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Project Management of Small Projects in the Oil and Gas industry

By

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The undersigned certify that they have read, and recommended to Faculty of Graduate Studies for acceptance, a thesis entitled "Project Management of Small Projects in the Oil and Gas industry" submitted by Ebrahim Eghbal in partial fulfillment of the requirements for the degree of Master of Engineering in the Department of Mechanical and Manufacturing Engineering.

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ABSTRACT

The purpose of this thesis it to develop the best applicable method that contributes to the effective management of small projects in the oil and gas industry. The projects in this huge industry are of different sizes and can be completed within a few months to a couple of years with various kinds of implementation and execution. The scope, duration and cost of the project can vary based on the location of the project, nature of the project and the time required for execution and construction.

To manage small projects in the oil and gas industry, a method termed the "Gorgan Method," is developed with its related monitoring and reviewing tool, "Diamond Method", in order to complete the projects within a predetermined time frame and budget. A standard method of completing small projects could be beneficial to companies and project managers as it would make the process more efficient, utilizing more effectively the resources available. The framework is then applied and validated through a real case study project.

The "Gorgan Method" includes three sections and deliverables including Gates, Levels (phases) and Category Cost Estimates. The "Diamond Method" reviews and monitors the executed projects in the four main concepts including Scope, Time, Cost, and Quality.

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DEDICATION

Dedicated to the invaluable camaraderie of my wife, Bahar

and

our families

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Oil and gas projects usually have various strategies of implementation and execution plans. Projects are of different sizes and can be completed within a few months to a couple of years. The scope, duration, and cost of the project can vary based on the location of the project, nature of the project, and the time required for execution and construction.

Projects in general are implemented using different methods based on company policies and workload. In some companies, projects are a part of in-house projects, and are executed by the company itself, without any assistance from external consultants. The design team members of the company are working on a project from start to completion. The second type of projects execution involves a consulting company handling the project, and completing it in their office. In this case, a representative of the owner company is present in order to resolve potential questions and issues. The third type of projects is called an "Alliance project," which is executed at the owner company. In this case, the consultants work alongside the owner's staff on the same project to design, and execute the project from the first step.

There are some typical problems and concerns in the existing project management systems and models. These problems are in different sections of a project including scope, time, cost, quality, and construction. Potential problems must be considered in all sections of the project to avoid them in advance and a system must be implemented to monitor them. As most of the applications and systems focus on midsize and large size projects and try to improve them, this thesis focuses on small projects with a maximum of one million dollars budget, introducing a framework for executing this type and size of projects.

A conceptual model is introduced in this thesis in order to explain the best possible way to complete small projects. This methodology, which is termed as the *"Gorgan Method" from now on, explains how a small project is to be designed, developed, and executed from its inception to its final construction and start-up. The "Gorgan Method" is developed to avoid the existing problems in managing small projects. Most of the missing factors, which have been not considered in existing project management methods and systems, are incorporated in this method to minimize the potential problems related to scope issues, cost issues, time issues and quality issues.

Gorgan is the capital of the state of Golestan in North of Iran.

1.2 Thesis objectives

The overall objective of this thesis is to develop and design a framework for small projects that fulfills the project scope of work and related activities, in order to complete it within a predetermined time frame and budget. To achieve this objective, the following sub-objectives and steps have been identified:

1. Identify the typical problems that exist in managing small projects.
2. Identify existing methods and systems available for managing projects.
3. Design and develop the conceptual model of "Gorgan Method" and its monitoring and reviewing tool called the "Diamond Method".
4. Identify all levels of the "Gorgan Method".
5. Identify all activities in each of the related levels
6. Identify key issues and the importance of the "Gorgan Method" to avoid the existing typical problems of a real project case study performed in another project management system. In the other words, validating this method by highlighting its essential strengths to avoid potential and existing problems by reviewing a real case study.

1.3 Methodology

In order to create and develop the conceptual model of the "Gorgan Method" along with its monitoring and reviewing tool, and optimize the management practices and activities in small projects applied in the framework, information was collected and reviewed from different sources and references. This information was obtained by utilizing sources in a way that would efficiently and effectively identify relevant data as well as any significant problems associated with managing small projects. The following is a description of how and to what extent the information sources were utilized.

1) Literature review

A comprehensive literature review was performed on small projects and their execution methods. The current applied project management methods, models, frameworks, and systems in managing the projects were reviewed. The critical issues, concerns and problems associated with the existing methods and systems were identified. Different sources including books, journal articles, conference papers and reports from the Internet were used in this review.

2) Review of actual case studies

In order to complete the research and observe the real and practical project management issues and concerns, a couple of projects under design and construction were reviewed to collect and complete some actual information. This research was performed in different forms as follows:

A) Site visits: Several site visits were performed in order to oversee the schedule and progress of some of the projects, and also to identify the problems that are faced during construction, pre-commissioning, and commissioning of the projects. These site visits were important since meetings were required with construction people as well as operations personnel to discuss existing issues in project construction. These visits provided information about the quality of the design of the projects and the missed items in preliminary stages of the projects, which need to be considered in future projects.

B) Monitor Daily/Weekly/Monthly Meetings: For the projects, there were different kinds of meetings conducted to review schedule, priority, man-hours as well as financing and technical issues. During the

meetings, specific work to be completed in the coming days/week(s) was considered and key technical issues were discussed.

C) File Review: Project related information is usually available in separate history files. Examples of the kind of files reviewed for couple of projects include:

- Engineering files involving preliminary studies, initial calculations, and design;
- Engineering drawings;
- Schedule and budget information;
- Contract documents;
- Procurement files;
- Vendor drawings;
- Development agreements;
- Approvals and applications;
- Construction files;
- Construction completion certificates; and,
- Final acceptance certificates.

3) Identify the critical issues to develop the "Gorgan Method"

The above-mentioned information and data showed there is a lack of a comprehensive method to manage small projects and avoid the current existing problems and concerns. All of the problems and issues of the existing models and systems were identified. These items were avoided in the design and development of the "Gorgan Method."

4) Develop the "Gorgan Method" and "Diamond Method"

The "Gorgan Method" was created to specify key components of a small project and identify the best possible way to design and manage a small project from start to completion. The design and development of the method was based on identifying and reviewing current problems and missed information in the current project management systems. The following steps were taken to design and develop the "Gorgan Method" and "Diamond Method:"

A) Identify the current problems;

B) Reasons for occurrence of the problems;

C) Solutions to avoid the problems;

D) Evaluate and compare the model with a completed real project to ensure it avoids the existing problems and issues.

5) Review the "Gorgan Method"

The method was reviewed from different perspectives. Efforts were made to improve and complete it for managing small projects. The method was discussed with several experts in the field to ensure it is a comprehensive model to design and construct small projects according to the framework. In the "Gorgan Method," different levels and related stages of each particular level avoid the potential problems in a small project and improve the project management system for managing this type of project. The levels of the "Gorgan Method" are the preliminary phase, detailed design phase, final design phase, and construction phase. There is a gate review at the end of each design level of the project to completely review the related phase from the technical and financial point of views. A category cost estimate as one of the stages in first three levels, reviews and evaluates the estimated cost of the project.

6) Verify the "Gorgan Method"

A real completed project in Iran was reviewed as a case study, and the existing problems and potential issues in the current project management system were identified. Then the benefits of applying the "Gorgan Method" to avoid these problems were identified and highlighted.

7) Write the thesis

After completing the above activities, the thesis is written explaining all of the issues and concerns. The conceptual model of the "Gorgan Method" is specified for managing small projects in the oil and gas industry. Efforts are made to explain and describe the method in the most complete and simplest way.

1.4 Thesis organization

There are six chapters in this thesis and they are as follows:

A literature review on the kind of work that was performed in the project management field pertaining to the oil and gas industry is provided in Chapter 2.

The main concepts of the project management such as scope management, time management, cost management, and quality management, and highlighted potential problems and issues in the existing systems is provided in Chapter 3. The missed items in current projects' undertaking are also discussed.

The framework for managing small projects in the oil and gas industry is introduced in Chapter 4. Key components of small projects, which need to be

considered during design and construction, are identified by the conceptual model of the "Gorgan Method." Its related method, the "Diamond Method," is introduced to analyze, review and monitor the main factors of the small projects executed in the "Gorgan Method" or in general in other methods and systems with some modifications and updates, if required.

Chapter 5 is about the applications of the "Gorgan Method" for managing small projects. A real project case study as well as related key project management issues and concerns are outlined in this chapter.

And finally, Chapter 6 includes findings, conclusions, contributions and recommendations for future studies and researches.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, a summary of the research performed in the project management area is provided, concentrating on small projects and the recommended methods or improvements for execution of these projects. Some of the existing methods and systems for managing the projects are introduced, such as PMI (Project Management Institute). At the end, the main missing items in the existing research and management systems are covered, and the reasons for the lack of a comprehensive framework for managing the small projects are provided.

2.2 Background

In the 1960s, project management began to be recognized as a distinct subset of management and was followed by others; (Steiner and Ryan, 1968), (Lock, 1987), (Bastani, 1988), and (Cleland, 1989). A limited amount of literature on project management was available during that time in areas such as construction, aerospace, and defense.

However, in 1971, the Harvard Business Review published a collection of selected articles on some unique themes of project management (Gaddis, 1959), (Wickesberg, 1962), (Middleton, 1967), (Howell, 1968), and (Jonason,

1971). These articles mainly deal with broad and generic issues of evolving practices in task-oriented project management without recommending a specific framework to manage small projects.

Later on, much research performed in this field and many papers were published in journals, conferences and seminars. A general review of these papers shows the importance of project management. Various subjects are discussed and some guidelines are provided.

2.3 Literature review

Project management is defined as the art and science of directing and coordinating human and material resources through the life of the project, using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction (PMI). The project is defined as a time-based, multi-phased entity; characteristics that distinguish it from other management environments (Allen, 1999). In this section, some of the current project management systems are reviewed briefly and related papers and research are provided.

1) Current project management systems and models:

There are various methods and systems in the project management of projects in general. Three methods are briefly introduced here to show different perspectives of project management systems:

A) Project Management Institute (PMI):

The Project Management Institute has explained and classified the project execution in nine different knowledge areas as the main necessary parameters to perform a project, including project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management, and project procurement management. The project management framework of PMI provides a basic structure for understanding project management. After an introduction to project management, it provides the project management context that describes the environment in which projects operate, and the importance of understanding the project by team members. Finally, it explains a generalized view of how the various project management processes commonly interact and why an understanding of these interactions is essential to complete the project.

B) SMART project management (Hartman, 1999):

SMART project management considers projects in four key principles. These are:

1. *Strategically Managed* means the project must fit into the strategy of the companies involved in it, and secondly, a holistic approach is used in the planning and management of the project.

2. *Aligned* is a difficult concept which is absolutely critical to success of a project. There are two aspects to alignment. The first and the most important is the overlap of expectations of the different stakeholders. The second is the use of management tools and techniques that reflect the priorities of the project.

3. *Regenerative* is the concept of a regenerative organization that is low stress, highly productive, and with low staff turnover. It will produce better than average results through good teamwork.

4. Transitional. This element is based on recognition that all assumptions in proceeding with a project are susceptible to change, and many will change. It means the outcomes of a project are unpredictable.

Hartman then explains the project phases in three phases including planning phase, implementation phase, and finally completion and follow-ups.

C) Applied project management, (Kerzner, 2002):

Kerzner has many publications in the project management area. He has mentioned in his book, "applied project management, best practices on implementation", that effective project management requires extensive planning and coordination. As a result, work flow and project coordination must be managed horizontally, not vertically, as in traditional management. Horizontal work-flow generates productivity, efficiency, and effectiveness. Organizations that have mastered horizontal work flow are generally more profitable than those organizations that continue to use vertical work flow exclusively. Kerzner then explains the main factors of a project management system, which can be used to overcome project problems, and complete the projects successfully.

2) Conference papers and magazine articles:

A complete review of the related papers shows a focus of the project management including project management concepts, project planning and control, project quality, time and cost management, and risk management. Research performed in different organizations and institutes in the last twenty years in this field. Here, the related papers and research are provided for three main areas include general project management, risk management and training. A summary of each one of the main achievements are as follows:

A) General project management:

The most interesting research regarding project management and small project implementation are summarized as follows:

(Blankevoort, 1984) explained that project management is coming of age as a profession, but while communication of data and information is essential to good management practice, it is often one of the neglected aspects. One of the most fundamental changes in modern project management is the use of computerized data-processing systems as management support, but it is not explained that a system or framework is required to manage the projects using these machines to support the whole system.

(Malinen, 1984) explained a result-oriented approach, which assumed that national requirements and administration of the company were the most significant components of the project environment.

(Zachau, 1984) mentioned that companies delivering systems facilities such as turnkey plants tend to work in a project-oriented manner that brings out problems in terms of cooperation and coordination of responsibilities, duties and authority which demands special skills of the project manager.

(Wearne, 1984) explained that fast tracking allows a project to be executed in a shorter period of time than average and achieving this obviously demands changes from usual practice in managing the execution of a project, but no framework or conceptual model was recommended.

(Bishop and Gembey, 1985) described every project organization as a pyramid, with a project manager at the apex and supporting staff below, increasing in number at each level. They attempted to draw attention to principles that are fundamental to dealing with these requirements and

to explain how the principles are implemented and why the size of the project will determine future organization growth.

(Pannenbäcker, 1985) mentioned that for implementation of project management systems for completing a large, complex project within its budget and time limits, it is important that a standard data and documentation codification system be implemented at the start of the project.

(Dingle, 1985) under the same topic mentioned that project management is concerned primarily with the correction and prevention of problems, many of which originate in the conceptual stage of project development. Using a series of definitions and examples, a set of guidelines is presented that can help to identify where these problems are likely to arise and some useful suggestions are made as to how they can be avoided.

(Tiner, 1985) explained that in order to control a project, construction management requires project information. This is obtained through accounting, estimating, cost management and scheduling functions,

which produce project reports. These reports are best obtained by subdividing the project into small parts.

(Bolliger, 1986) suggested some factors for successful project management to avoid the failure factors in major Swiss projects. Suggestions are made on setting up a project team, defining relationships and responsibilities.

(Carrier, 1987) considered the sequence of activities involved in the design phase of a project. The process was split into conceptual, detailed and production design phases, and an attempt was made at identifying the priority tasks in the design phase and setting the sequence in which they should be performed.

(Morgan, 1987) defined the front end of a project as that time when resources have to be expended without any guarantee of return. As such, the best available project management is required during this period to ensure that resources are expended as effectively as possible in a manner that will give the highest probability of return.

(Wideman, 1989) mentioned chances of successfully achieving the required objectives during the course of implementation of a capital project are slim indeed, unless an adequate level of control is exercised throughout. He focused on scope control, possibly one of the most overlooked areas of project control.

(Somasundaram and Badiru, 1992) explained that to achieve long-term success, a company must be willing to change and continuously improve competitiveness in all its functions. This is particularly the case because the quality perceptions of users also keep changing. Organizations are trying to implement projects such as continuous process improvement, total quality management, total productivity management, and so on to improve the quality of their products and services. Project management principles and techniques play a major role in the success of these efforts.

(Anderson, 1992) mentioned managing of projects with quality, as a key objective, requires the implementation of sound project management practices. For any project management system to be effective, a project must be managed by a project manager who exhibits high quality managerial attributes. His research confirms empirically the critical

relationship between the project manager's managerial attributes, the use of key project management principles and practices, and project performance.

(Munns and Bjeirmi, 1996) described the successful implementation of different project management techniques that have been widely established in areas such as the planning and control of time, cost and quality.

(Koskela et al., 2002) mentioned that the design process can be conceptualized in at least three different ways:

1- As a process of transforming inputs into outputs,

2- As a flow of information through time and space, and

3- As a process for generating value for customers.

Case studies and research findings to date indicate that design management in construction is deficient in all three of these points of view. A series of experiments aiming at creating clarity and introducing systematic management principles from all three perspectives is described. The results of these experiments suggest that the use of relatively simple, albeit theory-driven, tools can achieve major improvements in the process of construction design. It is argued that only

when based on suitable conceptualizations, and informed by empirical data, can effective methods be devised to ameliorate construction design and engineering.

(Gao, 2002) in a paper about budget and schedule success for small capital facilities projects mentioned that the project management environment of small capital projects is unique in many ways. One unique aspect is the total administrative burden they place on resources for approvals, reviews, and execution relative to the overall value of the capital works program. Administratively, many organizations follow a prescribed approval process for all capital project expenditures regardless of size. For these organizations, small capital projects constitute 80% of the projects executed per year but only account for approximately 16% of the capital projects' budget expenditures. The opportunity to improve organizational performance through more effective project execution on small capital projects could provide substantial savings within individual small capital-project programs. The author concludes that the factors on small projects are not unlike those on large projects. The key differences noted were related to the frequency of process implementation, which affects the timing and execution of the project work phases for small projects.

B) Project risk management:

As an important part of the projects execution, much research is performed regarding risk management, which is an important issue for projects implementation. The following papers highlight a summary of research and studies which focus on this part of the projects:

(Pugh and Soden, 1986) described the use of risk analysis in a real life environment, with a concentration on the areas of project cost estimates and project control.

The process of risk management was broken down into identification of risk sources, assessment of their effects or risk analysis, development of management response to risk, and providing for residual risk in project estimates (Perry, 1986).

(Franke, 1987) mentioned only knowledge of the risk structure and of the dates when risks occur during the project sequence make it possible to initiate definite measures for minimizing risks.

(Ward and Chapman, 1991) published a paper for extending the use of risk analysis in project management, which is concerned with the expansion of the role of risk analysis in project management. Risk analysis can assist in accept or reject decisions and project design, and subsequently in the development of risk management strategies. Where a project involves contracting parties, risk analysis can help to determine the appropriate allocation of project risks.

In a more recent article, (Ward and Chapman, 1995) highlighted the shortcomings in the project management process as major project risks and placed them in the project lifecycle. The project lifecycle is described in terms of four phases; conceptualization, planning, execution and termination.

During the period between 1991-1997 there has been a sharp increase in survey-based opinion research aimed at investigating the risk perceptions and risk management practices of construction clients, professional consultants and contractors (Edwards and Bowen, 1998).

(Akintola and MacLeod, 1997) performed risk analysis and management in construction based on a questionnaire survey of general contractors.

They concluded that risk management is essential to construction activities for minimizing losses and enhancing profitability. Construction risk is generally perceived as events that influence project objectives of cost, time and quality. Formal risk analysis and management techniques are rarely used due to a lack of knowledge and doubts on the suitability of these techniques for construction industry activities.

