Construction Management versus Construction Project Management

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ABSTRACT

Within the South African construction industry today, the terms Construction Management and Construction Project Management are used by professionals when in fact they themselves are unsure of the exact definition and description of what each profession entails in adequate detail. This treatise article aims to address that issue. It describes in detail exactly what each profession entails as well as highlighting software, systems and programs that both professions would need and be able to adequately use and which also serves as a valuable communication tool between both the two professionals and as well as the project team involved within a specific project.

Contents Page

Summary Conclusion Testing of Hypothesis			
Chapter 04 Introduction Administrative Project Structure Communication Structure Contractual Structure Client Assuming Role of CPM Similarities between CM and CPM Summary Conclusion Testing of Hypothesis			
Chapter 05 Modern day software and Programmes used within the industry today Introduction Use of Software within a Construction company 2-Dimensional software programmes 3-Dimensional software programmes 4-Dimensional and Beyond Programmes in Practice Summary Conclusion Testing of Hypothesis			
Chapter 06 Summaries, Conclusions and Recommendations Conclusion Testing of Hypotheses Testing of main Hypotheses Recommendations			

List Of Tables and Figures

1. Chapter 01 - Introduction

The construction industry, be it in South Africa or the world is a rapidly changing industry, and is never static. With new innovations and techniques almost limitless within construction today, it is imperative that competent professionals be appointed that bring value to the project and manage it adequately. Without the competent professional individuals, the project will almost certainly be over budget, behind time and not of adequate quality.

Construction project management's potential and value within South Africa has not yet been fully realised, certain members within the professional team will do some of the functions and share some of the responsibilities of what a project manager should have, and will thus not be managed and executed as efficiently as if an appointed construction project manager performed the task.

'Project management – The career number one choice' – Forbes magazine (4th February 2009)

Construction management is another aspect within the construction industry that is misunderstood and often misinterpreted especially within South Africa. Many firms only have a construction foreman whose roles and responsibilities differ quite significantly from that of a construction manager.

Construction managers and construction project managers are fundamental to a development or project. Their management function and leadership is an important

asset within the industry as they are responsible for keeping the project up to date, within budget and within acceptable quality standards. Many people assume that a construction manager and a construction project manager are one and the same and other professionals involved within a project at times assume that because they have certain responsibilities of a project manager that they are the project manager of the project. The definitions and roles of a project manager are not as cut out and black and white as other definitions of specialised professionals within the project team.

In this day and age, decisions regarding construction are a lot more varied. Every single project is unique and no two projects are the same, thus the roles and responsibilities of a construction manager and a construction project manager will also differ with each project to compliment these unique characteristics.

It is important to accurately define the two professions to get a better understanding of what they entail. How many construction managers must be involved in a project? What are the responsibilities and roles of the project manager? What are their relationships with the client? Which party has direct contractual relations with the client? To the client or owner these are questions that need to be addressed before the project gets underway. The liabilities of each party must also be known should a dispute arise. A construction project manager is imperative to a project and it is known that within the South African Construction Industry, the numbers or these qualified professionals are increasing, but there is still however a skills shortage within the South African construction industry and their value is at times underestimated.

A company is only as good as the people who work for it regardless of its resources or current financial position. This same principal also applies to a project, without

competent professionals and personnel, regardless of the investment and resources available, the success of the project relies on the human resource function.

The tools and resources that a construction manager and a construction project manager have are also constantly changing. Systems and programmes are constantly bettering themselves and if used correctly can boost the efficiency of a manager as he/she will be able to control quality, time, cost and resources a lot more effectively. However simply using systems and programmes to do your job will not be sufficient. Many other skills and attributes are required by construction managers and construction project managers. Another important question is do construction managers keep themselves up to date with the latest programmes? And does this give them an advantage over the less technology literate managers.

As of late, there have been a number of fatal and dangerous incidents on construction sites within Gauteng, namely Johannesburg and Pretoria. These incidents have put a cloud of speculation on the competency of the construction industry as a whole, and in turn the competency of the professionals involved. It is a result of incompetent persons acquiring the roles of construction managers and construction foreman, as well as unskilled labour who do not have the skills and knowledge to erect a building adequately and safely. Negligence is also to blame. The company responsible for this ends up paying dearly and tainting its name and within this industry, a company's name and reputation goes a long way.

1.1. Statement of the main Problem

Construction Management versus Construction Project Management. Both of these aspects will be thoroughly analysed to obtain a better understanding of exactly what each entails and their appropriateness and importance within the construction industry. These two different fields are sometimes categorised into one, when in actual fact they differ quite a lot. Can a project be as successful with only a construction manager or vice versa? Their value that they bring to a project or development must be known. Another important question is that can a project still function and be executed without one or both of these professionals?

1.1.1. Hypothesis – Both construction management and construction project management are imperative in a project.

1.2. Sub – Problems

1.3. What are the roles and responsibilities of a modern day construction manager? – With all the advances in the construction industry, the role of the construction manager is constantly changing to adapt to the industry. What are the differences between a South African construction manager and an overseas based construction manager? What are the differences between construction managers who are involved in a relatively small development to construction managers involved in a multi billion Rand development? Their roles have changed significantly over the past few years. Can a project be executed adequately without a construction manager? Can it also be executed adequately with multiple construction managers?

1.3.1. Hypothesis – Construction management in the modern day and age is a challenging profession, and their role within a construction project is imperative for the successful execution of a project. The larger the project then the greater the responsibilities and role of a construction manager. Construction management as a management function must be as universal as possible, regardless of geographic location.

1.4. What are the roles and responsibilities of a construction project manager? – In this modern day and age, the importance of a project manager in the professional team is imperative. All aspects of a construction project manager will be researched. What does the job of a construction project manager entail? Can there be more than one construction project manager involved in a project? Can one run more than one project concurrently? Does the lifecycle of a project influence the roles and responsibilities of a project manager? Does communication channels and the way in which the company is structured play a role for the construction manager, and to what extent will this help him/her?

1.4.1. Hypothesis – Project life cycle, communication channels and structure will influence the efficiency of a construction project manager, but to what extent is not known yet. Project management's importance with regard to the project is imperative.

1.5. What are there similarities, differences and relationships, if any between the two professions? – Where do construction managers and construction project managers fit into the professional team involved in a project? How do professionals involved in more than one project handle the many responsibilities? Are the differences between the two disciplines significant? Or can one assume the responsibility and roles of the two disciplines? If the differences are significant, what makes them so different? Where do the project structure and communication channels fit in within a project?

1.5.1. Hypothesis – There are similarities between construction managers and construction project managers, but they are unclear at this point in time. They will be known as the research progresses. Differences between construction managers and construction project managers also do exist, and these will also be researched.

1.6. What are the modern day systems and programmes used within the construction industry today? – There are a number of modern day systems and techniques that assist the modern day construction and construction project manager, making the current project easier to analyse, control and predict activities and keeping quality, cost and time within necessary boundaries that ultimately boosts the efficiency of a manager. The programs and systems used within the construction industry will be researched and their appropriateness analysed. All projects are unique, so the biggest challenge will be providing a standard system that accommodates all these different aspects. Construction software technology is also advancing at an exceptional rate. Is this technology that is available easy to learn, understand and does it create value, as well as a competitive advantage to those companies that put it to use? Can too many systems, programmes and software being used concurrently actually hinder the project or the efficiency of the individual utilising it? How does South Africa fare in this regard to that of developed countries? Are we still in the 'dark ages' when compared?

1.6.1. Hypothesis – Within South Africa, these systems and programmes are highly underutilised, and relatively unknown as they are not as exposed as professionals in developed first world countries. When these programmes are utilised properly they can add real value and efficiency to construction managers and construction project managers.

1.7. Delimitations

1.7.1. All interviews and questionnaires will be conducted within the Pretoria area, so will not necessarily apply to the rest of South Africa.

1.8. Definition of Terms

1.8.1. Construction Manager – CM

1.8.2. Construction Project Manager – CPM

1.8.3. South Africa – SA

1.8.4. The male gender (referred to as He) includes the feminine gender (she) too and vice versa. – He

1.9. Assumptions

1.9.1. A competent professional is assumed that he/she is qualified and fully capable to carry out his/her responsibilities.

1.10. Importance of the study

The importance of this study is to highlight the fundamentals of CM and CPM, as well as their similarities and differences and to stress their importance within the construction industry as a whole. Comparing these two professions will also give a clearer idea of what they are about. Assessing and highlighting the programmes, systems and software that CM's and CPM's utilise to improve their efficiency for the job at hand is also important. Determining recent construction related accidents and their causes will also highlight the negative aspects of employing incompetent personnel.

1.11. Research Methodology

This treatise article will be researched by the following relevant methods:

1.11.1. The internet– Information posted on the web such as e-journals, articles blogs and other forms of information available on the internet to aid in the research

1.11.2. Published Academic Articles – It is important to find out and research what similar articles and topics that have already been published

1.11.3. Published Books – Books published with information that will aid in the research of the topic. They are very valuable sources of information as the information they contain is more thorough and comprehensive than an academic article.

1.11.4. Newspaper Articles – Information and stories and current events of what is happening in the 'real world.' Contains unbiased reporting on real events that have occurred within the construction industry to date.

2. Chapter 02 – The Roles and Responsibilities of a Construction Project Manager

2.1. Introduction

A CPM is a pivotal and important role player within the project team. An efficient and effective CPM will have a positive influence on the success of a project. Not only will knowledge and experience be important for the CPM, but his personal attributes will also be important. A CPM could have all the knowledge to be a competent CPM, but if he lacks the necessary 'people' skills, he will struggle to be as effective. This is very important as a CPM's job is very task and goal orientated and requires gaining participation, dedication and motivation from the whole project team. Interaction between all the project team members in imperative, so it is important to maintain healthy relationships between all the professionals and the CPM and this also means maintaining the relationships between the project professionals themselves. Conflict should not necessarily be viewed as detrimental, and should be encouraged at times, however what is actually more important is how this conflict is managed, as inadequate conflict management may be extremely destructive as participation, motivation and dedication would fall drastically and thus the effectiveness and efficiency of the project team would also drop drastically and thus would compound into many more problems, delays and more destructive conflict having a very negative influence on the overall project outcome. So it is also important to determine the interpersonal skills of a CPM as this is a major asset for the CPM.

Another very important aspect of the CPM's job is keeping the project within the constraints of time, quality and within budget. If any one of these three aspects is not adhered to, it will have detrimental consequences toward the project. Quality, budget and time constraints are determined at the beginning of the project and they are determined by the stakeholders and are usually included in the client's objectives as the project is still in the project initiation phase.

A project in its entirety is an immense undertaking and to simply try and undertake it with no real plan will lead to certain failure. Thus to make it more manageable it is imperative to break it down into phases to make the project more manageable. If a project is broken down it is then easier to manage and to determine exactly what is required. It is important that the advantages of this be determined. Without a project broken down into phases it would be difficult to determine a CPM's roles and responsibilities in a project as they differ quite significantly in each phase.

The construction industry whether in South Africa or the world is not a generic, static environment and is constantly changing. And each project is unique. For example two exact buildings constructed next to each other with the exact same building specifications, may differ quite significantly. A scenario where the first building may have relatively easy site access so is constructed with no difficulties or challenges, whereas the next building may have a very restricted access thus planning, coordination and construction preliminary costs will be significantly higher than the first building and may take longer to complete.

2.2. Construction Project Management Process

Although each project is unique, there is a standard process that can be incorporated and applied to each project, to make it more manageable and to optimise a project's efficiency.

