The Exploration of Projects' Failure Factors in Oil & Gas Industry in UAE

الكشف عن عوامل الفشل للمشاريع في مجال النفط و الغاز في دولة الإمارات

By:

Student Name: Saleh Ahmed Saleh AL Hashmi

Student ID # 110161

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Faculty of Business

Dissertation Supervisor

Professor Abubakr Suliman

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Abstract

As everybody usually says that project is the mean for changes and developments, so it is very important to know how this mean can be effectively used and safely protected. Normally, the concept of project is applied through the implication of project management knowledge, process, and procedure which is generally identified by some international organizations such as Project Management Institute. Knowing how to apply this knowledge is not that difficult, but the success on how to protect the application of this knowledge from the surrounded effects, which could lead any project to fail, is the real puzzle. Therefore, in this work I will try to explore the reasons behind project failure in oil and gas industry especially in one of UAE Gas Production Company.

These reasons were developed and they were ranked using technique of Critical Failure Factors (CFF) analysis. In order to evaluate the reasons for project failure through the determined CFFs, a comprehensive literature review was performed. CFFs relevant to the domain of the study were grouped under three main areas, which were procurement, scope of work, and communication management. These CFFs and their groups were tested empirically through two successive surveys. In the first survey, each of the CFF's group was tested based on a five points lickert scale (1 being extremely disagree, 5 being extremely agree and 3 being neutral). This survey aimed to confirm the importance and relatedness of these subjects to GPC overhaul projects. Based on this confirmation the CFFs were gathered under these groups. Then, second survey was carried out. In the second survey CFFs were individually ranked under each group using same method as in the first survey but with different linkrt scale criteria (1 being least important, 5 being important and 3 being neutral).

As result of the methodology that used and the evaluation that followed, a list for the most five critical CFFs under the three above mentioned groups was developed. In addition, some recommendations were proposed as protective actions or solutions to ensure the success for the future overhaul projects in the targeted company.

In conclusion, the determined model of CFF grouping and gradation of each CFF can be effectively used as a tool to deploy better project management process for overhaul projects with the intention to reduce the probability of failure for such projects.

ملخص البحث

إن المشاريع مثلما يشار لها عند كثير من الناس بأنها أداة للتغيير والتطوير، ولهذا كان من المهم بمكان التعرف على كيفية استخدام هذه الأداة بشكل فعّال والقيام بالحفاظ عليها. إن المشاريع في العادة تنفذ باستخدام علوم إدارة المشاريع وتطبيقاتها المختلفة والتي هي معلومة ومعرفة عند كثير من المنظمات والمؤسسات العلمية المتخصصة في مجال إدارة المشاريع في شتى أنحاء العالم فعلى سبيل الذكر لا الحصر معهد إدارة المشاريع المسمى PMI.

في الواقع إنه ليس من الصعوبة معرفة كيفية تطبيق علم إدارة المشاريع ولكن الصعوبة تكمن في كيفية المحافظة على تطبيقات هذا العلم من المؤثرات الخارجية والتي عادة ما تحيط بجميع أنواع المشاريع، وتعمل غالباً على إفشالها وهنا تكمن المعضلة في كيفية تجنبها.

ولهذا فإن هذه الدراسة تقوم بمحاولة التعرف على هذه الأسباب التي هي وراء فشل بعض المشاريع المتعلقة بالصناعات البترولية وبالتحديد الخاصة بأحد الشركات المنتجة للغاز في دولة الإمارات العربية المتحدة.

حيث أن هذه الدراسة قامت بتحديد هذه الأسباب وترتيبها حسب الأهمية باستخدام التحليل العلمي للعوامل الأولية المتعلقة بفشل المشاريع. ولتقييم هذه العوامل قد تم الاستناد إلى بعض الدراسات السابقة التي قامت بشكل مسهب في تحليل هذه العوامل ودراستها. ولكي تكون هذه الدراسة أكثر فاعلية قد تم تحديد ثلاث فئات مهمة تندرج تحتها هذه العوامل وهي كما يلي:

- فئة إدارة العقود والمشتريات الخاصة بالمشاريع.
- فئة إدارة الأعمال المطلوب تنفيذها للمشاريع .
- فئة إدارة المعلومات والمحداثات الخاصة بالمشاريع.

حيث أن هذه العوامل والفئات الخاصة بها قد تم دراستها علمياً على مرحلتين. وذالك عن طريق المسح الاستبياني باستخدام تقييم ليكيرت والذي يتكون من خمسة درجات. فكانت المرحلة الأولى من هذا التقييم يهدف إلى دراسة أهمية هذه العوامل وقوة تأثيرها على مشروع الصيانة والعمرة لمصنع الغاز. في سنة 2009 والتابع لأحد الشركات المنتجة للغاز في دولة الإمارات وقد اختير إسماً مستعاراً لهذه الشركة وهو GPC لحماية خصوصية المعلومات الخاصة بهذه الشركة. وفي هذه المرحلة كان مقياس ليكيرت يضم خمسة درجات أدناه درجة واحد وهي لا أوافق بشدة وأعلاه خمسة أوافق بشدة . وأوسطها ثلاثة وهي محايد، وأما في المرحلة الثانية من التقييم فقد كان يهدف إلى تحديد ترتيب هذه العوامل حسب أهميتها تحت كل فئة. وكان مقياس ليكيرت الذي استخدم خمسة درجات أدناها الأقل أهمية وأعلاها الأكثر أهمية وأوسطها محايد.

وكانت خلاصة هذه الدراسة بأنه قد تم تحديد أهم خمسة عوامل لفشل مشروع الصيانة لشركة GPC تحت كل فئة من الفئات الثلاثة المذكورة أعلاه. بالإضافة إلى ذلك فإنه قد رشح عن هذه الدراسة بعض التوصيات والآليات التي يجب أن يعمل بها كنوع من الحلول الوقائية التي سوف تعمل على إنجاح مشاريع الصيانة والعمرة المستقبلية لشركة GPC .

وختاماً فإن النموذج المستخدم لتحديد وترتيب العوامل المؤدية لإفشال المشاريع تحت فئاتها الخاصة بها يمكن استخدامه كأداة فعالة للحصول على إدارة ناجحة للمشاريع ترتكز على تقليل خطر إمكانية فشل مشاريع الصيانة العامة والعمرة الخاصة بمصانع إنتاج الغاز .

Dedication

This Research Paper is lovingly dedicated to my respective parents who have been my constant source of inspiration. They have given me the drive and discipline to tackle any task with enthusiasm and determination. Without their love and support this project would not have been made possible.

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Abbreviations

CSF – Critical Success Factor

CFF – Critical Failure Factor

GPC – Gas Processing Company

IT – Information technology

P.M. – Project Management

Chapter 1

Introduction

1.1 Background:

In today business world, projects have been considered as an important means to achieve organizations' strategic objectives. And it is not exaggerating, if it is said that projects are part of our daily lives. For instance every day we go to our works, schools, shops or anywhere else; and to do so, we usually decide earlier our objectives and in this case it will be our destinations. Then, we plan our trips by allocating the suitable resources from time, money, and type of transportation that we need to use. Finally we proceed or execute our plans to obtain our objectives. These three simple stages for our daily basic activities not surprisingly are the main phases for any project life cycle. Although, this example is visualizing project as component of some basic sequential activities that one follows another in order to achieve certain objectives; in reality, the elements under these activities which will be discussed in details later on are a lot more comprehensive than it seems to be in the example. Regardless to project's stages and their details, the main fact that we could observe from this example that project is basically a dynamic transportation device which people use to reach to their goals and aims. Thus, many of the modern organizations have held this same point of view and strongly supported and considered as a key point for their success. In other word, they believe that project concept is the new business fashion for developing their companies organizationally and financially. For example if one of these companies has determined today that there are needs for improving or upgrading its internal IT system to get a better work function, they would immediately look at the project management process to be used as a tool to implement this specific task. The same action also will be followed by other similar companies, if they decided to introduce their products or services to a new market to generate and improve their financial income. Because of these important roles for projects in absorbing companies' internal and financial needs, there is a great global growing in implementing project management process in the work process loop of many modern companies. A fast rising trend for such approach can be particularly noticed among those companies who are worldwide involved in a very strong business competition and high market rivalry. This phenomenon has been rapidly spread out and exported to the new developing countries such as UAE and other gulf countries. Although, the maturity and the competition magnitude of business market in the gulf region is unmentionable comparing to those in USA and other advanced markets, many of giant organizations within the gulf region are trying competitively to catch up with their peers' from world class countries by adopting their standards, new business models, and practices. Regardless of

different needs and aims for both groups, what it is really important are the benefits of applying the project management model by clear understanding of its concept and the perfect implementation of its method. However; this is not the case in many of the largest organizations in UAE who are mostly split between two main industries; namely, are the Oil & GAS and the Construction sectors.

