertation will generate a recommendation based on the findings of the research and case study and do further research into areas that are found to be lacking to improve and finalise the recommendation in the conclusion chapter.
2. LITERATURE REVIEW – PROJECT MANAGEMENT

In recent years, projects have become an everyday occurrence, whether it is in our daily lives, economies or societies. Projects shape and define the way that work is being done in all aspects of our lives and having a strong foundation in projects and their activities will ensure greater success rates (Jensen, Thuesen, & Geraldi, 2016).

When considering project management (PM) it is important to note, that although there are numerous methodologies, that are two main bodies that can be considered as a standard for all these different types of PM. The literature from two will be used to evaluate how PM is seen and maintained from their perspective. The first review will be from the Project Management Institute (PMI) and the second will be from the Office of Government Commerce (OGC) that was developed in the United Kingdom.

Figure 1: Principles of Project Management (Baker, 2018).
2.1 Introduction

While considering the basics of PM, it is important to ensure that the definitions of a project as well as that of the PM are clearly understood. A Project is a temporary endeavour, meaning it has a definitive start and end, that is utilised to create a unique deliverable, whether it be a product service or result (PMI, 2013). Project Management is the application of the relevant knowledge, tools and techniques to the different activities that are created in projects (PMI, 2013).

Projects are generally endeavours undertaken to assist organisations to meet certain levels of performance or strategic needs. These projects are normally constrained by the competing priorities in the organisation’s project environment (Van Wyngaard, Pretorius, & Pretorius, 2012).

Project management as a methodology is the “planning, delegating, monitoring and control” governing all the actions and personnel in the project to ensure that the project meets its independent and organisational goals (OGC, 2009).

2.2 Project Management Body of Knowledge (PMBOK)

The PMBOK is a written standard that can be used across multiple platforms as a guideline. It is however not a complete answer to all problems that may be experienced. The standard is however internationally accepted and widely considered the best platform for the PM profession. The sections covered below will give a brief introduction and explanation into the workings and terms of the PMBOK the generate a wide view of the standard.

Project Management Framework

The PMBOK considers five basic process groups that any project management process can and should be divided into, namely Initiating, Planning, Executing Monitoring and Controlling and finally the Closing stage. Some of the most important project constraints include the Scope, Quality, Schedule, Budget, Resources and Risk. It is however important to note that these are not the only constraints that can be considered, and they do vary greatly depending on the project product (PMI, 2013).

Over time projects in general have failed to comply completely with the triple constraint, creating a lack in skill and infrastructure development surrounding it. The success rate of projects and the priority given to the triple constraint are in direct correlation to each other,
thus the more effectively it is managed and understood greatly increases the success rate of projects (Mokoena, Pretorius, & Van Wyngaard, 2013).

Figure 2: Due to a growing movement the triple constraint triangle has turned to a diamond (SmartSheet, 2018).

The success for projects within any organisation is greatly influenced by the interpretation of the original triple constraint, and the same holds true for the upgraded diamond version. By utilising an integrated model, the overall organisation management can be utilised as function for PM within an organisation (Van Wyngaard, Pretorius, & Pretorius, 2012).

When considering the management of PM in the organisation structure, it is important to mention the Project Management Office (PMO) which is a body in the organisation that is responsible for overseeing, aligning and assigning projects for the organisation (PMI, 2013).

Most of the time PM takes place in environments that is much broader than the project itself. This means that the project forms part of a bigger picture and understanding the bigger picture and aligning with the goals and methodologies of the organisation a project will have a greater chance of success (PMI, 2013).

The lifecycle of a project is defined as a set or collection of sequential events, but these events can overlap and are project specific. The number of these events or phases is determined by the control needs of the organisation.
All projects, independent from their type or size, can be mapped as per Figure 3: Typical Project Life Cycle Structure, and can be broken down into the following cycle structures, as per (PMI, 2013):

- Starting or Initiating the project
- Organising and preparing
- Completing project work
- Closing the project

When considering the difference between projects and normal organisational work it is important to note that they both do share similar characteristics, and that projects may be utilised to accomplish organisation work. The main difference is that normal operations are ongoing and produce repetitive work or results.

Organisational Influences and the Project Lifecycle

How an organisation is constructed carries a large influence on how projects are performed within the organisation itself. These can include the culture, structure and styles of management. PMBoK defines the ability of an organisation influence a governance of projects the PM Maturity level (PMI, 2013).
There are many different types of organisations and each will have a different impact on projects and their management. These structures will be defined later in the document in more detail.

Table 1: Influence of Organizational Structures on Projects (PMI, 2013).

<table>
<thead>
<tr>
<th>Organization Structure</th>
<th>Functional</th>
<th>Matrix</th>
<th>Projectized</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weak Matrix</td>
<td>Balanced Matrix</td>
</tr>
<tr>
<td>Project Manager’s Authority</td>
<td>Little or None</td>
<td>Low</td>
<td>Low to Moderate</td>
</tr>
<tr>
<td>Resource Availability</td>
<td>Little or None</td>
<td>Low</td>
<td>Low to Moderate</td>
</tr>
<tr>
<td>Who manages the project budget</td>
<td>Functional Manager</td>
<td>Functional Manager</td>
<td>Mixed</td>
</tr>
<tr>
<td>Project Manager’s Role</td>
<td>Part-time</td>
<td>Part-time</td>
<td>Full-time</td>
</tr>
<tr>
<td>Project Management Administrative Staff</td>
<td>Part-time</td>
<td>Part-time</td>
<td>Part-time</td>
</tr>
</tbody>
</table>

Stakeholders can be either individuals or groups that may have a direct or indirect impact on a project itself, or the project may have a similar effect on the stakeholder. Managing the expectations of stakeholders can become a challenge to any PM as they are normally not aligned to each other and this will be critical to the deliverables and success of the project. Governance allows organisations to constantly control projects to ensure that they are completed to their full potential and aligning them to the organisational strategy (PMI, 2013).
Project teams comprises of all the individuals that work together on the duties of a specific project. These can include individuals that do project related tasks but are not necessarily involved with the management of the project itself, being full – or part time (PMI, 2013).

Each project can be broken down into different phases / cycles throughout its lifetime. These phases combine to form the Project Life Cycle. These phases follow one another, and the status of each phase can determine the progress and status of the project. These phases can also be sub-divided into smaller tasks that are required to complete the phase itself. It is important to note that phases normally require their individual predecessor to be completed before it can start (PMI, 2013).

**Project Management Processes**

Project Management is defined as the application of tools, skills, techniques and knowledge to the required activities of a project to meet its requirements. To ensure the success of any project PMBoK identifies 5 steps that the project team needs to complete and acknowledge (PMI, 2013):

- Selecting the required processes
- Use a defined approach
• Establish communication channels and maintain constant communications with all relevant stakeholders
• Manage and comply to each stakeholder’s requirements and expectations
• Balancing the competing constraints of the project

Further to these stems, PMBoK defines 5 Project Management Process Groups into which all process can be broken down into. These PMPG’s are (PMI, 2013):

• Initiating
• Planning
• Executing
• Monitoring and Controlling
• Closing

Figure 5: Interactions between the Project Management Process Group (PMI, 2013).