2.2.1. Basics

- A project should always begin with a start and an end (known as a life cycle)
- Start with the end in mind (final deliverable product)
- Break the project up into phases
- Plan phase 1 in detail, and the others roughly
- The actual work done in phase 1, will then clarify the work required in phase 2

- When phase 2 is then planned in detail, the other future phases will then be adjusted as the project moves forward
- Thus a ‘rolling horizon’ for planning

2.2.2. Phases and milestones

Once the project has been divided into the various phases, milestones (deliverables) should be set at the end of each phase. The advantages of this are:

- Each phase generates information for the next phase
- Reduces the uncertainty on the future phases
- If a project is broken up into phases, the uncertainty of each phase is less than the uncertainty of the project as a whole.
- Phases are motivational for the project team

The following tables below illustrate the total uncertainty of a project compared to the uncertainty of a project phase.

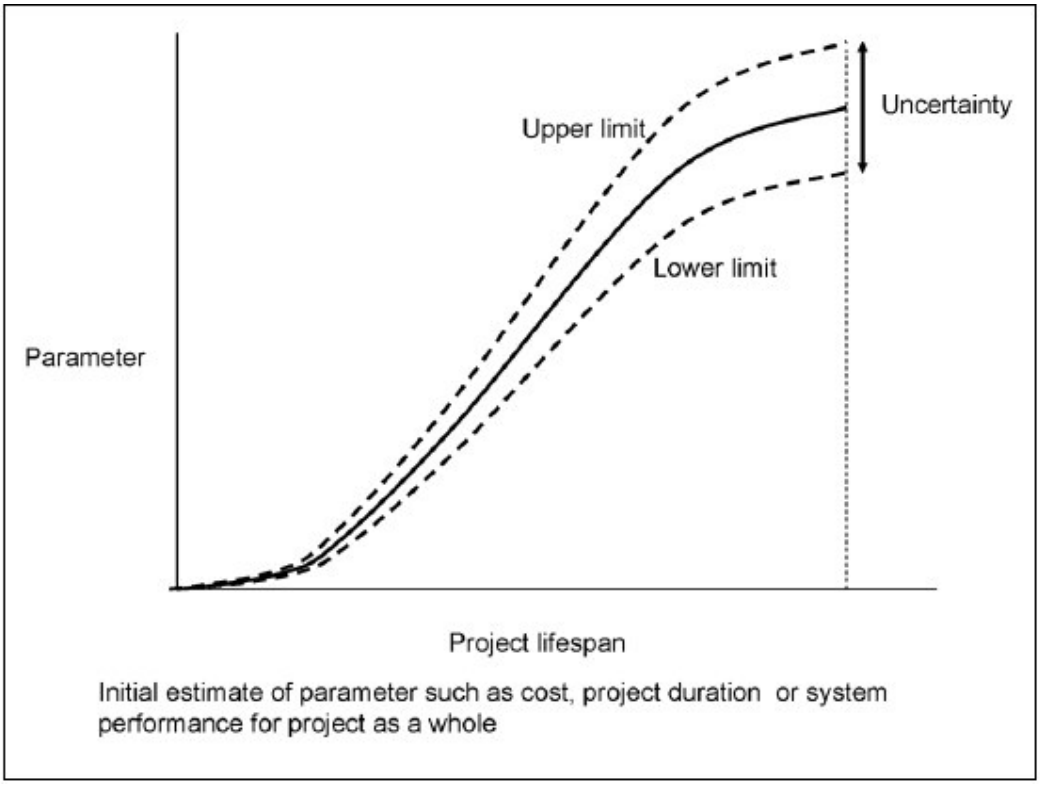


Figure 1: Shows the total uncertainty of a project in its entire life cycle. Source : Kerzner (2006)

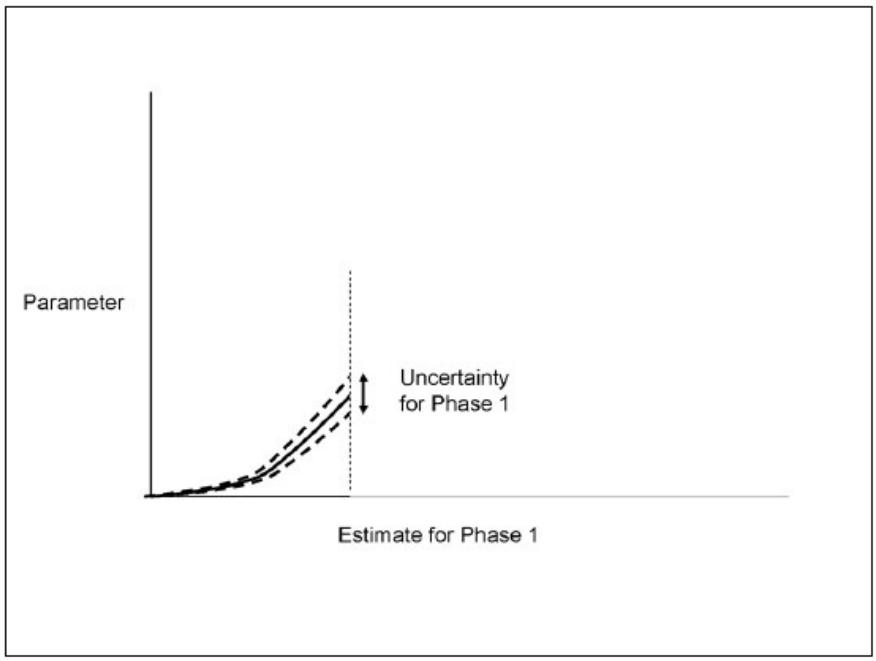


Figure 2: Shows the total uncertainty for phase 1 of a project. Source: Kerzner (2006)

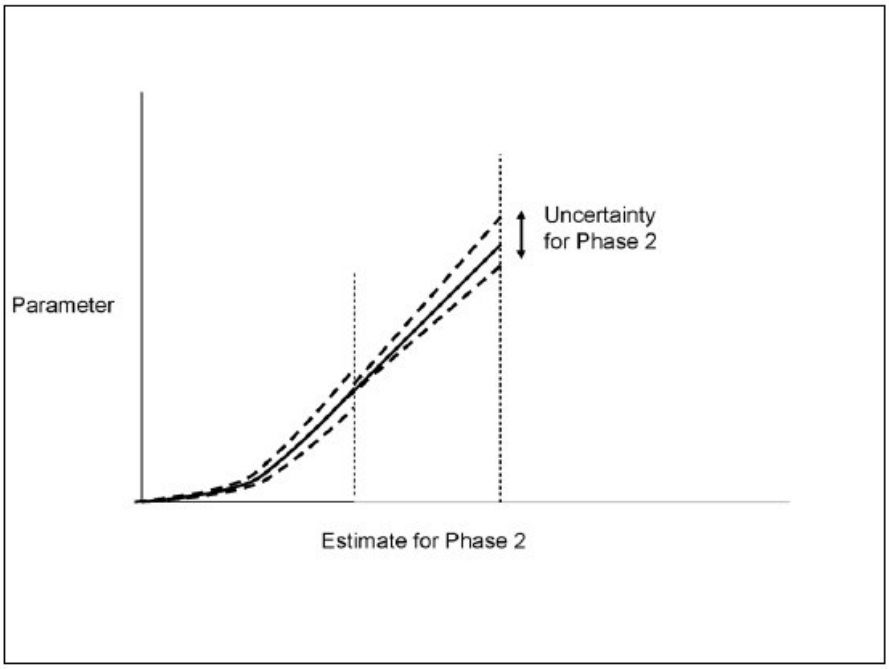


Figure 3: Shows the total uncertainty for phase 1 and phase 2 combined. Note that it is considerably less than the uncertainty than table 1. Source: Kerzner (2006)

2.2.3. Project Phases

As previously mentioned, successfully undertaking a project from its inception to its completion is an immense undertaking. Without adequate planning the project will almost certainly fail. Once a project is broken down into phases, the specific outcomes and goals of each phase can be determined. The amount of work and effort required can be determined, and various roles and responsibilities can be shared between the project team. Because the desired goals and objectives are recognised this will also greatly improve the motivation and moral within the team and when the desired objectives have been met, a sense of accomplishment will be felt and will improve cohesion between the members. A CPM's main priority is to make sure the development meets the client and stakeholders objectives, and must make sure that the development does not clash with his own personal objectives. Although each project is unique, CPM's still perform the following standard services under the following stages:

2.2.3.1. STAGE 1 – Project Initiation and Briefing

The first stage of the project is where the CPM must:

- ♠ Reach agreement with client requirements and objectives.
- ♠ He must assess user needs and options
- ♠ Appoint the necessary consultants in establishing the project brief, priorities, constraints, assumptions and strategies.

The deliverables (outcomes) of this stage that are determined at the beginning of the stage are the following:

- ♠ Project procurement policy
- ♠ Project brief

- ♠ Singed agreements between the client and the professional consultants
- ♠ A project initiation programme
- ♠ Approval by the client to proceed to stage 2.

2.2.3.2. STAGE 2 – Conception and Feasibility

This stage is the finalisation of project. In this stage the CPM must:

- ♠ Prepare and finalise the project concept in accordance with the brief, which includes character, function, form, the preliminary programme and viability of the project.

The deliverables of this stage are:

- ♠ An indicative project documentation and construction programme
- ♠ Signed agreements between parties
- ♠ Approval by the client to proceed to stage 3.

2.2.3.3. STAGE 3 – Design Development

In this stage the CPM must:

- ♠ Manage, co-ordinate and integrate the detail design and development process within the project scope, cost, quality and time constraints.
- ♠ The design must be finalised and the specifications outlined.

The deliverables of stage 3 are:

- ♠ Signed agreements
- ♠ Detailed design and documentation programme
- ♠ An updated indicative construction programme
- ♠ Approval by client to proceed to stage 4
- ♠ A cost plan must be finalised
- ♠ A financial viability of the project must be determined.

2.2.3.4. STAGE 4 – Tender documentation and Procurement

This is the process of establishing and implementing procurement strategies and procedures which includes:

- ♠ Preparation of necessary documentation, which aids in the effective and timeous execution of the project.
- ♠ Procurement of necessary resources for the execution of the project.

The stage 4 deliverables of the project are:

- ♠ The contractors, sub-contractors and suppliers procurement strategy
- ♠ The project procurement programme
- ♠ Project tender and contract conditions
- ♠ Approval by client of tender recommendations.

2.2.3.5. STAGE 5 – Construction documentation and Management

This is the management and administration of the construction contracts and processes which includes the preparation and co-ordination of necessary documentation to facilitate the effective execution of the works.

The deliverables of stage 5 are:

- ♠ Agreed contract programme
- ♠ Signed agreements between parties
- ♠ Adjudication and award of contract claims
- ♠ Monthly progress payments
- ♠ Monthly project progress reports
- ♠ Certificate of practical completion

2.2.3.6. STAGE 6 – Project Close Out

This is the process of managing and administrating the project close out and includes the preparation and co-ordination of the necessary documentation to facilitate the effective operation of the project.

The deliverables of this stage are:

- ♠ Certificate of works completion
- ♠ Certificate of final completion
- ♠ Project close out reports

2.3. Human Resource Function of a CPM

To first understand the human resource function, the definition of a construction project manager must be known. According to the South African Council for the Project and Construction Management Professions, (SACPCMP) stated in the 'Guideline scope of services and tariff of fees, (2004) (page 3) CPM is defined as: "The management of projects within the built environment from conception to completion, including management of related professional services. The construction project manager is the one point of responsibility in this regard."

With reference to this definition, and taking into account the sub-problem, a CPM is able to manage more than one project concurrently. The stage of a project will play a major role. As a project in its close out phase will not require as much attention as a project in its construction documentation and management phase. However the size of the project is also a major factor. A CPM could simply not be actively involved in two major projects each exceeding 100's of millions of rand. He may oversee them, but would require subordinates to execute the major work required by a CPM. It does depend on the resources and information available to the CPM. A CPM with limited available resources and information will find it difficult to make informed decisions and struggle to delegate and lead the project team as he himself will be unclear on the project direction and current progress.