This research will focus on the evaluation of potential reasons for the failure of projects in oil and gas sector by studying the critical failure factors pertaining to overhaul projects. The results of this study will be used for better deployment of the Project Management process and applications in future projects specially at the area where are considered as key points toward projects' success. Not only that, but also the whole study as one piece will be as an essential reference for any future research, since the studies about project failures in oil and gas industry are very few (ex. Mahmoud et. al. (2009) and Fiberesima and Abdul Rani (2011)) comparing to the industry criticality and importance. The domain of study refers to one of the biggest offshore gas liquefaction and exporting company in UAE, which it would be named in this research as GPC for the purpose of the company protection and confidentiality. GPC has about one thousand five hundred employee's population to manage the plant maintenance, plant reliability, gas production, and other general and support services. GPC plant consists of three gas processing Trains that produce, Liquefied Petroleum Gas (LPG), liquid Sulfur, and Liquefied Natural Gas (LNG) with designed production capacity of 2.2 million tons, 0.35 million tons, and 5.5 million tons respectively. So with this size of operation and facilities, it is unsurprisingly that GPC generates a significant number of projects yearly to improve the plant's operation and to maintain the company's products production lines efficiency and continuity. Although these projects vary in their nature and importance, but all of them in principal should apply the same project management concept and process. As matter of fact, most of GPC's projects do not apply project management principles effectively and beneficially. Such wrong practice has developed a lot of financial losses and technical failures to GPC. A good example for these failed projects is the GPC Plants Major Overhauls. In fact, these annual projects are considered as the most important and significant projects, because of their criticality in term of works' nature and quantum, and the short period that is given to complete these tasks. Usually, these types of projects with their unique characteristics and conditions are accounted as a perfect case to be used in determining the Critical Failure Factors that standing behind the unsatisfactory result for GPC's overhaul projects.

For the research investigation reason, and both the data availability and time limitation, the GPC's 2009 Train 1 Major Overhaul project was selected as a sample for this study. The project was

initiated on July 2008 and completed on December 2009. Normally in such type of projects, the execution phase is usually the most critical phase in the project, where it must be strictly completed within the given time frame in order to meet both the gas supplier and the customer commitments. In the case of 2009 overhaul project, the execution period was originally planned only for forty days; however, the target date was not met and seven days of production delay/loss resulted. In general, the delay, which is defined as time overruns either beyond completion date that specified in the contract or the date that parties agreed upon for delivery of the project Salleh (2009), could lead to a significant profit loss in case of oil & gas's projects. In same context, the effect of delay may include cost overrun, disputes, arbitration, litigation, and total abandonment Chan and Kumaraswamy (2002). Refer to 2009 Train 1 overhaul, the mentioned delay happened because of several factors like disappearance of good communication, incessant change in the project work scope, poor procurement management, and other reasons which are hereditarily called as critical success factors Belassi and Tukel (1996). Overall, these critical success/failure factors related to overhauls projects were analytically and rationally discussed throughout this research.

1.2 Train 1 2009 GPC's Major Overhauls Objectives:

To perform a major maintenance schemes to maintain efficient and safe performance of Plants and Equipments. Also, the project must be delivered in reliable and safe manner, and within time, budget, and quality specifications.

1.3 Problem Statement of the Research:

Project Management is one of the most recent debatable subjects in the modern industry and in business world in general. As a matter of fact the success or the failure of any project, it greatly depends on how good or how poor the project management concept and process has been affectively applied. Therefore, it has become indubitable for many organizations the necessity of using an effective and efficient project management process to achieve their objectives brilliantly. On the other hand the appearance of poor project management is seriously indicates the instant need for a clear understanding, deep analysis, and practical solutions for the problem in order to be avoid it in the future.

Recently, GPC have complained from its insufficient capabilities and experiences in handling different type of projects and explicitly their plant major overhaul projects. This problem was referred to the inadequate implementation of the project management process in GPC plants major overhaul projects. Although, GPC is arguing that their project management system is based on the worldwide best practice of the project management model, but the reality shows that GPC has a

major misunderstanding of the project management principles and its practical application. The current situation had led many of GPC's projects to suffer from major technical and financial failures. Therefore, it became very interesting to discuss deeply the project management system in GPC by studying the project Critical Success/Failure Factors through one of GPC plants' major overhaul projects. In other word, if the GPC could clearly identify the CSF/CFF in their projects, then GPC might have better application of project management on those areas.

The yearly sequential requirement of major overhaul to GPC's production trains is unavoidably enforcing GPC to book about 40 days every year for its extensive overhaul works. During that scheduled period, a full shutdown for the targeted train is required to overhaul all of the associated equipments safely and effectively. Any delay in the completion of deliverables results in millions of dollars loss to GPC. In contrast, if the required deliverables are fulfilled earlier, it will result in a significant profit to GPC.

Hence, the importance and the criticality of such type of project with respect to GPC business nature are extremely high; it was strongly recommended to consider the type of overhaul projects as a case study in this research.

1.4 Research Aim and Objectives:

1.4.1 Aim:

To study the critical failure factors and their effect on the failure of overhaul projects in terms of completion time delay.

1.4.2 Objectives:

Objectives to be achieved in this study are:

1. Identify the CFFs that are responsible for delay of overhaul projects from extensive literature review.
2. Prepare a methodology to perform research survey to identify the effect of CFF on the delay of overhaul projects.
3. Grading the CFFs based on the increasing order of importance.
4. Based on the graded CFFs, a framework of corrective actions to be developed.

1.5 Dissertation Outlines:

Chapter 1 is generally gives an introduction about the whole thesis with a background setting of the work. In addition, in this chapter the research problem statement is logically arrived, and based on that the aim and objectives of the research were determined.

Following the general research structure pattern the literature review is developed in the second chapter. The literature review chapter is deeply focused on gathering all the previous studies, articles, and books that defining the project critical failure factors for a possible application to the domain of the present study. As result of the literature review outcomes, an umpteen number of CFF's in the literature is found. Therefore, a clear research boundary is designed by categorizing these CFF into three major groups that fit the most; namely, procurement, scope of work, and communication CFF. Furthermore, a survey is floated to test the validity of these CFF groups with the listed CFF's. However, all these essential information, classifications, steps, and methods which are incorporated in this research; it might not be used effectively, if it is not specifically identified in the research framework section at the end of the literature review chapter. In fact, the research framework section can be called as the steering wheel for the entire research, because of the key role that plays in keeping the research within the required boundary.

As part of the thesis structure sequence, the research methodology discussion takes place after the literature review chapter. A substantial detail is given in chapter 3 about the methodology that adopted to validate the determined CFF from the literature review and the relevant grouping gradation.

Following to the above mentioned chapters the Data analysis is presented in chapter 4 which includes the detail discussion for the research outcomes substantiated with rational backups from literature review resources. Based on that review and analysis the CFFs are grouped and ranked in the most reasonable way.

Finally, conclusions with limitations of study are presented in chapter 5. The proposed model that connecting project delay with CFF groups and their individual CFFs is presented for further application in overhaul projects which could avert or minimize any potential delay in the future.

Chapter 2

Literature Review

2.1 Introduction:

Chan (2003) claimed that success of a project is ambiguous as far as construction projects are concerned. While some identified time, cost and quality as success factors, others concluded success is much more complex than that Dyrhaug (2002). However, in GPC Overhaul project, project success is considered as time factor as discussed in introduction chapter. This is because any save of the project time reflects in the project framework achievement. Work flawless study (GPC 2009) stated that any delay in the project program normally leads to scope, procedure, and standards compromising which is considered in oil and gas industry as project failure. GPC has measured time as criteria of success because any reduction in time for completion of overhaul works implies additional profit incurred due to extra quantity of the product that produced during the saved time. In contrast, any delay in the overhaul project timeframe implies loss of profit due to the absence of production in this extended time period. Variation of cost in overhaul projects is considered negligible compared to the variation in cost of the plant production in the delay period/savings period. Hence, time is pointed out as criteria of success for overhaul projects.
Looking at the problem from that point of view, leaves no rooms for speculation in how to diagnose this problem except from studying and evaluating the reasons for overhaul projects delays.

Many of the overhaul projects that completed with time delays have resulted in substantial economical losses to GPC as indicated in Train 1 Management Report (GPC 2009). In this context, a study was proposed to examine the problem's root causes. Moreover, the study aimed to identify the causes for the delay and further observation of these causes to avoid any similar delays in future projects. As per GPC regular practice, all the project activities are scheduled by standard software using work break down structure and various levels of scheduling to eliminate any chances for project activities delay. Further to GPC projects procedures and process, a project milestone system established based on earlier developed schedules to control and monitor contractors' interim payments. So, it seems in general that GPC having in hand a proper system to schedule their projects activities before the onset of the project implementation. In fact, this is indicates that the current study should also look at the factors that beyond the project scheduling aspects to seek the best outcomes from the cause analysis of GPC projects delay. In same concept, it was observed by

Belassi and Tukel (1996) that such factors which are recognized as the causes for project failures are commonly labeled as critical failure factors.

However, while reviewing literature, studies on critical success factors (CSF) and critical failure factors (CFF) found to be mixed, and in the same time that the studies on critical failure factors were very few. As common sense, it could be stated that factors which affect success also affects failure, if not properly attended. Hence, these CSF's can also be coined as CFF's, in order to broaden the approach towards the problem, in the initial stage.