(Uher and Toakley, 1999) reviewed risk management in the conceptual phase of a project with a study into the use of risk management in the conceptual phase of the construction project development cycle in the Australian construction industry. The study consisted of a literature review, a survey to examine skill levels and attributes of key players to risk management, and their attitude to change. It was found that while most respondents were familiar with risk management, its application in the conceptual phase was relatively low, even though individuals were willing to embrace change.

Effective risk management was explained as a central function in the successful planning and execution of projects (De Zoysa and Russell, 2003). They mentioned how current knowledge-based approaches for

risk management can be improved upon so that they are more responsive to the attributes of a project and the needs of system users.

C) Project management training:

Many research and studies are performed regarding the importance of project management in organizations. Selected examples are provided here:

(Loo, 1986) explained that project management is becoming more widely used in organizations, and so project-management training is also attracting more interest. The study described in the paper surveyed 500 Canadian organizations with at least 500 employees. Findings from the 120 responding organizations revealed that only 41 of them offered project-management training. Short courses and in-house training were the most frequently reported training approaches, and few organizations evaluated the effectiveness of such training. The most frequently reported expected benefits of project management training were improved productivity of the work unit, increased job knowledge and skills, and improved communications in the workplace. Overall, findings from the study were similar to those reported from US studies.

(Loo, 2002) examined another study for the best practices in a heterogeneous sample of 34 Canadian organizations having professional project managers. The study also examined barriers to best practices and the organizational context in terms of leadership styles and organizational culture. Like other studies, these results revealed a mix of technical and people-oriented best practices and areas for improvement.

(Ayaz, 1996) mentioned professional project management aims for continuous improvement with every project. This paper presents learning as the key strategic variable for project management. Looking at project management from a learning perspective will develop reflective practices to improve the ability to generate knowledge, make it explicit and capable of being shared within the organization as new projects are undertaken. The project network structure enables effective learning with project management because it enhances knowledge creation and improves the quality of information transfer within and between projects. Thus, it provides the organization with dual benefits: short-term achievement and building learning capacity for long-term capability.

3) Case studies

One interesting case study in this field is summarized here with its conclusions for typical work which has been performed in this area:

Project management approach for small capital projects (Source, www.pmi.org):

Worldwide petroleum and chemical industry spends billions of dollars each year to upkeep the existing manufacturing facilities. With the exception of routine maintenance tasks, all other retrofit and de-bottlenecking efforts are best executed as small capital projects. In this research, a small project is defined as a capital project with total installed cost of $1.0 million or less. A program is considered consisting of hundreds of small capital projects in a large chemical company with multiple operating units or business lines, and hence many internal customers. The challenge was to ensure individual satisfaction of each customer by delivering superior value in terms of cost, schedule, and quality for each and every project. The challenge has been met considering the following key attributes of the project management system:

- Alignment of program objectives with the requirements of each individual project and customer.
- Setting fair expectations about cost and schedule.
- Utilization of contractor resources through alliance or continuous service agreements.
- Integration of work processes between owner and contractor.
- Building an Intranet web system that links owner and contractor, facilitates resource planning, and improves timeliness of projects. The presentation will include demonstration of a prototype system.
- Building a knowledge base of the owner's existing plant and machinery, more specifically a customized design criteria for each operating unit.
- Metrics and continuous improvement. It is included a new graphical presentation of customer satisfaction metric.

There are other case studies that currently exist that contribute to small projects, which allow project managers to hone their skills. The *Benefits of Small Projects Team Initiative, SPTI* (www.asce.org), was developed and implemented by the Seattle District of the U.S. Army Corps of Engineers, and was intended to lower the design costs on construction

projects where the design scope is simple and/or the administrative and construction processes are somewhat routine.

Another case study available to current project managers is the *Budget and Schedule Success for Small Capital-Facility Projects* (www.asce.org). Its focus was on budget and schedule success in small projects and in the process highlighted the fact that the project management environment of small capital projects is unique in many ways from that of larger projects.

The *Pre-Project Planning, Beginning a Project the Right Way* (www.construction-institute.org) case study also had as its focus resource utilization.

The other two case studies available to project managers focused on the implementation of projects and efficient use of resources. The *Design and Build Project Success Factors, Multivariate Analysis* (www.asce.org) identified a set of project success factors for design and building (D&B) projects, and examined the relative importance of these factors on project outcome. *Summary of a case study issues in an oil and gas organization*, on the other hand, reviewed a small project completed

according to the participating oil and gas company's existing project management system, and highlighted some of the typical problems and issues faced by project managers implementing a small project.

While these case studies and methods of project implementation have become ready tools for project managers, they fail to acknowledge several areas specific to the oil and gas industry projects. Time management, cost management, scope management, and quality management are the main necessary parameters for reviewing and analyzing the extent of success of the project and related project planning and project control issues in these concepts are highlighted. Some of the problems and issues are highlighted as follows:

- Lack of clear project goals definitions.
- Lack of a definitive statement of the project scope of work.
- Lack of clear definition of major milestone dates.
- Lack of parallel tasks or sequenced tasks definition.
- Incorrect preliminary project cost and time estimation.
- Lack of identification project resources availability.
- Lack of communication between team members and project manager.
- Lack of a consistent project change management.

- Lack of periodic reviews of the project work.

2.4 Discussion and conclusions

An overall review of previous works and research shows that most of the efforts made in project management system improvement and development are focused mainly on some specific areas and topics. In the respective studies performed, researchers have tried to explain some of the weak points inherent in the existing systems or contribute some new ideas or methods. As the area is very wide and fairly new, much can be done to improve the methods and applications that currently exist. Some theoretical management materials can be applied, tolerated, and improved based on the type of industry and project, which can help organizations and companies to follow pre-approved methods, frameworks, and models.

The reviewed papers and existing project management systems show that there are no specific methods or frameworks for a small project completion. There are some primary reasons for this lack of a specific method or comprehensive framework. The top five are as follows:

- Small projects can technically be quite diverse in nature, which means many technical and business issues are involved and each one might be

different with the other one. So no one to this point has attempted to design and provide a complete sequenced framework to manage various kinds of small projects. On the other hand, the diversity of small projects from the technical point of view and the nature of their differences make these projects different to mid-size or large projects. Small projects are different from each other as they might be a part of a future large project in a company or an activity to open further concerns for continuation or taking decisions. In some cases they are executed as a pilot plant of a larger project, which may be considered in the future as a real project, if the technical results and performance of the small size is acceptable. Besides this, most of the upgrading and repair or maintenance activities are considered as a small project to bring the system back to work and make it operational or profitable with minor assumed changes and modifications.

- As each small project is unique and may be a once-for-all event, there were no attempts to provide a general framework that can cover all aspects of the projects.
- It may be different organizations' point of view that never led to creating or using a specific framework or applying a recommended model in order to handle their small projects.

- The reason for not establishing such a system may also be related to the size of the projects. Sometimes companies are so focused on large projects and joint-venture applications that they do not feel the lack of an organized system for completing their small projects including new projects, upgrading sections of existing plants or some modification and maintenance activities.
- Some companies look at a small project as an activity that needs to be completed, regardless of a specific time frame or limited budget. As long as a project is completed within a certain quality range and the scope of the project is covered, the project completion is deemed successful and adequate.

Various research and available project management systems explained some major issues or items for the successful completion of a project without using a comprehensive model. These research and studies outline some effective issues to be considered or the items to be avoided for a successful project, but again a framework or model is missing. Existing project management systems such as PMI and SMART are very general and typically considered for larger-scale projects. They focus on some major parameters of the project management or some of the concepts to complete a project successfully. This

means that methods or systems are required to compile all the recommended ideas and improvements in order to make these efforts more applicable.

CHAPTER 3: ESSENTIAL PROJECT MANAGEMENT CONCEPTS

3.1 Introduction

Project management, in general, involves many concepts. For example, Project Management Institute (PMI) has explained and classified them into nine different areas including: project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management, and project procurement management. However, in this chapter, four essential project management concepts, including time management, cost management, scope management, and quality management are explained. These concepts are the main necessary parameters for reviewing and analyzing the extent of success of the project and related project planning and project control issues in these concepts are highlighted. In the "Gorgan Method" framework and its related monitoring and reviewing system, the "Diamond Method", the previously mentioned four areas are covered.

The potential problems and concerns related to managing projects in the oil and gas industry are highlighted in this chapter. A brief review of the missing items in current project management systems are also discussed.

3.2 Scope management

"Project scope management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully" (Duncan, 1996). It includes initiation, scope planning, scope definition, scope verification and scope change control.

Furthermore, scope management generally involves two different phases which are: scope management during the planning phases and scope management during the implementation phases.

Scope planning is the process of developing a written scope statement as the basis for future project decisions including, in particular, the criteria used to determine if the project or phase has been completed successfully (Ruwanpura, 2001). It includes various activities including:

-What must be done?

-How should it be done?

-Who will do it?

-By when it must be done?

-How much will it cost?

-How good does it have to be?

The project baseline plan is to be updated and reviewed for all of the scope changes and their potential effects on the project cost and project schedule.

Scoping the project is the first step once the project has been assigned. It is important and essential for various reasons, including:

- Laying the foundation for all the work to be completed at this point.
- Defining and confirming overall objective and outcomes.
- Setting objectives including collecting facts, information and opinions.
- Making assumptions.
- Deciding and defining items to be included and excluded.

Setting project objectives includes:

- Thinking about the project's intended outcomes.
- What will the project look like when it's done well?
- Decide and define what is to be achieved within a specified time period.

Scope definition involves subdividing the major deliverables into small, more manageable components in order to:

- Improve the accuracy of cost, time, and resources estimates.
- Define a baseline for performance measurement and control.
- Facilitate clear responsibility assignments (Ruwanpura, 2001).

3.3 Cost management

"Project cost management includes the processes required to ensure that the project is completed within the approved budget" (Duncan, 1996). It is a combination of the following items with a focus on resource planning, cost estimating, cost budgeting, and cost control:

- Estimating, the preparation and development, in a financial sense, of budgetary quotes and formal proposals.
- Budgeting, the process of translating approved resource requirements into time-phased financial requirements.
- Cash flow forecasting, predicting the cash flow of the system. (Cash flow is defined as funds gained by owned works, or the net profit/loss plus depreciation of property, plant, and equipment and negative adjustments of financial investments both effecting profit/loss, reevaluation of property, plant, and equipment and of financial investments, both affecting profit and loss.)
- Commitment management, management of the binding financial obligation, in the form of a purchase order or, as used in the military service, the amount administratively reserved for future obligations against available funds based upon firm requisitions.

- Expenditure management, managing or using up of money or time for goods or services.
- Monitoring and reporting, the observation, analyzing, and reporting of the project performance and comparison to the established and planned systems.
- Management action, the decision taken to the management team or the project manger of the project especially during the time that the project has some technical or financial issues (Cleland and Kerzner, 1985).

Project cost management and related planning and control issues are important activities within the project life cycle. The estimated cost versus the real cost of the project to be reviewed, and all of the cost adder items of the project need to be placed on time to keep the cost management system updated. To establish a better cost management system in a project the following questions must be answered:

- Is there funding up front, is it "pay as you go" or cash on delivery of the system or product change? (How is cash flow affected?)
- What will it cost?
- What will it save in the long term?
- Are "guesstimates" acceptable for some decisions?
- What detail of record keeping is required to reclaim costs?

- Is there discount for bulk material? What about the discount to purchase the spare parts of equipment for the next three or five years?
- Are there any restrictions on the funds allocated? (Ruwanpura, 2001).

3.4 Time management

"Project time management includes the processes required to ensure timely completion of the project" (Duncan, 1996). Time management involves planning and scheduling, monitoring, evaluating, reporting, management control, manpower management, and similar issues in every project. It includes the processes and activities that ensure timely completion of the project. Definition of the project sequences and activities, duration estimates, and related schedule development and control are the main considerations of time management.

To establish a better time management system in a project the following questions must be answered:

- How much time is available?
- How much time does each key activity need?
- Will a change make a difference to the speed of information delivery or response time to the customer?

- Within what degree of accuracy should completion of the project take place? Are we talking days, hours or minutes?
- Does any stage or activity of the project have a particular deadline or restriction on time?
- How much notice do contractors or suppliers need?
- What activities can take place in parallel, rather than in series?

The schedule of the project needs to be updated in different stages to incorporate the changes on the project as well as potential delays of a specific section of the project, which has been affected due other changes and revisions (Ruwanpura, 2001).

3.5 Quality management

"Quality management includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of:

Quality planning - Identifying which quality standards are relevant to the project and determining how to satisfy them.

Quality assurance (QA) - Evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

Quality control (QC) - Monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance" (Duncan, 1996).

The QA plan defines how the project team ensures that quality standards are properly and completely applied during the execution of the project. The QC plan, on the other hand, explains the actions and activities that are aimed at implementing the QA plan and are carried out by all the project team members. Both of these plans are established and carried out by QA/QC specialist who provides essential services during the manufacturing process, inspections for required tests, and the final inspection for release of the package.

The QA/QC specialist requires the following information to establish a better quality system in a project:

- What are the expressed outcomes to be measured?
- Who is measuring, and do they know what they are measuring?
- Who is responsible for quality?

- When will the quality be checked? At the input stage? Ongoing? When is the project finished?
- Is the project expecting "zero defects"? What tolerance levels are acceptable?
- What is the procedure when quality is below acceptable levels?
- What steps or procedures could be put in place to ensure quality at every stage?
- Is functionality more important than cosmetics?

The quality plan of the project considers all of the above mentioned issues. It has to be planned as per previous completed projects and the suppliers' capabilities and documented results (Ruwanpura, 2001).

3.6 Potential problems in the current project management systems

In general, all existing project management systems and methods have some strengths and weaknesses. As new project management research is carried out and new knowledge and experience is obtained, these methods and strategies are improving. There is no perfect or standard method to cover all projects nor is there one that project managers can rely on for managing their projects. One of the reasons may be that each of the existing methods are suitable for a specific kind of job, specific area or culture, and are specific to organization

policies and preferences. Those organizations that have some systems to manage their projects are satisfied with their existing models and in most cases they do not feel their systems are imperfect. Various references including case studies and their current issues and concerns are mentioned in Chapter 2.

Planning and monitoring activities as a part of the management system of the projects are a must, but not enough. There should be an appropriate level of control on the project activities. So that the required actions can be implemented in advance or to resolve the issues when they arise to improve the management process. A lack of sequential framework for managing small projects in order to perform a perfect management system cannot be considered a negligible issue. Controlling a project along with reviewing and monitoring the project in a proper way and applying an adequate framework will be beneficial to the companies for their future projects.

Recently, many organizations, based on their size and type of projects, have tried to establish some methods, models and frameworks, instructions and manuals, and some training for managing their projects and improving their systems. But, there is still a lack of a suitable framework for managing the projects in general, for use in the oil and gas industry.

Part of the difficulty in developing a generalized method lies in the vast potential and actual problems faced in the duration of these projects. Typical problems and concerns in the existing management systems and models fall within the categories of project scope management, cost management, time management, and quality management. These are outlined below:

A) Problems regarding scope management of the projects:

- Project goals are not completely understood. Also there is no documentation of project definitions and strategies before proceeding on the project.
- There is a lack of a definitive statement of the project scope of work.
- There is a lack of definition of the project objectives.
- There is a lack of identification of the substitute technical options and methods.
- There is a lack of required paper work and project documentation coordination with the owner for scope changes.
- There is a lack of incorporation of operational performance requirements in the scope of the project from early stages of the project.
- There is a lack of incorporation of specific quality standards of the project to the scope of the project.
- There is no system setup for periodic reviews of the project work.

- The procedures to control and input the scope changes to the project are mostly weak.
- The primary data is not sufficient.
- The construction plan is not scheduled effectively.
- The construction plan is scheduled without any comments or input from those involved in the project.
- The construction plan is not followed constantly and hence some activities are missed during construction.

B) Problems related to cost management of the projects:

- There are some errors in preliminary estimation.
- Design information at the time of estimation is incomplete.
- There are unforeseen time delays in the project, which has increased the total cost of the project.
- There are some changes in the project scope of work, and the system is not capable of incorporating the time and cost changes into the project.
- There are some unanticipated contract changes, and the system is unable to incorporate them into the project properly.
- Project estimation is not based on the historical data and previous information obtained from different disciplines.
- The time spent on estimation is inadequate.

- The preliminary budget cost for the project was not accurate.
- The staffing requirement is not correct.
- Because of the lack of the missing items, some parts of the project need to be updated and some sections rebuilt which puts extra cost on the project.

C) Problems related to time management of the projects:

- The original project time schedule is defined optimistically.
- The project resources availability is not identified completely.
- The time estimate for each individual activity is not assigned correctly.
- The communication between planning and scheduling is not realized effectively.
- Project monitoring is not performed continuously and some issues that arose later have affected the total time of the project.
- The plan has a lot of tasks to be completed in a very limited time.
- The major milestone dates are not clear.
- Changes are not reported properly which creates problems in later stages.
- Milestones of the project are missed and hence, there is no push to get every section completed on time for the next step.

- There are no meetings, and communication is weak between team members of the construction team creating delays in the works to be done.

D) Problems related to quality management of the projects:

- The project task and subtasks are not defined properly. The project has to focus on a perfect and complete definition of the desired tasks in the project to manage them properly.
- The parallel or sequenced tasks are not clear in the project plan.
- The project subtasks are defined, but some sequence issues have arisen. These sequence issues can stop the project if they are not properly resolved on time.
- Incorporation of specific quality standards to the project is not performed.
- The owner has not defined the required paper work and project documentation properly.
- Team members are not on the same view track, and do not share the same target.
- The scheduler performs planning and scheduling without any help or input from the project manager.

- Existing problems and technical issues of the pre-commissioning stage are not resolved completely, and so appear in the final commissioning stage.
- The initial quality and quantity information is not gathered correctly and completely such as:
    - How much can be produced through the project without sacrificing quality for quantity?
    - At what level of output do "economies of scale" come into effect?
    - How many people are required to complete the job?
    - For how long will the project need them?
    - How much scope is there for "waste" or "trial and error?"
    - What's the probability the project will require back up materials?
    - Can the project deal with the demand, usage, etc.?

3.6.1 Potential problems applying project management software

Some of the companies are applying different advanced project management software (specially project planning and project control software) to improve their project management methods and to overcome their existing weakness.

There are different project management software packages such as Microsoft Project, CA-Super Project, Project Scheduler, Sure Track Project Manager, Time

Line, and High-End Project Management. These software packages are user-friendly and have an easy-to-use graphical user interface (GUI), which mean they can be used for planning and scheduling activities, establishing tasks, viewing the relationship between various tasks, managing resources, monitoring the progress of the project and much more.