Human resource planning is a management function that involves the organising, leading and monitoring of people that are involved in the project during the whole of the project lifecycle to ensure optimal performance. It involves the following:

- Planning of effective roles and responsibilities (recruitment)
- Selecting and placing (project team acquisition) of the most competent people within the project team
- If necessary development and training (In most projects today there will usually not be sufficient time available for this so individuals that are already capable to efficiently perform their project roles will preferably be selected)
- Team development
- Relationship management
- Efficient and effective project leadership

2.3.1. Positive attributes needed for a CPM

In order for a CPM to successfully manage, motivate and ensure commitment form his team, he must possess the following positive attributes:

- He must always be positive, have high energy levels and be enthusiastic to act as a role model
- Must focus on effective communication
- Be compassionate, but at the same time, be firm
- Must gain commitment from the project team
- Be specific and keep focus (to do this a scope statement should be made)
- Encourage the individual but at the same time stress team. To do this each individual must be aligned with the project goal, then get the team to work on it.
- Treat others within the group with respect

- Make the most of it (project) even if it gets tough
- Be consistent (in your judgement, actions and decisions) and thus gain trust.
- Learn the art of persuasion (this will be very useful during the project lifecycle)
- Expect change and adapt to it (the construction industry is constantly changing, a CPM must anticipate it, and act accordingly)
- Avoid the 'blaming' culture (accept responsibility for your own mistakes and learn from these shortcomings)
- Understand the project environment (this will help plan and execute better)
- Involve the stakeholders involved in the project at the right time in the right stage
- A CPM cannot manage a person but rather the environment and the processes. (Encourage them to manage themselves by having clear roles and responsibilities)
- Create a situation where people within the project team take ownership and do not just play a participation role. Source: Prinsloo (2009)

A CPM must be willing, have a positive attitude, have the capacity and aptitude, the necessary skills and knowledge and have the organisational support in order to optimally perform on a project.

2.3.2. Imperative skills of a CPM

1.1.1. Leadership skills – Ability to lead people and groups/organisations

1.1.2. Ability to develop people – Recognise their full potential

1.1.3. Communication skills – Essential when interacting and conveying important information

1.1.4. Interpersonal skills – Interaction between group members is key.

1.1.5. Stress-handling skills – Keep a cool head in stressful times and to avoid burn out.

1.1.6. Problem-solving skills – Every new project will present a new and different problem. Anticipate and think logically

1.1.7. Time management skills – Avoid micro management

1.1.8. Common sense – Approach each situation logically, and implement the simplest, yet most effective plan.

2.4. Cost Influence on a Project

A CPM has a great influence on the overall cost on a project. He has the influence to substantially save a great percentage on a project, through both his decisions and his actions. As can be seen by the table below, which shows the portion of a CPM's fees according to the stage of the project where the bulk of their fees are commissioned in stage 3 – Design and development and stage 5 – Construction and contract administration.

Project Stage	Description	Percentage of Total Fees
Stage 1	Project Initiation & Briefing	10%
Stage 2	Concept & Viability	10%
Stage 3	Design Development	25%
Stage 4	Tender Documentation & Procurement	10%
Stage 5	Construction & Contract	40%

	Administration	
Stage 6	Project Close Out	5%

Table 1: Indicating the percentage of total fees apportioned for a CPM according to the phase of the project. Source: 'South African Council for the Project and Construction Management Professions, (SACPCMP) stated in the 'Guideline scope of services and tariff of fees, (Page 16)' (2004)

This table also indicates the amount of effort and time a CPM should invest at each stage of the project. The higher the percentage then the greater the input required, and this is also directly proportional to the influence a CPM has and his ability to influence and save costs on a project.

The 3 most important aspects of a project that a CPM must always keep in are that it must be completed within the specified time, within budget and of adequate quality. The CPM must make a decision and commitment on all 3 dimensions and from once the commitment is made; it cannot be changed without client approval. A simple diagram below illustrates this:

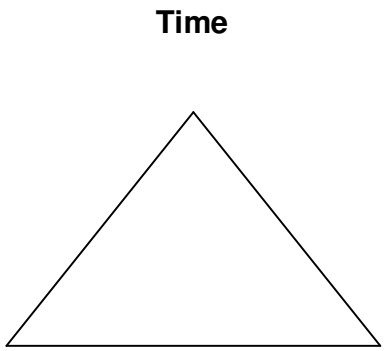


Figure 5: Indicating the relationship between cost, quality & time

The CPM must commit to a point anywhere within the triangle that the client is happy with, and this cannot be changed unless expressly approved by the client.

2.5. Managing Conflict within the Project team

The CPM is the role player within the project team, so it is up to him to ensure the cohesion and smooth running of the project team as the development progresses. 'A well oiled machine will run a lot better than one with imperfections and inconsistencies.' Howes (2009)

Conflict within a team is inevitable, so a CPM must be prepared for this and be ready to handle it in the correct and constructive manner as constructive conflict will be beneficial for the group. Prinsloo (4th July 2009) states that there are certain ways in which conflict can be handled, these are:

- Withdrawing/Avoiding (retreating) – Does not solve the problem in any way and this must not be encouraged.
- Smoothing/Accommodating (emphasise agreements rather than disagreements) – Only works on the short run, as it creates a short term solution
- Compromising (bargaining) – Provides a definite solution
- Forcing or competing (win-lose situation) – May only solve the conflict temporarily, but hard feelings will eventually resurface in time to come
- Collaborating – Seeking consensus and commitment – This provides a long term solution

- Confronting – Process of problem solving and negotiating, whereas the situation is treated as a problem that needs to be solved, and aims at a win-win situation. This is the ultimate and preferred solution.

2.6. Project Time Management

For a CPM, time planning is the foundation of planning, and thus the foundation for projects. If this is combined with cost estimates it also helps to facilitate cash flows and is a valuable tool for presentations and progress reports.

There are many techniques available, and they help manage uncertainty and the influence that a large number of variables on a project. The technique that a CPM wishes to employ should be flexible, in order to handle change and variations and thus not only to accommodate planning but also accommodate re-planning to accommodate the changes.

2.6.1. Planning Techniques Available

2.6.1.1. The Bar/Gantt Chart – Most common and most popular technique employed. It is in a simple format, easy to understand, well known, visual. The disadvantages are: Not suitable to predict or accommodate uncertainty, does not accommodate critical path or float for activities, no early/late start and is not suitable for complex projects.

2.6.1.2. Sloping Bar Chart – This is similar to a bar chart, and is regarded as being more visual. The disadvantages of using this technique are: It is not generally known, only suitable for a few activities and also does not accommodate float, critical path and uncertainty.

2.6.1.3. Line of Balance Programmes – This indicates the number of units versus time. Shows balancing or resources/trades. The advantages of using this technique are: Shows trades as well as sequence of work, it indicates number of teams, their activities and waiting times, organises repetitive work, it is very visual, balances out resources, and it is easy to control and is able to indicate unproductive sequences. The disadvantages of this are: The activities are summarised, detail is needed for the first unit and it lacks the necessary detail that may be required.

2.6.1.4. Networks: PERT/CPM Planning – The advantages of this technique are: It is able to show relationships and dependencies, critical path is indicated, various probabilities are given in order to achieve end result, able to handle the affect of variation orders, can accommodate a large number of activities. However the disadvantages of using this technique are: It is very complex to use, lots of data regarding the project must be input first, not everyone is able to understand it and it is very expensive to keep up to date.

When utilising a specific technique the following must be kept in mind:

- Each plan should be used for the specific process for which it is most suited, this may result in incorrect deductions made and a CPM may be forced to implement a 'forced fit.'
- Plans must be kept as simple as possible
- The time plan must be able to measure progress and be updated regularly
- Different plans should be used for different purposes of planning. For example a bar chart used overall planning and presentations of sub-sections, while a PERT network is used for resource levelling and critical path planning.

2.7. Project Cost Management

According to the Project Management Book of Knowledge (PMBOK) 2004, Project Cost management is defined as: 'Involves determining what physical resources (people, equipment, materials) and what quantities of each should be used and when they would be needed to perform project activities, which involves:

- Resource planning
- Cost estimating
- Cost budgeting
- Cost control'

2.7.1. Resource planning

This involves the planning of:

- People – Engineering services, scarcity of skilled resources and pre-production cost calculated as a percentage of direct field costs
- Money – Cost of capital, the contracting strategy (i.e. penalties imposed/incentives) and cash flow.

2.7.2. Cost Estimating

There are 3 types of cost estimating that exist, these are:

- Order of magnitude estimates – A rough estimate that is not entirely accurate and is based on assumptions
- Semi-definitive Estimates – More accurate than an order of magnitude estimate, but still not entirely accurate, but is based on more accurate information and less on assumptions

- Definitive Estimate – Very accurate estimate and is based on accurate information obtained, with very little assumptions.

2.7.3. Cost Budgeting

The inputs required for cost budgeting are the following:

- A cost estimate of the project must first be completed
- A work break down structure must be implemented before an accurate cost budget can be made.
- A schedule is required indicating the logical process of activities and to determine predecessors and following activities

Once a cost budget is compiled, a detailed cost control plan can be produced.

2.7.4. Cost Control

A cost control system utilised by a CPM must be able to:

- Measure the resources used
- Status measured in real time
- Must be able to compare with budget, future projections and standards
- There must be a basis for diagnosis
- Must be able to accommodate re-planning

When implementing a cost control strategy, one must be tempted not to alter figures or processes in order to obtain favourable results as this can lead to disastrous consequences and even certain failure of a project.

2.8. Summary

In this chapter the basic scope and responsibilities of a CPM were included. And this information concludes that a project will not be able to be implemented efficiently and effectively without the valuable contribution of a CPM. All the

imperative requirements and responsibilities were mentioned, which ranged from the construction project management process to project cost control.

2.9. Conclusion

The role of a CPM is pivotal and absolutely necessary within the construction industry of both South Africa and the world. The CPM is a leader and must coordinate the project team in order for them to meet their objectives. He acts as a bridge between the client and the project, and must also keep the project within its given constraints. The CPM's influence within the project is also great, and his actions and decisions whether positive or negative have great influences on the project. The importance of a CPM within a project cannot be stressed enough.

Without a CPM in a project the roles and responsibilities would have to be shared among the project team, and would be as efficient or effective and coordination and implementation of activities and resources would most definitely be erratic and inconsistent.

2.10. Testing of Hypothesis

The initial hypothesis stated that project life cycle phases, communication all affect the efficiency of a CPM, and his importance within a project is imperative. The hypothesis is true. Project life cycles, communication and management all play an imperative role for the CPM and the role he plays within the construction industry regardless of geographical location in imperative.

3. Chapter 03 – The Roles and Responsibilities of a Construction Manager

3.1. Introduction

'The term construction management may be confusing since it has several meanings. It may refer to the contractual arrangement under which a firm supplies construction management services to an owner. In its more common use, it refers to the act of managing the construction process' – Construction methods and management, Nunnally, (5th Edition, 2004)

The role of a CM is very important during the 5th phase of a project, construction and contract administration. He has a major influence on the end product deliverable he may even influence the success of the overall project.

Good management, motivation of the workforce, cost control and quality management are all important factors that a CM must employ to ensure success of the project. He must not just master one of these factors in order to ignore another, but rather find a balance between all the important aspects. Reducing costs while maintaining quality and schedule is imperative, and cost savings even occur in the design process before construction has commenced.