Concept of critical success factors (CSF) for evaluating projects was developed by Ronald Daniel (1961) which was further refined by Rockart (1981). It was stated that these factors shall be given constant and continuous attention so that the project shall be a success. In any business, the critical success factors are only certain number of areas, if they are achieved successfully, they will ensure competitive business performance Rockart (1982). Other researchers same as Chan (2003) named critical success/failure factors as key performance factors (KPI) which were used as a benchmark to evaluate projects objectively and subjectively. CSFs were initially developed for data analysis and business analysis. Further to this, critical success factors were applied to many projects to ensure success or to assess the success /failure of projects. These factors are discussed in details below to give insights to various aspects that responsible for project success or failure. Upon reviewing these literatures, it is expected that the methodology for evaluating most potential reasons for project failures (in terms of time) in Oil and Gas projects will be arrived at.

Additionally, the literature on CSF/CFF did not indicate a consensus for CSFs which can be commonly applied due to projects dissimilarity in nature, scope, priority, type of organizational structure, locations …etc. However, related projects based on the present works are studied and listed below in order to stand on all of the relevant CSFs/CFFs and proceed with further investigation on same subject.

On reviewing the existing literature, these factors can be understood in a broader perspective. Moreover, the methods for grading the CSF's also can be arrived through literature review process.

So based on the current understanding, the literature review will be specifically focused on the following questions:

- What are the CSFs/CFFs that associated with project success/failure and relevant to construction projects or oil and gas industry, so that these can be applied for present domain of work?

- What are the methods adopted for grading CSFs?

For finding answers to these questions, a thorough literature review is performed as follows.

2.2 Effect of CSF/CFF on Project Delay:

From the previous session, it can be initially hypothesized that critical success factors affect the project success. This hypothesis can be applied in order to understand the root cause of failure of most projects associated with GPC. So, the critical success factors affecting project success are reviewed from literature and listed below to establish a platform as start point of research work.
Since the present area of study is related to oil and gas field in term of plant overhaul projects including mechanical, electrical, and civil works, the relevant CSFs are only closely reviewed and studied.

Fiberesima and Abdul Rani (2011) had performed investigation on the critical success factors required for the successful deepwater development in the offshore areas of Nigeria. Fiberesima and Rani have categorized CSFs in their study as follow CSFs affecting project success, CSFs affecting portfolio management strategy, project budget, and project schedule. In that study CSFs that affecting the project success were found to be good project formulation, project management capability, good project implementation, realistic project duration, effective risk allocation, resource availability, access to secure finance, communication, innovative technology and proper estimation of capital cost. Similarly, the CSFs that affecting the portfolio management strategy were identified as follows realistic project duration, proper estimation of capital cost, project management capability, good project implementation, effective risk allocation, proper contract management and planning understanding of local environment, resource availability, access to secure finance, fast project delivery, communication, innovative technology and good project formulation. On the other hand, the factors that influencing the project budget were indicated to be proper contract planning and management, proper management capability, good project implementation, project duration, effective risk allocation, fast project delivery, communication, innovative technology and proper estimation of capital cost. And last but not the least, the CSFs that controlling project schedule were good project implementation, good project formulation, proper contract management and planning, proper estimation of capital cost, realistic project duration, effective risk allocation, understanding of local environment, resource availability, access to secure finance fast project delivery, communication, innovative technology and project management capability. Out of the CSFs mentioned above, thirteen were found out to be in common. Each of the CSFs were measured by a five point Lickert scale ranging from 1 which represents strongly disagree to 5 which represents

strongly agree and 3 represents neutral. Results of the study revealed mean value of CSF's affecting project success was 4.75, mean values of CSF's affecting portfolio management strategy was 3.83, mean value of the CSF's affecting project budget was 3.96 and mean value of CSF's affecting project schedule was 3.76. Also, major CSFs affecting project success (by considering average lickert scale values above 4.4) were good project formulation (4.44), good project implementation (4.49) and proper estimation of capital cost (4.44), and resource availability (4.45). Similarly, the highest score of the CSFs affecting portfolio management strategy were proper contract planning and management (4.24), good project formulation (4.14) and resource availability (4.07). Also statistically found that the most CSF's affecting project budget were proper estimation of capital cost (4.55), proper contract planning and management (4.26), and project duration (4.13). In the same way, the CSF's affecting project schedule the most were proper contract planning and management (4.53), good project formulation (4.39), project management capability (4.32) and understanding of local environment (4.28).

Belassi and Tukel (1996) had studied interaction of CSFs in affecting project success by introducing a scheme that classifies CSFs and describes the impact of these factors on project performance. First, CSFs were grouped into factors related to project manager and team members, factors related to project type, factors related to organization, factors related to external environment. Furthermore, Belassi and Tukel have looked at these factors from the point of an integrated system behavior where interfaces between them taking place toward project success or failure. The results of that study showed that CSF's affecting project success were different when they were put under scheme or system, and that was because of the noticeable relationships showed between these CSFs when they acted within this scheme. CSFs linked to the project manager group were revealed to be capability to delegate authority, tradeoff skill, coordination skill, awareness of role and responsibilities, competence and commitment. CSFs associated with project team members group were communication skills, commitment, trouble shooting skills and technical background. And, for the factors correlated with project type group widely found to be project's life cycle, project's value and size, uniqueness of project activities, project urgency and density. Where, the CSFs that linked to organization group were specified as follow top management support, project organizational structure, functional mangers' support and project champion. Correspondingly, CSFs involved with external environment group were political environment, economical environment, social environment, technological environment, nature, client, competitors and subcontractors. In the other hand, when the study looked at the CSFs behavior within the system concept some observation outcomes had been noted. First, the CSFs associated with response of the client consultation and acceptance system (it is a function of factors within the schemes of external environment, project

manager, and team members, and also another system response which is project managers' performance on job). Second, CSFs behavior toward the system response of project managers' performance on job (this is encompass interfaces of two another system responses and five group factors; respectively, client consultation and acceptance, project preliminary estimates, project manager, team members, project type, organization, and external environment). Third, CSFs relevant to project preliminary estimates response system (it is a function of two system responses which are project manager's performance on job, and availability of resources, and two group factors; namely, organization, and external environment). Finally, the system response of resources availability consisted of the function of another system module which was project preliminary estimates and two group factors related to organization and external environment. CSFs were measured when they were individually assessing project success using the objective choices to various factors and the results showed highest rank as availability of resources and top management support. However, when CSFs were grouped and shown with the interaction, and when the same objective choice was given for the same factors, different ranks for CSFs emerged comparing to when they were acting alone. These CSFs were top management support, factors related to project manager such as coordination and competence and some factors related to projects.

Baccarini (2009) performed a case study on 104 project completion reports and examined occurrence of CSF and identified top ten CSFs. At the beginning, he classified all CSFs from the studied reports into 18 groups. Then, a detailed description for each CSF in each group was given in order to list the top priority CSF. These 18 CSF groups were identified based on the review of literature and the recurrence of these CSF groups as follow: effective stakeholder management (90 occurrences), effective project planning (81), effective sponsorship (61), competent project manager (47), clear and realistic objectives (45), good communication (45), effective monitoring and control (43), competent and committed project team (37), sufficient and well planned resources (23), effective procurement (20), proven technology utilization (17), realistic, accurate budget and schedule (16), effective risk management (12), learning from previous experience (12), positive culture (9), clear logistic requirements (6) and absence of bureaucracy (3). Furthermore, these groups were shorted to ten items based on the most relative CSF group to project success comparing with the project completion reports which were found to be competent and committed project team (18.8 %), effective risk management (15.2 %), effective procurement (11.6 %), effective stakeholder management (10 %), realistic accurate budget and schedule (9.1 %), effective project planning (8.2 %), effective quality management (5.8 %), clear realistic objectives (4.3 %), good communication (4.3 %) and effective monitoring and control (4.3 %). Baccarini had also concluded that during any project, a particular attention must be paid to the committed and competent project team CSF group since it is the

number one item in ranking. And this attention must be more directed toward each of CSFs within that group in proportional to their criticality percentile as follow (from top to bottom) poor technical performance- design (52 % occurrence), lack of experience (13 %), poor time performance (13 %), poor technical performance- construction (8 %), non- compliance with standards (6 %), lack of commitment (5 %), inappropriate team culture (3 %).

Dyrhaug (2002) formed a generalized CSF model for managing offshore projects in Norway. The CSF categories that studied were global/industry related, macro environment, higher management within the company yet outside the project, between project organization and basis or supporting organization, internal influences, current and future, temporal end enduring, risk abatement/ uncertainty utilization, performance/ quality requirement, special monitoring and modification management. Results of the study revealed that understanding of project success criteria is different from one industry to another.

Tishler et al. (1995) had studied CSFs in 110 defense projects and its details were as follows. CSFs were generated using different criteria of project success such as success in meeting design goals, benefits to the end- user, benefits to the developing organization and potential benefits to the national defense and civil infrastructure. Inter-correlation analysis or canonical covariance for screening the CSFs took into account the mutual interaction of CSF's and success measures. Following that, the following CSFs were identified design considerations in the early phases of the development cycle and systematic use of methods to control schedule, urgency of need, , pre-project preparation, quality of the development team and its manager, professional growth and continuity, design policy of the developing organization, quality of the follow up team, budget and performance.