These software packages complement project management by allowing easy outputs. Although there are some benefits and advantages in using project management software, there are some concerns and possible problems that project managers should be aware of such as:

- Project management software may create some distraction for the project managers, as they might need to spend a lot of time on the software to get familiarized with it and its features.

- Over-reliability on the system and the software is another potential problem. A false sense of security may creep in. Reasons including:

    A) Having good software may lead project managers to believe they can perform beyond their capacity and accomplish more than is actually feasible.

B) Project managers may think that if there was a problem in the project or if something went wrong, the software would figure out the problem for them and they could get back on track.

C) If the software is not used properly, it might report false information and project managers may feel they have the project under control when in actuality they do not.

In general, it is important to realize that project management software is only a tool to help managers complete their projects more effectively and efficiently, and that the software by itself cannot manage the project. Project managers should manage the project based on their past experiences and other resources such as people.

3.7 What items missed in current projects' execution?

As explained earlier, most organizations have made some efforts to establish management systems and procedures for the execution of projects of any size. Even if their current management system covers various kinds of work through advanced planning and forecasting methods to overcome any problems, there is a lack of an applied method or a sequenced framework and procedure for their projects. On the other hand, their current project management system, applied materials and experiences are sufficient for the execution of the

projects, but may not guarantee completion of the work within a specified time frame and a predetermined budget. There are some general models and systems, as explained in chapter 2, such as PMI, SMART, and other organizations established methods, but there is a need for a method and related guidelines to explain the project execution strategy in different phases for successful completion of the project. Also, there is a need for an ensured system, which can halt the project if there are any cost or time over-runs.

Projects are successful as long as they are within a limited and approved time and cost window, and the required scope and quality is covered. If a company's procedures or applied systems are not designed to factor in any undesirable changes and their effects on the project, the company will not be very successful in its work.

In addition to the above-mentioned issues, the following items need to be added to the company's project management methods and systems:

- Different levels or phases in the system with the related activities for that specific level so that project activities/stages can be summarized for each related level of work.

- The direction and sequence of the various activities to be performed in each level. This includes all the required steps for that particular level of the project.

- Categorizing the project in different technical phases from the basic or preliminary activities to the detailed and final completion. This will help save time and money, as well as discontinue the project if required, without extra expenditures.

- A gate or project review and consideration in each level. This is an advantage to the company and the project manager for reviewing the work that has been performed in the project until that point and review the next level expectations.

- Handling the project step by step as per a framework. This helps the project manager and the other team members concentrate better on the work to be completed. On the other hand, it is obvious that the previous levels have already been covered and completed in each specific step.

- Splitting the project into different milestones on the related phases and levels so that the volume of the work to be performed is similar during the project duration.

3.8 Conclusions

Project management, in general, has some issues and concerns. The main potential problems were discussed and explained in this chapter. With all of the potential and actual setbacks that may occur in a project, the use of a standard method for implementing small projects has become necessary. Many organizations utilize such methods for large projects due to the sheer size and vastness. However, smaller projects are more manageable and are implemented by companies of various sizes and resources. Projects are implemented using various methods, which may or may not be the most effective means for that company. Moreover, any one of or combination of time management, cost management, scope management, and quality management may be missed or not handled as effectively as is necessary. There is a lack of a general method and framework to manage projects related to the oil and gas industry, focusing on small size projects. This method should cover all management requirements and overcome the potential issues that exist in other methods and systems.

CHAPTER 4: CONCEPTUAL MODEL OF THE "GORGAN METHOD" FOR MANAGING SMALL PROJECTS

4.1 Introduction

As explained in previous chapters, most of the current project management applications, procedures, frameworks, and methods have some limitations and issues, and there is a lack of a comprehensive model to manage small projects. The typical problems and issues are encountered in different sections of a project including scope, time, cost, and quality. Potential problems are to be considered in all of the sections of the project to prevent them in advance, and the system to be improved to monitor and report them. Some of the major typical problems are project goals definitions, project scope of work, major milestone dates, parallel tasks or sequenced tasks definition, and periodic reviews of the project work.

Establishing an efficient project management framework is important in order to mange the entire project step by step, and to complete the work. Such a system and its related framework can handle various activities to final completion of a project. As mentioned before, the current project management systems and models, are not suitable for managing small projects since they focus mostly on a higher level of management on larger projects or specific problems and solutions.

The "Gorgan Method" is a powerful framework to manage small projects. Different organizations in the oil and gas industry can use this model to handle their small projects, especially if they are also focused on large projects. They may emphasize high-level management style, and do not follow a step-by-step framework, but they can apply the "Gorgan Method" for executing their small projects including new projects, upgrading sections of existing plants or some modification, and maintenance activities. Some companies may look at a small project as an activity that needs to be completed, regardless of a specific time frame or limited budget, so the "Gorgan Method" can provide a comprehensive system that helps companies review their small projects and manage them in an efficient and better way. The "Diamond Method", a part of the "Gorgan Method" framework, is an effective tool to monitor and report the project status or to analyze the project on completion, for future technical and financial references. It is useful to align the four major concepts of the project including scope, cost, time and quality, which have a direct link to the "Gorgan Method".

As most of the effort and work is focused on the first three phases of the project, including preliminary design, detailed design and final design which are critical stages of the project design, therefore many anticipated problems and issues in the construction phase are avoided and controlled and the project is in a good

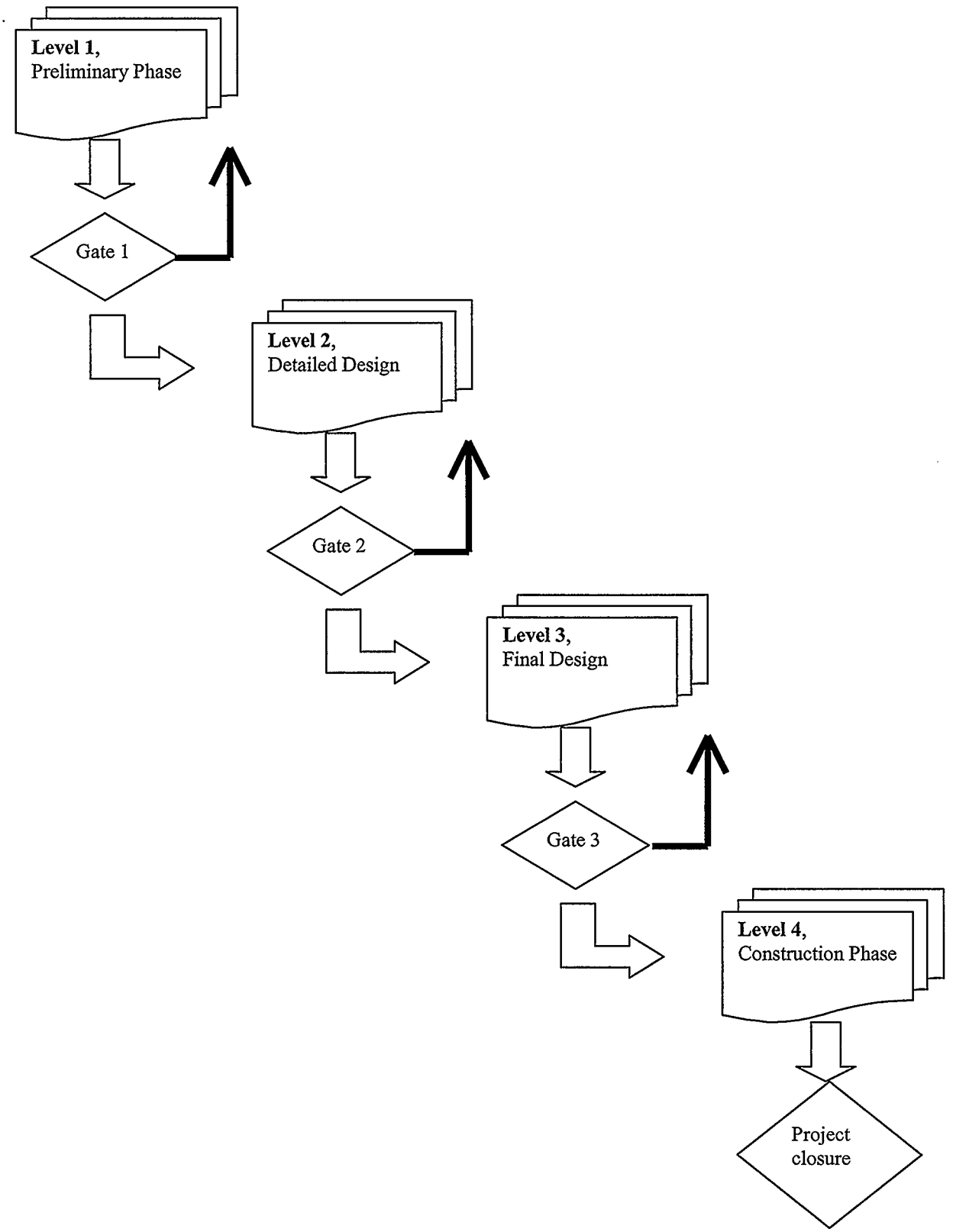
shape. However, the construction phase of the project is important and critical because it is the last and final stage of the project and it has to be covered and completed carefully.

4.2 Conceptual model of "Gorgan Method" Framework

The "Gorgan Method" explains the project sequences from project start to project end. The overall framework of the "Gorgan Method" is shown in figure 4-1. With the "Gorgan Method" a project has sections and deliverables including Gates, Levels (phases) and Category Cost Estimates.

According to this method, in the first phase the project is defined as an opportunity within an organization. The next steps to be performed are based on the framework to complete the project. This framework will lead the project into separate phases or levels. Each phase of the project has different stages which need to be completed to finalize that specific phase. When the cost estimate of the project is made based on the current information of that completed phase and the schedule is made or updated, that phase goes to an entire review and analysis. If that specific phase passed the gate requirements based on the submitted information, the project will be continued and the next phase of the framework will begin.

Fig. 4-1, Overall view of Conceptual Model of "Gorgan Method"



If for any reason during the gate review of the project, it is decided to keep the project in that phase because of some technical or financial issues, all sequenced activities of that phase have to be reviewed one by one to resolve the problem and the gate review will be repeated after collecting all required modifications and approved documents.

At the end of the project, the project will go under post project analysis highlighting all issues and concerns during the project's lifecycle. This will be performed through the collected information in project file and the project periodical reviews through the "Diamond Method."

4.2.1 Concepts and definitions in the "Gorgan Method"

Project General Document (PGD): PGD explains the proposed strategies and key issues to be considered during the project design and implementation as well as general information about the project including project name and document number, plant/area location and business opportunity summary, with cost, and schedule (desired completion date) information. Detailed information and technical issues are covered in other related documents, Project Execution Plan (PEP), and Design Basis Memorandum (DBM).

Project Execution Plan (PEP): PEP reflects planned progression of the project through different milestones from the design stage, to completed construction, and organizing the people and various disciplines involved in the project. To prepare the PEP, some activities need to be completed, such as establishing the project purpose and objectives, providing a brief scope of work, services, schedule, budget, and quality plan, and finally clarifying customer requirements.

Design Basis Memorandum (DBM): DBM is a document which includes the main design contents of the project and also covers the scope of work in general for the project.

Issued For Review (IFR): A term used for reviewing the drawings of the project. This is the first step of issuing the technical drawings of the project for review by all of the disciplines involved.

Issued For Engineering (IFE): A term used for the second set of technical drawings of the project. In this step, the previous comments of the IFR drawings are incorporated, and new comments and issues are raised.

Issued For Approval (IFA): A term used for the approval stage of the project technical drawings. In this stage, all of the technical comments are incorporated

from the IFE stage and drawings are approved from the engineering point of view.

Issued For Construction (IFC): The last step in which drawings are stamped and are shipped to the field for the construction stage.

Management Of Changes (MOC): During different phases, especially the construction phase, some changes might apply. A MOC report and file shall be provided by the appropriate discipline and signed off by the project manager.

Gates: There are three gates in each project, which are explained in detail below. The project should pass all of these gates successfully to be counted as an ongoing project and be approved for construction. These gates are known as "Gate 1," "Gate 2," and "Gate 3."

A project can pass "Gate 1" when the PGD review is completed and the Category "A" Cost Estimate and the schedule must also be accepted. High risks are identified in this step, as safety risks, quality risks, cost risks, schedule risks, and environmental risks. The basic project team is formed in this stage, and the preliminary Process Flow Diagram (PFD) and Piping and Instrumentation Diagrams (P&ID's) are prepared properly.

"Gate 2" will be passed when a detailed design is approved and the Category "B" Cost Estimate and schedule are accepted. There should be any no risks technically or environmentally involved in this stage. The final project team is formed and completed. PFD and P&ID's are issued for engineering in this stage.

"Gate 3" or the last gate, will be passed if the project objectives are completely satisfied from the final design and budget point of view. Final constructability review and DBM have now been completed. Drawings are issued for construction. After this gate, the project will be ready for the construction as per the scheduled plan. (The complete set of activities, which is required for construction phase, is covered in level 4 of the framework.)

Levels: There are four levels in each project, levels 1 through 4. Each level includes specific sections of a project. These levels are described as follows:

"Level 1" or "Preliminary Phase" is the part of the project that begins with project opportunity identification and involves the completion of major activities such as high-level risk assessment, PGD, and PEP.

"Level 2" or "Detailed Design" begins after passing Gate 1 with the formation of the final project team and involves activities such as creating a preliminary DBM and updating it. It also involves IFE drawings, ordering of long lead items for the project, and completion of a detailed risk assessment.

"Level 3" or "Final Design" begins after passing Gate 2 with inter-discipline meeting where IFE drawings are reviewed. This level involves a final constructability review, procurement of materials and services, completion of IFC drawings, the final DBM, and the final construction plan.

"Level 4" or "Construction Phase" begins after passing Gate 3 with the start of construction of the project, and involves major activities such as pre-commissioning, commissioning, start-up, and project close out. As this is the last section of the project and the project will be completed in this level, there is no gate review at the end of this level.

Category Cost Estimate: In each of the above-mentioned levels, except level 4 the construction phase, there will be a cost estimate based on the most recent information. The idea of the Category Cost Estimate is to review the cost of the rest of the project at certain points which are known as Category A, Category B,

and Category C. (As there is no gate review required in the last phase of the project, there will be no Category Cost Estimate for this phase).

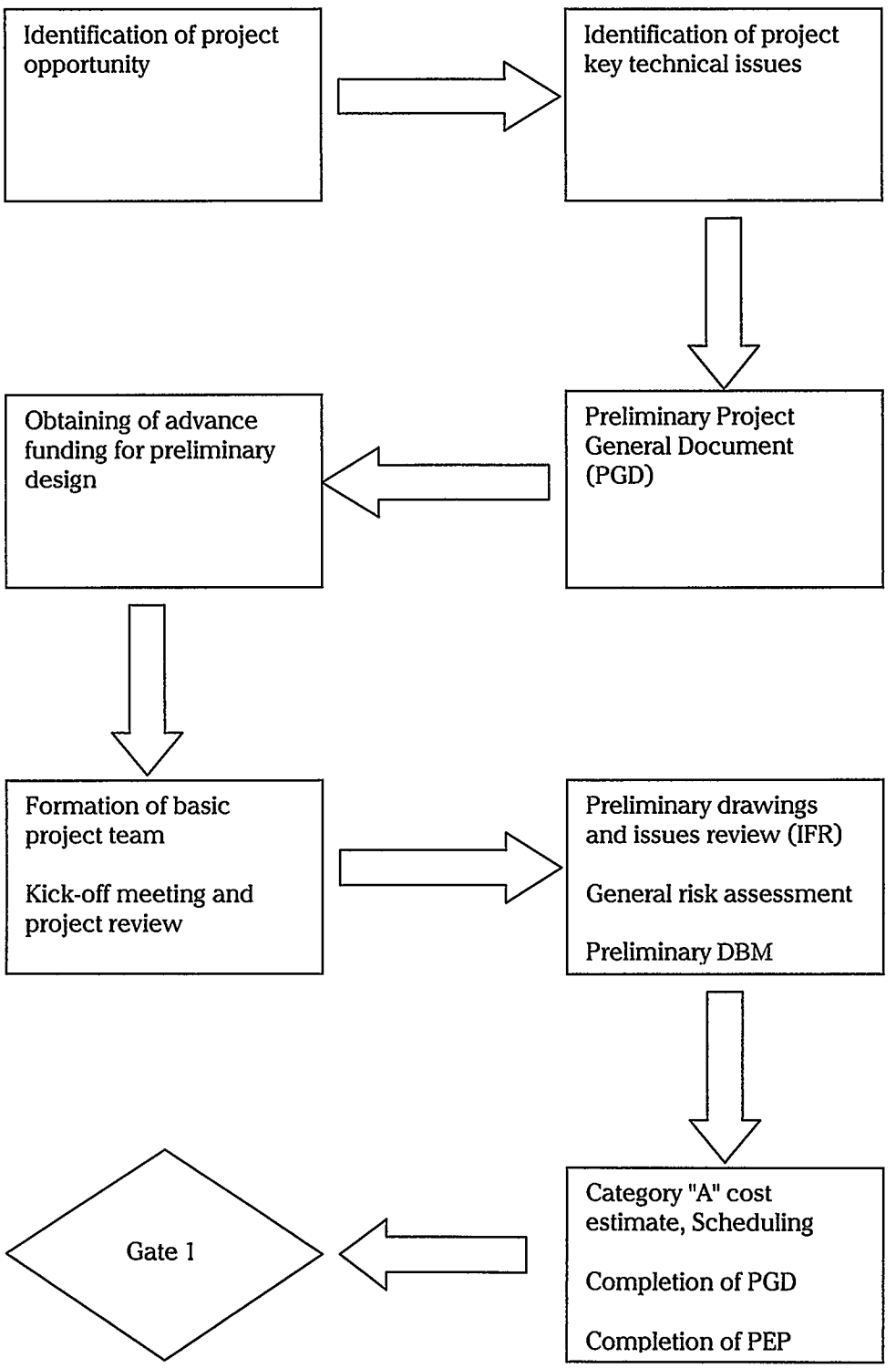
Sometimes projects are technically approved, but financially, there are other priorities that may stop a project from proceeding. A project may also be stopped if the cost estimate is higher than expected. In the "Gorgan Method," the main cost estimate occurs in Level 1 before passing Gate 1. This helps project managers consider whether to proceed or not, and also shows how close it is to the original cost estimate, based on previously completed projects, when the project was identified as a potential project.

The estimates are to cover future extra costs that were not accounted for during progress in a certain phase of the project, or when a part of the design or scope of work was changed slightly.