Each of these groups will interact with each other in some point in time within the project phases, as can be seen in the figure below.
Finally, this section identifies the PM Knowledge Areas as identified by PMBoK. These are the major points of consideration when looking at all projects. Each individual area will not guarantee the success of a project on their own but rather a holistic view of each item within the Project Life Cycle.

These areas for the core of the PMBoK standard and are listed as (PMI, 2013):

- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management
Project Management Process Map

Figure 7: PMI Process Map (Scott, 2015).
2.3 Projects in a Controlled Environment

Projects in a Controlled Environment (PRINCE2) is a philosophy structured around the experienced gained over thousands of executed projects, form all organisational and project team (OGC, 2009).

Introduction

Projects can also be a temporary miniature organisation that is only created to deliver one or more of the organisational products according to a predefined organisational business case (OGC, 2009).

Projects mainly differ from normal day-to-day organisational activities because of the following core characteristics:

- Projects are generally a way by which organisations introduce change
- Projects are only temporary in nature
- Projects involve teams comprising of different sills, they are thus cross-functional
- Each project is unique in its nature because of the varying contributing factors
- All projects contain a certain extent of uncertainty

Figure 8: PRINCE2 Project Management Cycle (OGC, 2009).
Following the PRINCE2 philosophy, there are six major aspects that a PM needs to control to ensure projects are executed successfully, these are (OGC, 2009):

- Costs
- Timescales
- Quality
- Scope
- Risk
- Benefits

The PRINCE2 philosophy has seven principles that are universal, self-validating and empowering when used to govern projects. These principles are (OGC, 2009):

- Continued business justification
- Learn from experience
- Defined roles and responsibilities
- Manage by stages
- Manage by exception
- Focus on products
- Tailor to suit the project's environment

**PRINCE2 Themes**

As with PMBoK, PRINCE2 also has core knowledge areas, or themes as they are referred to, that are used to describe the individual broad-spectrum aspects on PM. These must be continually managed and maintained to ensure success on each project. These themes are (OGC, 2009):

- Business Case
- Organisation
- Quality
- Plans
- Risk
- Change
- Progress
For the purposes of this dissertation and its focus, the dissertation will only focus on in-depth research and evaluation into the Business Case theme.

The Business Case (BC) theme’s purpose is to evaluate whether the project is desirable, viable and achievable. The BC utilises the best mix of information for the project stakeholders and organisational board members to evaluate with the project will be viable. This is a continuous effort to ensure that external factors such as market changes are always considered. This implicates that the BC is not a static document or decision, but rather and ongoing endeavour until the project is finalised or discarded (OGC, 2009).

![Diagram: Relationships between outputs, outcomes and benefits (OGC, 2009).]

Each project has different objectives and goals, and these will determine the nature of the project. Depending on these objectives, the project will be evaluated and classed differently, for example:

- Compulsory projects
- Not-for-profit projects
- Evolving projects
- Customer / supplier projects
- Multi-organisation projects.
PRINCE2 has a set approach to developing a project BC at the start as well as how to maintain and verify the viability of the BC throughout the project lifecycle. These steps are (OGC, 2009):

- Develop
- Verify
- Maintain
- Confirm

Figure 10: The development of the Business Case (Robinson, 2018).

Finally, this paper considers a general BC that is generated by the PRINCE2 guidelines and typically contains the following (OGC, 2009):

- An executive summary
- Reasons
- Business options
- Expected benefits
- Expected dis-benefits
- Timescale
- Costs
- Investment appraisal
- Major risks

One important consideration is that all roles and responsibilities need to be clearly identified and defined at the start of the project. These will broadly form part of one of the four groups, corporate, project board, PM and team levels. With all team members clearly understanding
their roles will ensure everyone knows what is required of them and to whom they will report. This also assists with the optimal use of organisational resources throughout the lifecycle (Robinson, 2018).

**PRINCE2 Processes**

PRINCE2 is a process-based approach to PM. These processes can be broken down into several structured sets of activities to accomplish set objectives at certain intervals in the project lifecycle. These processes are (OGC, 2009):

- Starting a Project
- Directing a Project
- Initiating a Project
- Controlling a Stage
- Managing Product Delivery
- Managing a Stage Boundary
- Closing a Project

![PRINCE2 Process Model Diagram](image-url)

*Figure 11: PRINCE2 process model diagram (PRINCE2 Wiki, 2018).*
Tailoring PRINCE2 to a Project Environment

The PRINCE2 methodology is not a rigid approach and can be moulded to suit varying project environments and organisational needs. It is important to keep a lesson learned log from previous projects and ensure that these are utilised to customise and improve the future approach, while considering that each project and their situations and objectives are different. (Robinson, 2018).
Figure 12: Best Practice Model proposed by PRINCE2 (PRINCE2, 2018).
2.4  Main Differences Between PMBoK and PRINCE2

From Sections 2.2 & 2.3 it can be derived that there are quite a few similarities between the two standards. From the outline of the two standards it can also be noted that PRINCE2 can also be used to supplement the PMBOK, instead of competing against it. This is due the fact that although both standards are highly detailed and descriptive, both cover sections where the other is lacking in. These differences as highlighted by PRINCE2 can be found in APPENDIX A
3. PROJECT MANAGEMENT IN DIFFERENT ORGANISATIONAL STRUCTURES

The second main area of focus of this dissertation is to review the most commonly used project focussed organisational structures, and then identifying the best suited structure to manage PM from an EM perspective. These structures are required for the organisation to supply resources and control for projects, this section will review these structures, along with their individual impact on PM.

![Diagram of three basic organisational structures](image)

Figure 13: Three types of basic organisations (Lester, 2017).

In most instances organizational design has not been clearly researched, although it has great support and interest in the PM field. Project management has many theoretical inputs into the design of an organisation, but it has created confusion with the amount of terms that describe the organisation and their function itself (Aubry & Lavoie-Tremblay, 2018).

Organizations re characterized as an efficient course of action of work force of offices to achieve the key objective set for the organisation (PMI, 2013). To characterizes the Nature of Organizations, one requires the contribution of unmistakably expressed essential points of the association with all the corporate destinations recorded. The Functions of Organizations will rely upon the cooperation between various offices or divisions in that.

A cautiously viewed Organizational Structure is fundamentally essential for any business, and in addition a necessity to expand the business shot of progress. While setting up the hierarchical structure it is essential to consider both the logical and social elements of the said business. It is
basic to survey the accompanying viewpoints previously making the hierarchical structure; authoritative attributes, connections, rivalry, and execution (Tiller, 2012). At present the definition for the hierarchical structure does not characterize the job that it plays in encouraging or restraining information creation (Izunwanne, 2011).

3.1 Functional Organisation

The functional organisation is a traditional model that is best suited to a single process type of operation, like that of a manufacturing line, however this structure does now easily allow for cross-functional coordination that is a necessity for PM. The basic problems identified when trying to implement PM into these organisations are the mistrust between the functional groups and the creating of appropriate project teams and the structure thereof. These problems are primarily a resistance to change and thus is more a “people” problem than a problem with the system of structure itself (Payne, 1993).