Al- Tmeemy et al. (2011) through a detailed study specified that project success is not merely through criteria of cost, time and quality, but by project management success, product success and market success. This study was relating to building projects in Malaysia.

Yu and Kwon (2011) identified CSF for urban regeneration projects in Korea and a model was proposed to prioritize them. Prioritizing model was based upon importance and satisfaction factors. CSF's were selected based upon brainstorming process among researchers confirmed by Delphi round which was further confirmed later through 29 expert surveys. Enlisted CSF's arising out were reasonability of project master and implementation plans, optimization of legal and administrative services, good communication and information sharing, minimization of disagreement between stakeholders, standardization of decision making process suitability of project management system, establishment of suitable organizational structure, cooperativeness of stakeholders on project,

performance management at each phase, balanced adjustment between the public and private interests. The most remarkable result of this study was that 'minimization of conflict between stakeholders' as the most crucial CSF. Priorities of CSFs were determined by a priority index (PI) calculated using the equation:

$$PI = (I - S) \times (I \div S)$$

Where I is the importance factor and S is the satisfaction factor. CSF is regarded as more important and of priority when the difference between I and S is large. In cases where I-S of two CSFs are equal, I/S gives the difference. That is the reason why I-S and I/S are combined so that at any case, the difference exists.

Delphi round, I and S measurements were performed using a 7 point likert scale from 1 which means strongly insignificant to 7 which means strongly significant.

These CSFs were evaluated in various phases of the project (from initial to execution phase) and observed that initial phase is the more critical one.

Ghosh and Jintanapakanont (2004) identified critical risk factors (CRFs) for a mass rapid –transit underground rail project. CRFs were initially floated by extraction from a review of literature. Further, a survey was performed to isolate and assess the risk factors. 59 variables (CRF) were adapted from studies by Akinci and Fischer, Andi and Minato, Balaoi and Price, Casey, Chan and Kumaraswamy, Chapman and Ward, Charoenngam and Yeh, Conroy and Soltan, Dey et al., Kartam and Kartam, Nkado, Rahman and Kumaraswamy, Shen, Tummala and Burchett, Yates and Eskander and Zhi (references listed in Ghosh and Jintanapakanont (2004). These 59 CRFs were errors and omissions, defective design, scope of work definition, inadequate specification, accuracy of project program, material productivity and shortage, fire and theft, construction method, culture difference between consultants, consultant lacks of adequate number of staff, subcontractor lack of adequate number of staff, contractor competence, economic disaster, design modification, subcontractor failure, coordination with subcontractors, conflict of document, damage to persons or property, poor team communication, availability of resources, delay in solving contractual issues, poor liaison with local authority, unsuitable type of contract, treatment of material removed from site, site access, defective construction work, construction delay, third party delays, quantity variations, change in work, late drawings and instructions, cost of test and samples, system outages, equipment productivity, quality of work, suitability of materials, accidents, labour disputes and strike, inflation, unavailability of funds, labour productivity, exchange rate fluctuation, tendered price, financial failure of contractor, financial failure of subcontractor, cost of legal processes, war, act of god

(earthquake, landslide, wind rain and flood), subsurface conditions of ground water, pollutions and safety rules, public consultation, change order negotiation, delay payment on contract and extras, subsurface conditions of geology, delays in solving disputes, permit and regulation, ecological constraints, environmental clearing risk and infrastructure by others not provided to program. Ranking of factors were extracted from factor analysis using a non-dimensional parameter called importance index.

Importance index $= \Sigma aX \times 100/5$

Where a is a constant that expresses the weighing given to each response, ranging from 1 (not important) to 5 (extremely important) and X=n/N , where n is the frequency of responses and N is the total number of responses.

Analysis was carried out after grouping the aforementioned 59 CRFs in 9 factors. From the analysis, it was observed that the risk of delay is most critical risk (importance index of 79 %). Safety and social risk was found to have the highest significant correlations.

Elenbass (2000) strongly argued that "projects are about communication, communication, communication". That is true; any project may still succeed, but without good internal and external communication the cost of success will be much higher and takes much longer than it should be.

Being capable to communicate clearly will keep you from re-explaining information over and over, and save a lot of time for the project. Therefore, Elenbass (200) insisted in his recommendation that regular communication with project stakeholder should be enhanced through weekly status reports and regular formal and non formal meetings.

Elenbass recommendation is in line with Jacobson and Choi, (2008) outcomes. Jacobson and Choi had studied the principal factors that contribute to successful projects through many interviews and observations. They found out ten success factors, but the high degrees of commitment and shared vision between the stakeholders were shown to be the most important aspects as well as open communication and trust with high levels of cooperation or teamwork. They concluded that trust and open communication can help the stakeholders to understand each other easily and to avoid unnecessary cost which could affect the project success.

In same context but in the field of information and technology projects, Acquah (2012) had highlighted many critical success factors, but the second most important one was in his argument that clear communicated project information and objectives. This result came out from a set of interviews

where the interviewees asked to rank the given success factors of project from 1-5 based on their importance, which 1 means being the least important and 5 being the most important.

Wixom (2001) also confirmed that the essential factor which could decide project success or failure is communication, because it is the tool to make sure that project management process and system is implemented successfully.

Nguyen, Ogunlana, and Lan, (2004) pointed out that a good implementation of project communication system helps to clarify and distribute all essential project information to all internal and external project stakeholders at the right time. As result, success could be solidly secured and possible failure could be prevented in projects. This conclusion arrived by Nguyen, Ogunlana, and Lan from the outcomes of designed questionnaire that asked the respondents to rate the degree of significance of 20 success factors. This questionnaire result showed that communication has been ranked as number four from top to down related to its importance to project success.

Braimah and Ndekugri (2008) studied factors that influence the delay and disruption of contractor's progress by identifying 18 factors obtained from literature review and pilot surveys which were further ranked for their relative importance based on the data collected from the nationwide survey of UK construction organizations. Factor analysis was then utilized to reduce the factors into six group factors. Factors studied were records availability, baseline program availability, nature of base line program, updated program availability, time of the delay, causes for the delay analysis, the other party to the claim, applicable legislation, the type of contract, cost of using the technique, size of project, duration of the project, complexity of the project, nature of the delaying events, skills of the analyst, the amount in dispute, dispute resolution forum and the number of delaying events. In the first stage for arriving at the factors, a questionnaire was prepared based on literature review which was further analyzed by collecting feedback from practitioners using a 5-point Likert scale (1 for not important and 5 for important) for the degree of importance and provision was there for adding any extra factor also. Results of the survey showed that record availability ranked in the first place, followefromby baseline program availability, while the bottom comes "the other party to claim" and "applicable legislation". Ranking with respect to contractors, consultants and overall was measured using a non-dimensional parameter, herein defined as relative importance index (RI).

$$RI = \left[\sum_{i=1}^{i=5} w_i f_i \right] \times \frac{100\%}{n}$$

Where f_i is the response frequency, w_i is the weight for each rating (given by rating in scale divided by number of points in the scale which is 5 and n is the total number of responses.

The degree of agreement between two groups in their ranking was investigated using Kendall's coefficient of concordance (W).

$$W = \frac{12 \times s}{k^2\left(N^3 - N\right)}$$

Where s is the sum of the square of deviations of ranking sum of the factors from the mean, k is the number of respondent groups, which is 2 in this case and N is the number of factors ranked. The significance of W was tested using a chi square approximation of the sampling distribution with $N-1$ degrees of freedom.

$$\chi^2 = k(N-1)W$$

For the purpose of future development of the model, 18 factors were grouped using factor analysis. The appropriateness of using factor analysis was first confirmed by number of tests including Kaiser-Meyerolkin (KMO) measure of sampling adequacy and Barlett test for sphericity. Principal component analysis was further used to extract six group factors with the eigen values greater than 1, suppressing all other values with eigen values less than 1 based on Kaiser's criterion. To clarify the factor pattern so as to ensure that each variable loads high on one group factor and minimal on all other group factors, the variables were rotated using varimax orthogonal rotation method. Thus, the six groups were record availability, characteristics of baseline program, cost proportionality, contractual requirements timing of the analysis, and project characteristics.

Looking back on Braimah and Ndekugri (2008) study, it will be noticed that project characteristics is one of the important CSF group in their study which include the project scope work size and definition is key player on that group. Acquah (2012) also described scope management is the most factors responsible for success or failure of projects. Not far from Acquah point of view, Songer and Molenaar (1996) had the same degree of agreement that the project scope and definition of objectives is one of important variable for project success. Similarly, Akintoye (1994), Pearson and Skues, (1999) shared same view that the first step for project success is to have very clear scope and efficient control of that scope.

Although, in the real world is not possible to say that project scope should never change, but what it possible say that these changes should be always minimized and well controlled.

During Acquah (2012) study investigation about factors that cause project to fail or succeed, it was revealed from the interview results that scope change is one of the direct causes that responsible for project failures. It was also discovered that the reasons gives for failure, at least 50 % are scoped based reasons. On the other hand, the factors that accounted for successful projects were more than 50% scope related factors

Attarzadeh and Ow (2008) had conducted study regarding why some projects were completed successfully where others were not completed on time, over budget, or being cancelled. In order to study this phenomenon, they used a questionnaire methodology that covers the key factors in project management like budget, time and scope. They found out that the more proper understanding of scope, the better job on monitoring project progress and controlling outcomes can do by organization which eventually leads to attain the project deliverables successfully.