Management of available scarce resources is imperative to a CM. Skilful CM results in the project finishing on time and within budget. Poor CM may result in the following:

- Project delays – Increased labour, equipment costs and cost of borrowed funds, thus finishing over budget and a longer practical completion date.

- Increased material costs – Due to poor purchasing techniques, resulting in increased waste, deterioration of material quality, loss and subsequent repurchasing of the same material.

- Increased sub-contractor cost and poor sub-contractor relations

- Inadequate health and safety provisions leaving the CM's company with a poor track record, resulting in high insurance costs.

- Less profit made on the project, hampering the overall growth and success of the company.

Continued practise of poor CM will ultimately lead to the failure of the contractor company. "Such studies indicate that at least 90% of all company failures can be attributed to inadequate management." – Nunnally, (6th Edition, 2004) Construction methods and management,

Modern day construction is an ever evolving and developing field, as construction methods and management are continually advancing. So it is important a CM keeps up to date with relevant advances in order to gain a competitive advantage in an extremely competitive environment. It is especially more competitive now during the current global recession. The most important aspects of construction management will now be discussed in detail.

3.2. Total Quality Management

Quality management has shifted from the mindset from reacting to the outcome of site production to becoming a strategic business function within the company. A construction company must guarantee its client a quality product, if it cannot it will no longer be able to compete in the market.

There are various concepts that are considered to influence the quality of a product and these are illustrated in the chart below:

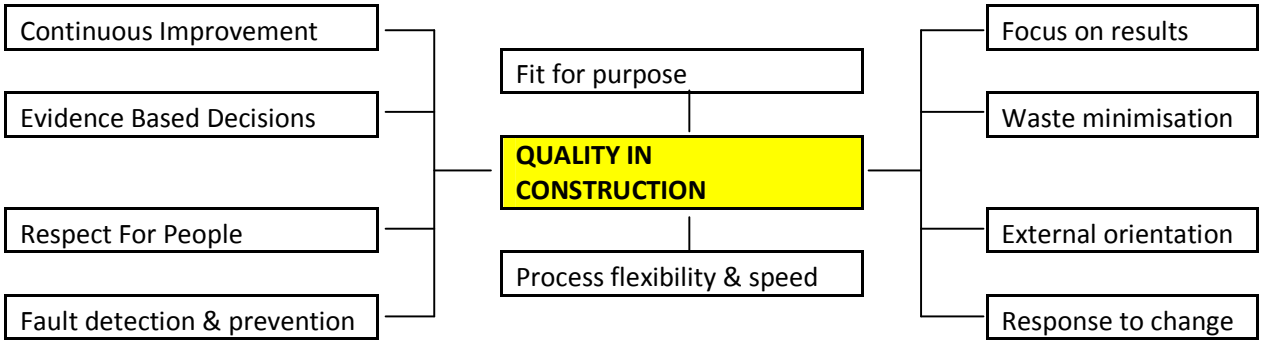


Fig 6: Shows the aspects of construction quality – Source: Harris & McCaffer, 2006 Modern construction management, 6th Edition,

3.2.1. Quality Transition

Quality is considered to have progressed through major stages over recent years, as follows:

3.2.1.1. Quality control and inspection – This is the process of checking what has been produced and making sure it is what is required.

3.2.1.2. Quality assurance – This was developed to ensure that specifications are constantly met, and the term 'fit for purpose' is the principle of quality assurance. The ISO9000 standards that were derived are essential in the modern day construction industry.

3.2.1.3. Total quality assurance – This is the philosophy of continuously improving goods or services, and total quality management is now seen as essential to long term survival in business. Total quality management must be implemented and practised by everyone in the organisation from top management to general labour. Success total quality management ensures the following:

- Be fit for purpose and a reliable basis.

- Impress the customer with the service that accompanies the end product

- Supply a product that is a lot better than the competition, that customers want regardless of price

3.2.1.4. Quality management systems – This is a system that presents a set of processes that ensures the attainment of defined quality standards for provision of services and products by the construction company.

3.3. Workforce Motivation

Success of implementation or work incentives that are aimed at producing higher levels of production output largely depends on creating a balance of many interrelated motivating factors necessary in achieving worker satisfaction. The nature of the construction industry itself often further complicates this. Factors such as:

- The unique nature of each project

- The tough working conditions and extreme physical aspect of construction

- Industrial relations related to the construction and engineering industry.

3.3.1. Motivation Theories

3.3.1.1. Maslow – Maslow suggested that people seek to satisfy needs sequentially i.e. that as each need is satisfied then a new set of needs emerges which pertains to self motivation. Basic needs such as food, shelter, then to belong, recognition, respect, to self expression and finally self fulfilment

3.3.1.2. Herzberg – Herzberg's interesting pointers to motivation identified the following factors of job satisfaction:

- Achievement – The desire to achieve and excel
- Recognition – For work done and accomplishments to date
- The work itself – An employee will have a greater motivation if he enjoys the work he does
- Taking responsibility – The more responsibility, then the greater the motivation
- The chance to advance – Will greatly improve motivation
- Factors of demotivation include:
- Working conditions – Poor or unsafe conditions
- Salary – Poorly paying salary will negatively affect motivation
- Relations with superiors – Poor relations with superiors will be detrimental
- Company policy – Strict policies that he does not agree with

3.3.1.3. Factors affecting construction worker motivation

- Job satisfaction factors – Such as reward, achievement, recognition
- Fair level of pay – Pay according to level of responsibilities and the actual work itself
- Incentive corresponds to financial reward – The greater the incentive, the greater the reward
- Pay received on time – Pay on a set day or time of the month. As late payments will have a snowball effect on the employee (i.e.

Employee falls in default of other payments if he has not received his pay on time such as insurance)

- Good facilities on site – Well maintained, easy to access facilities
- Safe and healthy working conditions – Hygienic ablution facilities, clean running water
- Good working conditions – Safety first should always be the main priority on site
- Favourable promotion prospects – Chance to excel in the company.
- Good working relations with other crew members – Able to work as a team and encourage team work.
- Job security – A labourer who always has his job threatened will become less motivated.
- Reasonable level of overtime demand – Overtime should not be viewed as the norm.
- Competent supervisor – Who provides guidance and direction and has a reasonable level of knowledge and experience
- Recognition for doing a good job – From either superiors or work colleagues
- Reliable job description – Precise so the employee knows his exact role within the company
- Type of work – More physical work is a lot more demanding and straining to the individual

- Challenging tasks – Allows the employee to problem solve and think outside the box
- Responsibility – Taking accountability for his work, will ensure that he will do it right the first time
- Good relations with employer – A fair level of respect between both parties will ensure higher work motivation
- Participation in decision making process – Employee will feel as if he's a part of the team and will understand exactly what needs to be done
- Job Dissatisfaction Factors
- Poor treatment by supervisors – Lack of respect and understanding will have a negative effect
- Lack of recognition of good effort – Failure to give credit where it is due, is poor management
- Productivity urged with indifference – Productivity cannot be increased simply because the superior requested it from the labourers
- Reducing work opportunities – Reducing responsibilities, increasing supervision will have a negative affect on an employee
- Incompetent crew colleagues – Un-skilled labourers who have no training or experience
- Poor communication with management – Aim for pro-active management rather than re-active management

- Under-utilisation of skills – Skills and knowledge of employee not put to the test
- Lack of participation in decision-making – All decision making up to superiors, reducing responsibility of employee and thus less motivated to do work
- Unsafe working conditions – Safety not put first, which can be extremely dangerous on site
- Poor supervision – Incompetent supervisors that know less than the employees
- Little supervision – Only finding mistakes and irregularities once job is finished due to lack of supervision

3.3.1.4. Methods of encouraging Motivation of work

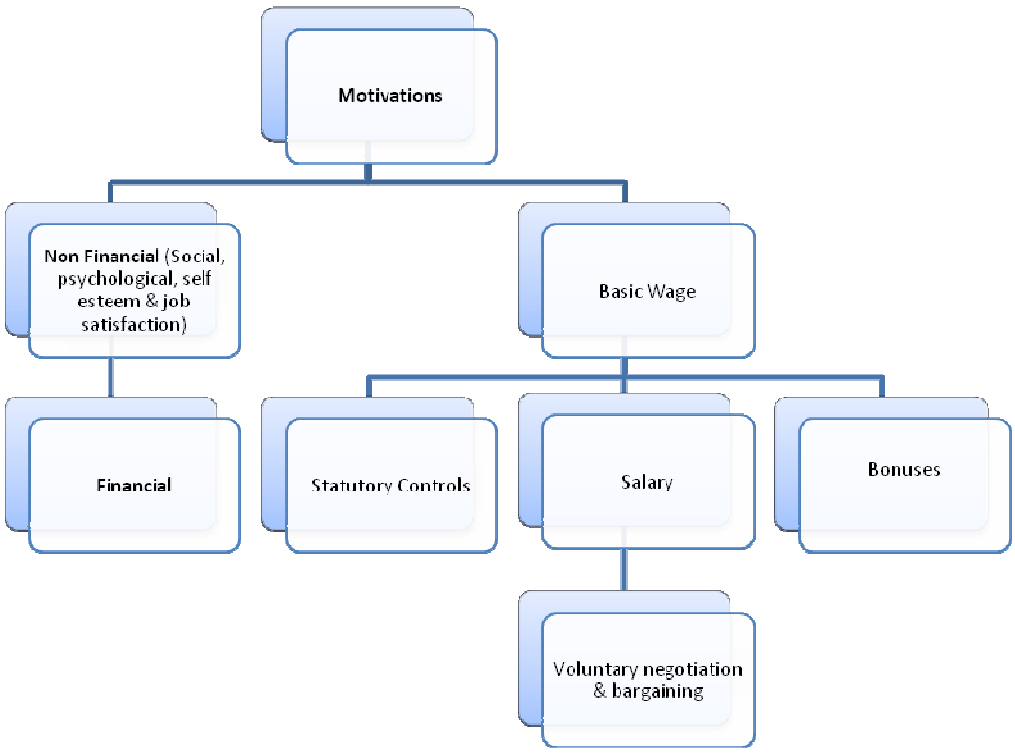


Figure7: Methods of encouraging motivation to work. Source: Construction methods & management, 6th Edition, Harris & McCaffer, (2006.)

3.4. Cost Control

The construction industry is concerned mostly with one-off projects, thus is not similar to other manufacturing situations. This creates challenges for effective control because each new contract has:

- A new management team
- Labour often recruited temporarily
- Sites dispersed around the area, in which effective communication with other parts of the company is difficult.
- Frequent use of subcontractors and lump-sum labour items
- Adverse weather conditions

Despite these challenges production costs need to be monitored and controlled if the anticipated level of profit is to be reached.

3.4.1. Fundamentals

Cost must be controlled, however it cannot simply be controlled on paper, the decisions of the CM that something should be done differently, and the translation of that decision into practice, are the important actions that realise this control. The main elements of any control system are:

- Observation
- Comparison of observation with some desired standard

- Corrective action to take

The main downside of control systems is that they have a long response time. I.e. Information is received today on what happened last week or last month, thus the extent of corrective action is limited.

3.4.2. Current Systems

The following main systems are used in the construction industry today, these are:

3.4.2.1. By overall profit or loss

Contractor waits until the entire project is complete and then compares the amount of money paid out (materials, labour payments, plant, overheads) with amount of money received. This system is only really useful on small contracts with relatively small durations involving a small workforce with small plant and is usually only used for subcontracting.

3.4.2.2. Profit or loss on each contract at valuation dates

Total costs to date are compared with valuations of money received. Attention must be paid to materials delivered to site but not yet invoiced. The main disadvantage here is that there is no breakdown of the profit figure between types of work and only provides attention on which contract needs management attention

3.4.2.3. Unit Costing

Here, costs of various types of work (i.e. mixing and placing of concrete are recorded separately). The costs are divided by quantity of each type that has been done. This provides unit costs that can be compared with those in the priced bill of quantities given at the time of the award of the contract. This is an accurate way of controlling costs, as it is very accurate.