![Functional Organization](image)

Figure 14: Functional Organization (PMI, 2013).

3.2 Project Organisation

The opposite from functional organisations, in terms of PM, the project organisation as the name implies focused on PM. Up until recently little research has been completed on how these organisations translate internal and external experiences to improve their PM strategies. From previous research and case studies there has been a correlation between

- 30 -
Revision 3
adaption of stronger PM principles by an organisation and the improvement of management practices accordingly. This process only happened over a period as senior management required a better understanding of these principles and how to adapt the management strategy. Adapting these strategies increases the effectiveness of the organisations PM practices (Kwak, Sadatsafavi, Walewski, & Williams, 2015).

The project organisation can be viewed ans a innovative structure that uses projects and their activities to define and develop the organisations culture and strategies. Structures as these have segments into which they can be broken into, “namely values structures and people”. This structure is defined as utilising a variety of management disciplines at the same time (Gemünden, Lehner, & Kock, 2018).

Although organisational structure design is an established research field the understanding of the project organisation is very limited (Mitrev, Mancini, & Turner, Towards a design for the project-based organization, 2017).

![Figure 15: Projectized Organization (PMI, 2013).](image)

This leads to the conclusion that although the projectized organisations will have a strong impact on projects, they may be lacking in other areas. This will cause complications when moving over from the traditional structures and may case irregularities.
3.3 Matrix Organisation

A matrix organisation can be defined as an organisation that utilises a multi-command system, including the supporting structures, culture and behaviour. This structure can also be described as a mixed or overlapped structure with the interdependencies between functional groups and project managers (Ford & Randolph, 1992). The figure below indicates the major differences between this matrix, functional and product organisational structures and the relative influences they share.

![Diagram showing the continuum of alternatives between structures](image)

*Figure 16: A continuum of alternatives between structures (Ford & Randolph, 1992).*

There are numerous different types of the matrix organisation, these types can be as simple as the intercommunication channels between Functional managers or more to the topic of this dissertation to project teams that consist of members of members from varying departments (Pretorius & Taylor, 1986). The matrix organisation essentially means that the teams are focussed on their individual tasks from the project start to end. These teams are led by project leaders, who has similar authority to a functional manager with regards to the project itself (Walden, 2008).

The matrix organisation is most likely the most common organisational structure to date for project orientated organisations, as it offers the least disruptive environment for the functional divisions. All employees allocated to a specific project will be reporting to the PM to ensure they meet the three fundamental project criteria, i.e. time, cost and quality. All this is concurrent with the individual employee’s departmental manager to review their performance according to the standards of the department (Lester, 2017).
The major advantages of a matrix organisation are (Lester, 2017):

- Staff can be allocated to different projects if delays occur, instead of the organisation battling with unused resources
- All lessons learned within the different departments are quickly and effectively transferred to all projects
- Staff does not have to be moved around in the organisation, as they will work independently in their departments
- Staff members can still strive for their individual career paths
- Project changes can be handled swiftly with minimal disruptions to everyday duties.
- Lastly, the PM will have the ability to expand or reduce his project team as is required during the project lifecycle

Although there are several advantages to a matrix organisation, similarly there are negative aspects as well (Lester, 2017):

- Project prioritisation can cause conflicts
- The employee’s loyalty will be tested due to the dual reporting structure
- Depending on the outlay of departments, communication can be delayed
- Lastly, senior management will spend a considerable amount of time maintaining the balance within the organisation between departments and PM’s

Depending on the degree of authority the project manager has over his team, the organisational structure can be call strong or weak. This adds to the conflict in power, but all disadvantages can be managed by senior management and their input and control over the organisation (Lester, 2017).

As an example, the matrix organisation that has been installed at the City of Los Angeles, Bureau of Engineering, has found that the implementation of the adapted strategy has some problems, the overall project performance of the organisation has increased significantly (Kuprenas, 2003).
From the research above, this paper concludes that a starting point for structure migration is best suited to the matrix organisation. It not only allows for simpler integration into existing models, but also drastically increases the effectiveness of projects and their activities.
4. PROJECT MANAGEMENT IN DIFFERENT MANAGEMENT STRATEGIES FOR THE ENGINEERING ENVIRONMENT

The third major focus point of this dissertation is to review the most commonly used managerial topics, principles and theories and deduce the most effective approach from an EM perspective.

4.1 Important Management Topics and Principles

Engineering Management (EM) is a relatively new field of engineering, and accordingly it does not have a wide range of definitions allocated to it. The EM field requires the individual to apply certain engineering principles, tools and techniques along with certain managerial functions to managerial problems (Kahraman & Onar, 2015).

Communication forms part of our daily lives, and communication for an Engineering Manager may include not only employees, but also stakeholders, suppliers etc. (Meid, 2015). Communication has always been viewed as an essential required skill, but only in recent times have the specific effects from a leadership perspective gained incredible ground in the field (Jacqueline Mayfield, 2016). The distinction among efficient and effective communication has turned out to be increasingly evident in varying disciplines and is regularly underestimated, both of which having different methods assigned with diverse techniques allotted with various results relying upon the circumstance. Communication majorly affects the achievement or failure of any project, contingent upon how well it is managed (PMI, 2013).

When considering EM, Personal Management is viewed as promoting oneself as an example to others, particularly to those employees or members that will be overseen. This aspect likewise incorporates self-improvement, by learning from one’s own mistakes and assuming liability as opposed to searching for a simple way out of a troublesome circumstance. At the point when a manager comprehends that quality is an essential part of any association; the nature of human pride and ability development will be comprehended (Singh, 1996).

The Integrated Management Model is a framework that involves consolidating or gathering a part of business components. The quicker and progressively productive this integration gets actualized, alongside persistent enhancement, the sooner the business will reach a competitive advantage. From the distinctive perspectives of various researchers, it can be concluded that there is no single answer for various associations to indicate specific integration (Rebelo, 2014).
The Schools of Management Thought can, according to Dr H. Koontz, be divided into six schools, each with sound supporting (Philip C. Hicks, 2015).

1. The Management Process School is based on the functions of managers in an organization.
2. The Empirical school, which utilizes the investigation of experience to distinguish the administration procedure.
3. The Human Behaviour School that is produced from the connections between people.
4. The Social Systems School that sees the executives as “social system or system of cultural interrelationships”.
5. The Decision Theory school, that depends on the basic leadership process, or the decision-making process.
6. The Mathematical School that to be a “system of mathematical models and processes”.

A critical aspect for the success of EM is to Manage and Motivate Knowledge workers requires an alternate methodology in management to that of hands-on or blue-collar workers. These specialists, for the most part, go through the greater part of their day working with information or data, and thus require additional inspirational components, such as (Huang, 2011):

- “job complexity”,
- “information processing”,
- “problem solving”,
- “skill variety and specialization”.

Dealing with these laborers “is the process of tracking team member performance, providing feedback, resolving issues, and managing team changes” (PMI, 2013).