Thomas and Tang (2010) established CSFs for labour- intensive construction subcontractors using a self administered questionnaire survey. Identification of CSFs was made through descriptive statistics. Questionnaire for survey was identified based on literature survey and it administrated into three sections, first section was for the general information of the respondents, further two sections were designed to capture the views of respondents on the level of labour and equipment intensiveness of different kinds of subcontractors as well as the importance of 29 success factors. In order to differentiate a highly labour intensive or highly equipment intensive, respondents were asked to select a 1-5 scale (1 is full labour intensive and 5 is full equipment intensive). Further, respondents have to indicate whether each of the identified success factors is least important (as represented from 1 to 5-point Likert scale) or very important. In the data analysis, the mean and the rank of the variable was found. From the data analysis, it was observed that the top five subcontracting disciplines being identified as labour intensive were steel fixing works, finishing wet trades, painting works, joinery and wooden flooring and water proofing system. On the other hand the highly equipment intensive subcontractors disciplines found to be excavation works, foundation works, demolition works, pre-stressing works and lifts and escalators. As per the mean ratings and rank, nine CSFs received a mean of 4 and above and they were regarded as important. These factors were timely completion, profit, program/planning, cash flow, management level leadership, relationship with main contractor/client/consultant, staff team spirit/morale, staff qualification and growth in revenue. Significance of the sample was obtained from one sample t-test and one-way anova test with an adjusted alpha level of 0.025. A factor analysis was conducted to understand the structure of the relationships between success factors. A Kaiser-Meyer-Olkin measure of sampling adequacy is used to test the data as adequate and while an observation of 0.5 is considered generally

acceptable, obtained value of 0.7 confirms the data despite quite small is adequate for factor analysis. A factor loading with an absolute value of less than 0.4 is suppressed. Bartlett's test of sphericity, a statistical test for the presence of correlations of variables, is 127. 504 and the associated significance level is 0 is obtained. The three factor components extracted from the factor analysis were managerial performance, financial performance, and labour intensive specific factors.

Fortune and White (2006) introduced a formal systems model which can be used a framing devise to deliver the benefits of CSFs while avoiding criticisms associated with CSFs. CSF mapped into formal systems model. This formal system identifies relationships between CSFs which was considered as drawback of CSFs. Interaction between various systems with CSF linked with each system is suggested. CSFs linked with each system were as follows. Support from senior management, competent project manager, strong detailed plan kept up to date, realistic schedule, good leadership, correct choice/past experience of project and management methodology/tools were part of decision maker(s) in the system. Skilled/suitably qualified/sufficient staff/team was part of transformations system. Political stability, environmental influences, past experiences and organizational adaption, culture etc. are part of environment system. CSFs such as project size, level of complexity, number of people involved and duration were part of the boundaries in the system. Adequate budget, sufficient/well allocated resources, training provision, proven/familiar technology, good performance by suppliers/contractors and consultants were part of resources system. Risk addressed/assessed/managed, user/client involvement, different viewpoints, project sponsor/champion and effective change management were part of continuity system. These systems were properly connected to arrive at the relations between systems and also the relationships between CSFs in the system too.

In a research conducted in Hong Kong SAR China during 2000-2004 in the field of information and communication industry, Ugwu and Kumaraswamy (2007) reported that cost of development, top management support, availability of appropriate hardware/software, clear communication, change management at organizational level, clear understanding of end user requirements and development of team knowledge were the most CSFs in the majority of information and technology projects.

Data analysis were performed for weighing CSF's using a parameter called "IT benchmark index" and is given as follows:

$$ITB_i = \frac{\sum W}{AN}, \left(0 \le ITB_i \le 1\right)$$

where, w = weighting given to each factor by the respondent, which is ranged from 1 to 5 , where 1 is “not at all” and 5 is “a very large extent”.

A = the highest weighing, which is 5, and

N = the total number of respondents

Saqib et. al. (2008) assessed CSFs for construction projects in Pakistan. Seven CSF groups were arrived at after a thorough literature review. These included project management factors, procurement related factors, client related factors, design team related factors, contractor related factors, project manager related factors, and business & work environment related factors. These factors were assessed based on a survey using questionnaire. This questionnaire consisted of two parts. Part A consisted of respondent’s personal information. Part B consisted of checklist (consist of 7 CSFs aforementioned) which was prepared after extensive literature review. The respondents were asked to rank the CSFs in the checklist. Ranking of CSFs was based on a rating of 1 to 10 (1 having the lowest importance and 10, the highest). Mean and model values of each CSF were identified. Criticality index was assigned to each factor as a function of mean factor score range I.e. Criticality index is 1 if mean is between 1 to 2.5, 2 if mean is between 2.5 to 5, 3 if mean is between 5 to 7.5, 4 if mean is between 7.5 to 10. Criticality index of 1 point to least significant towards project success and 4 indicates most significant towards project success. Various CSFs related to project management were control mechanism, trouble shooting, planning effort, coordination effectiveness, decision making effectiveness, formal dispute resolution process, communication system, project monitoring, implementing an effective safety program, implementing an effective quality assurance program, feedback capabilities, control of subcontractor’s work, prior project management experience, developing an appropriate organization structure, risk identification and allocation, motivation/ incentives, constructability program, training the HR in the skill demanded by the project and overall managerial actions. CSFs linked to procurement related factors are project bidding method, project contract mechanism, and project delivery system. CSFs associated to client related are influence of client/ client representative, nature of client (privately funded vs. publicly funded), size of clien’s organization, client’s emphasis on quick construction, owner’s risk attitude (willingness to take risk), client’s experience, client’s knowledge of construction project organization, owner’s construction sophistication, owner’s clear and precise definition of project scope and objectives, client’s confidence in construction team, timely decision by owner/ owner’s representative, client’s emphasis on low construction cost, client’s emphasis on high quality of construction, client’s project management, client’s ability to brief, client’s ability to make decision and client’s ability to define roles. CSFs correlated to design team were project design complexity,

mistakes/ delays in producing design documents, design team experience, design team's contribution to construction (constructability review, value engineering etc.), and adequacy of plans and specifications. Contractor related CSFs were site management, supervision, contractor experience, contractor's cash flow, effectiveness of cost control system, extent of subcontracting, and speed of information flow. Project manager related CSFs were project manager's experience, selecting key team members etc., project manager's commitment to meet quality, project manager's authority to take day-to-day decisions, project manager's competence, project manager's authority to take financial decision, leadership skills of project manager, organizing skills of project manager, technical capability of project manager, coordinating ability and rapport of project manager with contractors/ subcontractors, coordinating ability, rapport of project manager with owner/owner representatives, cost and time, project manager's early and continued involvement in the project, motivating skills of project manager, project manager's ability to delegate authority and construction control meetings. CSFs related to business and work environment were economic environment, social environment, project manager's adaptability to changes in project plan, political environment, physical work environment, administrative approvals environment, commitment of all parties to the project, adequacy of funding, technology availability, industrial relations environment, human skill availability and X –factor (fraudulent practices, corruption, favoritism, lack of ethics etc.). On data analysis, the top five CSF groups were project manager related factors, design team related factors, procurement related factors, contractor related factors, and project management related factors. Top 10 CSFs in descending order were project manager's experience, planning effort, contractor's cash flow, timely decision by owner/owner's representative, decision making effectiveness, site management, supervision, contractor's experience, prior project management experience and client's ability to make decision. This paper focused on CSFs only and not on the measurement of project success, ie. key performance indicators (KPI's). Further studies are required to identify KPI's and finding relationships between KPI's and CSF's.

Relevant to Saqib et. al. (2008) study, Hulme (1997) found out that procurement is not the only factor that effect higher failure rate to the project; it was also the main source of difficulty that project could face. Furthermore, Hulme (1997) defined project procurement as a starting relationship with a vendor to execute any project, so if the selection of vender was wrong, the whole project will be in danger. Based on Hulme (1997), it seems that procurement is one of the most crucial stages for any project, and therefore it will be very beneficial to identify the CSFs that related to procurement which could play vital role toward project success / failure.

Yi et. al.(2006) explored the factors responsible for the failure of Chinese construction Industry. Methods used to evaluate these factors were literature survey, questionnaire surveys and case studies. Thus failure factors obtained and classified into three groups namely failure of construction project, construction enterprise and failure of construction manager. Factors associated with failure of construction project were fault in project decisions, fault in project financing, fault in project surveying, fault in building designing, losing control of delivery time of project, losing control of cost, losing control of quality management, losing control of risk and fault of techniques and responsibilities. Factors associated with failure of construction enterprise were failure of beneficial results, losing credit, failure of strategic decisions and performance, marketing failure and failure of employments of managers. Factors associated with failure of construction manager were failure of social and moral, failure of management and failure of law- discipline.

Poon et. al.(2001), through their paper have identified success factors in the construction process namely, top management support, planning, control, approximate size of work package, clarity/ definition of project objective, communication and information management, scope of project, project manager, project team scope of project, project manager, project team, environment, health and safety. These factors were obtained after reviewing a set of literatures.