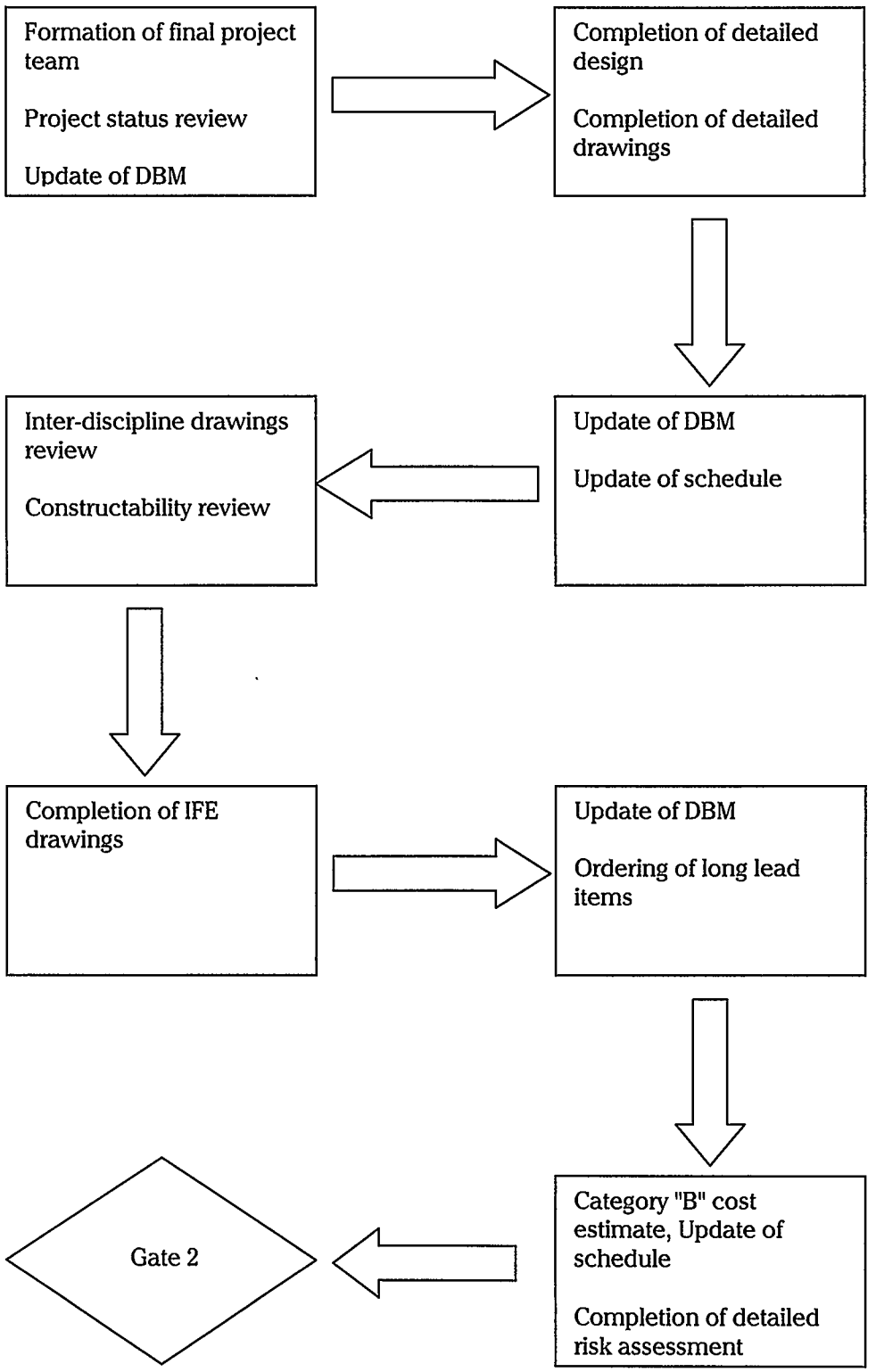
As shown in figure 4-2, the following are the sequences and activities to be performed in order to complete a project:

Fig. 4-2, "Gorgan Method" Framework

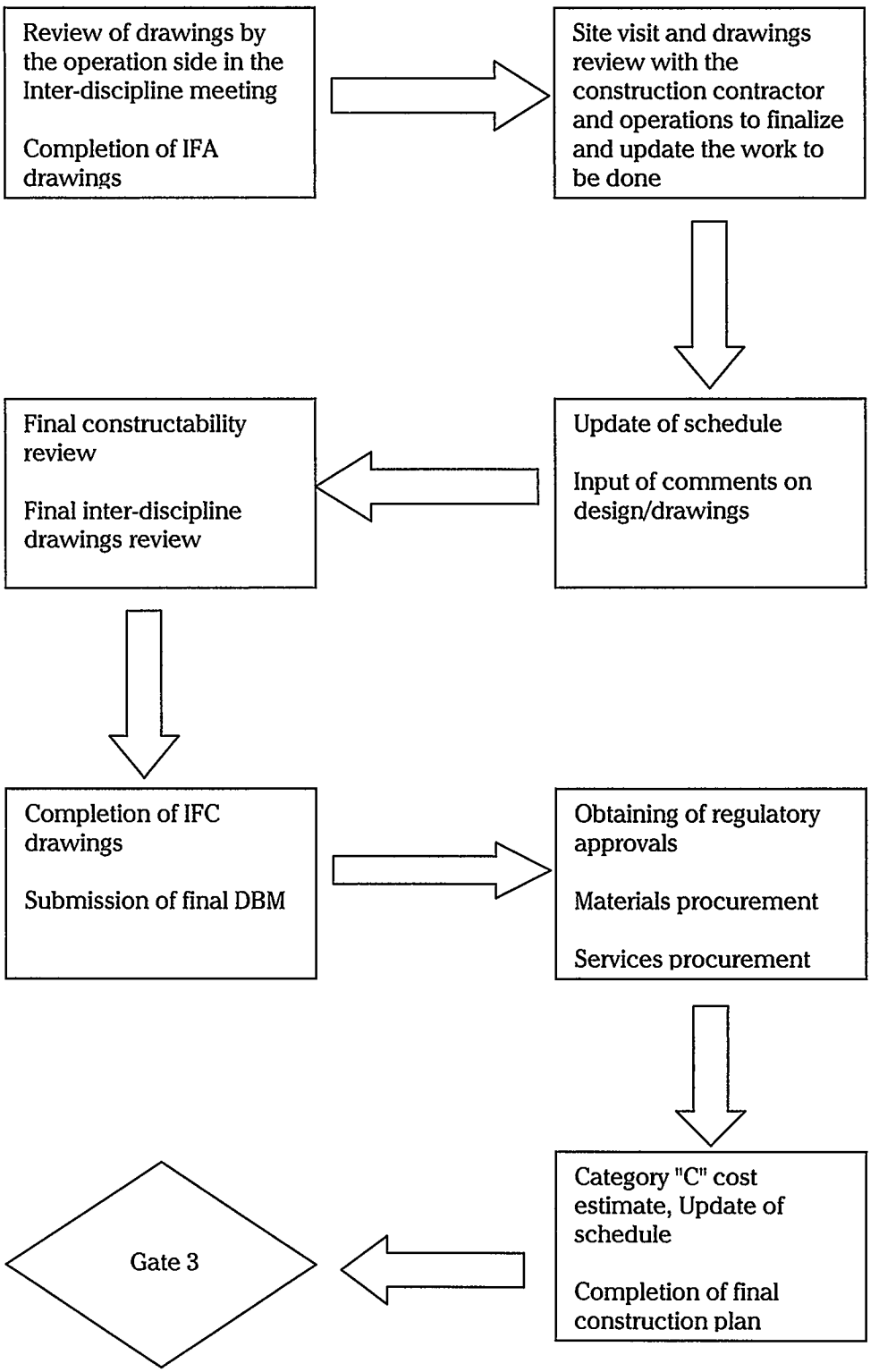
Level 1, Preliminary Phase



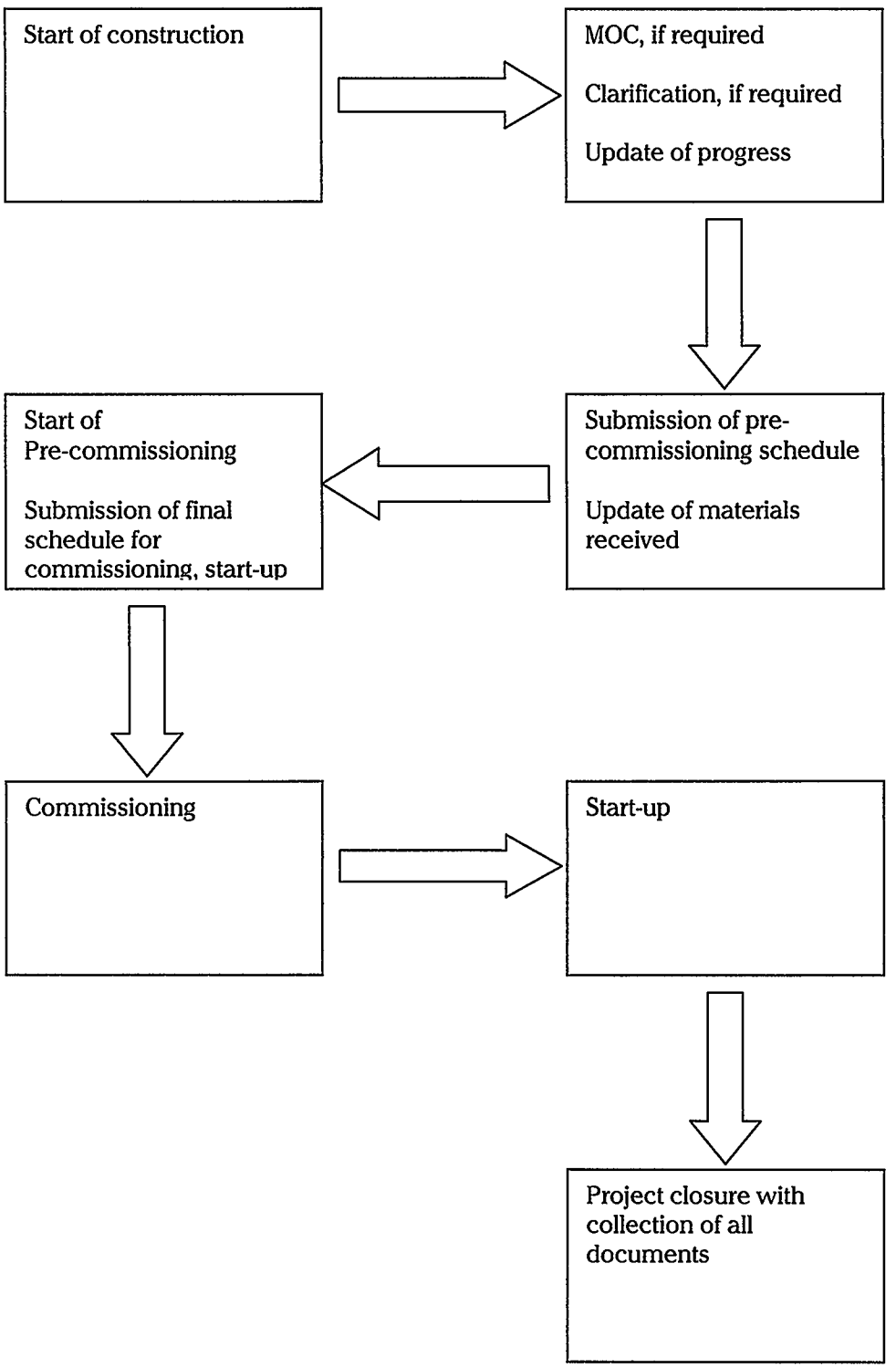
Level 2, Detailed Design



Level 3, Final Design



Level 4, Construction Phase



Level 1: Preliminary Phase

- Identification of project opportunity
- Identification of project key technical issues
- Preliminary PGD
- Kick-off meeting and project review
- Preliminary drawings and issues review (IFR)
- General risk assessment
- Preliminary DBM
- Category "A" cost estimate
- Scheduling
- Completion of PGD
- Completion of PEP
- Passing of Gate 1

Level 2: Detailed Design

- Formation of final project team
- Project status review
- Update of DBM
- Completion of detailed design
- Completion of detailed drawings
- Update of DBM

- Update of schedule
- Inter-discipline drawings review
- Constructability review
- Obtaining of advance funding for preliminary design
- Formation of basic project team
- Completion of IFE drawings
- Update of DBM
- Ordering of long lead items
- Category "B" cost estimate
- Update of schedule
- Completion of detailed risk assessment
- Passing of Gate 2

Level 3: Final Design

- Review of drawings by the operation side in the inter-discipline meeting
- Completion of IFA drawings
- Site visit and drawings review with the construction contractor and operations to finalize and update the work to be done
- Update of schedule
- Input of comments in design/drawings
- Final constructability review

- Final inter-discipline drawings review
- Completion of IFC drawings
- Submission of final DBM
- Obtaining of regulatory approvals
- Materials procurement
- Services procurement
- Category "C" cost estimate
- Update of schedule
- Completion of final construction plan
- Passing of Gate 3

Level 4: Construction Phase

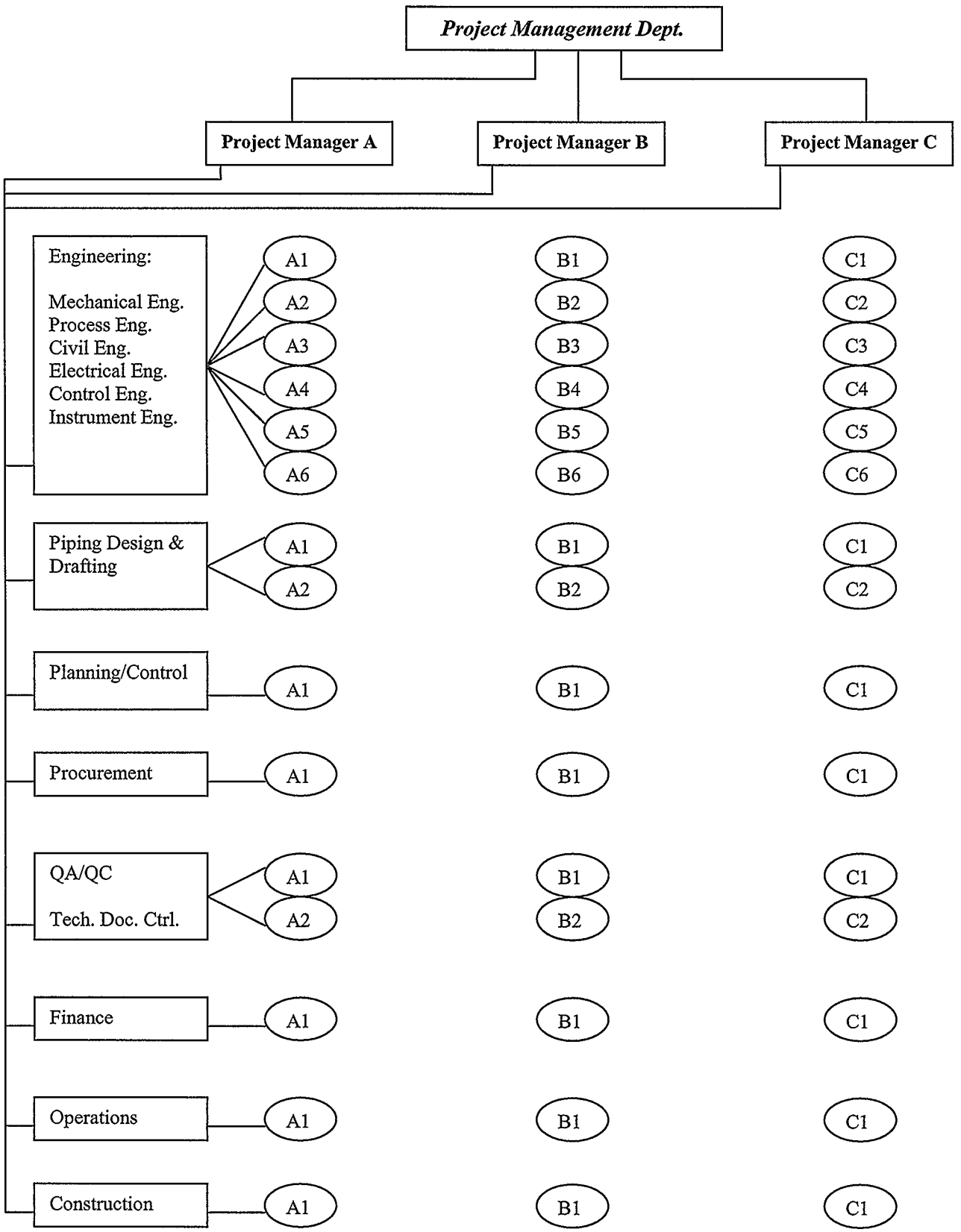
- Start of construction
- MOC (if required)
- Clarifications (if required)
- Update of progress
- Submission of pre-commissioning schedule
- Update of materials received
- Start of pre-commissioning
- Submission of final schedule for commissioning and start-up

- Commissioning
- Start-up
- Project closure with collection of all documents

The recommended project organization chart for the "Gorgan Method" is shown in figure 4-3. According to this chart, all of the project managers are under the general project management department head of the company. Each project manager will work with a complete technical team of various engineers and other technical/administration people. The technical/administration team members might be involved in other projects at the same time; therefore they work with different project managers of various projects. There might be also some projects, which are under management of the same project manager. In all these cases, each team member is responsible for the section(s) he/she is involved to finalize it in the required time frame.

Guidelines for the project kick-off meeting: The project manager is responsible for arranging the project kick-off meeting during the project initiation at an appropriate time, mostly when the project team is formed. All team members involved in the project execution should be present at this meeting.

Fig. 4-3, Recommended Project Organization Chart in "Gorgan Method"



The related documentation must be available prior to the project kick-off meeting for distribution and discussion at the meeting, such as key technical issues, project strategies, and objectives.

(Hamburger, 1992) in a paper under project kick-off, getting the project off on the right foot, explained that every day wasted in getting organized at the beginning of a project is a day that the project manager will wish was available at its conclusion. An effective kick-off, both internally and in the initial client meeting, is needed to get the project started off on the right foot, heading in the right direction, as quickly as possible. During the internal kick-off process the project manager's responsibility is established, the project effort and the project team are organized, the team-building process is started, and the initial project plan is developed.