3.4.2.4. Systems based on the principles of standard costing

These systems are used successfully in manufacturing industries. Variances are calculated by comparing value of output by cost of production. Thus it is possible to analyse total variance into sub-variances (i.e. material price, material usage, labour rate, labour efficiency, fixed and variable overheads, volume of production and sales)

This is not really applicable in construction due to the variety of the product, thus the most accurate would be the unit costing method.

3.5. Summary

What has been discussed and highlighted in this chapter are the most important aspects pertaining to construction management. It emphasises the importance of the role a CM plays. The success of the whole project depends on the construction of the building/structure. There are many important aspects a CM must take into consideration when construction is underway and have been mentioned in this chapter.

3.6. Conclusion

Construction management is an elaborate and technical job that requires great planning, management and implementation of strategic decisions and careful utilisation of scarce resources. Poor implementation of any of these aspects will greatly affect the project as well as the contracting company. Although the roles of a CM and a CPM may differ they are imperative to successfully complete a project from inception to close out. A very competent CM would utilise all these aspects when construction of a project is underway, however the roles in the actual industry may not be as black and white, and may actually be shared between professionals, as each company will have different strategies and processes to successfully complete the job.

3.7. Testing of Hypothesis

The hypothesis stated that the role of a CM within the construction industry is an important one. And as this chapter has revealed, this hypothesis is totally correct. The roles and responsibility of a modern day CM within the construction industry is absolutely imperative.

4. Chapter 4 – The Similarities, Differences and Relationships between a Construction Manager and a Construction Project Manager

4.1. Introduction

The roles and responsibilities of both a CM and a CPM have already been highlighted, to gain an even better understanding their similarities, differences and where they fit in a project must also be known.

The hierarchical and communication structure of the project team is also important. This will affect the overall efficiency and progress of the project. However in smaller projects such as house building, where there is often just an architect and a principal agent and where the client has no construction knowledge background, the project team will basically consist of the three parties, with the project structure based on the contractual obligations between them. If however the client does have construction

knowledge background, he may assume the role of a CPM and manage and administer the project himself, and even with regard to larger projects such as an office development this may still be possible.

The role of construction companies are constantly evolving, especially within the developed countries. A few years ago, a construction company would have been a general contracting company that would have specialised in the procurement of contracts. In the modern day, companies have evolved and adapted to changes and opportunities within the market and now offer a wide range of services including financing, construction support and various material purchasing options and also offering CPM to oversee the project. These clever initiatives will improve a company's market share and gain a valuable competitive advantage against other companies. However this advancement has not really picked up in South Africa and the developing countries as financial institutions (such as Standard Bank, First National Bank, ABSA etc.) are still the major financiers when it comes to property finance, although some major property development companies do finance a majority of their own developments.

4.2. Administrative Project Structure

The structure of a project is very important as it influences the overall efficiency of a project. This is also important in determining the differences between a CM and a CPM, because their roles and responsibilities are different, thus where they fit within the structure will differ. The construction manager overseas the construction of the building, whereas the CPM overseas the execution of the entire project. According to Project Management Body of Knowledge, 2004, 3rd Edition, p.25 the administrative structure of a project is shown by the following diagram:

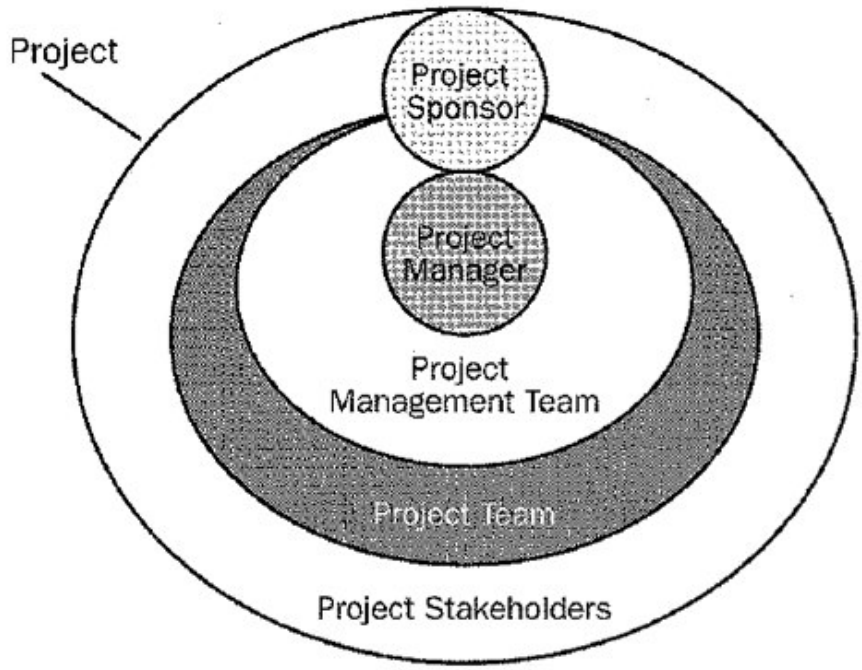


Figure 8: The structure of the project team with regard to a project. Source: PMBOK, 3rd Edition,(2004), p.25

In this diagram the CM would fit into the project team, and would be responsible for undertaking the construction of the building. The project team would also include:

- The mechanical engineer
- The structural engineer
- The electrical engineer
- Other relevant professional consultants necessary for the successful execution of the project.

4.3. Communication Structure

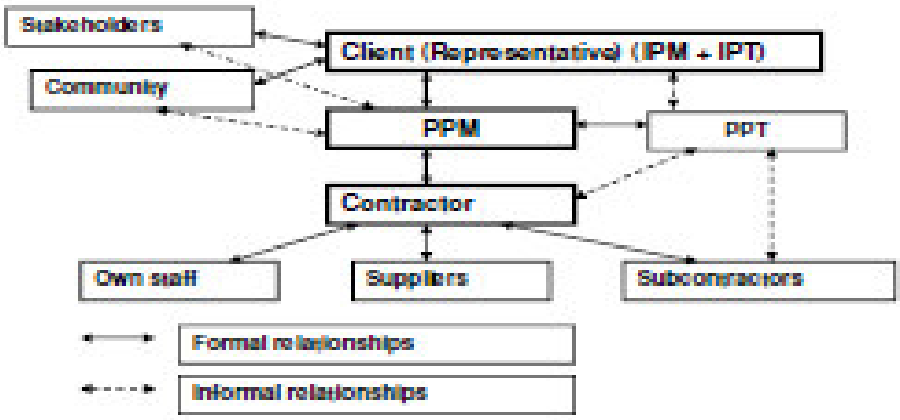


Figure 9: The communication structure of a project. Note the Project manager is directly above the CM. Source: Kerzner (2006)

4.4. Contractual Structure

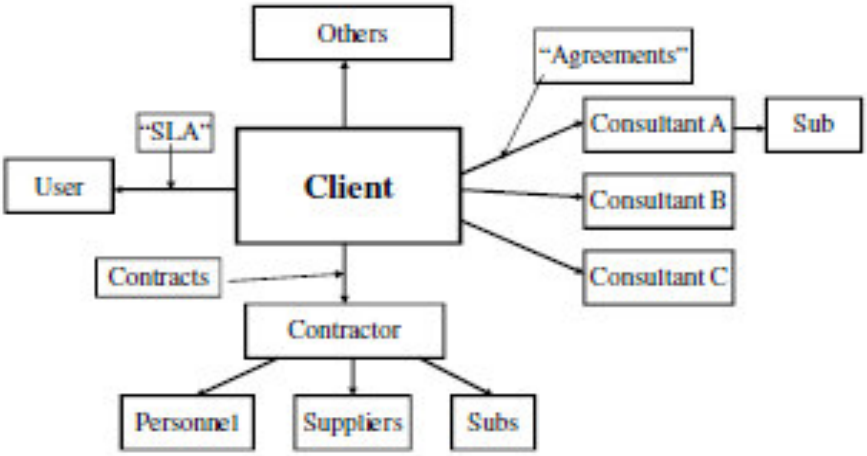


Figure 10: Indicating the contractual structure within the project team. Note how the contractor has a direct contractual obligation to the client, and is directly responsible for the execution of the works. Source: Kerzner (2006)

4.5. Client Assuming Role Of CPM

With the owner assuming the role of CPM, the structure is slightly different as the client is responsible for all major decisions and remains in control over the project from start to completion.

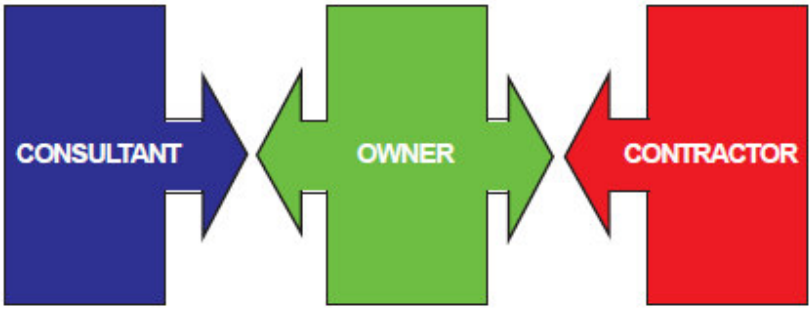


Figure 11: Indicating the relationship between the parties when the client assumes the role of the CPM. Source: www.structuretec.com Total building Envelope management solution,(accessed 20th August 2009.)

4.6. Similarities Between CM's and CPM's

Although the roles and responsibilities of the two respective professions may vary there are still some similarities that do exist.

4.6.1. Personal Attributes

Both CM's and CPM's must have favourable personal attributes in order to manage people, processes and responsibilities. These are:

- Leadership skills – Ability to lead people, motivate them and align them with the goals of the project
- Communication skills – Communication is imperative, as it greatly improves the efficiency of a group especially with regard to problem solving, teamwork etc.
- Interpersonal skills – Desirable personal attributes that one must posses. Such as compassion, trust, commitment, sense of humour etc
- Stress-handling skills – Ability to handle stress, which includes emotional intelligence. Which helps to remain calm in tense situations, and still be able to effectively manage in highly stressful situations

- Problem solving Skills – Your ability to 'make a plan.' Because every project is unique, a unique situation or problem will arise. Your ability to think on your feet and to quickly resolve challenges and problems that arise is very advantageous.

- Time management skills – Your ability to prioritise and efficiently complete jobs and tasks on time is imperative.

4.6.2. Basic Similarities - There are also more obvious similarities between CM's and CPM's. Firstly, they are both professionals involved within the same industry namely the construction industry. Their knowledge of the construction process and construction materials available must be thorough and adequate. Their management skills must also be adequate, as the CM must manage the construction process as well as the various sub-contractors, while the CPM must manage the professional team in order to successfully complete the project. Their overall project goals are similar. Complete the project, within time, on budget and of adequate quality. It is also important that the two professionals when involved in the same project, that they themselves work as a team, ensuring that cooperation, communication and cohesion are maintained at all times. It would be very detrimental to the progress of the project as well as detrimental to the project team.

4.6.3. Basic Differences - There are also obvious differences between a CM and a CPM when performing their duties and obligations. A major difference is that a CPM is more client orientated, in that he focuses on getting the job done while at the same time meeting the performance criteria specified by the client, whereas a CM's main focus is on getting the job done while at the same time meeting the contractor's defined performance (quality, on time and within budget) criteria and completing his obligation.