Al-Barrak (1993) studied the causes for contractor's failure in Saudi Arabia. The causes were broadly classified into managerial, environmental, financial and expansion. Under managerial causes, the sub-causes identified were lack of experience in the line of work, replace key personnel, assigning project leader in the site, inadequate decisions in regulating company policy, labour productivity and improvement, use of project management techniques, company organization, procurement practices, claims, internal company problems, recruiting from one country, recruiting multi-nationality, owner absence from the company, using computer applications, frauds and neglect. Environmental clauses were classified as national slump in economy, construction industry regulations in Saudi, owner involvement in construction phase, and region climate. Financial causes were broadly sub-classified as low margin profit due to competition, cash flow management, poor estimation practices, bill and collection, controlling equipment cost and usage, evaluate project profit in one fiscal year, employee benefit and compensations. Expansion factors were subcategorized as expanding into new geographical locations, opening a regional office, increased number of projects, change in the type of work, lack of managerial development as the company growth and change from private to public and vice versa. These failure causes were classified based on a five point scale "very influence, influence, slight influence, no influence, can't decide. From this study, it was observed that insufficient experience in the line of work and poor estimation practices, no restriction

on those entering on construction market, delays in payment, labor productivity and lack of managerial maturity are the main causes of failure to various grades of contractors.

Yan (2009) identified critical factors for managing project team communication in the construction stage. Factors considered were contractor's expertise, social and informal mechanisms for a collaborative working environment, arrangement of organizational structure, designer's expertise, project client expertise, capable construction project manager, project document management and project communication media infrastructure. From the study, the top critical factors emerged were contractor's expertise, social and informal mechanisms for a collaborative working environment, and arrangement of organizational structure. A five point scale of frequency was adopted to measure the project communication performance. In this scale, 1 indicates always and 5 indicates never (experiencing frequency).

Salleh (2009) reported by reviewing literature by Baldwin et. al (1971) that weather, labour supply and subcontractor's scheduling are the major causes of delay for major construction projects. Based on this study, seven most important causes of delay for construction projects in Brunei were highlighted as follows Lack of communication between parties, Slow decision making, Change orders, Inadequate contractor planning, Finance and payment of completed work, Subcontractor performance, and Inadequate contractor experience.

2.3 Comments from the Review of Literature:

It is clear that there are umpteen CFFs/CSFs expressed in the literature, applied to construction industry and oil & gas fields. However, it is not possible to select all of them for further analysis through some test means, since; any survey requires a limited domain of the variables to be tested. Hence, for practical verification and ranking of CFFs, these CSFs were revisited once again in order to be grouped and rearranged. The outcomes of this filtration process for the unlimited literature are presented in the framework portion of the thesis. In order to convert the infinite degree of freedom of the study to finite one, it is reasonable to exercise applicable assumptions. The assumptions are (A) CFF/CSF's can be put in to convenient groups so that many CFF/CSF's having similar meaning can be put as one, so that the number of variables can be reduced (B) Those coming outside the domain of CFF groups can be put in any one CFF group having near domain set (C) Those CFF's which do not have application in the domain of study can be neglected.

2.4 Framework of Dissertation:

2.4.1 Introduction:

From review of literature, there are many CSFs are based on various project types which gives no directions for further work. Hence, idea of grouping CSF was thought off. Belassi and Tukel (1996), as well as Fortune and White (2006) had grouped CSFs and interlinked them functional wise to have more fruitful results. In this school of thought, the above CSFs were thought to be grouped together to serve the research aim. Three groups were proposed to befit most of the CSF/CFF above which are Procurement, scope of work, and communication. These groups found to be very critical areas in the project management process that used in any projects. These findings agree with the statements that previously mentioned by Hulme (1997), Attarzadeh and Ow (2008), Acquah (2012), Skues, (1999), Akintoye (1994), Songer and Molenaar (1996), Nguyen, Ogunlana, and Lan, (2004), Wixom (2001) , and Elenbass (2000). Based on this broad agreement by many researchers beside Major Overhaul Lesson Learned Document (GPC 2009), It was thought that these groups are the pillar stones for any type of construction project and in particularly GPC overhaul projects.

Hence, on observing the CSF/CFF's on the above literature and their projected groups, the following table was arrived at.

Table 1: Ramifications of CSF Groups from Literature

Sl. No.	Details of CSF groups and detailed CSF's			Relevant source
	Ramifications from Procurement	Ramifications from scope of work	Ramifications from communications	
1.	Adequate contractor experience.	Good control of change orders /scope	Effective communication between parties.	Salleh (2009)
2.	Contract planning, management, and resource availability.	Proper estimation of capital cost and project formulation.	Communication integrated system.	Fiberesima and Abdul Rani (2011)
3.	Availability of contractor resources.	Size and value, uniqueness of project activities, density of a project, life cycle and urgency project, and project works/packages	Co-ordination of project manager and communication skills of project team members.	Belassi and Tukel (1996)

		estimate.		
4.	Realistic and accurate budget and schedule for procurement. Sufficient and well planned resources.	Clear and realistic project objectives.	Suitable communication means.	Baccarini (2009)
5.	No specific parameters given	No specific parameters given.	No specific parameters given	Dyrhaug (2002)
6.	Methods to control schedule, budget, and contractor performan*ce*	Pre-project preparation design to be considered in the early phases of the project development cycle.	No specific parameters given	Tishler et. al.(1995)
7.	Study was about criteria regarding project success	Study was about criteria regarding project success.	Study was about criteria regarding project success.	Al- Tmeemy et. al.(2011)
8.	No specific parameters given	Reasonability of project master and implementation plans.	Minimization of conflict between stakeholders, good communication, information sharing, and establishment of appropriate organizational communication procedure.	Yu and Kwon (2011)
9.	Contractor competence, delay in solving contractual issues, subcontractor failure, availability of contractor's resources, unsuitable type of contract, quantity variations, , unavailability of contractor pre-spend funds, financial failure of contractor, financial failure of subcontractor, delay on contractor payments for original and variation works, and conflict of contract documentation.	Scope of work definition, inadequate design specification, change in work scope and tendered price.	Poor team communication, cultural differences , poor liaison with local authority, and coordination with subcontractors.	Ghosh and Jintanapakanont (2004)

10.	Monitoring of subcontractors claims. Dispute resolution forum. Record of contractor previous projects in term of delay claims. Form of contract, and applicable legislation.	No specific parameters given.	No specific parameters given.	Braimah and Ndekugri (2008)
11.	No specific parameters given.	No specific parameters given.	No specific parameters given.	Thomas and Tang (2010)
12.	Adequate budget. Sufficient/well resources allocation. Good performance by suppliers/contractors.	No specific parameters given.	No specific parameters given.	Fortune and White (2006)
13.	Control of subcontractor's work, project material delivery system, project bidding method, contractor selection criteria, project contract mechanism, contractor's cash flow, contractor experience and nature of client (privately funded vs. publically funded)	Clear and precise definition of project scope and objectives by client/customer.	Clear project organization structure, feedback capabilities, trouble shooting, effective coordination and communication system.	Saqib et. al. (2008)
14.	Fault in project financing method and contractual payments method.	No specific parameters given.	No specific parameters given.	Yi et. al.(2006)
15.	No specific parameters given	Clear definition of project objective and project scope.	communication and information management	Poon et. al.(2001),
16.	Claims resolution	Poor estimation practices.	Recruiting multi-nationality	Al-Barrak (1993)
17.	No specific parameters given.	No specific parameters given.	Social and informal mechanisms for a collaborative working environment, project document management and project communication media infrastructure.	Yan (2009)

From table 1, the CSFs and CSF groups are refined and rephrased to be more clear and precise as shown in table 2, for further verification of its application in the present domain of study, indicating the nomenclature of the variables. Furthermore, the name of CSF was replaced by CFF (Critical

Failure Factor), since it is only a two faces of one coin, and in the same time to be in line with study aim and objective.

Table 2: C.F.F. Groups and C.F.Fs Considered for Data Analysis

Sl. No.	**Procurement related** (P*)	**Scope of work related** (S*)	**Communication related** (C*)
1.	Insufficient contractor resource availability.	Unanticipated work	Poor liaison with local authority
2.	Inadequate contractor resources planning.	Absence of structured process for adding work	Un-established communication procedure within the project organization.
3.	Absence of procurement plan control and monitoring system.	Inadequate design specification	Insufficient Project communication media infrastructure
4.	Inefficient project bidding method.	Undefined scope	Unsuitable selection of communication means
5.	Non-availability of contractor previous projects records in term of delay and claims.	Pre-project preparation design to be considered in the early phases of the project development cycle.	Lack of communication between stakeholders
6.	Delay in solving contractual issues.	Unclear objectives for the project	Inadequate social and informal mechanisms for a collaborative working environment
7.	Delay payment on contract.	Insufficient time available comparing to work required to be done.	Incompetent project documentation management system.
8.	Nature of client (privately funded vs. publically funded)	Uniqueness of project activities.	Poor coordination with subcontractors.
9.	Poor monitoring of subcontractors claims.	Adding anytime work with overhaul work	Cultural differences (due to multi-nationalities recruitment)
10.	Conflict of contractual documents.	Improper estimation of capital cost which leads to scope reduction.	Inadequate Communication skills

11.	Inefficient contract planning and management.	Improper project works/packages estimate	Ineffective co-ordination of project manager.
12.	In appropriate contractor selection criteria.	Change of scope due to absence of real cutoff date.	Late and incomplete feedback
13.	Poor project material delivery system	Unreasonable project master and implementation plans.	Lack of sharing information.
14.	Incapable contractor.	-	-
15.	Insufficient contractor's cash flow	-	-
16.	Unsuitable type of contract.	-	-
17.	Lack of experience of subcontractor	-	-

* Coding-Pi indicate CFF's i ranging from 1 to 17 in procurement related factors (P1 is the first CFF under procurement related factors)

*Coding-Si indicate CFF's i ranging from 1 to 13 in scope of work related factors.