These subjects may be discussed in the kick-off meeting as well as project activities and duties such as:

- Project description and objectives
- Scope of work
- Review of design input
- Project execution strategy including:

  - Work breakdown
  - Engineering plan
  - Procurement plan
  - Construction plan
- Quality plan
- Safety management
- Schedule and key schedule drivers if any
- Project budget
- Project procedures such as:
  - Project organization
  - Communications
  - Design basis and standards
- Project closeout and termination

Scheduled meetings and reports: The project manager is responsible for establishing both internal meetings with design team members and external meetings with the construction side. Weekly internal meetings are effective and suitable for these kinds of projects. The project manager is also responsible for setting a reporting system which team members shall follow in order to improve the project activities and progress updates.

4.2.2 Verification of "Gorgan Method" framework step by step

The following is a complete list and description of the activities to be followed using the "Gorgan Method" framework step by step at the four different levels to avoid the previous mentioned issues:

Level 1, Preliminary Phase

1) Identification of project opportunity

This activity is the first step of the project, which identifies it as an opportunity to consider the project. In this step, the management teams of the projects and operations discuss the project from a technical and operational point of view. The rough estimated cost for the project usually would be discussed in this step. Minutes of meeting are prepared and submitted for the project file and future reference. (Sometimes the selected project manager for execution of the project is already invited to the meeting to make the next step easier to follow up.)

2) Identification of project key technical issues

The selected project manager reviews the minutes of meeting and highlights the main technical issues of the project. If a site visit is required, the project manger will visit the site for a complete project review. Sometimes he/she may

call a meeting with the site operations' technical team. The results of the site visit and meeting will be saved in the project file.

3) Preliminary PGD

PGD is usually provided by the project manager and it explains proposed strategies and key issues to be considered during project design and implementation as well as the general project information. Detailed information and technical issues are covered in other related documents.

4) Obtaining of advance funding for preliminary design

The project manager sends a complete report of the project issues along with the information and data gathered in order to receive advanced funding to start the project. This report allows him/her to receive preliminary funds and to work on the project with the selected team members for the next steps.

5) Formation of basic project team

The project manager forms the basic project team. The most important technical people to be involved in this stage are usually the process engineer and the mechanical engineer. As this is the preliminary team, usually it consists of the following team members depending on the type of the project:

Mechanical engineer, process engineer, civil engineer, electrical engineer, control engineer, instrument engineer, planning/control specialist and piping design & drafting group. The other people who will support the project manager, mostly in next levels, are the QA/QC specialist and the technical documents control.

6) Kick-off meeting and project review

The project manger calls the kick-off meeting, and it covers the project introduction, project objectives, technical issues, estimated completion time, and other related issues and requirements. The preliminary tasks will be discussed in this meeting, as well as future planned site visits/meetings. (Small projects usually have some pre-planned site visits and weekly or bi-weekly meetings. If there is an issue to be resolved, there are sometimes site visits or meetings to solve the issue. In general, along with the basic and mandatory pre-planned visits and meetings, other unplanned meetings and visits are common in managing the small projects.)

7) Preliminary drawings and issues review (IFR drawings)

After the kick-off meeting, the project team begins working on the project. The preliminary drawings will be completed soon and they include the technical project requirements, as well as the operation's requirements. All team

members will then review this set of drawings. Team members and the project manager will sign off a final copy. (Each team member provides a preliminary cost estimate for the related equipment/accessories in his/her section. Most of the time, the person in charge starts working on the RFQ packages in this level, as the data is required for the next steps of the project. The project planning/control department will use these data for estimating and scheduling.)

8) General risk assessment

The basic or general risk assessment meeting usually considers the project in two different categories, including environmental risks and technical or operational risks. The project manager, risk assessment specialist, technical project team members, and operations' technical members attend the meeting. The project manager runs the meeting along with the risk assessment specialist. All requests from the operation people for the project will be discussed in the meeting. The results of the meeting will be distributed between team members and kept in the project file. (Usually all of the drawings from the IFR step are already submitted to all of the peoples involved in the meeting. Mark-ups and related technical issues that are missed or added to the project are to be incorporated into the drawings after the meeting.)

9) Preliminary DBM

This includes the main design contents of the project and also covers the scope of the work in general. The project manager is responsible for creating this document, which is the most important document of the project. It explains the technical concerns of the project. As this is the preliminary DBM, it has to be updated to correspond with project progress. This document also plays an essential role for the last step of this level, which is passing the gate. If this document is weak or if it has not covered the entire technical requirements of the project, then the project may fail technically. This document will be completed by all of the disciplines, and is to be updated as required, especially in the selected stages shown in the "Gorgan Method" framework.

10) Category "A" cost estimate

This is the first cost estimate of the project, which has to be completed in this stage. All team members have already submitted their estimated cost for the relevant equipment or accessories. The person in charge will incorporate the project manager's concerns to the preliminary stage of the cost. The cost of the entire project in this step will be estimated according to the existing methods in the industry. As the "Gorgan Method" is not recommending any new method for range estimate, the person in charge can use the existing methods and recommended models for the project preliminary cost. (This estimated cost,

along with other technical documents, is a part of the files/documents to be provided to the higher level management for the gate 1 review and evaluation.)

11) Scheduling

The person in charge prepares a detailed schedule of all project activities. He/she reviews it with the project manager and the other team members, if required. The schedule provides the milestones of the project and other required information.

12) Completion of PGD

PGD will be completed in this section according to the latest information available and confirmed.

13) Completion of PEP

This reflects the planned progression of the project through different milestones from the design stage to the completed construction and organizing the people and various disciplines involved in the project. To prepare the PEP, some activities need to be completed such as establishing the project purpose and objectives, providing a brief scope of work, services, schedule, budget, and finally clarifying operations' requirements.

14) Passing of Gate 1

All of the essential documents of the project up until this step are to be reviewed in a gate review meeting. They are provided to the higher level management in advance. On the scheduled day, a complete review of the project files will be performed concentrating on cost, schedule, and risk issues, as well as any related technical concerns. If the project passes this stage, it can go to the next level. If not, some clarification may be required. The management team may decide to stop the project at this level for more clarification or it may decide to completely cancel it. Projects are sometimes put on hold at this stage depending on the budget or if other projects have a higher priority.

Level 2, Detailed Design

1) Formation of final project team

The final project team for the detailed design of the project will be formed in this step. Usually, based on the schedule and size of the project, more piping and drafting people may be involved in the project at this stage.

2) Project status review

The project manager calls for another official meeting in this step to review the project status. He/she explains the steps involved in this level or phase. Good

team work is required as the project is already passed phase 1 and the new technical/operational issues will be involved in the detailed phase of the project. (The project manger calls for a meeting when required, according to the project status. The meetings indicated in the "Gorgan Method" are the mandatory meetings to keep the project on track and to pass or acquire information to and from team members. It is the project manger's job to run a meeting when it is required, planned or unplanned, with all of the team members or some of them.)

3) Update of DBM

The project manager updates the DBM at this step with the current feedbacks and issues.

4) Completion of detailed design

The detailed design of the project is completed in this step.

5) Completion of detailed drawings

Inputs from the design are incorporated in the drawings. They are updated according to the most complete available information.

6) Update of DBM

The project manager updates the DBM at this step, according to the most recent completed information.

7) Update of schedule

The person in charge updates the schedule, incorporating the project manager's comments and requirements.

8) Inter-discipline drawings review

A meeting is held to review the most completed drawings. In this meeting the drawings are reviewed in detail by team members. All of the comments are incorporated into the drawings.

9) Constructability review

Along with the technical drawings review, the constructability is considered as well. Sometimes a portion of a project might be technically acceptable but in terms of constructability issues, it might be impossible or more expensive than assumed. This meeting reviews all of the technical and construction issues.

10) Completion of IFE drawings

The drawings are updated and issued to engineering. In this step, the project is acceptable from the design and construction point of view, but still there might

be some modifications or changes by the operations team or the construction team in the future levels.

11) Update of DBM

The project manger updates the DBM again in this step, incorporating the comments and other technical issues from the IFE drawings stage.

12) Ordering of long lead items

If there are any long lead items, they are ordered in this step. Long lead items are the items that need more time to be provided by the specified vendor and supplier of the project. The project manger, with key technical team members, decides what equipment is to be purchased in this step, according to the project schedule and the delivery time for the related equipment/accessories. (Usually, the related team members during last phase and this phase of the project, work on different options for the specified equipment. The RFQ or Request For Quotation packages are already sent out, and the bid evaluation forms are prepared. The final decision is already made, and it is the time to complete and send the RFP or Request For Purchase package out to the selected vendor.)

13) Category "B" cost estimate

The person in charge provides a cost estimate for the project at this step, according to the available information of the project. This cost estimate, which is called Category "B" cost estimate in the "Gorgan Method," estimates the future costs of the project, based on the most recent information in the detailed phase of the project.

14) Update of schedule

The person in charge updates the schedule incorporating the other team members' comments and the final review by the project manger.

15) Completion of detailed risk assessment

In the second and final risk assessment meeting reviews the same issues are reviewed again to make sure the previous problems are resolved in the detailed phase of the project, and there are no new issues or concerns. The project manager and the risk assessment specialist provide final minutes for this important meeting. A copy is distributed to the team members to incorporate the related issues in their sections.

16) Passing of Gate 2

The project goes through another evaluation and review with the most updated documents available in level 2. The management team reviews the documents

with the project manager, and approves it for the next level if it is acceptable technically and from the cost point of view.

Level 3, Final Design

1) Review of drawings by the operation side in the inter-discipline meeting

The operations team reviews the IFE drawings before they go to the next detailed level. In this meeting, all involved operations team members of the plant review the drawings along with project team members to check the operability issues and technical concerns. Their comments are incorporated in the next set of drawings.

2) Completion of IFA drawings

IFA drawings are those drawings which are submitted for final approval. Once they are approved, the project is complete in terms of final design and from the operational point of view. (The constructability review will be performed in this phase in the following steps.)

3) Site visit and drawings review with the construction contractor and operations to finalize and update the work to be done

In this step the project manager, with the key technical team members, makes a site visit to meet with the construction team and the technical operation members to review the drawings.

4) Update of schedule

The schedule is updated.

5) Input of comments in design/drawings

The comments of operations and construction members are incorporated where applicable.

6) Final constructability review

After these inputs, the drawings are reviewed for the last time, concentrating on the constructability issues.

7) Final inter-discipline drawings review

The final inter-discipline drawings review is performed, and all of the comments from the design team members are incorporated.

8) Completion of IFC drawings

Drawings are issued for the construction in this stage. These are the final drawings of the project. If some changes are required in the future, especially in the construction phase, it has to be done through the MOC system.

9) Submission of final DBM

The project manager completes and submits the final DBM of the project. All key team members update their sections and sign off the DBM.

10) Obtaining of regulatory approvals

If there are any regulatory issues or concerns, they are to be completed by the person in charge.

11) Materials procurement

The remaining materials are procured in this step of the project.

12) Services procurement

If a service is required for the project, it has to be purchased in this step.

13) Category "C" cost estimate

As with the previous two category cost estimates, the new cost estimate is provided by the person in charge, for the remainder of the job, which is mostly the construction phase.

14) Update of schedule

The person in charge updates the schedule, concentrating on the construction phase and related activities of that phase, such as pre-commissioning, commissioning, and start-up.

15) Completion of final construction plan

The construction plan is completed and developed by the scheduler, construction team, and project manger.

16) Passing of Gate 3

This is the final gate to be passed to complete the project from the design point of view. In general, when the project gets to this point, the design part is completed and the construction will be started soon. In some particular cases, if the project missed the original scheduled time to start the construction, this phase may be completed in the next year. For example, the winter window is a limited time for some companies in Canada. The ground is frozen and the construction can be done in that period of time. When spring starts and the

ground is not frozen, there are some muskeg issues which make construction almost impossible. Again, based on the type of project and the location, there is a possibility that the construction will be stopped for another year. For some companies, because of the weather constrains, there might be an overlap between some of the phases of the projects. This means the construction phase might be started when the project is still under final design and review.

Level 4, Construction Phase

1) Start of construction

The design and engineering is completed and drawings are issued for construction. The construction team starts working on the project according to the construction plan.

2) MOC (if required)

In most cases there will be some issues and constrains during the construction. If part of a drawing needs to be updated or changed, it is performed through the MOC system and the project manager's coordination.

3) Clarification (if required)

If some clarification is required, or if some updates are performed, the project manager resolves them through the project team members.

4) Update of progress

The person in charge updates the progress of the construction phase of the project. This is a very critical issue as the future stages are to be incorporated and updated in the progress reports.

5) Submission of pre-commissioning schedule

The construction manager submits the pre-commissioning schedule. This needs the project manager's and scheduler's inputs and comments.

6) Update of materials received

A list of purchased materials of the project, which is received on site, will be submitted by the construction team. This helps the project manger determine the remaining materials, and required follow-ups for the undelivered materials.

7) Start of pre-commissioning

Pre-commissioning is started in this step. Usually, the project manager attends this activity for potential questions or technical issues.

8) Submission of final schedule for commissioning and start-up

According to the results of the pre-commissioning, the construction manager provides the final schedule for commissioning and start-up. It explains the required activities to be done during these stages.

9) Commissioning

Commissioning is performed. If there are any issues, they will be resolved before the next stage.

10) Start-up

Start-up is performed.

11) Project closure with collection of all documents

The project manger collects all of the files of the project from the first phase to the end of the last phase. They include all of the construction files during construction, pre-commissioning, commissioning, and start-up. They are kept in the project file and the electronic files are saved in the project file directory of the system.

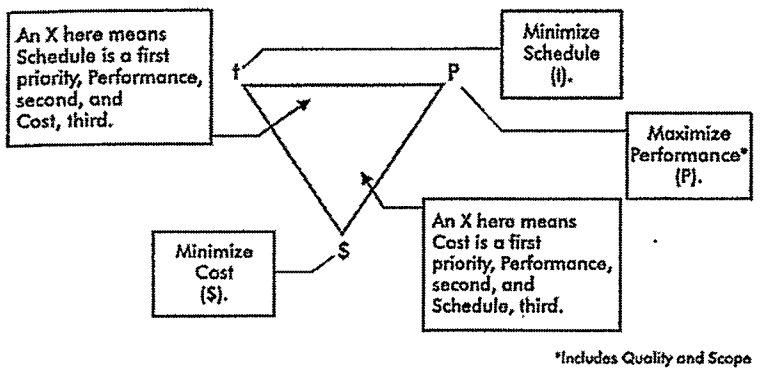
4.3 The "Diamond Method," the monitoring and reviewing tool

In general, for every project the possible shifts in project targets in terms of cost, time, and quality must be considered as well as how and when these shifts in

targets will influence the management of the project and related expectations. The priority triangle, which shows these targets, was originally proposed to help with research on alignment of project management tools, processes, and business drivers. An extended study of over two hundred projects in seven different industries, which is performed by Hartman and his group, showed that not only were the targets misaligned on projects between stakeholders, but they were also in a constant state of flux.

Figure 4-4 shows the priority triangle. "The shift in priorities usually is driven by what is important at the time to a particular stakeholder. What can we do about this? We can't reasonably hope to control the priority shifts that occur. Thus, we need to maintain focus on what we are trying to achieve and manage the different stakeholders' expectations as we work through the project" (Hartman, 1999).

Fig. 4-4, Priority Triangle



The priority triangle is used when the project is focused mostly on one factor as a major issue or main target and the other factors have a lower level of importance. Another study, which was performed by Ruwanpura, considers the project targets versus project success in four areas including cost, quality, safety, and time. Each of four factors has two level of acceptance, which is defined either as the best or average degree of acceptance. They are as below:

1) The cost factor prefers the "cheapest" as a first option and "economical" as a second option.

2) The quality factor prefers the "best" as a first option and "adequate" as a second option.

3) The safety factor prefers the "safest" as a first option and "satisfactory" as a second option.

4) The time factor prefers the "fastest" as a first option and "reasonable" as a second option.

And in the center of these items, the customer satisfaction is considered.

(Wit, 1988) discussed the measurement of project success. It is essential that a distinction is made between project success and the success of the project management effort, bearing in mind that good project management can contribute towards project success but is unlikely to be able to prevent failure.

The most appropriate criteria to measure the success are the project objectives. The degree to which these objectives have been met determines the success or failure of a project. The criteria for success of the project management effort tends to be restricted to cost, time and quality/performance.

(Gardiner, 2000) considered the theoretical effect that each of the project items, including project budget, cash flow, cost control and time schedule, can have on the net present value (NPV) of a project. He proposed that investment appraisal techniques, such as NPV, can and should be used as an ongoing monitor of project health. Finally, the theoretical points are tested on a small sample of project managers. In conclusion, the research indicates that some project managers' claims that they have delivered their project successfully may be false.

The "Diamond Method" is a tool for reviewing and monitoring the small projects executed in the "Gorgan Method" considering four main parameters of the project including scope, cost, time and quality. It can then be used for other project management applications with some possible updates and modifications, where required. The "Diamond Method" explains how these concepts affect a project's success or failure, and how they are connected to the entire system.