If the accessible systems of an organisation allow the manager to do so, any Potential administrative problems can be caught early enough to be able to negate its effect. This will assist the organisation with optimizing its expenses and budgets (de Felice, Petrillo, & Autorino, 2014). When considering a Management System, it is essential to consider Peter Senge's fifth Discipline and the laws it portrays. These laws, in short these are (Senge):
• “Today’s problems come from yesterday’s solutions”
• “The harder you push, the harder the system pushes back”
• “Behaviours grows better before it grows worse”
• “The easy way out usually leads back in”
• “The cure can be worse than the disease”
• “Faster is slower”
• “Cause and effect are not closely related to time and space”
• “Small changes can produce big results – but the areas of highest leverage are usually the least obvious”
• “You can have your cake and eat it too, but not at once”
• “Dividing an elephant in half does not produce two small elephants”
• “There is no blame”

Leadership can’t just be a unique resource or delicate aptitude, since it has a complete direct effect on the required results. The main target for any leader is to ensure results, by assigning work to their colleagues or employees. To be a compelling leader, one should have the capacity to apply a wide variety of styles, contingent upon the circumstances they are working in and the colleagues they are working with. This will guarantee that all individuals are used to their maximum potential (Pandit & Jhamtani, 2011). Research examines directed demonstrates that a great deal of projects may fail if an undertaking supervisor’s leadership position is disparaged. This further features the imports of appropriate initiative in a group viewpoint (Anantatmula, 2015).

Underestimating the distinct effect different individuals can have on a Team, the viability of the team will be questioned. For longer time periods, the more assorted a team’s synthesis is, the more negative outcomes can be expected (Cristina Rubino, 2014). Sharing knowledge and experiences within a team requires all members examine the significant data they have with respect to the jobs that needs to be done. Preparing a team will enable individuals to deliver progressively positive outcomes and work more effectively and efficiently (Joan R. Rentsch, 2014). In the construction business, groups are viewed as a very basic integral part of the industry, and along these lines they majorly affect the execution of the industry. While assembling a team, it is vital to consider the jobs and prerequisites of the team as well as for each member require, and in addition their connections with one another. While choosing
individuals as indicated by Belbin’s Team Role Theory, the common roles of every part ought to be talked about and considered (Senarante, 2015).

A critical component of the EM field is a carefully planned Operational Management framework that will guarantee all activities are done viably and effectively inside the organization (Anice I. Anderson, 2004). The three noteworthy exercises in operational administration are Process Quality Control (which is a continuous procedure), Process Quality Improvement, and Periodic Process Review and Assessment (Defeo & Juran, 2014).

The principle requirement for Ethical Management originates from the detachment of morals from ordinary business practice. It is hard to see individuals as objects at whatever point they need to investigate subjects with respect to ethics. An individual’s feeling of ethics is shaped by the individuals own relationships and connections (Painter-Morland, 2008). Somebody in the professional environment must research the significance for their work that impacts others and dependably hold fast to a solid moral standard (Peterson, 1996). For engineers, they should take care of the specialized issues and in addition the more extensive extent of desires and standards. It is critical to ensure to not lean towards deceptive conduct to meet these expectations (George Geistauts, 2015).

The Strategic Planning Process is characterized as making a lot of ventures by using the associations objectives. This arrangement must incorporate a wide view of the objectives that should be accomplished, and additionally how to accomplish them. This process depends on ability frame senior management and is for the most part finished in advance. There is a reasonable relationship between the workers’ perspective of the vital arrangement and the degree to which they feel engaged by the arrangement itself versus the accomplishment of the arrangement itself (Brumm & Drury, 2013).

Although the vision, mission and objective articulations of organisations give some rule to where it is going, these are insufficient on their as the Strategic Management process has increased more endorsement from various engineering firms (Singer & Brown, 1991). A viable technique requires the contribution from the associations top managers to provide a reasonable key guidance and to inspire the arrangement as a management strategy (Ugboro, Obeng, & Spann, 2011).

Procedure Formulation is finished with the aim of producing progresses in the associations’ market, and in addition satisfaction of the gaols set by the association (Moghaddam, Nedaei,
Sahafzadeh, & Hosseini, 2013). The factors found in the process are (Andrews, Boyne, Law, & Walker, 2009):

- “rational planning”,
- “logical instrumentalism and strategy process absence”, and
- “the strategy content variables are prospecting, defending and reacting”.

The expression "Executing the Strategy” is portrayed best, as the procedure a manager will pursue to actualize the associations set destinations. Every system ought to incorporate an unmistakable vision clarifying how the outcome will be conveyed, in view of best practices (Tucker, 2017). Albeit numerous associations have techniques set up, not very many of them can effectively execute these plans. This failure is for the most part credited to powerless management in the association (Chung, Chao, & Lou, 2016).

Performance Measurement is the foundation of management practices (Muchiri, Pintelon, Martin, & de Meyer, 2010), with a solid hypothetical foundation it decisively affects the execution of a group and its individuals (Henman, 2016). Its goal is to provide (Wright, 2005):

- “measurable outcomes”,
- “setting performance targets”,
- “regularly monitoring performance”, and
- “working toward quality improvement”.

By utilising performance measure, a firm can utilise Performance Control the evaluate results of its internal projects, to line up with the organisations strategy. When looking at the organisations performance, Performance Evaluation is a management system that is considered one key areas. Without it continuously enhancing or training the organisations employees, achieving the strategic goals set will be unthinkable. (Yunting, 2012)

As a rule, innovation can be portrayed as the procedure of information transformation (Penide, Gourc, Pingaud, & Peillon, 2012). By using the outcomes accumulated from case studies and interviews completed by Rohrbeck & Gemūnden, three distinct Roles of Innovation can characterize and expand the associations limit with regards to innovation. These three roles are (Rohrbeck & Gemünden, 2011):
• “The strategist role”
• “The initiator role”
• “The opponent role”

The Strategic Management of Innovation is a major endeavour in the advancement of any organisation. It centres around the practices that advance development and is essentially focused around management and the help they give to the innovation process (Penide, Gourc, Pingaud, & Peillon, 2012).

If the best practices can be depicted as a set of various examples of process, at that point Innovation Best Practices is best portrayed as the required strides in the development procedure. The connection between business procedures and general development forms, portrays the prescribed procedures that is suited for the required business process (Penide, Gourc, Pingaud, & Peillon, 2012). Existing literature with respect to advancement of the executives discloses to us that these accepted procedures are unique to every association (Blindenbach-Driessen & Van den Ende, 2010).

Creating innovation, and examination into new items, is continuously and increasingly becoming risky, expensive and dependent on various information bases, all through different associations. Because of these reasons, a wide range of organisations are subcontracting development to their suppliers, although these providers might not have the required information for the said improvement. Surveying the capacities and defining clear objectives may help enhance the quality of these improvements (Handfield & Lawosn, 2007). These advancements are likewise required to keep associations aggressive in the market and may likewise incorporate the enhancement of existing items (Klus & Killingstad, 1988).