*Coding-Ci indicate CFF's i ranging from 1 to 13 in communication related factors.

2.4.2 Data Analysis Procedure:

Type and details of data analysis performed by different researchers were reviewed and given below in Table 3 for the purpose of selecting appropriate data analysis. Different formulae for evaluating the degree of importance of C.S.F., was also given in the same table.

Table 3: Different Data Analysis Modes Adopted by Various Researchers.

Sl. No.	Details of model for grading C.S.F./C.F.F.	Relevant source
1.	Each of the CSF's were measured by a five point Likert scale ranging from 1 which represents strongly disagree to 5 which represents strongly agree and 3 represents neutral.	Fiberesima and Abdul Rani (2011)
3.	CSF's were measured when they were individually assessing project success using the objective choices to various factors and the results showed highest rank is the criteria.	Belassi and Tukel (1996)
4.	Selection was based on percentage weighing of assessment.	Baccarini (2009)
5.	Not specified.	Dyrhaug (2002)
6.	Intercorrelation analysis or canonical covariance for screening the CSF's.	Tishler et. al.(1995)
7.	Not specified.	Al- Tmeemy et. al.(2011)
8.	$PI = (I - S) \times (I \div S)$ Where I is the importance factor and S is the satisfaction factor. CSF is regarded as more important and of priority when the difference between I and S is large. In cases where I-S of two CSF's are equal, I/S give the difference. That is the reason why I-S and I/S are combined so that at any case, the difference exists. Delphi round, I and S measurements were performed using a 7 point likert scale from 1 which means strongly insignificant to 7 which means strongly significant.	Yu and Kwon (2011)
9.	Ranking of factors were extracted from factor analysis using a non-dimensional parameter called importance index. Importance index $= \Sigma aX \times 100/5$ Where a is a constant that expresses the weighing given to each response, ranging from 1 (not important) to 5 (extremely important) and X=n/N , where n is the frequency of responses and N is the total number of responses.	Ghosh and Jintanapakanont (2004)
10.	A 5-point Likert scale (1 for not important and 5 for important) for the degree of importance.	Braimah and Ndekugri (2008)

11.	Respondents were asked to select a 1-5 scale (1 is full labour intensive and 5 is full equipment intensive).	Thomas and Tang (2010)
12.	Not specified	Fortune and White (2006)
13.	Ranking of CSF was based on a rating of 1 to 10 (1 having the lowest importance and 10, the highest). Mean and modal values of each CSF were identified. Criticality index was assigned to each factor as a function of mean factor score range. Ie., Criticality index is 1 if mean is between 1 to 2.5, is 2 if mean is between 2.5 to 5, is 3 if mean is between 5 to 7.5, is 4 if mean is between 7.5 to 10. Criticality index of 1 indicates least significant towards project success and 4 indicate most significant towards project success.	Saqib et. al. (2008)
14.	Not specified	Yi et. al.(2006)
15.	Not specified.	Poon et. al.(2001),

From the above, it is observed that a five point likert scale is adopted by many researchers. Hence, here also such is followed.

Explanations to CFF groups which include procurement, scope of work and communication are described in detail. Explanation on the type of survey used in this research is also given.

Fundamental purpose of such surveys is to see the reflection of CSF groups and the CSFs on the cross section of the survey domain, and to check whether the same CSFs have relevance in the domain of the project.

These CSFs were chosen on the basis that other usual ones well fit the areas like project scheduling, Scope work control, project communication system, quality control, HSE controls, well contract management system, qualified personnel for each specified post, and thorough specifications are a boon to GPC. The cause of failure due to out of track factors is required to be evaluated and put in the strategic framework to ensure better control. Such out of track factors are termed as critical success factors/critical failure factors

Even though without selecting from literature, CSFs can be set by direct experience of the project, since it is only required to be validated by the survey. However, such an attempt is not made. In fact, the CSFs from review of literature mean a wide range of opinion from across the world in the similar area; thus, they are directly pooled together before the survey round.

Evaluation of CSFs based on survey is a function of the response from people. People may be inclined towards or biased or fearing some aspects especially when responding about powerful persons who has still higher impact on them in future. Measures that required addressing this issue are not covered in the literature.

However, this issue is covered in this study by assuring the respondents that their responses will be treated as confidential information and it won't be disclosed with anybody within their company.

Research procedure:

1. Review of literature
2. Proposing the CFF groups relevant to overhaul projects and CFF's under each CFF group
3. Groups Sensitivity Survey was distributed and 13 respondents were received
4. CFF Gradation Survey which covering each CFF in Table 2 was distributed and 30 respondents were received
5. Survey questionnaires were transmitted to participants by email and face to face administration. Similarly, the responses were collected either through email or personal submission. Response of each participant was assured confidential.
6. Analytical analysis was produced based on the collected data from the literature review and the distributed surveys.
7. Recommendation/solution Matrix was incorporated in this research to improve GPC future projects.
8. Limitation of the work pertaining to the thesis is presented in conclusion chapter.

2.4.3 Scope of data analysis:

Hence, the scope of data analysis is to test the criticality of the listed CFF in each group as shows in Table 2 with the present domain of study.

Chapter 3

Research Methodology

3.1 Introduction:

In general, threshold of deep understanding of problem relies generally on case studies. This is because once the problem comes to surface, it will become with no doubt that some possible root causes are the bases of this problem Stake (2010). Thus, identification of these root causes becomes possible with the deeper understanding of the documents that originated by these problems Fortune and White (2006), Baccarini (2009). After identifying the problem and its cause, the solution phase for the problem it has followed. Simply the solution stage will be based on reviewing the resolutions of similar problems that tackled by other researchers which is clearly captured on the literature review section Creswell (2007). Understanding the problem through these exercises of case studies, threshold literature surveys a method for solution springs Saqib et. al. (2008), Yi et. al. (2006). In addition, a data survey has been generated to support the research proposition which can be also added to the cart of the above research methods. This collected data with its analytical analysis will give a substantial authentication to the problem definition as well as to the proposed solution. Going through these available methods including data collection found very efficient toward the final result of the whole research. Not to mention, the same pattern of methodology process was found in other studies related to same field. More or less, the same is also maintained here. This is explained in the subsequent sections one by one in detail.

3.2 Methodology Objective:

After having established the aim and objectives which pulled from threshold case study results and extended through extensive literature survey, it is imperative to discuss the methodology involved in this study during the course of this chapter. Furthermore, the methodology also identifies the method that will be used to capture the research data. Many methods of collecting data have been described in literature of Yan (2009), Bandara (2007), Salleh (2009). As matter of fact, it is very important to choose the right process in collecting the research data because of two main reasons as Johnson & Christensen (2012) claimed. The first one is for the data creditability; in other word, the truthfulness and accuracy of the information that gathered from the targeted sample. The second reason is related to the key role that the methodology plays in the information accessibility level and the collaboration extent of the surveyed sample. For instance, in multinational organization and in a closed culture corporation it will be more practical to use the interview method rather than the survey technique to

obtain the required information more effectively Glesne (2006). Because in such kind of organization it requires close interact with the employees to explain each enquiry in such way that takes out any doubts or worries that could surround the employees due to their differences in nationalities, languages, cultures, believes, or backgrounds. On the other hand, for large sample such as geographic sample it seems that the paper survey method is much easier and more efficient Yu and Kwon (2011).

Hence, the research methodology objectives are to:

a) form a methodology to investigate variables;

b) Use statistical analysis to interpret the results under a well defined model.

Scientific research refers to systematic, controlled, rigorous, and empirical investigation of a hypothetical proposition about a presumed relation in order to find a solution to the problem or to discover and interpret new knowledge Salleh (2009).

3.3 Type of Research:

The objective of any research is to produce new knowledge, so it is very important in any research to define the research type by understanding the research goals or what it is trying to prove or what this research is after Johnson and Christensen (2012). Generally, the type of any research falls under three main categories; namely, expletory research, constructive/descriptive research and empirical research Sekaran and Bougie (2009). The expletory one is basically addressing new issue or problem which is similar to what partially happening in this research. Then, the constructive/descriptive research where is trying to come up with solution for an existing and known problem, and this kind of research features also will be seen in some part of this research. And the last type of research is the empirical research which is studying the viability of the problem solution by applying the empirical evidence. However, in this research the characteristics of both expletory & constructive research types are combined to make full understanding about the problem in GPC overhaul projects and in the same to produce some tips to resolve this problem effectively. This is in line with the state-of-the-art practices Thomas and Tang (2010), Braimah and Ndekugri (2008). For example, some of known research's tools for collecting data have been used first to identify the problem. Then, the outcomes from the same exercise will be used to find out the most suitable resolution for the problem in line with the found facts in the literature review section.