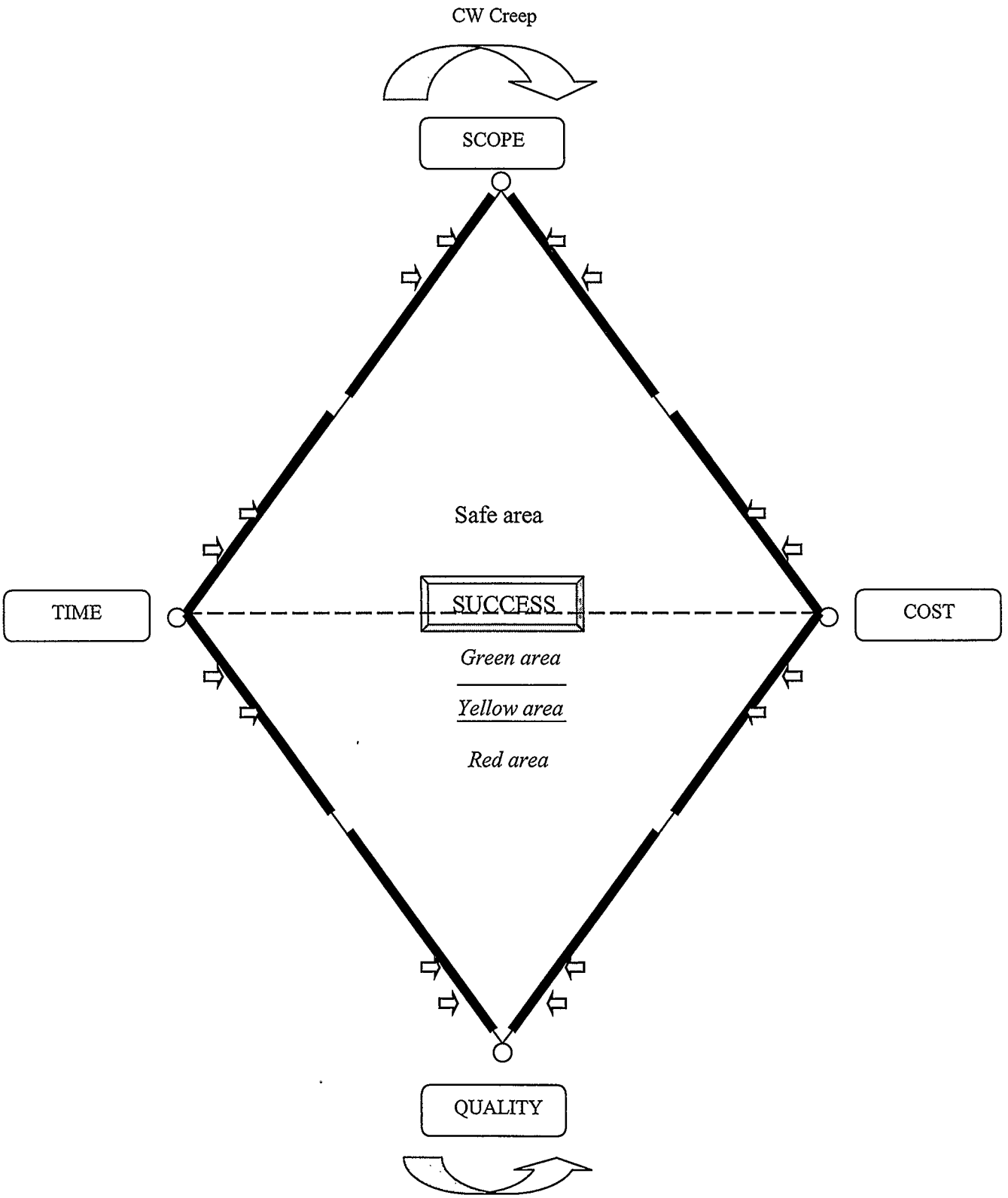
In this method, as it is shown in figure 4-5, the project success is the main task in the middle of the diamond with its predefined area. The other four main factors are in the four corners of the diamond, including scope, cost, time, and quality. In this method, these primary and main factors are also explained in terms of the situation in the diamond and their effects on the project's success.

4.3.1 Components of the "Diamond Method" and their creeps

1) **Scope:** Scope of the project usually changes during different phases of the project. The project is basically planned, based on the early stages of the project and, as it proceeds, some changes will occur. It is usually difficult to avoid these changes and modifications in a project, but the experienced project managers can foresee them in early stages and have the plan more completed and efficient.

Scope creep may happen due to several reasons. Market conditions is one issue, as sometimes for some competitions, the project must be completed earlier than was planned. Another reason is the existing, ongoing projects may affect the current one, and/or there are some potential upcoming projects that affect extra changes on the current project. Sometimes, upcoming projects

Fig. 4-5, "Diamond Method" of project review in "Gorgan Method"

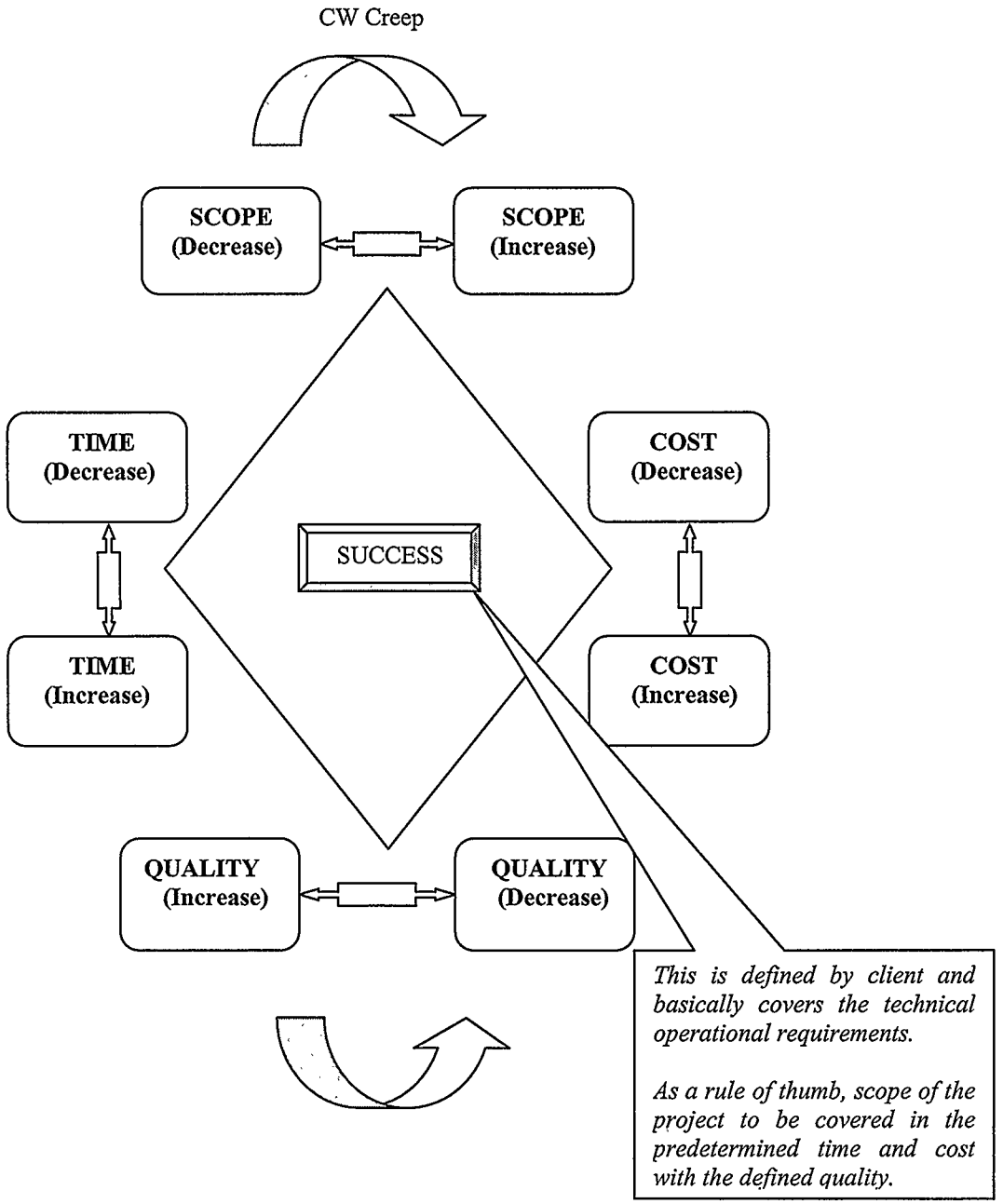


might affect some unpredictable changes in the project itself, or some items, including technical factors, were missed in the original plan. The scope of the project in general will be updated, changed, or increased and decreased, which has a direct effect on time and cost of the project. In The "Diamond Method," scope change in a clock-wise rotation is additional scope of work to the project and vise versa (figure 4-6).

2) **Cost:** Cost is a major consideration through the life cycle of a project. The first consideration usually occurs early in the informal review of the project. This preliminary cost estimation of the project, based on the contents, might be close to the real cost of the project. The project manager usually reviews the project and prepares a proposal including the estimated cost at that time.

Cost creeps may happen for various reasons. One of the factors which increases the total cost of the project is the manpower cost that comes through time overruns. When the duration of the project extends, the first effect is on the people cost. Another factor that causes extra cost is additional equipment and services. This usually comes through scope changes and by adding some sections to the project. The cost of the project may go down when the scope of work is reduced or the pre-estimates in the design stages were considered high.

Fig. 4-6, Creeps in "Diamond Method"



In the "Diamond Method," cost change in a clock-wise rotation means extra cost to the project and vise versa (figure 4-6).

3) **Time:** In general, cost and time usually are trade-offs with one another. Time is a basic factor and an interesting resource for the project. It is not possible to have it as an inventory item and it is consumed whether used or not. The project manager has to use time in the most effective and productive manner. When the project is started, time is the prime resource available to the project manager to keep the project on schedule.

Time creep in the project is either increased or decreased for some major reasons. The main item that typically causes time overruns is imperfect planning of the whole project and lack of experience and expertise. Basically, time has a direct relation with the scope of work. As the scope increases, it will directly affect the time of the project. In the "Diamond Method," time change in a counter-clock-wise rotation means extra time spent on the project and vise versa (figure 4-6).

4) **Quality:** So many items, mainly procurement and construction, affect the quality of the project. Because the project has a quality plan, the project has to be completed with the highest quality standards. In general, this might happen,

but in many projects as high quality brings high total price for the project, the midrange of the quality standards might be selected as long as it is appropriate for the project.

The quality of the project usually decreases in the construction phases of the project if the time is limited and the project has already faced some delays. Cost is the other item that may cause quality decreases. As the project policies might guide the project to a lower total finished cost, this will affect the quality of the equipment and services, and also the quality of the performed job in the construction phase. The quality of the project rarely goes up more than expected, unless there is some basic improvement in the system that keeps the total quality cost in the same predetermined price, but increases the level of quality and productivity. In the "Diamond Method," quality change in a clock-wise rotation means better quality and vise versa (figure 4-6).

5) Boundary of success of the project: The success of the projects is affected by the above-mentioned four factors. In the "Diamond Method," this item will go up from the horizontal axis line as a positive sign if the project success is more than what was expected, and it goes down as a negative sign when it is less than predicted (figure 4-6). The project is successful as long as it

is within the boundary of the company's defined system and the client acceptance.

4.3.2 How does the "Diamond Method" work?

All of the factors of the project shall be kept in equilibrium to complete the project successfully. Figure 4-5 shows a desirable project that is in perfect shape and balance. When the project proceeds, some of the factors might be changed slightly which amount of changes will affect on the project success and the system balance.

When the project success is better than expected and everything is on track or even ahead of schedule, this factor will be in the area called the safe area. There are three areas defined for the project success movements when it is on the decreasing status:

1) The first status or the lowest risk area of the project success is defined as the green area. This area provides hints to the project manager regarding the status of the project in general and indicates that the project is not in the success boundary. The project manager has to review the critical points of the project to determine the weak points for further improvements.

2) The second status or the middle risk area of the project success is defined as the yellow area, under the green area. This is the area which shows that the previous weakness of the project status is not yet completely resolved or some sudden changes happened in this stage, which put the project success in this yellow area. The project manager should take corrective actions to overcome the existing problems and issues and resolve them as soon as possible.
3) The third status or the high risk area of the project success is defined as the red area under the yellow area. This is the most critical status of the project, as the project manager has already lost his or her chance twice and the project is still getting worst. There are some serious problems in the project which have caused the final status of the project to be in the red area.

For all four factors, the related corner of the diamond is defined as a perfect point, which is the original point. The maximum assumed movement of each factor in either an increasing or a decreasing direction is indicated with a V-shaped bold black line. Each factor can be increased or decreased by a maximum of 50% in each direction. The selected points are defined as 10% and 15% changes. These four factors can be divided to two groups as quantitative factors and qualitative factors. Time and cost are quantitative factors and quality

is a qualitative factor. The scope of the project is a combination of both quantitative and qualitative. The project evaluation will then be performed graphically focusing on the changes and movements of the main factors and the final combination which affects the project success status and avoids all subjective assessments by others involved in the project.

4.3.3 Examples of creeps and their affects in "Diamond Method"

For a better explanation of the "Diamond Method," all types of changes on the cost and time of the project are shown in figure 4-7 with the final result on the project success. These changes include either creeps on just one factor in either direction or a combination of changes on both factors. This is the main guide for project evaluation in the "Diamond Method." The changes are considered in different ranges such as "Up to plus or minus 10%", "Between plus or minus 10%-15%", "Above plus 15%", etc. with the defined location of success factor in each situation.

(Aburizk, 2000) and (Ruwanpura, 2003) explained the determination of likelihood of occurrence of impact of risks on the projects with some assumptions in a similar risk management table. There are six categories defined as highly likely, likely, somewhat likely, unlikely, very unlikely, and

extremely unlikely under the descriptor item with the probability percentage number for each one.

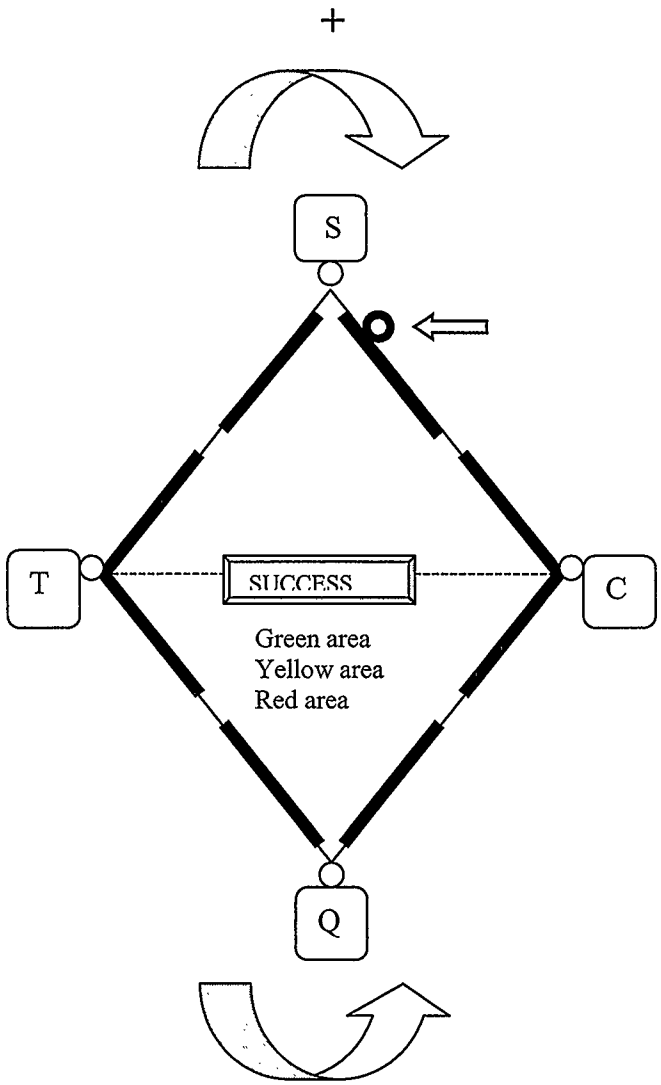
In the "Diamond Method," the quality increase or decrease is considered generally for the final evaluation of the project success status in that particular stage after applying figure 4-7 to the project. If the quality of the project according to the project quality plan is improved by five percent or more, then it will shift the project success status to one step higher than previously considered. For example, if the final result of cost and time changes take the project to the yellow area, then a five percent or higher quality increase will change the yellow area to the green area. If the quality is decreased by five percent or more, then it will take it to the red area in this example.

The scope of the project might be changed too. In "Diamond Method," in every stage of the periodical review of the project, a separate cover page is prepared indicating the most updated scope changes in any direction. This shows how much the scope of the project is changed already. Figure 4-8 shows an example of the status of the project when the scope is increased. In this picture the time and cost creeps are not yet shown, as there will be a second page for the new updated time and cost and the final status of the success factor when time and cost quantities are modified accordingly based on the most updated scope changes.

Fig. 4-7, Changes on Cost and Time and their affect on Success area

Cost changes	*Time changes*	*Location of Success factor*
0	0	Boundary
Up to +10%	0	Green area
0	Up to +10%	Green area
+10% to +15%	0	Yellow area
0	+10% to +15%	Yellow area
Above +15%	0	Red area
0	Above +15%	Red area
Any decrease (–)	0	Safe area
0	Any decrease (–)	Safe area
Up to +10%	Up to +10%	Yellow area
Above +10%	Above +10%	Red area
Above +10%	Up to +10%	Red area
Up to +10%	Above +10%	Red area
Up to –10%	Up to +10%	Boundary
Up to +10%	Up to –10%	Boundary
–10% to –15%	Up to +10%	Safe area
Up to +10%	–10% to –15%	Safe area
Any decrease (–)	Any decrease (–)	Safe area

Fig. 4-8, Scope increase in the "Diamond Method"



4.3.4 Comparison of "Diamond Method" and "Earned Value" method

The "Earned Value" is an integrated planning and control tool and its approach is basically a development of the cost/schedule control system towards full integration of cost and time.

When this is combined with forecasting, the project manager reviews the results. The performance measuring mechanism could be made periodically, for example once a week, to assess progress and cost against the project baseline plan. This method initially was set up to track the progress of cost and time, but in practice is often more appropriate to track progress measured as earned man-hours and time.

This method has it's own terminology with some calculations required to achieve the factors needed for further steps. Then it compares the budgeted cost for work scheduled of the project versus the other two concepts as budgeted cost for work performed and actual cost for work performed rather than traditional methods which review the project cost and project progress separately. The final analysis of the results will be through the numbers or a graph indicating the cost/schedule control system.

In the "Diamond Method," the project will be monitored for two more concepts including scope and quality, whereas in "Earned Value" there are just two concepts, cost and time, which are reviewed either by calculated factors and numbers or by a general graph.

The project success is not included in the "Earned Value" method for a quick review by the project manager. Having the project success situation in the "Diamond Method" helps the project manager about the overall status of the project based on four real factors of cost, time, quality and scope. In other words, each report will be presented graphically with the overall status of the project, which explains at a glance to the corrective actions needed while there is still time for the rest of the project.

4.4 Conclusions

In this chapter the conceptual model of the "Gorgan Method" for executing small projects is explained, along with its reviewing and monitoring tool, the "Diamond Method."

Most organizations may have similar approaches for the execution or completion of their projects, but many may not have their systems set up to halt the project at a certain stage for various reasons. In many cases, they may not

be able to monitor the real status of the project and forecast future upcoming difficulties or potential delays in the project or cost over runs.

As mentioned earlier project management is the art and science of directing and coordinating human and material resources through the life of the project to achieve predetermined objectives. On the other hand project management refers to trying to resolve project problems and offering a better system, based on previously completed projects or experiences. It is beneficial to know every project's failure and success factors so that they can be accounted for during the execution of the project. These factors may differ from one project to another. Most of the missing factors which have not been considered in existing project management methods and systems are incorporated in the "Gorgan Method" to minimize potential problems related to scope, cost, time and quality.