4.2 Systems Thinking

Systems Thinking is critically important to consider for a managerial and project perspective. It consists of five disciplines, Systems Thinking, Personal Mastery, Building Shared Visions, Team Learning and Mental Models. This thinking methodology is a very successful approach when solving complex and dynamic situations (Elia, 2017). This approach can be better understood when it is considered as a multi-disciplinary approach to problem solving (Shaked & Schechter, 2016).
Systems thinking is widely considered a very important ability for engineers who are taking a leadership role / position in complex projects. In numerous organisations project engineers with a clear understanding of systems-thinking enables these organisations and the relevant PM’s to allocate the best engineers for the respective jobs and project components that require a Capacity for Engineering Systems Thinking (CEST). Although this is a critical process there is no process defined to evaluate an engineer’s capacity or systems thinking (Frank, Zwikael, & Boasson, 2007).

Organisations are continuously placed under more constraints and are finding it harder to continuously increase their Rate of Return (ROI) for shareholders of the organisation. Although there are numerous paths that may be taken to increase the ROI, like new products and market diversification, these are all dependant on customer satisfaction. One possible solution to this problem is continuous improvement of existing products, that could lead to improved profit margins and greater levels of customer satisfaction. System thinking, and system dynamics plays a large role in continuous improvement and is greatly affected by the ‘feedback causality’ system (van Dyk & Pretorius, 2014).

<table>
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<th>Phases</th>
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<tr>
<td>Phase 1: Problem Structuring</td>
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<td>Phase 2: Causal Loop Modelling</td>
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<td>Phase 3: Dynamic Modelling</td>
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<td>Phase 4: Scenario Planning and Modelling</td>
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<td>Phase 5: Implementation and Organizational Learning</td>
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Table 2: Phases of the Systems Thinking and Modelling Methodology (Elias, 2017).

Based on the reductionism theory the best solution for understanding complex problems is to understand and solve each individual smaller problem and / or occurrences that creates the complex problem. In stark contrast to this the Systems Thinking approach is a holistic view
of the problem, that considers each individual problem to be part of, or at least connected in some manner, to the complex problem itself meaning that the “the whole is more than the sum of its parts” (Shaked & Schecht, 2016).

Over the past few years numerous researchers have demonstrated how the correct implementation and application of systems thinking has increased the efficiency of managers with handling complex situations in a wide range of areas. Because these researchers have also found a correlation between successful project performance and Systems thinking itself, systems thinking can also be considered as an effective methodology for business management (Shaked & Schecht, 2016).

4.3 Managerial Aspects for Effective Project Management

While considering how to manage and maintain effective project management, there are a few important considerations that need to be accounted for. This section describes some of the more important aspects identified briefly that can be utilised from a manager’s perspective.

When evaluating projects, it is important to accurately value the project and to consider and incorporate the risk preferences for the project stakeholders. One of the methods to do evaluation, is by using “Real Options”. These are easily available approaches the assist with the valuations of flexibilities in projects, although they do have shortfalls when considering the organisations risk appetite. Because of this shortfall, researchers suggest that the risk perspective should be estimated for each real option as well as the PM. A study completed by Andalib, Tavakolan & Gatmiri earlier in 2018 proposes such an approach for project based on economic behaviour, utilising three defined theories, namely (Andalib, Tavakolan, & Gatmiri, 2018):

- The binomial lattice method,
- Monte-Carlo simulation, and
- Cumulative prospect theory.

Another possible approach is the Earned Value Performance Management (EVPM). This approach was established and defined as a “Cost / Schedule Control Systems Criteria” by the USA in 1967. It has mainly been used in defensive projects with large budgets going over R 100mil. In recent years the EVPM is being implemented by the private sector for large scale
projects. Research completed by Vertenten on a target group of PM’s shows that the concept is in some form or another already being utilised within the SA Construction industry, although all the benefits were not being fully utilised at the time (Vertenten, Pretorius, & Pretorius, 2012).

When considering the success and continuous growth of an organisation, it is important to strive for sustainably, to optimise the organisation’s ROI’s and to refine a strong competitive market advantage. By implementing, monitoring and controlling the optimised management strategies efficiently an organisation has a greater chance to achieve its designation objectives. If these strategies are not controlled appropriately it may cause losses due to additional expenditure as well as schedule slippages and decreased market valuations (Naidoo, Pretorius, & Marnewick, 2015/6).
5. PROPOSED COMBINED MANAGEMENT APPROACH

Based on the research completed for project management strategies, organisational structures and management principles, it has been identified that a composite organisational structure with modern management principles will be the most successful in managing a project orientated organisation.

When considering any possible adjustments to existing structures or PM strategies, it is important to consider the Project Management Maturity (PMM). This topic was widely considered at the start of the new millennium and a variety of models was published during this time. Many acting Project Managers reviewed the research mostly positive at the time, but many organisations received little return when implement these models. The topic is still widely cruised and analysed mainly due the narrow focus and mechanistic approach to most models (Görög, 2016).

Research data from Fernandes, Ward, & Araújo suggests that organisations can implement certain useful project management improvement initiatives (PMIs) based on historical data from different organisations. This is more effective than existing literature on PM, as the implementation appears to be limited, however it must be a starting point before implementing any strategies (Fernandes, Ward, & Araújo, 2015).

5.1 Managing Project Orientated Organisations

The organisational structure plays a major role in the success of projects in any organisation, and thus it is critical to be considered when designing the organisation structure itself. Currently it is widely acknowledged that most organisations are complex and that the structure is ever evolving to suit market needs. The complexity comes into play when multiple projects are being executed while performing the regular day to day tasks of the organisation (Aubry & Lavoie-Tremblay, 2018).

Form research it is important to consider and adopt the contingency perspective as a baseline as it utilises the influences of projects on organisations against traditional organisations (Miterev, Mancini, & Turner, 2017).
5.2 Project Management Office in Organisations

When considering PM in any organisation, it is important to note that the project management offices, PMO, and the structure thereof will play a major role in the success rate of the organisations projects. If an existing PMO is not delivering the required project results the structure might require a reconfigure (Hobbs, Aubry, & Thuillier, 2008).

5.3 Identified Composite Organisational Structure

Along with the implementations of a PMO into an organisation, the organisations implementations of best practices for PM is a powerful attribute to their success rate. Organisations are responding efficiently and timeously order to adapt to the rapid changing environment of projects. When developing the PM strategy, it is important to consider the impact and buy in from all relevant stakeholders and employees in the organisation itself. Three important considerations points are (Carvalho, Tereso, & Fernandes, 2017):

- People
- Organizational Knowledge; Processes, Tools and Techniques
- General Management System.

Figure 18: Composite Organization (PMI, 2013).
6. CASE STUDY – ROYTEC GLOBAL

The dissertation next reviews a case study based on an existing organisation in the South African market with a strong project focus. The dissertation evaluates the information against the research completed thus far in this document. Based on these observations, there are some basic recommendations, but these can by no means be considered complete as further analysis will be required to test the validity of the proposal.