4.7. Summary

This chapter has highlighted both the similarities and differences between a CM and a CPM, and shows their role in a project team. This chapter also highlighted the basic relationships between the CM and the CPM and where they fit within the project team and overall built environment.

4.8. Conclusion

Although the two professions have many similarities between each other, their roles within the project team vary considerably. They are both knowledgeable about the construction project as well as the construction process and materials, but their roles and responsibilities and obligations vary between each other. One person would successfully not be able to assume the roles and responsibilities of both professionals. However they could manage and oversee more than one project, but only if their organisational structure can provide for this. (I.e. competent subordinates that will oversee the instructions and progress of the projects)

Both professions are imperative to the project, and without one the project would most definitely be doomed to fail.

4.9. Testing of Hypothesis

The hypothesis stated that there are similarities between a CM and a CPM and that there are also differences between the two professionals. This is entirely true. The similarities were stated as well as the differences.

5. Chapter 05 – Modern Day Software and Programmes Utilised within the Construction Industry Today

5.1. Introduction

A numerous number of modern day construction systems and programmes assist the modern day CM and CPM. This aids them and helps make a project more manageable and increases their effectiveness and efficiency. They also

assist in the planning and scheduling of the limited resources available, and quality, cost and time management is easy to maintain.

There are a number of various systems and programmes on the market today, and the roll of computers within the construction industry has become a pivotal part to the construction process as well as management process. A job that used to require a team of professionals is now only requiring one person, who has the necessary knowledge to use and implement various programmes and software.

A major challenge for software developers will be to provide a standard platform software package that accommodates the uniqueness of a project but at the same time is easy to use, understand and adds value to the user.

Programmes are essentially 'dummies.' They cannot do anything or apply themselves; the user must input data and operate the software in order to get the desired result. Applying Knowledge based expert systems and other visualisation techniques are an imperative tool for CM's and CPM's.

There are certain factors that affect the appropriateness and usefulness of a programme. These are:

5.1.1. Cost of purchase and obtaining legal right to use software – Excessively priced programmes may not help yield the desired return you initially

anticipated. Piracy also plays a major role in determining the price of software. Piracy includes obtaining an illegal license number, copying the software without permission and even selling copied versions as originals. This negatively affects the selling price of the software as software developers have to increase their price to meet their desired breakeven point as fewer customers buy the product thus resulting in a decreased income.

5.1.2. Ability to use programme – A programme that is not user friendly, difficult to learn will not be as affective. And not learning to use it properly will also have a negative affect on its usefulness. A non-user friendly product will leave customers frustrated as they will not be achieving their desired outputs required from the product.

5.1.3. Effective lifespan of programme – How long before the software becomes obsolete? This is very important, obviously the longer the lifespan, the more useful the product. Upgrading either the software license or the programme itself must also be taken into consideration.

The actual reality of the role that computers play is phenomenal. A company that needs to remain competitive within the industry especially during world recessions and even opportunistic times cannot stay afloat without adequately using some type of computer software.

5.2. Uses of Software within a Construction Company – Software uses are almost infinite within the construction industry, as every single professional within this field uses at least one programme every day, whether it be comparing progress on a project, designing the steel reinforcing in a concrete slab or even designing a multi billion rand shopping mall. All professionals namely: engineers, architects, CM's, CPM's, Quantity surveyors, project consultants

utilise programme software. To stay within the context of construction management and construction project management the programmes relevant to these professions will be focused on and analysed. Software is constantly adapting and bettering itself and other software, thus a programme has the inevitability of becoming obsolete within a period of time. Depending on the software this time could be months or even a couple of years.

What is conventionally employed within the construction and project management profession today is 2-dimensional modelling such as bar charts, pie charts, critical network charts which as K. W. Chau (2004) 4D dynamic construction management, states: 'lacks in spatial features of the actual construction.' What is not indicated on the chart or table is usually coordinated mentally which is drawn from the experience and intuition of the individual. Although it may be time consuming if done correctly can actually prove to be very effective.

Efficient and effective management to an extent depends on good access to and control of data especially data relating to the performance of a construction project. A major factor for the development of construction software is the acquisition, storage and presentation of the data and information. The quality of this information is imperative. Osama abudeyyer, (1996, Audio/Visual information in construction control) believes that: 'One such type of information, namely audio/visual, has long been neglected or not appropriately acquired, stored, processed and presented. The proper design of an automated solution has been lacking that would provide access to audio/visual data in support of project management. This is understandable as extra information received through different sensors (i.e. hearing and sight) will assist in understanding

different activities within a task and will help assist in planning it. And performance evaluation can depend both on numeric and pictorial reports.

3-Dimensional modelling software has also been available for a number of years, with the main use of it being for design (i.e. structures, loading of structures, design of buildings etc.) also known as CAD. (Computer aided design) 3-Dimensional modelling enables the designer manage construction information in projects by viewing them as holistic structures.

For relevance of this topic, the software programme types will be distinguished between 2-Dimensional, 3-Dimensional and more than 3-Dimensional which may indicate the direction in which new software development is going.

5.3. 2-Dimensional Software Programmes

This is the most common type found within the construction industry both within South Africa and within the modern day world. It is the most common because the majority of all programmes developed around the world are still conventionally 2-Dimensional, and nearly all modern computers and the operating software they use can accommodate these programmes. They are not obsolete by any means just because of the fact that 3-D and 4-D software is also available. The reason for this is that they are:

- Simple to use, operate and get your desired outcome

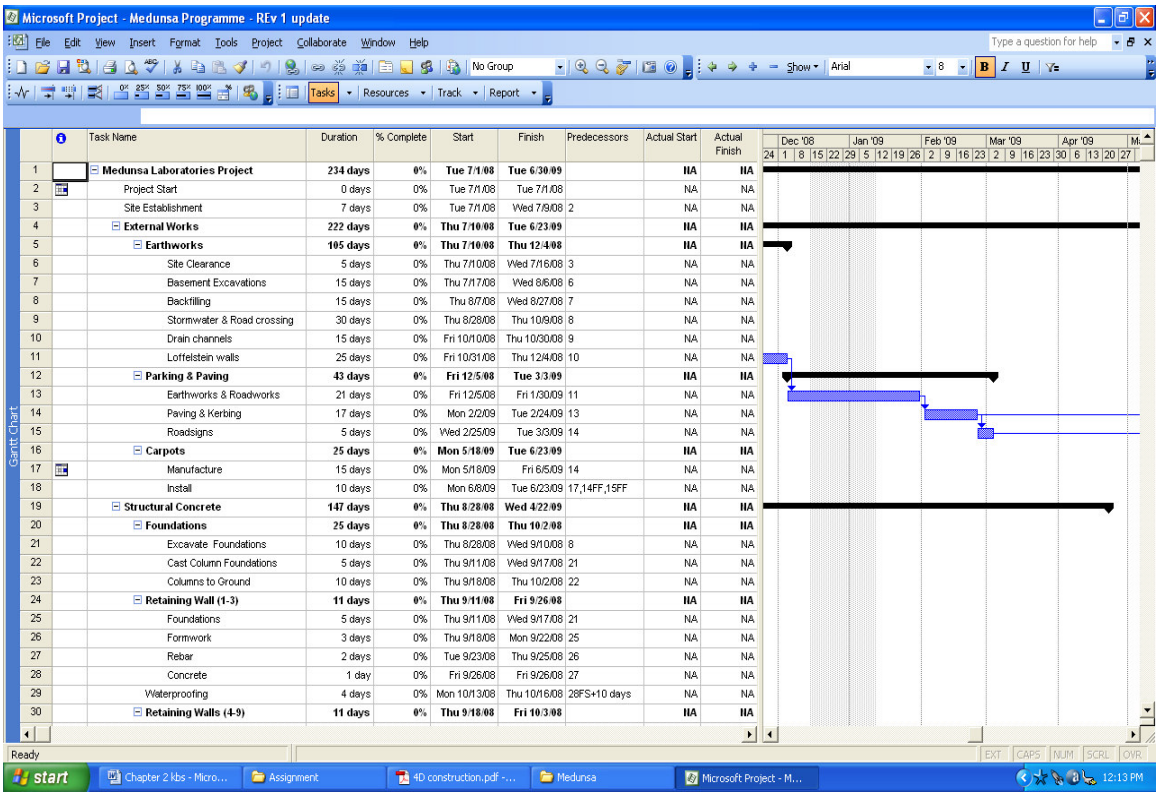
- Relatively cheap – Compared to the 3-Dimensional and 4-Dimensional software. A programme with more functions and a greater degree of outputs will be more expensive than its more simple counterparts.
- User friendly – Developed with the end customer in mind.
- Commonly found - In majority of shops, or can easily be obtained online.
- Homogeneity – A majority of programmes operate with similar basic principles, thus can be mastered in a relatively short time. (I.e. tabs, options, tools etc.)
- Have a reasonably long economic lifespan – For example; Microsoft office 2000, can still be used on today's operating software, although not as efficient.

5.3.1. Important Programmes Available for CM's and CPM's

There are many various different types and forms of programmes available on the market. Software companies are constantly developing and bettering their software to get that edge on the competition. But there are a few programmes that are tried and tested and are the best, as they have been industry leaders for years now, and serve as a valuable tool for CM's and CPM's. The industry leaders are the following:

5.3.2. Microsoft Project – This is definitely one of the most important programmes that are used by CM's and CPM's. Many uses can be derived from this programme. The most important being that it is able to provide a logical process of constructing a building for a CM, or for a CPM it provides a logical process of events from the project initiation phase to the project close out phase. The main advantage of this is that when a large project is broken down into smaller activities it is easier to plan durations, assign resources, and link similar activities, thus a more comprehensive, detailed programme of works is compiled. The cost of purchasing the professional edition of this programme is about R6 000.00

The Figure below is a snap shot of a project that is undertaken by Microsoft Project:



	Task Name	Duration	% Complete	Start	Finish	Predecessors	Actual Start	Actual Finish
1	**Medunsa Laboratories Project**	**234 days**	**0%**	**Tue 7/1/08**	**Tue 6/30/09**		**NA**	**NA**
2	Project Start	0 days	0%	Tue 7/1/08	Tue 7/1/08		NA	NA
3	Site Establishment	7 days	0%	Tue 7/1/08	Wed 7/9/08	2	NA	NA
4	**External Works**	**222 days**	**0%**	**Thu 7/10/08**	**Tue 6/23/09**		**NA**	**NA**
5	**Earthworks**	**105 days**	**0%**	**Thu 7/10/08**	**Thu 12/4/08**		**NA**	**NA**
6	Site Clearance	5 days	0%	Thu 7/10/08	Wed 7/16/08	3	NA	NA
7	Basement Excavations	15 days	0%	Thu 7/17/08	Wed 8/6/08	6	NA	NA
8	Backfilling	15 days	0%	Thu 8/7/08	Wed 8/27/08	7	NA	NA
9	Stormwater & Road crossing	30 days	0%	Thu 8/28/08	Thu 10/9/08	8	NA	NA
10	Drain channels	15 days	0%	Fri 10/10/08	Thu 10/30/08	9	NA	NA
11	Loffelstein walls	25 days	0%	Fri 10/31/08	Thu 12/4/08	10	NA	NA
12	**Parking & Paving**	**43 days**	**0%**	**Fri 12/5/08**	**Tue 3/3/09**		**NA**	**NA**
13	Earthworks & Roadworks	21 days	0%	Fri 12/5/08	Fri 1/30/09	11	NA	NA
14	Paving & Kerbing	17 days	0%	Mon 2/2/09	Tue 2/24/09	13	NA	NA
15	Roadsigns	5 days	0%	Wed 2/25/09	Tue 3/3/09	14	NA	NA
16	**Carpots**	**25 days**	**0%**	**Mon 5/18/09**	**Tue 6/23/09**		**NA**	**NA**
17	Manufacture	15 days	0%	Mon 5/18/09	Fri 6/5/09	14	NA	NA
18	Install	10 days	0%	Mon 6/8/09	Tue 6/23/09	17,14FF,15FF	NA	NA
19	**Structural Concrete**	**147 days**	**0%**	**Thu 8/28/08**	**Wed 4/22/09**		**NA**	**NA**
20	**Foundations**	**25 days**	**0%**	**Thu 8/28/08**	**Thu 10/2/08**		**NA**	**NA**
21	Excavate Foundations	10 days	0%	Thu 8/28/08	Wed 9/10/08	8	NA	NA
22	Cast Column Foundations	5 days	0%	Thu 9/11/08	Wed 9/17/08	21	NA	NA
23	Columns to Ground	10 days	0%	Thu 9/18/08	Thu 10/2/08	22	NA	NA
24	**Retaining Wall (1-3)**	**11 days**	**0%**	**Thu 9/11/08**	**Fri 9/26/08**		**NA**	**NA**
25	Foundations	5 days	0%	Thu 9/11/08	Wed 9/17/08	21	NA	NA
26	Formwork	3 days	0%	Thu 9/18/08	Mon 9/22/08	25	NA	NA
27	Rebar	2 days	0%	Tue 9/23/08	Thu 9/25/08	26	NA	NA
28	Concrete	1 day	0%	Fri 9/26/08	Fri 9/26/08	27	NA	NA
29	Waterproofing	4 days	0%	Mon 10/13/08	Thu 10/16/08	28FS+10 days	NA	NA
30	**Retaining Walls (4-9)**	**11 days**	**0%**	**Thu 9/18/08**	**Fri 10/3/08**		**NA**	**NA**