In general, existing systems, frameworks and applications aim for the successful completion of a project and explain to the project manager how the project is to be controlled and completed on time and within the predefined budget. It needs to be mentioned here that a project can be completed successfully by project manager A but fails to complete with project manager B even though they may have access to the same information and facilities in the company.

The "Gorgan Method" is developed in a way that a project can be halted, put on hold, reviewed or changed accordingly, as required. Other potential and typical problems encountered in existing project management systems and models are prevented in this method. The main characteristics of the "Gorgan Method" and its controlling tool, the "Diamond Method," are briefly highlighted as follows:

- Following the same framework for projects enables companies to have a better view of the work to be performed and the estimated time and cost requirements for it.
- Different levels or phases, which include a number of sequenced steps and activities to be completed in that particular phase. This shows the situation of the project and what activity is under completion at the moment or what steps are complete.
- Different gates relate to different levels, so if the project cannot pass the related gate of a level because of technical or financial issues, there will be no extra spending on the project.
- All of the main sections of completing the project are assigned in different levels. This ensures that there will be no missed sections or activities in the future as the project is progresses.

- The main four concepts of the project including scope, cost, time, and quality are considered and reviewed through the "Diamond Method." This shows the project status and evaluates the project at the end.
- Applying the "Diamond Method" as a reviewing and controlling tool for small projects executed through the "Gorgan Method," or with some possible modifications for other systems, can also help the project for priority considerations in terms of time, cost, scope, and quality.

CHAPTER 5: APPLICATIONS OF THE "GORGAN METHOD" IN PROJECT MANAGEMENT

5.1 Introduction

Oil and gas is a very broad industry and is still under development. In most organizations that are involved in this business, there are some small projects under review, design and/or construction. Other industries such as water and wastewater, power plant, mining, building, aerospace, pulp and paper, food, etc. are also under development and construction.

In this chapter, other industries that can apply the conceptual model of the "Gorgan Method" are mentioned, focusing on the oil and gas industry. A real project case study in this field is reviewed, and potential and existing problems regarding project management of this project using the existing method are discussed and the advantages of applying the "Gorgan Method" are highlighted.

5.2 Applications: Where can the "Gorgan Method" be applied?

Besides the oil and gas industry, the "Gorgan Method" can be applied to other industries such as, power plant, water and wastewater, mining, building, road, dam, pulp and paper, and food industry for managing their projects. In the oil and gas industry there are various types of projects, and small projects, based on the size and types of company, are in different cost ranges. Small projects

according to the "Gorgan Method," are defined as under one million dollars. Projects in this huge industry can be categorized as follows:

- New projects, which are under consideration and analysis and/or approved for construction.
- Pilot projects, which are a test and experiment for a future main project. The idea is how practically a project will operate in a smaller size during production phase, and what are the issues to be considered in the real size or commercial scale.
- Upgrading projects related to the existing plants, as they need development, upgrading, modifications, regular maintenance and repairs.

The oil and gas sector consists of many industries that can be classified into three main groups: oil and gas production, oil and gas processing and refining, and petrochemicals. There might be other classifications or sub-classifications in other parts of the world or in operating companies. For example, in Canada, the oil production sector is usually divided into "Heavy Oil" and "Conventional Oil" production. Each of these two production schemes could also be sub-divided into "Onshore" and "Offshore", or "Downstream" and "Upstream" sections.

The conceptual model of the "Gorgan Method", which is designed for the small size projects, can be applied in all of the above-mentioned categories, based on the size of the project. Even large size projects, as long as they are divided into a couple of areas and each area has its own project manager, can apply this method individually for each unit. This model is a very good match for pilot plant projects. It considers all of the details in different levels of the pilot projects, in terms of various technical documents and approved strategies from the early stages. Applying the "Gorgan Method" for the execution of pilot projects ensures there will be no any uncompleted sections in the project, which causes time or cost issues during design or construction of the project. The "Gorgan Method" is a useful application for upgrading projects as it considers all sections of the project and incorporates comments and requirements from the production and operations people for improving the results.

The "Grogan Method" may have some constraints when it is applied to other industries or other types of work. On the other hand, all efforts were made to create and develop this framework to fit in the oil and gas industry based on existing problems or unforeseen issues and it will prevent all of the potential and existing problems which were considered and reviewed in this industry. In other industries, this method is to be evaluated and reconsidered, especially on

the first application based on the prior concerns and issues. For some specific industries which need certain issues with high standard systems such as high-tech industries, applications have to be completely reviewed before applying the "Gorgan Method." More attention maybe required on the quality issues as well as the required scope performance in this type of industry as the time or cost of the project might not be a critical concern.

5.3 Case study

In this section, a project is introduced as a case study, based on the reviews of files. These files are summarized, or mostly deleted for the client's proprietary purposes. These files are under different definitions and categories in the client company and they are with concepts of the "Gorgan Method" system for a clear evaluation and review. The project is then explained, and the potential problems and issues with the current project management system are discussed. Then the advantages of using the "Gorgan Method" are highlighted, thus preventing the previously mentioned problems in design, construction, and commissioning of the project.

In this case study:

Company "A" stands for the Client Company or the Owner.

Company "B" stands for the Consulting Company.

Company "C" stands for the Construction Contractor Company.

Company "D" stands for the Manufacturer Company or Vendor, which gives a service, or provides equipment.

5.3.1 Project definition, "S refinery wastewater treatment plant project"

This project provides a new plant to treat the existing wastewater in the S refinery. The project scope includes the design and construction of a new treatment plant with specified requirements. Figure 5-1 shows the general drawing of the project.

The client of the project is "S refinery" which is known as Company "A." A team of client in this job is selected as consulting team, which is known as Company "B" as above. The construction contractor or Company "C" has completed the project as a turnkey project. And finally Company "D" stands for the manufacturer companies or vendors, who provides a service or equipment. As this is a turnkey project, the whole project is designed and constructed by Company "C", and Company "B" (the consulting section of Company "A") has an overall consulting role in this project. In general the required

FMX4001 MIXER
FT4001 BUFFER TANK 300 M3 BY CLIENT
FPF4201 FLOCCULATOR PFR 140
FFU4551 FLOTATIE UNIT IPF 180 m^3
FSC4551 SCRAPER
FT4601 SLUDGE TANK BY CLIENT
FT4051 PUMP PIT 24 M3 BY CLIENT
FAT4601 AERATION TANK 1490 M3 BY CLIENT
FT4052 OVERFLOW TANK
FSA4601A/B FLOATING AERATOR
FCL4801 CLARIFIER BY CLIENT
FT4851 SCUM PIT BY CLIENT
FT4101 PUMPPIT BY CLIENT
FSF4701 SANDFILTER
FSF4751 SANDFILTER
FT4251 CHEMICAL TANK FECL3 BY CLIENT
FT4301 CHEMICAL TANK PAC BY CLIENT
FT4401 POLY DOSING UNIT NMA 1000
FMX4451 MIXER
FT4351 CHEMICAL TANK NaOH BY CLIENT
FDT4651 DIGESTER TANKS BY TASFYEH
FT4701 DRYING BED BY TASFYEH

FP4001 FEEDPUMP
FP4551 RECIRCULATION PUMP
FP4051 FEEDPUMP
FP4101 FEEDPUMP
FP4501 RETURN SLUDGE PUMP
FP4502 EXCESS SLUDGE PUMP
FP4251 DOSING PUMP
FP4301 DOSING PUMP
FP4401 DOSING PUMP
FP4451 TRANSFER PUMP
FP4351 DOSING PUMP
FP4151 COMPRESSOR
FP4552 SLUDGE PUMP BY TASFYEH
FP4851 SLUDGE PUMP BY TASFYEH

STREAM LINES		1	2	3	4	5	6	7	8	9	10	11	12	13	REMARKS
FLOW RATE	m3/hr	130	130	129	136	260	127	132	127	127	2	130	6.5	17	
PUMP CAP.	m3/hr	–	136	–	150	–	–	–	130	–	13	130	–	–	
TEMPERATURE	°C	20–	20–	20–	20–	20–	20–	20–	20–	20–	20–	20–	20–	20–	Assumed as the outside temperature
PRESSURE	barg	–	0.62	–	8.0	–	–	–	1.0	–	0.5	0.55			
BOD	mg/lit	400	400	200	200	2400	150	4800	150	75	4800	4800	4800	4800	Assumed
COD	mg/lit	800	800	400	400	6000	1100	12000	1100	55	12000	12000	9600	12000	Assumed
TSS	mg/lit	150	150	75	750	4000	125	8000	150	74	8000	8000	320	8000	Assumed
MLSS	mg/lit	0	0	0	740	4000	110	8000	110	0	8000	8000	200	8000	Assumed
OIL	mg/lit	150	150	10	–	–	–	–	–	–	–	–	–	–	

Fig. 5-1, General drawing of S refinery wastewater treatment plant

TASFYEH Chemicals Ltd.

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equipment or services are either provided by Company "C" or subcontractors as Company "D" in general.

The term "Project" refers to a wide range of activities including evaluation, development, detailed engineering and design, procurement, construction management, pre-commissioning, commissioning and start-up of the whole system.

5.3.2 Project overview and description

The project is design and construction of a wastewater treatment plant for Company "A". The main process of the project according to the P&ID is summarized as follows:

The raw water is collected in a balance tank, which is pumped from the existing API separator. Then it is pumped to the flocculator where chemicals are dosed and added. For the chemicals, first a coagulant is dosed to coagulate colloidal matter and subsequently a flocculant is dosed to form the flocks, which can be separated by dissolved air flotation. From there, the water enters to the flotation unit.

In the flotation unit, the pre treated water is mixed with a recycled stream from the effluent compartment. This stream is transferred through a special pump and air saturation system in order to achieve very fine air dispersion in the water, which will stick to the impurities. The air with particle coagulants floats to the surface of the system where a continuous dewatering takes place before discharge into a collecting storage. Heavy particles like sand are intercepted in the on-build sediment trap and are infrequently removed by automatically operated valves.

From there the treated water flows to the pump pit, and it is pumped to the aeration tank of the biological treatment system. In this tank the neutralizer is dosed to correct and adjust the PH. A PH measuring electrode is installed in the aeration tank to measure the PH of the wastewater. Here BOD is further reduced and nitrification takes place by activated sludge and aeration. The air input is obtained by floating surface aerators. The oxygen concentration in the aeration tank is measured and it controls the start and stop actions of the floating surface aerator.

The activated sludge and treated water flows from the aeration tank into the clarification tank. The activated sludge then settles and most of it is returned to the aeration tank and any extra is discharged. Water is finally treated in sand

filtration system where ferric is dosed to reduce COD and TSS according required standards. The final treated water then can be used in the proposed plant as clean water.

5.3.3 Required equipment of the project

The following essential equipment is required for the project:

A) Buffer Tank, including

Mixer,

Feed pump,

Level sensor,

Ball check valve

B) Flocculator system, including

Flocculator,

Flow switch,

Coagulant dosing pump,

Poly make up unit,

Level measurement in polymat,

Dry material feeder,

Poly mixer motor,

Solenoid valve,

Pressostate,

Poly gear pump,

Poly dosing pump

C) Flotation unit, including

Flotation system,

Skimmer drive,

Recirculation pump,

Sand drain Valve,

Sludge drain valve

D) Pneumatic panel, including

Pressure switch,

Filter,

None return valve,

Solenoid valve,

Flow meter

E) Pump pit 1 and 2, including

Feed pump,

Level sensor,

NaOH dosing pump

F) Aeration Tank, including

Aerator,

PH measurement unit,

Oxygen measurement unit,

Clarifier bridge

G) Sand Filter, including

Sand filter,

FeCl3 dosing pump,

Compressor

H) Sludge treatment, including

Sludge pump,

Sludge return pump

5.3.4 Plant information including input and output

The plant information including plant influent or input and plant performance, which is defined as effluent or output, is completely deleted in this section for the client's proprietary purposes.

5.3.5 Existing project management system of Company "C"

The applied project management system for EPCM of the project is summarized as follows:

1) Project consideration in terms of size and type of work
2) Site visit
3) Meeting with the client
4) Initial project review by the management team
5) Overall technical review by the engineering team
6) Preparation of project proposal/technical section
7) Preparation of project proposal/financial section
8) Completion of project proposal file
9) Submission of the proposal to the client for review
10) Approval by the client
11) Kick-off meeting
12) Completion of initial drawings

13) Procurement of long lead items

14) Completion and updating of project plan

15) Start of possible construction activities

16) Meeting with the client and overall review of project activities

17) Updating drawings and submission to the client

18) Finalizing detailed design of the project

19) Procurement of all remained items of the project

20) Continuing construction activities according to the most updated information

21) Completion of construction activities

22) Internal meeting of the management team for finalizing the project

23) Project pre-commissioning

24) Resolve technical issues/preparation for start-up

25) Start-up

26) Finalizing as-built drawing

27) Project file completion including drawings/documents/approvals/etc.

28) Submission of project file to the client

5.4 Problems issued in managing the case study with the existing project management system

The case study project of Company "A" with general requirements and related technical documents is explained. This project was designed and constructed by Company "C". Company "D" and other similar suppliers were used for the required equipment and the related accessories. A team of technical people from different departments was established with a project manager for each section of the project. The project has been completed and it is currently operational as per planned technical design and operational requirements, but with the final 30% time overrun and about 12% cost overrun keeping the same requested initial scope and desired quality.

The overall review and evaluation of the project in four different stages of the project shows the following results:

Stage one: Cost is 3% extra and Time is 8% behind the schedule.

Stage two: Cost is 5% extra and Time is 14% behind the schedule.

Stage three: Cost is 9% extra and Time is 23% behind the schedule.

Stage four: Cost is 12% extra and Time is 30% behind the schedule.

If Company "C" had a proper monitoring system such as the "Diamond Method" to determine the cost and time overruns in their, the project could have been executed with better results for the client and more profit for the construction

firm. According to the "Diamond Method", in the first stage when the project was under review, the project success would be in the yellow area. In the second stage, the project success would be in red area according to the table as well as the rest of stages.

In general, a project is successful and complete as long as the time, cost, scope, and quality are covered as per plan, and customer satisfaction is attained. This project was completed with a cost higher than the preliminary estimated cost and with some delay in the delivery date. It could be completed faster and cheaper with some modifications and improvements in the system, which prevent time and cost over runs, as well as higher performance in the project. In this section the observed problems of the case study project and other potential issues and matters are explained.

The problems in execution of the case study project, according to the existing system, are highlighted here for overall information. The other issues and concerns that may cause a failure in projects are mentioned. These issues are categorized in two main stages as "design stage," and "construction stage," concentrating on design stage. Summaries of the main problems encountered in these two stages are shown separately in figure 5-2 and figure 5-3 with the solutions in the "Gorgan Method".

A) The problems and issues during the "design stage" of the project are as follows:

1) Project goals were not completely explained. On the other hand, the project definitions and strategies documents for proceeding with the project were poor.

2) Project cost and time estimation was not based on historical data or discipline inputs. The primary data was insufficient, therefore, the total budget cost for the project was not accurate.

3) Time spent on estimation activities was insufficient, which caused the above-mentioned issues.

4) Planning and scheduling was performed mostly by the scheduler, without involving the project manager in some of the sections or incorporating some of the subtasks.

5) Project monitoring was not performed continuously, and some issues that arose later affected the total time of the project.

6) The major milestone dates were not clear.

Fig. 5-2, Comparison table of selective existing problems in Design phase of the real case study project and the solutions according to the "Gorgan Method"

Problem 1:
Project goals and objectives were not completely explained.

Solution:
According to the framework, the PGD and PEP is covered in the first phase to cover all goals and issues of the project.

Problem 2:
Cost and time issues; information was not realistic and historical data were not used.

Solution:
According to the framework, the PGD, schedule and Category Cost Estimate in level 1 are covered these issues as well as the required scheduled meetings for detailed discussions and further decisions. Applying the "Diamond Method" to illustrate the problems is beneficial to the project.

Problem 3:
Time spent on estimation activities was not sufficient and caused problems.

Solution:
Level 1 to 3 with step-by-step activities, and organized scheduled updating activities in various steps according to the framework will prevent this issue. Most of this will be covered in level 1 for the gate review.

Problem 4:
Planning and scheduling issues created some problems, and the project manager was not aware of them.

Solution:
Scheduled meetings in a couple of steps for discussions before taking any further steps as well as schedule updating points will prevent this issue. Applying the "Diamond Method" for evaluating the success of the project is beneficial to the project.

Problem 5:
Lack of the proper monitoring system for the project review was another issue.

Solution:
Following up the framework to guarantee that all activities were performed as they were planned as well as designated gate reviews avoid the issue. Schedule updating and updating the DBM to have all required activities included is also helpful. Applying the "Diamond Method" for

monitoring and reviewing the project will explain the weak points and the need to take proper actions.

Problem 6:
Milestones of the project were not clear.

Solution:
All milestones and required activities of the project are defined and explained in PGD, PEP, DBM, and project gate reviews according to the framework.

Problem 7:
Tasks and subtasks of the project were poorly defined.

Solution:
Following up the framework, scheduled and unscheduled meetings for the project review, various levels of the project with their own tasks and steps, and updating the DBM to incorporate all required technical activities of the project would prevent these issues.

Problem 8:
Confusion of team members of the project, and lack of a good communication system was another problem.

Solution:
Following up the framework and step-by-step activities of each phase of the project, as well as required scheduled meetings for clarifications will prevent these issues. Different required and assigned stages of drawings review will prevent these issues properly.

Problem 9:
A lack of adequate design information about the project was another problem.

Solution:
Levels of the framework and different steps for completion of tasks, required site visits and meetings with different teams for completion of DBM, various types of drawings review in different steps of the project will avoid these issues.

Problem 10:
Project scope changes and modifications were not caught.

Solution:
Following up the framework, updating the information and initiating MOC where required, and updating the schedule in different steps of the project will avoid these problems. Applying the "Diamond Method" for explaining the scope changes is beneficial for the project to avoid this issue.

Fig. 5-3, Comparison table of selective existing problems in Construction phase of the real case study project and the solutions according to the "Gorgan Method"

Problem 1:
Project construction plan was weak.

Solution:
Following up the framework and updating the schedule is required. Inter-discipline meetings for drawings review and construction plan on the selected steps of the project will avoid the issues. MOC and materials updates as important activities to be executed where required according the framework.

Problem 2:
Communication was weak. Construction issues occurred and required information were missing.

Solution:
Following the framework, scheduled meetings, schedule updates, and using the approved construction plan will avoid the problems. Applying the "Diamond Method" to review the status of the project would be beneficial.

Problem 3:
Issues arose because of a lack of reports of changes in plan and scope changes issues occurred.

Solution:
According to the framework, performing the required meetings and updating the schedule and progress, as well as issuing the MOC will avoid these issues.