6.1 Background

The organisation is Roytec Global and is a privately owned & managed organisation that prides itself on delivering to their commitments (Roytec, 2018).

The organisation was first established in 2001 as Roymec Technologies but has since been rebranded in 2015 to Roytec Global. The organisation specialises in the supply of Filtration & Separation Equipment and tailored to support African Mining & Industry. They continuously strive for innovative and cutting-edge technologies to provide an ever-improved service to their clients and strives to ensure that they are Leading Equipment Suppliers of thickening, clarification, filtration and flotation equipment (Roytec, 2018). The organisation offers Proprietary Technology in Thickeners, Clarifiers, Multi-Media Filters and Ion Exchange as well as Partnered Technologies for Flotation, Vacuum Filtration and Pressure Filtration (Roytec, 2018).

The organisation strives for a Passion for Excellence by ensuring that the relevant Shareholders are Directors and Managers in the organisation and everyone has a passion for Excellence in Technical Support, Project Delivery and After-Sales service (Roytec, 2018).

The organisations project management reputation has been built on reliable timely delivery according to specification. The project managers (Contract Engineers) of the organisation are empowered and motivated to meet the organisational goals, no matter what the contract requirements may be. The organisations Board regularly monitors updates on Project progress and actively gets involved early if problems arise (Roytec, 2018). The Project Managers and Directors are fully accountable for all decisions and are always available for consultation. A measurement of the organisational success is Client Satisfaction and repeat business with Clients returning for new projects and equipment upgrades (Roytec, 2018).
6.2 Organisational Structure

The organisation’s full organogram is as follow:
Figure 20: Roytec’s higher level organogram
In recent months Roytec has identified the need for change in the organisation to manage the foreseen growth of over R100m in revenue. Due to this, the Contract department structure has changed its structure to the following (including the quality side managed by the same HOD):

Figure 21: Roytec’s Contracts Department current organogram
Figure 22: Roytec's Contracts Department quality structure
6.3 **Contract Department Procedure**

The procedure defined below is to effectively execute all equipment purchase orders and contracts that are received in the Contracts Department (CD). The CD is responsible for the engineering, procurement, delivery, installation and commissioning of equipment in accordance with the relevant laws and standards.

The basic steps of the departmental procedures are (Roytec, 2018):

- The first step to starting the procedure is by receiving an order form a customer
- Next is to nominate a Contract Engineer (CE) for the contract (project) by the HOD
- Then there will be a sales handover to discuss the details of the purchase order and discuss the complete Scope of Work (SOW)
- All technical details will be captured in the Technical Specification document by the Product Champion and handed over to the nominated CE
- The CE is required to ensure that a formal acknowledgement letter is sent to the respective client.
- The CE needs to arrange a kick-off meeting with the client to introduce himself and discuss any items not highlighted during the handover meeting
- The CE will issue formal Work Requests (WR’s) along with an updated Technical Specification (Tech-Spec) and Contract Budget to the Head of Department (HOD) for approval
- The CE shall generate the schedule, including design engineering timeframes, procumbent, fabrication, assembly, delivery and installation dates and milestones.
- The CE shall compile a Quality Plan and issue to the customer for approval
- The CE must compile a Contract Status Report to summarise the commercial, technical and delivery aspects of the PO for approval by the HOD.
- The CE shall expedite the basic engineering drawings via WR’s from the technical department for submission and approval by client before detailed engineering commences. This includes the PID, PFD (when required), GA and engineering lists.
- The CE is required to finalise the Procurement Register and allocate the Scope of Supply to the relevant vendors.
- The CE shall issue Request for Quotation (RFQ) documents for required packages to suppliers and ensure tenders are received by the required date.
- The CE shall complete the adjudication sheet to ensure that quotes are as per the required scope, budget and schedules.
• The CE shall schedule final clarification meetings to finalise any misaligned terms with the nominated supplier.
• The CE shall generate the relevant Purchase Order (PO) Requisition documents for order placement on suppliers
• The Engineering Assistant is responsible for the issuing of the official PO to the relevant suppliers and Quality Manager
• The CE shall arrange a kick-off meeting with the relevant suppliers where required along with the Quality team and client.
• The CE needs to expedite and approve the relevant supplier documentation as per the PO requirements via a formal document transmittal procedure.
• The supplier is required to add these approved document int there Databook for submission to the client.
• The CE is required to ensure that a full spare parts list is submitted with required information to combine and submit to the client
• The CE is required to verify the material receipt at the suppliers and arrange customer inspections, along with invoicing with relevant documentation.
• The CE is further responsible for managing and monitoring the fabrication process to ensure that all standards and specifications are adhered to.
• The CE is responsible for relaying any possible delays to the HOD and finally to the client if the need arises.
• The CE is responsible to ensure that the critically important Factory Acceptance Test (FAT) is completed before equipment is released to the client.
• Along with final release the equipment needs to be disassembled, if required, marked, packed and crated. The CE is responsible to arrange all documentation for transport as well as arranging transport itself.
6.4 Observations

The purpose of this section is to evaluate the structure identified in the case study against existing standards.

By reviewing the organisational structures above, even with the updated Contract Department structure change, it is clear to see that the organisation still follows a functional layout, as indicated in Figure 23: Basic Functional organisational structure. This is evident by the clear split between different departments and all decision making is still reliant on the involvement of the relevant HOD.

![Basic Functional organisational structure](image)

Figure 23: Basic Functional organisational structure (Lester, 2017).

One of the focus points of the organisations in this case study is that it is an organisation mostly focussed on equipment sales, and with that the design, supply and fabrication of these equipment packages are managed as projects. The management by means of projects is a correct decision as they have definite start and end dates with clear goals set by the stakeholder.
By evaluating the management style currently in use, it is clear to identify as the “militaristic” style for communications and decisions moving from the top to bottom. In previous generations this approach has been effective, but in the current innovative era organisations are currently in, this approach only dampens innovations. Currently the CE carries all the responsibility and if any errors occur, the CE is to blame. Because there are no clearly identified team members the accountability of actions is only shouldered by a single person. This does not allow the relevant managers to identify areas where the respective team members may be lacking in and may possibly require training on.

This organisational style and management approach do not readily allow itself to move forward with new innovations or technologies.
6.6 Recommendations

The organisational structure and management cultures are not set up for the most efficient delivery of projects. From the research completed earlier in this paper, there are definite shortfalls identified in the current organisational approach and the following three basic recommendations can be made:

1. Project management principles

   To start any project, according to PMBoK a project charter needs to be generated to clearly identify all the roles and responsibilities of the project manager. This also allows the PM to establish the team best suited for the project itself.

   The PM’s of the organisation, or Contract Engineers as they are referred to, needs to be handed the authority and responsibly to manage their individual teams to ensure the best results are obtained for each project. Each individual team member can still report to their functional heads, which can assist the relevant PM’s in scheduling the members for work across different projects as the project progresses past certain stages.

   The next major recordation is to generate a clear reporting structure or platform for the projects. The HOD as well as the newly appointed Contract Managers relies on verbal transmission of information and all information to clearly evaluate the project is not automated. The organisation needs to implement a system, like EVPM, to ensure that information is accurate and readily available.