Figure 12: Shows a current project applied in Microsoft Project

More advantages of Microsoft Office are as follows: (Source: Howes (2009))

- The duration of a programme can accurately be determined – By determining the duration of each activity by defining their start dates, finish dates and desired float the duration of the whole project can be determined. Non-working days and public holidays are also taken into account.

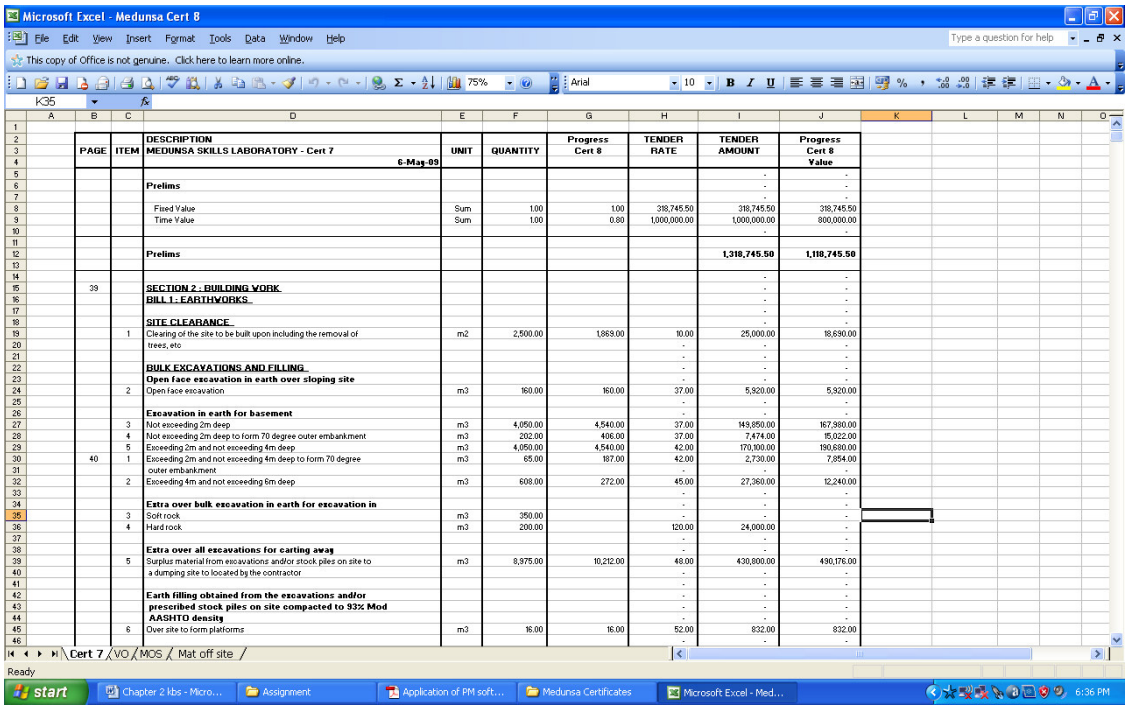
- Scheduling of resources can also be applied – Determining what resources are required for each activity, and if these resources need to be shared at the time, or focussed on one main activity.
- It is easier to compose a Work Break Down Structure – This greatly assists CPM's as well as CM's in completing the project on time, within budget and of adequate quality standard.
- Critical Processes are Determined – This is crucial as more effort and focus must be on these processes, because a delay in these activities will result in a delay in the project as a whole.
- Activities are Linked and a logical Process of construction is compiled – Thus preventing mistakes such as completing ceilings and partitioning without starting ceiling air conditioning ducting.
- The estimated cost of a Project as well as a cash flow budget can be compiled – Enabling the finance of the project to be managed better and thus the performance of the project in terms of budget can be monitored closely to determine whether or not the project is running within budget.
- Performance of the Project can be accurately Measured – As the project progresses the current progress can be compared with the baseline estimate to establish if the project is on schedule. If not then either greater resources (i.e. labour, plant) must be added to recover lost time.
- Delays occurring within the project can easily be identified and can be easily remedied – By regularly updating progress, a delay can easily be picked up and corrective remedies can be implemented so to keep the project on schedule.

5.3.3. Microsoft Office – Microsoft office is a number of programmes included in one bundle. These are; excel, word, powerpoint and outlook.

5.3.4. Microsoft Excel – Another important application used by both CM's and CPM's. All calculations such as a cash flow budget, simple additions,

multiplications, subtractions that are needed for monthly interim calculations can also be done on this application. Estimates; either regarding a bill of quantities or for a specific project can also be done. Trends and predictions can also be applied to a project that could be useful for a final reconciliation or during a project can be applied, to determine the financial performance of the project.

The table below shows an insert of an excel spreadsheet that is applied to a current project, in order to determine progress and claiming progress in terms of a monthly interim certificate claim.



PAGE	ITEM	DESCRIPTION MEDUNSA SKILLS LABORATORY - Cert 7 6-May-09	UNIT	QUANTITY	Progress Cert 8	TENDER RATE	TENDER AMOUNT	Progress Cert 8 Value
		Prelims					-	-
		Fixed Value	Sum	1.00	1.00	318,745.50	318,745.50	318,745.50
		Time Value	Sum	1.00	0.80	1,000,000.00	1,000,000.00	800,000.00
		Prelims					**1,318,745.50**	**1,118,745.50**
39		**SECTION 2 - BUILDING WORK**					-	-
		BILL 1 - EARTHWORKS					-	-
		SITE CLEARANCE					-	-
	1	Clearing of the site to be built upon including the removal of trees, etc	m2	2,500.00	1,869.00	10.00	25,000.00	18,690.00
		BULK EXCAVATIONS AND FILLING					-	-
		Open face excavation in earth over sloping site					-	-
	2	Open face excavation	m3	160.00	160.00	37.00	5,920.00	5,920.00
		Excavation in earth for basement					-	-
	3	Not exceeding 2m deep	m3	4,050.00	4,540.00	37.00	149,850.00	167,980.00
	4	Not exceeding 2m deep to form 70 degree outer embankment	m3	202.00	406.00	37.00	7,474.00	15,022.00
	5	Exceeding 2m and not exceeding 4m deep	m3	4,050.00	4,540.00	42.00	170,100.00	190,680.00
40	1	Exceeding 2m and not exceeding 4m deep to form 70 degree outer embankment	m3	65.00	187.00	42.00	2,730.00	7,854.00
	2	Exceeding 4m and not exceeding 6m deep	m3	608.00	272.00	45.00	27,360.00	12,240.00
		Extra over bulk excavation in earth for excavation in					-	-
	3	Soft rock	m3	350.00			-	-
	4	Hard rock	m3	200.00		120.00	24,000.00	-
		Extra over all excavations for carting away					-	-
	5	Surplus material from excavations and/or stock piles on site to a dumping site to located by the contractor	m3	8,975.00	10,212.00	48.00	430,800.00	490,176.00
		Earth filling obtained from the excavations and/or prescribed stock piles on site compacted to 93% Mod AASHTO density					-	-
	6	Over site to form platforms	m3	16.00	16.00	52.00	832.00	832.00

Figure 13: Excel spreadsheet used for interim monthly payment certificate claims.

To purchase the most comprehensive edition of this software package, (Microsoft Office) will cost approximately R4 000.00, with the basic edition (student edition) costing approximately R900.00.

5.3.5. Microsoft Word – This application allows a CM and CPM to write letters of correspondence, and provides a platform for which an individual can write whatever he wants in whatever format and writing style. This treatise title has been written using Microsoft Word.

5.3.6. Microsoft Powerpoint – Used mainly for presentations. This is a very valuable programme as CM's and CPM's will need to make presentations to other members of the professional team or stakeholders involved in the project. Either reporting on progress or illustrating the advantages of a new construction technique, the possibilities are limitless.

5.3.7. Adobe Acrobat – This is another important programme used by CM's and CPM's. The cost of Adobe Acrobat professional edition is approximately R5 000.00 The uses of Adobe are as follows:

- It enables the user to view PDF (personal document format) files. These files are important as it is a read only file that cannot be edited or manipulated once saved as a PDF file.
- The user is able to create personal PDF files quickly and easily.
- Scaled drawings stored as PDF files can be accurately measured (i.e. length, area, width)
- PDF documents can be marked-up, highlighted and commented on.
- Able to be used on any operating platform (macintosh, Windows XP, Vista)

5.3.8. **Other Programmes available** – The majority of professionals will only utilise the above mentioned programmes. This is sufficient, and they will not be 'left behind.' However there are other programmes available that a CM and CPM can also use. There are many, many programmes available that may be generic to the major programmes (eg. Microsoft Office) and are not

worth mentioning. However some other important programmes available are listed as follows:

5.3.8.1. Candy Buildsmart - Developed in 1978. This is a construction enterprise accounting system that integrates costing and project accounting which is suitable for a CM as real time analysis allows for effective construction management. It manages all sources of project cost such as material procurement, labour payroll, subcontractors, plant stock and overheads. It allows information to be entered when it is produced, either on site or at head office and can be viewed wherever in the world (provided it is over a secure network that has internet connectivity.) Candy also allows for estimating, critical path planning, forecasting, cash flow modelling, cost reconciliation and time location charts.

*"*We have been using Candy for the last 12 years and in all that time had excellent support. Their continuing commitment to upgrade and improve Candy has always maintained them as a contractor's system at the leading edge of technology" – Mike McCara, Concor Building, South Africa (2008)

5.3.8.2. Methvin – Programme designed and developed for use in the construction industry that is applicable for CM's and CPM's. This programme allows a user to estimate and manage large construction projects more effectively. When estimating: 'It allows for tasks to be broken down further into sub-bills to allow for more detail and the ability to lock tasks independently to allow for imbalanced rates.' – www.methvin.org (accessed March 2009)

Some advantages are as follows:

- Helps improve risk assessment
- Each resource can be date stamped
- Network up to 250 members concurrently
- Last minute discounts can be entered into easily
- Improved project pricing processes

5.4. 3-Dimensional Programmes

These are programmes know as Computer Aided Drafting (Auto CAD) These programmes are mainly used by designers (i.e. Architects and engineers) so will not be mentioned with great detail as CM's and CPM's will not necessarily use these programmes, although they may provide information required by the designers. These programmes allow a designer to construct a 3D computerised model of their design which greatly assists the designer. The advantage of using CAD is that the programme is used across all disciplines (i.e. Architect, Structural engineer, Electrical Engineer etc) so information is able to be communicated through one medium.