Problem 4:
Monitoring system was weak.

Solution:
Updating the project construction progress and updating the schedule as well as monitoring the project through the "Diamond Method" will solve the issue.

Problem 5:
Commissioning problems occurred.

Solution:
Updates on the project and progress according to the required step-by-step activities especially in pre-commissioning step will minimize the problem.

7) The project task and subtasks was not defined sufficiently.

8) The project parallel tasks or sequenced tasks were not clear in the plan.

9) Some of team members were not on the same view track, and did not understand the milestones of the project.

10) The project time schedule was originally defined optimistically.

11) The time estimate for each individual activity was not assigned correctly.

12) The project resources availability was not identified completely.

13) Design information at the time of estimation was not complete.

14) There were some changes of project scope of work, and the system was not capable of incorporating the time and cost changes on the project properly. Some of these issues are as follows:

- Lack of definition of the project objectives.
- Lack of a definitive statement of the project scope of work.
- Lack of incorporating operational performance requirements in the scope of project from early stages of the project.
- Lack of periodic reviews of the project work and incorporating the required issues to the project.
- Lack of a proper procedure to control and input the scope changes to the project.

- And the most important issue, was lack of unscheduled meetings and discussions. For most of the projects, the regular weekly or biweekly meetings are not necessarily enough, and sometimes more meetings, discussions and site visits are required, especially when the project is not on track. The more team members that are involved in group meetings and resolutions, the more successful the project.

B) The problems and issues during "construction stage" of the project are as follows:

1) The construction plan was scheduled without any comments or input from those involved in the project.

2) There were not enough meetings in the construction phase, and communication between team members of the construction team was weak.

3) Changes in construction activities were not reported properly, which created some problems in later stages.

4) Milestones of the project were missed, and hence there was no push in order to get every section completed on time for the next step.

5) Existing problems and technical issues of the pre-commissioning stage were not resolved completely, and so they appeared in the final commissioning stage.

5.5 Advantages of using the "Gorgan Method" to avoid the potential issues

In this section the advantages of applying the "Gorgan Method" framework for managing such a project is discussed, and the success factors of using this conceptual model are considered.

The main factors, which lead a project to successful completion, are the established framework, organization structure suited to this type and size of project, and finally, clear steps and activities, which are to be followed at each, level and phase.

As per the "Gorgan Method" framework, the project manager in each level, shall check all the steps of the framework, and before passing any gates of the current level, he/she finalizes and reviews the following aspects of the project:

- What has been done so far and how?
- What are the next steps before proceeding to the next level?

If the project manger considers all the stages of the project properly, and has a perfect monitoring system set up for the current progress of the project, and a

week look ahead of the activities, the project will not have any time related issues.

The "Gorgan Method" emphasizes the completion of all project documents such as PGD, and PEP as well as Category "A" Cost Estimates in the first level of the project, and updating the DBM continuously until completion of the finalized document in the design stage of the framework (level 3). It may look like there is more bureaucracy in this method when compared to other systems, but the system is set up to handle it accurately, and results are adequate at the end. In general, the following activities are required to be completed during the early stages of a project in order for the timely and successful completion of the project:

- The project definition.
- The project objective(s), tasks and subtasks.
- Determination of the required duration of the tasks and subtasks.
- Resource allocation for these tasks and subtasks.
- Preliminary schedule and updating the plan when required, in next stages as per project changes, or in other words, schedule control.
- Review and update of the schedule by the project manager, in order for him/her to take prompt action when necessary to overcome any potential problems.

Completion of the above activities, prevent many problems and issues during design stage of the project.

Cost management for the project is an issue to be considered carefully. In the "Gorgan Method," the major activities in every level consist of a category cost estimate that roughly summarizes the expected costs of the project through project completion. As the project progresses to the next level, this estimate gets closer to the real cost of the project.

In the "Gorgan Method", a rough estimate is made during early stages of the project, based on previously completed projects. Later on, when other members of the project get involved in the preliminary phase and the project officially begins, a Category "A" cost estimate is prepared for the total cost of the project. The project could pass "Gate 1" of the first level if this cost estimate is lower than the estimated cost previously predicted by the management discipline of the organization.

For the other levels of the project, similar cost estimate systems are established in order to check the future cost expectations of the project, which are called Category "B" and Category "C" cost estimates. In general, these different gates and category cost estimates in the project make a project more accurate in cost

estimation and also in monitoring the activities and performance of the project more realistically. This system, which is developed for monitoring and reporting the project costs, is an effective methodology for comparing actual costs of the project vis-à-vis the initial plan and project budget. This identifies the project's potential cost problems at the earliest possible time.

The major activities to be performed during different stages of construction of a project based on the "Gorgan Method" are as follows:

- Construction and installation
- Pre-commissioning
- Commissioning and Start-up

For all of the tasks or subtasks in construction and installation, pre-commissioning and final commissioning, and start-up of the project, a clear procedure should be prepared in order to complete it successfully. Some related activities include:

- Careful and realistic preparation of the construction plan along with general and detailed sections.
- Complete review of the drawings with the construction team.
- Material control.
- Preparation of the schedule for delivered purchased equipment.

- Establishing an efficient meeting schedule and reporting system.
- Establishing management of changes in the project.

5.6 Conclusions

The previously mentioned advantages of applying the "Gorgan Method" in the execution of small projects, leads the involved organizations in the oil and gas industry to the fact that there are still potential improvements to projects, and systems can be optimized more efficiently and completely. The conceptual model provides the essential requirements of the projects' execution, and highlights all of the steps from the early stages of the project to the final construction in detail.

The other point is that the opportunity of applying this method in the oil and gas industry is provided and the possibility of using it in different type of projects is presented. New projects, up to a certain size (or dividing a large project to sub-projects), upgrading projects and pilot plants which are small size projects can use this method. Also, this flexibility allows the use of this method in the other industries, with some minor changes, based on the fundamental requirements.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Overall review and results

Project management is a broad field and almost new to industry. There has been much research and many articles written around the world for this field. As time goes by, new methods and techniques are developed to make it more successful and improve the previously completed works and ideas. In this thesis, a method for managing the small projects (under one million dollars cost) is explained with its reviewing and monitoring tool because of the lack of a strong framework for managing small projects in the oil and gas industry. The logical and sequential steps are covered and explained in detail for different phases of the project. The monitoring and reviewing tool is described for applications in the "Gorgan Method." It can be developed and used in other systems and methods where required. To make this thesis more useful for different type of small projects in the oil and gas industry, a real case study project was reviewed. Potential and typical problems, or on the other hand, the failure key factors of the project were discussed. There are various reasons for the success or failure of a project.

Mostly a project fails when there are overruns in cost or the schedule is not met. Also, sometimes the scope of work is changed to meet the time schedule or keep a constant budget for the project. Sometimes these issues might not be

considered as a fail item, based on the location, nature of the project, client requirements and similar concerns. This means the completed project might be concerned as a successful project with having these kinds of problems, if the final outcome of the project in general is satisfactory and acceptable by the client.

These are some of the failure key factors in projects in general:

- In some projects, the total budget initially is calculated low and the project manager had no control on it.
- Sometimes, the original time or performance requirements of a project are initially set too optimistically, and the project manager couldn't manage the project.
- Poor coordination is another factor which can cause a project to fail. Without a strong coordination in a project, that project will fail sooner or later. If team members are not directed, and if they have no idea about the procedures or time frame because of lack of adequate management, the project will not be successful.
- Team members' relations, is another main factor in failed projects. Establishing a strong system and guiding the team members inside the system for better relations is a must in every project. This kind of

coordination makes for better cooperation between the people who are directly involved and those who are indirectly involved in a project.

- An appropriate and adequate organizational chart and project structure is a key factor, as the roles and responsibilities are well defined.
- Establishing and maintaining a perfect project planning and control system is another successful factor. This can help the project to be delivered on time and keeps the productivity at a high desirable level.

The other common failure factors of a project include:

- The client's conditions of satisfaction of the project are not negotiated.
- The project has no priority any more.
- People do not feel responsible for the project.
- The schedule was too optimistic.
- The project status was never compared to the plan.
- The project plan was just on paper and had never been used or looked at carefully.
- Sufficient resources were not committed.
- The project lost its original plan.
- There is no management of changes in the project.
- No formal communication between team members existed.

6.2 Recommendations for future research

The "Gorgan Method" framework is developed for small projects. It can be used in different types of small projects. This flexibility in managing small projects helps companies with an appropriate overall management on their work and handling of their projects. Following the same framework for their projects enables them to have a better view of the work to be performed and the estimated time and cost requirements.

As such, it is recommended, for future research, that some projects be developed and implemented using the "Gorgan Method." Applying this framework to real projects will indicate the possible disadvantages and problem areas within the "Gorgan Method" which can be explored and corrected. All recommended and highlighted corrections and modifications will be used in order to improve the system.

Another area for future research is the development of the "Gorgan Method" for mid-size or larger projects with some modifications and changes. By breaking the project into smaller sections, for each specific section this framework can be applied and used. An overall management system is to be designed and considered for keeping all the various sections under control and review.

Future research can also concentrate on applying this method to other industries, with some changes and modifications to the "Gorgan Method" framework. The "Diamond method," is a good and strong tool for project monitoring and reviewing, since it includes the four major concepts of a project.

Future research can be undertake to determine how to apply the "Diamond Method" to the above-mentioned areas where applicable, and use it as a monitoring and reviewing tool in various industries with different sizes projects.

(Voropajev and Scheinberg, 1992) mentioned that it is necessary to develop the theoretical base of project management methods and tools now for future decades. They discussed some issues regarding the current state of the art of project management methods and tools, and the required developments for project management tools and methods for the 21st century. They concluded that the problem of the development of project management methods and tools for the 21st century can be solved only by joint efforts of all the national project management organizations.

In the future, as IT (Information Technology) will be more involved in all businesses, efforts should be made to consider it for project management issues. Important factors such as interpersonal skills, team working,

organizational issues, etc. should not be removed from these systems. (Froese et al., 2001) described how IT will be used to support project management in the year 2020. The paper reports and interprets the responses received from a group of experts in the field of architecture, engineering and construction (forty-eight responses from eighteen countries). About 65% of the responses described issues related to collaboration, communication, access to information, information sharing, interoperability, and data standards as the most important way that information technology will change the way project managers work by 2020.

The most important conclusions of the survey explains that computers will be massively more powerful in the year 2020, and user interfaces are likely to be significantly different from those of today. IT issues will become increasingly important for companies practicing project management, and IT will become fundamentally inherent in our work practices. However, these will not remove other important topics such as interpersonal skills and organizational issues. The overriding role of IT will be to provide ready access to all information at all times, and to support much richer forms of communication and information sharing.

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   www.asce.org

2) Construction Industry Institute

   www.construction-institute.org

3) Project Management Institute

   www.pmi.org

4) International Journal of Project Management

   www.sciencedirect.com/science/journal/02637863

5) Journal of Construction Research

   www.worldscinet.com/jcr/jcr.shtml

6) Journal of Construction Procurement

www.fbe.unsw.edu.au/JOCP/

7) Canadian Journal of Civil Engineering

http://pubs.nrc-cnrc.gc.ca/cgi-bin/rp/rp2_jour_e

8) The Internet for Civil Engineers

www.icivilengineer.com/Construction

9) Journal of Engineering, Construction and Architectural Management

www.blackwell-synergy.com

10) Successful Project Management

www.pmboulevard.com

11) The Project Managers Homepage

www.allpm.com/static.html

12) Project Management Journals, Magazines, and Books

www.pmforum.org/library/journals.htm

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GLOSSARY OF TERMS

Activities: Project work items having a specific beginning and completion points, and duration times; or a series of tasks performed over a time period. It usually has an expected cost, an expected duration, and expected resource requirements.

Actual Start Date: It is the point in time that the actual work started on an activity.

Actual Finish Date: It is the point in time that work actually ended on an activity.

Commissioning: The terminal phase of a project, commencing around completion of construction, and comprises activities (inspection, testing, calibration, etc. to design criteria) that are preparatory to initial operations of the satisfactorily completed and tested facility.

Consultant: Independent expert hired to supplement available expertise for the project; advises about what (product) and how (process).

Contingency: A term in planning the project to mitigate cost and/or schedule risk.

Contract: It is a mutually binding agreement which obligates the seller to provide the specified product, and obligates the buyer to pay for it.

Contract close-out: Completion and settlement of the contract, including resolution of all outstanding items.

Contractor: Carries out construction work on site in accordance with the contract with the client.

Control: The process of comparing actual performances with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.

Cost control: Controlling changes to the project budget.

Cost estimate: An estimate of costs for completion of project activities.

Cost schedule: A time-sequenced listing of specified work items on the project together with the estimated total cost and the actual cost to date for each activity.

Deliverable: Any measurable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a project.

Design Basis Memorandum (DBM): A document, which includes the main design contents of the project, and also covers the scope of work in general for the project.

Duration: The number of work periods required to complete an activity or other project element.

Engineering, Procurement, and Construction Management (EPCM): A term for the execution of the projects from the early stage till the final construction which covers the main sections of the project, including design and engineering, procurement, and construction management.

Equipment manufacturer: Or vendor or supplier is the entity that manufacturers and, in some cases, installs equipment for a project according to design specifications.

Issued For Approval (IFA): A term used for THE approval stage of the project technical drawings. In this stage, all of the technical comments are incorporated from the IFE stage, and drawings are approved from the engineering point of view.

Issued For Construction (IFC): The last step whereby drawings are stamped and shipped to the field for the construction stage.

Issued For Engineering (IFE): A term used for the second set of technical drawings of the projects. In this step, the previous comments of the IFR drawings are incorporated and new comments and issues are pointed.

Issued For Review (IFR): A term used for reviewing the drawings of the project. This is the first step of issuing the technical drawings of the project for a review by all of the disciplines involved.

Key date: Dates on which specific activities for completion of an ensuing milestone event have to be finished.

Master schedule: A summary-level schedule, which identifies the major activities and key milestones.

Matrix: A multi-dimensional structure of relationships interfacing people, things, or activities.

Milestone: A major event in the project, such events, may be designated as milestones. Examples include: important delivery dates, major phases of construction completion, or equipment installation on site.

Monitor: To capture and report actual against planned performance.

Piping and Instrumentation Diagram (P&ID): A term used to show more process detailed information, including mechanical specifications, modes of control, and instrumentation.

Plan: An intended future course of action.

Planning: Ordering of activities through systematic reasoning to solve specific problems.

Process: The set of activities by which an output or objective is achieved.

Project: Unique, non-repetitive undertaking having a definite objective, and specific beginning and completion points. Project activities are set up in a logical order (plan and schedule) to achieve the overall objectives.

Project baseline plan: The original plan of the project.

Project control: Monitoring of performances in all aspects of project management against planned schedule, cost, quality, taking early corrective action to avoid delays and, cost overruns.

Project Execution Plan (PEP): Carrying out the project plan by performing the activities included therein.

Project General Document (PGD): A document which explains the proposed strategies and key issues to be considered during project design and

implementation as well general information about the project including project name and document number, plant/area location and business opportunity summary, with cost, and schedule (desired completion date) information.

Project lifecycle: The segments in time sequence (with varying levels of resource loading), through which a project passes. Namely; concept, growth, maturity, and commissioning.

Project management: A specialized branch of management which is the art and science of planning, coordinating, executing, and controlling the complex activities inherent in a project, toward its successful completion within cost, schedule, and technical constraints.

Project management techniques: Generally proven techniques employed in managing a project, which are a condensation of thought and experience in the field of project management over time.

Project phase: The division of a project into the largest logical collective of related activities.

Project plan: A summary document that gives the essentials of a project in terms of its objectives, and how these will be achieved. It describes all major activities to be completed. The project plan is logically developed, with increasing detail at lower levels.

Project planning: The development and maintenance of the project plan.

Project quality management: A subset of project management that includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It usually consists of quality planning, quality assurance, and quality control.

Project risk management: A subset of project management that includes the processes concerned with identifying, analyzing, and responding to project risk. (Hazardous Operation (HAZOP) or Hazard and Operability study is an examination procedure. Its purpose is to identify all possible deviations from the way in which a design is expected to work and to identify all the hazards associated with these deviations.)

Project stage: A specific point in time within a project phase.

Project schedule: The planned dates for performing activities and the planned dates for meeting milestones.

Project team members: The group of people who work in a project and report directly or indirectly to the project manager.

Project time management: A subset of project management that includes the processes required to ensure timely completion of the project.

Process Flow Diagram (PFD): A technical term, which provides the basic process flows in a set of technical drawings of all of the stages that the product is made or a desired result is achieved. (The final heats and mass balances)

Procurement planning: Determining what to procure and when.

Resources: Money, skills, personnel, material, or equipment that may be required or consumed in completing activities on a project.

Resource planning: Determining what resources (people, equipment, and materials) are required in what quantities, to perform project activities.

Quality Assurance (QA): The process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

Quality Control (QC): The process of monitoring specific project results to determine if they comply with relevant quality standards, and identifying ways to eliminate causes of unsatisfactory performance.

Quality planning: Identifying which quality standards are relevant to the project and determining how to satisfy them.

Risk: The possibility that an expectation may remain unfulfilled.

Risk analysis/assessment: The evaluation of the elements of uncertainty involved in a forecast, and estimates reasonable limits of uncertainty for each element.

Request For Purchase (RFP): A final document to purchase the selected equipment.

Request For Quotation (RFQ): A type of bid document used to solicit proposals from prospective sellers of products or services in terms of type, price, delivery time, and quality.

Schedule: Detail of time span (with order and duration) for jobs in the plan.

Scope: The work content of a project or component of a project. Scope is fully described by naming all activities performed, the end products, which will result, and the resources consumed. It is documented by contract parameters to which the project is committed.

Stakeholder: Individuals and organizations who are involved in or may be affected by project activities.

Start-up: Commencement of initial operations of the completed facility, after essential commissioning activities are complete, and process fluid has been introduced in the systems.

Status report: A cogent and timely report to inform management about project status at any given time. This report may be quantitative, qualitative, or a combination of both.

System: A methodically linked assembly of actions, equipment, processes, and people forming a logical and interrelated scheme or unit with an objective.

Termination: The set of activities at the end of commissioning phase, essentially of administrative and contractual matters. These are designed to close the project, with the completed facility attaining satisfactory performance under design load after initial operations.

Work breakdown structure (WBS): A task oriented family tree organizing, defining, and graphically displaying the total work to be accomplished to achieve the final objectives of a project.

Work package: A description of what must be performed, by whom, and in what time duration. It is prepared for each WBS element. Each work package is assigned a cost accounting code to track and report expenditure.