2. Organisational structure

   It is recommended for the organisation structure to move over to a matrix style instead of the current functional style. This will allow the CE / PM’s better control over the relevant team members. The will also allow the organisation so better distribute the responsibilities of the workload. This will also assist to ensure that all team members can receive continuous training as areas will clearly identified where they may be lacking.

   This structure will also speed up the efficiency of communications as the relevant CE will have more control over the decisions that are required in the project. The structure may also be further broken down to allow for Portfolio Managers that will essentially be the current CM’s appointed.
Figure 24: Basic Matrix organisational structure (Lester, 2017).

3. Management style

As Engineering Management (EM) is one of the newer fields of engineering, it doesn’t have a large set of definitions allocated to it. It is recommended for the management to consider the following points, as highlighted in section 4 of this paper. To name but a few that needs to be considered and implemented are:

- Systems Thinking
- Communication
- Personal management
- Managing and Motivating Knowledge
- Integrated Management Model
- Operational Management system
4. General

It is also a strong recommendation for the organisation to use a strong financial platform, such as SAGE or SAP, to automate the labour-intensive manual structures. This will allow for a single system to support the organisation financials as well as allow the levels of HOD to CEO to be able to pull reports, such as the EVPM and accurately track each project / contract and status.

This will also allow for coalition between the sales and project teams as budgets and requirements can be preloaded, and any items additionally required can be identified and pre-loaded for future use.
7. CONCLUSION

In conclusion there are numerous areas identified that will require more in-depth research that did not form part of this paper. Without this additional required information, the basis formulated can by no means seen as complete or used as a final proposal.

This paper considered the two main-stream project management philosophies, especially their impact with regards to the organisational structure of project orientated organisations as well as the management of projects and project managers. It is recommended that an organisation implement most if not all the best practices highlighted from these to standards. Although the standards should only be a guideline that needs to be customised to the need of the organisation itself, this will allow the organisation to maximise the success rate of the projects and as well as the profit margins of these projects.

The second consideration of this paper was the different organisational structures and what is best suited for project orientated organisations. In the current South African industry, most organisations lean strongly to a functional organisation, to move over to a pure project orientated structure will be a costly and time-consuming endeavour. It is recommended that organisations start utilising a matrix organisation. This will allow the organisation a smoother transition while still greatly improving the success rate of projects.

The last portion of research this dissertation reviewed more modern types of management styles especially pertaining to the management and impact on projects and project orientated organisations. Depending on the management personalities and organisational it is recommended to incorporate these principles to ensure that the management team as well as organisation stays in trend with the current philosophies.

The final portion of this dissertation reviewed an external organisation in the form of a case study with regards to their project department, the organisational structure and the general management. There are some recommendations that have been discussed with the management of the said organisation and some will be considered soon.
REFERENCES


APPENDIX A

Table 3: Key Differences between PMBOK and PRINCE2 (PRINCE2, 2018)

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<thead>
<tr>
<th>PMBOK</th>
<th>PRINCE2</th>
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<tr>
<td><strong>Purpose</strong></td>
<td>To determine the feasibility and potential success of the project.</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>To define the boundaries of the project.</td>
</tr>
<tr>
<td><strong>Time Management</strong></td>
<td>To schedule the project activities.</td>
</tr>
<tr>
<td><strong>Cost Management</strong></td>
<td>To monitor and control the project costs.</td>
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<tr>
<td><strong>Quality Management</strong></td>
<td>To ensure the project satisfies the requirements.</td>
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<td>To document the project management plan.</td>
</tr>
<tr>
<td><strong>Key Deliverables</strong></td>
<td>To identify project outputs.</td>
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</tbody>
</table>

PRINCE2 is a process-driven framework, whereas PMBOK is a naturally occurring approach.
<table>
<thead>
<tr>
<th>Class</th>
<th>Project Plan Management</th>
<th>Integrated Change Control</th>
<th>Stakeholder Management</th>
<th>Risk Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Getting Started: Setting up the Project Plan</td>
<td>Setting up the Change Management System</td>
<td>Identifying Stakeholders</td>
<td>Identifying Risks</td>
</tr>
<tr>
<td></td>
<td>Project Plan Development</td>
<td>Change Management Plan</td>
<td>Stakeholder Participation</td>
<td>Risk Response Plan</td>
</tr>
<tr>
<td></td>
<td>Managing the Plan</td>
<td>Change Management Process</td>
<td>Stakeholder Communication</td>
<td>Risk Monitoring and Review</td>
</tr>
<tr>
<td></td>
<td>Project Control</td>
<td>Change Request Management</td>
<td>Change Management Records</td>
<td>Risk Assessment and Analysis</td>
</tr>
<tr>
<td></td>
<td>Ensuring the Plan</td>
<td>Change Log</td>
<td>Change Management Reporting</td>
<td>Risk Evaluation and Mitigation</td>
</tr>
<tr>
<td></td>
<td>Project Closeout</td>
<td>Change Approval</td>
<td>Change Management Review</td>
<td>Risk Communication and Reporting</td>
</tr>
</tbody>
</table>