5.5. 4-Dimensional and Beyond

5.6. Building Information Modelling - 'Computer Aided Drafting (Auto CAD) was for a time the most sophisticated modelling technique available. It is now giving way to more complex technology of Building Information Management. (BIM)' – Sabongi, Integration of BIM in the undergraduate Curriculim: an analysis of undergraduate courses, Minnesota State University. (2004)

Construction managers are striving to improve their project development and operational management through the use of increasingly highly developed software. The use of BIM is ever increasing within the construction industry

in the U.S. This is a relatively recent development as its first inception came around 1997. BIM creates intelligent, multi-dimensional building models. Designers can enhance their computer projections to incorporate actual building materials, and shows a building at every aspect of its development and illustrates construction, design and materials in detail. Thus it is not only suitable for designers but also for CM's and CPM's and multiple groups in different locations is able to concurrently work on projects. You are able to see how pieces of project data fit together in real time. Using conventional programmes and systems this type of documentation and data would otherwise be created in isolation by various professionals within the team. Parametric modelling is the basis of BMI processes. Parametric means that a design can be worked on concurrently by various professional fields, thus it is generated from a relational database that contains information regarding attributes of structures elements and the relationships among them. This model can be used to generate space calculations, energy efficiency analysis, structural details and traditional design documents. Thus this is a complete system that starts at the initial implementation stage and finishes off at the project close out phase.

This new modelling system is greatly growing in popularity, although relatively unheard of in South Africa but rest assured its popularity will grow phenomenally worldwide within the near future. The traditional roles of professionals within the project team will have to shift to accommodate this shifting in mindset and technology. And by certain professionals that chose not to adapt, this could mean their skills and roles ultimately become obsolete.

'The way we do things now "traditionally" is very different from the way the process could be working. The building information model allows space, form, and time to be represented in a single interoperable product.' – Young, (20th May 2005)

The programme that adequately incorporates BIM, is a programme known as 'Revit'. It is used by some architect firms within South Africa but not by all, and is still relatively unknown by other professionals involved within the industry i.e. engineers. Another major advantage of this programme is that alterations to design can be done almost instantly without major delays, and mistakes in design that would only be picked up during construction are now picked up and quickly rectified before construction documentation is even issued, thus greatly saving time, project cost and reputation. BIM also complements lean construction as planning and efficiency on site is maximised.

5.7. Programmes in Practice

Interviewing Mr. Andre Rautenbach, CEO of DLR Construcution (Pty.) Ltd. (2009) the following information was obtained about the company and the software the company uses.

DLR Construction is a medium sized construction company that operates around Pretoria, with its head office based in Centurion. The company uses the following software programmes:

- Microsoft Project 2002 – A bit outdated but still effective. Used for all construction programmes and obtaining performance of the project
- Microsoft Excel 2002 – Used for all reports, such as cashflow predictions and trends, cost reporting, financial analysis and performance of current projects, final cost recons, profitability of projects, tenders.
- Microsoft Word 2002 – Provides platform on which all correspondence is done (i.e. Faxes sent, letterheads, communication between construction sites etc)

- Adobe Acrobat – Programme allowing all PDF files to be viewed as well as producing own PDF files, and determining areas on scale drawings
- Microsoft Powerpoint 2002 – Used for performing presentations when required.

5.8. Summary

This chapter has listed the major types of software programmes available to CM's and CPM's and their uses and advantages, as well as the cost of purchasing them. Differentiating between 2-D and 3-D and also beyond 3-D and the future and the direction, software is taking. There are many available and a lot of generic programmes also exist, but the most important programmes were listed. This chapter also revealed the latest development in software and systems concerning the construction industry (BIM) and the importance that this will change the traditional roles of professionals within a project team, thus it is imperative that the roles will have to adapt to this development.

5.9. Conclusion

Computer programmes are an essential asset to modern day construction practice and management. In order to maintain or gain a competitive advantage, CM's and CPM's must familiarise themselves with the programmes that are essential to maintaining an efficient performing project. Learning to utilise these programmes effectively is imperative in this modern day and age. With the introduction of Building Intelligence Modelling (BIM) this will change the very structure of today's industry and roles and responsibilities will shift as professionals adapt to this new programme. Because it is relatively new, South Africa has not really adapted this, but will certainly within the near future.

The programmes currently used within the construction industry by CM's and CPM's is adequate and the professionals are effectively utilising programmes to enhance their capabilities. With global competition on the rise, and international barriers falling away, especially within a developing country, the South African Construction Industry is of a high standard, and is keeping up to date with available software and programmes. CM's and CPM's within South Africa are very competent and computer literate.

Effectively utilising software programmes is imperative for CM's and CPM's, but one cannot simply employ all available programmes to do his job. Good old fashioned leadership, common sense and experience are also necessary to complement the computer literate skills of a CM and CPM.

5.10. Testing Of Hypothesis

The initial hypothesis stated that CM's and CPM's are not exposed to the software programmes available in the developed world and are underutilising them, thus not being as efficient as they could be.

This hypothesis in incorrect, CM's and CPM's within South Africa are of a very high standard and in order to adequately do the job, programmes are effectively used. The programmes used are adequate and not underutilised. To stay competitive within the industry, professionals must be up to date regarding the programmes and software they employ, thus CM's and CPM's use the available software adequately and realise the true potential of it.

6. Chapter 06 – Conclusions, Summaries and Recommendations

6.1. Conclusion

Construction management versus construction project management, the aim of this title is to compare the two professions and to determine which of the two is more important when undertaking a project.

Construction Management and construction project management, are two very important professional fields within the construction industry in South Africa and worldwide. Although their roles differ quite a lot from each other, some professionals within the construction industry do not fully understand the differences. In order to fully comprehend what each one entails, both professions should be analysed thoroughly and their similarities and differences will be clearer. In order to do this the following aspects had to be researched:

6.1.1. The roles and responsibilities of a construction project manager

In this chapter, the construction project management process was shown which included the basic guidelines, explained phases and milestones of a project and how it eases uncertainty and risk. Project phases were also highlighted and how it helps make the project more manageable.

The human resource factor of construction project management is also another very important factor to highlight, as the construction project manager must have important interaction and communication skills in order for the project team to meet the proposed project deliverables. Managing conflict is another important aspect of a construction project manager, as it affects the project team and their efficiency to work as a team.

The work of a construction project manager also has a major influence on the cost of a project, and the efficient the CPM, then the greater his influence he has to keep costs as low as possible while maintaining quality and speed of progress.

Time and cost management is also imperative for the CPM. The progress must be monitored closely and regularly updated to compare with a baseline to determine whether the project's progress is as anticipated.

6.1.2. The roles and responsibilities of a construction manager

Adequate construction management is another imperative factor for the success of a project. Total quality management in managing construction is imperative. It stresses proactive management rather than reactive management, which is of major importance especially when unnecessary costs and time delays must be kept to an absolute minimum. The optimum use of the scarce resources available to the CM is also important.

Workforce motivation is important as the CM involved must keep his workforce working as efficiently as possible. It is important to know certain drivers and needs of a person and by satisfying these certain needs of an individual their motivation and moral can be maintained, and thus work productively.

Cost control is also an important aspect for the CM. A contracting company cannot prosper in its endeavours without a system for controlling and monitoring costs incurred on the project.

Time and resource management is also imperative. Resources are scarce and limited in number, thus a CM must carefully plan and control the use of these resources to ensure optimum efficiency. Time management involves careful planning of the progress and reaching important milestones in the project. Breaking the project down into stages and milestones reduces uncertainties and risks and makes the project easier to manage.

6.1.3. The similarities and differences between a construction manager and a construction project manager

It is important to realise the similarities and differences between both the CM and CPM, which helps gain a better understanding of both professions.

Their roles within the project team may differ quite significantly, but there are still fundamental similarities between the two professionals such as desired personal attributes.

Their contractual obligations differ as well as their communication structures within the professional team.

6.1.4. The modern days systems, programmes and computer software used by construction project managers and construction managers

The use of computers within the construction industry is also imperative. The use of computers and computer software within any industry has had exponential growth since their inception. Calculations and projections that would take many man hours to do can now be done in an instant, which greatly improves company efficiency. Software is differentiated between simple 2-D programmes, more complex 3-D programmes as well as the latest '4-Dimensional' programmes that incorporate design, cost, durations and construction planning.

The important programmes used by professionals within the construction industry are critically examined and their advantages as well as disadvantages are listed.

The main programmes used within the construction industry are utilised by both CM's and CPM's, thus both professions are literate with each party's software, greatly improving communication and understanding for the two professions. If a dispute was to arise, using one programme where both can communicate and understand each other will greatly improve the resolution of that dispute.

6.2. Testing of Hypotheses

6.2.1. The roles and responsibilities of a construction project manager

The initial hypothesis stated that project life cycle phases, communication all affect the efficiency of a CPM, and his importance within a project is imperative. This hypothesis is true; project life cycles, communication and management all play an imperative role for the CPM and the role he plays within the construction industry regardless of geographical location is imperative. The CPM and his roles and responsibilities are pivotal for the successful implementation and execution of a project.

6.2.2. The roles and responsibilities of a construction manager

The hypothesis stated that the role of a CM within the construction industry is an important one. The hypothesis is correct; the roles and responsibility of a modern day CM within the construction industry is absolutely imperative. The larger the project, the greater the responsibilities of the CM, although a small project does not mean that a CM has minimal responsibilities, the fundamentals will still be similar, just on a smaller scale.

6.2.3. The similarities and differences between a construction manager and a construction project manager

The hypothesis stated that there are similarities between a CM and a CPM as well as certain differences between a CM and a CPM. This hypothesis is true; although there are basic inherent differences between the two professions, they still have fundamental similarities that both professions share.

6.2.4. The modern days systems, programmes and computer software used by construction project managers and construction managers

The hypothesis stated that CM's and CPM's within South Africa are not exposed to the current software and programmes available to the more developed countries. When these programmes are used adequately they

can add real value and efficiency to the project and professionals using the programme. The hypothesis is incorrect. CM's and CPM's in South Africa are of very high standard and in order to adequately execute a project programmes used by the professionals are thus used effectively. To stay competitive within the industry, professionals must be up to date regarding the programmes and software they employ, thus CM's and CPM's use the available software adequately and realise the true potential of it.

6.3. Testing of Main Hypothesis

Construction management versus construction project management, the main hypothesis stated; both construction management and construction project management are imperative in a project. And both professions have a major influence on the outcome of the project. This hypothesis is true; one is not more important than the other as they both have differing roles and responsibilities and obligations toward the project that are imperative to the project. If for example there was no CPM appointed for the project, then it would be possible for the principal agent such as an architect to encompass the role of the CPM too, however it would not be possible for the CM to also take the role of the CPM and vice versa due to contractual obligations as well as sheer work load, and would be detrimental to the progress of the works.

6.4. Recommendations

6.4.1. Project management and construction project management differ somewhat from each other; to fully understand the role of a project manager regardless of the industry this must be further researched.

6.4.2. It will be important to know just exactly what the views and opinions are of professionals within the construction industry in South Africa, and how well do they really understand construction management and construction project management and exactly what it entails. This can be done by

composing a simple questionnaire and asking various professionals involved in construction.

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