Revision 3
<table>
<thead>
<tr>
<th>Chapter</th>
<th>PARCIS Summary</th>
<th>PRINCE2</th>
<th>Comments by Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Selection</td>
<td>The identification and documentation of interactivity logical relationships. This suggests network planning as a tool.</td>
<td>Covered by the last step of PR2 (showing a Project Flow Diagram) and the second half of process PR2. PRINCE2 also suggests network planning software tools.</td>
<td>PRINCE2 gives an overview of the methods of estimating, but not enough to be able to use them.</td>
</tr>
<tr>
<td>Activity Duration Estimating</td>
<td>Estimating both the work period required to complete an activity and the elapsed time.</td>
<td>This is covered by PR2.</td>
<td>PRINCE2 has a risk management plan as part of the risk management section, but does not consider updating tasks as a result of planning.</td>
</tr>
<tr>
<td>Schedule Development</td>
<td>The iterative process of determining start and finish dates.</td>
<td>Covered by PR2.</td>
<td>Both methods include updating tasks.</td>
</tr>
<tr>
<td>Schedule Control</td>
<td>Influencing the factors that create schedule changes to ensure that changes are agreed to by all stakeholders.</td>
<td>Covered in greater detail in the change control process, such as Stage 5 (Stage 2) and PRINCE2.</td>
<td>Both methods include updating tasks.</td>
</tr>
<tr>
<td>Ch. 7 Project Cost Management</td>
<td>This chapter outlines the procedures required to ensure that the project is completed within the approved budget. The first three steps are part of the planning process. The last two steps develop a budget for the project and include a financial review.</td>
<td>PRINCE2 was the first three chapters of PR2; Schedule. The final two chapters covered the PRINCE2 approach to managing and planning the C2 project, as described in the Schedule Control section.</td>
<td>PRINCE2 goes into more detail than PRINCE2 in this area with the exception of handling changes. It describes how PRINCE2 covers in much more detail in the Control element, SLOPs (agreement with the Project Board on Stage 1 Interventions) and CSS/7 and PRINCE2.</td>
</tr>
<tr>
<td>Resource Planning</td>
<td>PRINCE2 was the most detailed.</td>
<td>PRINCE2 was the most detailed.</td>
<td>PRINCE2 covers in more detail than PRINCE2 in this area with the exception of handling changes. It describes how PRINCE2 covers in much more detail in the Control element, SLOPs (agreement with the Project Board on Stage 1 Interventions) and CSS/7 and PRINCE2.</td>
</tr>
<tr>
<td>Cost Estimating</td>
<td>The process of accurately estimating and managing the costs associated with activities.</td>
<td>PRINCE2 covers this briefly, but does not separate this from the other aspects of scheduling. Cost estimates are not as part of the project and are not covered by PRINCE2.</td>
<td>PRINCE2 does not cover this and does not include any reference to forecasting or managing costs.</td>
</tr>
<tr>
<td>Cost Budgeting</td>
<td>PRINCE2 covers this briefly, but does not separate this from the other aspects of scheduling. Cost estimates are not as part of the project and are not covered by PRINCE2.</td>
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<td>PRINCE2 does not cover this.</td>
</tr>
<tr>
<td>Ch. 8 Project Quality Management</td>
<td>The process of ensuring that quality standards are met.</td>
<td>Covered by PR2.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
</tr>
<tr>
<td>Quality Planning</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
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<td>Quality Control</td>
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<tr>
<td>Ch. 9 Project Human Resources Management</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
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<td>Organisational Planning</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
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<td>Staff Acquisition</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
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<tr>
<td>Team Development</td>
<td>PRINCE2 does not cover this.</td>
<td>PRINCE2 does not cover this.</td>
<td>Both methods include recognising customer expectations, ensuring that quality and inspection are compatible.</td>
</tr>
<tr>
<td>Chapter</td>
<td>PNBOK Summary</td>
<td>PRINCE2</td>
<td>Comments by Website</td>
</tr>
<tr>
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</tr>
<tr>
<td>Ch 10 Project Communications Management</td>
<td>This covers the timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information. PRINCE2 describes the products, tools and data.</td>
<td>Covered by the Communication Plan, part of the PIP.</td>
<td>Both methods link communications to the organizational structure.</td>
</tr>
<tr>
<td>Communication Planning</td>
<td>This includes determining the information and communications needs of the stakeholders.</td>
<td>Covered by the Communication Plan, part of the PIP.</td>
<td>Both methods link communications to the organizational structure.</td>
</tr>
<tr>
<td>Information Distribution</td>
<td>This covers the implementation of the communications management plan as well as responding to unexpected requests for information.</td>
<td>Covered by the Communication Plan, part of the PIP.</td>
<td>Both methods link communications to the organizational structure.</td>
</tr>
<tr>
<td>Performance Reporting</td>
<td>This involves the collection and dissemination of performance information, plus the dissemination of the data in an organized fashion.</td>
<td>Covered by the Communication Plan, part of the PIP.</td>
<td>Both methods link communications to the organizational structure.</td>
</tr>
<tr>
<td>Administrative Closure</td>
<td>This covers the documentation of results to formalise acceptance of the product and the archiving of project records.</td>
<td>Covered by the Communication Plan, part of the PIP.</td>
<td>Both methods link communications to the organizational structure.</td>
</tr>
</tbody>
</table>

| Ch 12 Project Risk Management | The systematic process of identifying, analysing and responding to project risk. | The Management of Risk is covered fully in PRINCE2. | PRINCE2 can work equally well with the risk approach that it describes or any other risk management method. |
| Risk Management Planning | This covers identifying and planning the risk management activities for a project. | Covered by the Risk Management Plan. | The risk management plan is covered in PRINCE2. |
| Quantitative Risk Analysis | The numerical analysis of the probability and impact of a risk. Risk analysis techniques are briefly described. | Covered by the Risk Management Plan. | Both methods offer the same type of risk analysis and management in the PNBOK and PRINCE2. |
| Risk Response Planning | This covers the development of systems to anticipate risk, including the assignment of individuals to take responsibility for each agreed response. | Covered by the Risk Management Plan. | Both methods offer the same type of risk analysis and management in the PNBOK and PRINCE2. |
| Risk Monitoring & Control | Keeping track of identified risks and identifying new ones, ensuring that the plan is executed and that the effectiveness of risk management is measured. | Covered by the Risk Management Plan. | Both methods offer the same type of risk analysis and management in the PNBOK and PRINCE2. |

| EL 13 Project Procurement Management | This covers the processes to acquire goods from outside the customer organisation. | Not covered. | The procurement process is covered in PRINCE2. |

<p>| Elaboration Planning | This covers the planning of activities and resources necessary to acquire goods and services outside the project organization. | Not covered. | The procurement process is covered in PRINCE2. |
| Solicitation Planning | This covers the preparation of documents necessary to request prospective suppliers, including evaluation criteria. | Not covered. | The procurement process is covered in PRINCE2. |
| Source Selection | This covers the examination of bids and other responses to the solicitation and selection of a provider, including contract negotiation. | Not covered. | The procurement process is covered in PRINCE2. |
| Contract Administration | This is the process of ensuring that the seller's performance meets contractual requirements. | Covered by the procurement process. | The procurement process is covered in PRINCE2. |
| Contract Closeout | This is similar to administrative closure, described earlier. It involves both product verification and the updating of records and their publishing. | Covered by the procurement process. | The procurement process is covered in PRINCE2. |</p>
<table>
<thead>
<tr>
<th>Cluster</th>
<th>PMBOK Commentary</th>
<th>PRINCE2</th>
<th>Comments to Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. The Project Management Institute Standards Setting Process</td>
<td>This defines what the PMI standard documents are, the handling of the development of original works and adoption of non-original works as standards.</td>
<td></td>
<td>These are PMBOK specific and do not concern PRINCE2.</td>
</tr>
<tr>
<td>B. Evolution of PMBOK A Guide to the Project Management Body of Knowledge</td>
<td>A history of the evolution of the PMBOK plus lists of the standards committee, contributors, reviewers and production stuff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. Notes</td>
<td>Where applicable this lists the source of information used in the various chapters such as the American Heritage Dictionary of the English Language.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Application Area Extensions</td>
<td>An Application Extension Area is where there are generally accepted knowledge and practices for a category of projects in an application area that are not generally accepted across the full range of project types. The Appendix contains the need for these, criteria for their development, the publishable and format of them and the practices for development and maintenance of them. Re-examples are given.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Additional Source of Information on Project Management</td>
<td>This lists a number of professional and technical organizations, some commercial publishers, a reference pointer to a website for the PMI Registered Education Provider Program and a very vague mention that many educational institutions offer project management education.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. Summary of Project Management Knowledge Areas</td>
<td>This is a summary of the topics of sections 1 and 8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glossary</td>
<td>Glossary includes and excludes: A list of common acronyms. Definitions of project management terms</td>
<td>PRINCE2 terminology is not included, except where both use a common term.</td>
<td></td>
</tr>
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</table>