3.4 Source of Research Data:

Knowing the type of data that it will be used in the research is very critical, because it is the cornerstone in deciding the method that will be followed to collect these data Sekaran and Bougie (2009). In other words, the better mean used in collecting information the better quality of data will be. Thus, it is very necessary before deciding what method that will be used in collecting the research's data; it will be first better to filtrate the data sources into two groups. The first group is the secondary data which refers to the data that already existing. In many cases the secondary data come in the format of technical reports, scientific studies, experiment result or any other archived documented data which was already tested and made available as reference for any study in the future Vartanian (2011). As part of this research the secondary data that will be used are GPC Tender Document for the Major Overhaul Main Contractor Selection, GPC 2009 Work Scope Addition & Deletion Document, GPC Train1 2009 Major Overhaul Management Report, GPC 2009 Major Overhaul Lesson Learned Document, and GPC 2009 Work flawless study. The data in these documents will be used to define the problem and then later to be used as a guideline for the problem solution. The second data group is the primary data which is simply is a data does not exist yet and requires further investigation and close searching Creswell (2007). Again, this type of data shall be analyzed either through qualitative and quantitative research. The quantitative research is based on experimental examination of the quantitative properties and the phenomena and their relationships. In other word, the quantitative reach is aiming to prove theories or assumptions in very systematical, objectively, and mathematical way by using for example statistical data or other similar tools Yin (2003). On the other side, the second type of research analysis method is standing to introduce itself as qualitative research analysis type. Normally, the researchers using this method of research when they are trying to gather, analyze, understand data by monitoring the targeted subject very closely Zikmund and Babin (2007). Moreover, the qualitative research is explaining the phenomena in a subjective form by using the definitions, meanings, features, signs, and descriptions of things which is simply the opposite of the quantitative research Glesne (2006). In the case of this research the qualitative type of research will be deployed to suit up the available sources of data. As a matter of fact, the data will be mainly collected from Train 1 2009 major overhaul case study and a set of distributed surveys to overhaul project team members. Both of the above mentioned methods Case Study and Phenomenology; respectively, are two out of three kinds of data collection tools in the qualitative research basis besides the Ethnography method which is also indirectly presented here. This is similar to many other works observed in the literature of Ghosh and Jintanapakanont (2004), Braimah and Ndekugri (2008). In addition here and in many cases, data obtained from literature through survey usually become as case study results of others' work. This mixture of sources for the

data is deliberately meant in order to give more reliability and accuracy for the data that collected and for the analysis that developed Stake (2010).

3.5 Data Collection Tools:

3.5.1 Ethnography:

The ethnography method is based on the researcher direct participation and observation of the event Goulding (2005). Although this tool is not directly applied in this research, but my previous participation in GPC overhaul projects as services engineer who is looking after the project contract administration, project budget control, and project resources planning had played a key role in evaluating the data credibility and accuracy that received from the surveyed sample. Moreover, this past daily interact with subject had also built a solid base on understanding the root cause of GPC overhaul projects failures. In addition, this personal experience of the daily activities during the overhaul projects has added a great value to the quality of the research data outcomes in specific and on the research results as overall Sekaran and Bougie (2009).

3.5.2 Case Study:

Beside the ethnography method, this research will also be substantiated by the data of GPC Train 1 – 2009 Overhaul as case study Baccarini (2009). This selected case study is chosen to be first as good example for the poor implementation of project management concept, and secondly due to the quantum of available documented data to support the research argument and outcomes. Using Train 1- 2009 Overhaul date as case study will grab the readers interest by making them live the GPC's project management collapse attributes in terms of figures for time, money, and quality.

Other different case studies were reviewed and results were generated through deep survey investigation of these studies. However, the result of this investigation does not have any global relationship with elsewhere in the similar field nor having repeatability assurance. Thus, the Train 1 2009 found to be the most suitable case study for this research purpose.

3.5.3 Phenomenology:

The last tool that also is engaged in this research is the Phenomenology method which is intending to understand how one person or more look at a phenomenon Yu and Kwon (2011), Yi et. al.(2006). In such cases the answers of these individuals are sought by direct survey Goulding (2005). Therefore, a semi-structured questionnaire process has conducted. For the purpose of setting a time for questionnaire survey, the individuals have been in advance informed about the questionnaire requests

along with a short brief about the survey intention to allow the repliers to choose the convenient time for them and to make them get prepared for. Similar pattern in terms of the questionnaire organization and structure has been followed. For example, in the beginning of the survey a general social chatting with the individuals adopted to make them feel more comfortable and relax, and then followed with an introduction about the purpose of this survey. Getting the best result out of these individuals require more of the ice breaking strategy such as starting with very open general questions by asking about their opinion the outcome of the current project management process Johnson and Christensen (2012). Moreover, the respondents have also experienced some of the semi-closed question in terms of yes or no answers. For instance, the candidates asked if they would like to change the current practices, and if they answered with yes they have to tell how, when, and why is that. The survey flow consistency has noticed during the subjects discussion interchanging. Using this kind of strategy has positively succeeded to set up the perfect conditions for the survey results, and deliberately sparking the candidates' interests.

3.6 Theme Analysis Method:

The thematic content analysis method is applied in this research for the various CFFs that determined earlier. This method aims to group relevant subject into one group which makes the research argument more focus and much realistic in term of outcomes Hsiesh and Shannon (2005). This route in gathering and treating different data results as one group was found very productive tool during data analysis stage due to many research purposes. One of these reasons is the flexibility that this method provides the researcher with in managing various data toward the aimed propositions Cavanagh (1997 in Hsiesh and Shannon 2005). For instant, the argument of this research based on the effect of three main areas on project management process of GPC Overhaul projects; namely, Procurement, Scope, and Communication Management. In fact, many CFFs that determined during literature review were falling under these three main categories. Grouping these different CFFs into these categories will help to discuss them under the structure of three areas rather than each CFF is discussed individually which is in our case is not possible due to research time limitation Hsiesh and Shannon (2005). Therefore, the thematic content analysis method found that considerably is serving the purpose of this study.

3.7 Details of Survey Sample:

The sample in the conducted survey is selected to present about 70% of the Major Overhaul project team, which is an integration of the GPC staff, main contractor, and subcontractor key role personals. The sample represents a range of collection from managerial down to junior level. A total of 30 candidates were interviewed, ten of them from GPC staff and the remaining were from the main contractor and subcontractor senior staff. Details are given in tables 5 and 6. Demographic profile is also given in Table 4. My previous direct involvement with the overhaul project as part of the integrated team has helped to know closely each individual role in the projects and their knowledge about the subject. In fact, this is has deeply reflected on the collected information from the view of the data research reliability, transparency, and accuracy.

Data survey process is implemented in two steps. In the first step, the three proposed groups are assessed by the respondents in term of their relatedness to GPC overhaul project failure. The assessment is based on likert scale Thomas and Tang (2010), Braimah and Ndekugri (2008), Yu and Kwon (2011). Details of data are given in tables 8 to 10. The second step is the assessment of the CFFs listed in Table 2 using same method but in term of their importance or impact to GPC overhaul project. Details of data are given in tables 11 to 13

The credentials of questionnaire results are a function of the background of each respondent. Hence, the demographic profiles of respondents and details of individual respondents are given below in the organization structure that belongs to. The questionnaire results are given in detail in the following sections.

Table 4: Demographic Profile of Respondents

Paramteer	Group	No.	Frequency
Age	25-35	9	30
	35-45	13	43
	45-55	8	27
Educational qualification	Matriculate	3	10
	Graduate	24	80
	Post Graduate	3	10
Experience in present working company in years	0-5	4	13
	5-10	21	70
	Above 10	5	17

Table 5: Profile of Respondents from GPC

Interviewee	Designation	Interviewee	Designation
1	Project manager	6	QA/QC Senior Engineer
2	Engineering Manager	7	Safety Engineer
3	Procurement Manager	8	Cost Engineer
4	Site Superintendent	9	Mechanical Supervisor
5	Senior Planning Engineer	10	Operation Area Controller

Table 6: Profile of Respondents from Contractor

Interviewee	Designation	Interviewee	Designation
11	Project manager	15	QA/QC Engineer
12	Engineering Manager	16	Safety Engineer
13	Procurement Manager	17	Cost Engineer
14	Site Superintendent	18	Mechanical Supervisor
19	Senior Planning Engineer	20	Electrical & Instrument Supervisor

Table 7: Profile of Respondents from Subcontractor

Interviewee	Designation	Interviewee	Designation
21	Site Manager	26	QA/QC Inspector
22	Senior Mechanical Engineer	27	Safety Supervisor
23	Senior Electrical & Instrument Engineer	28	Civil Work Supervisor
24	Procurement Engineer	29	Transportation Supervisor
25	Planning Engineer	30	General Foremen

Table 8: Answers of Respondents with Respect to Procurement CFFs Group

(Answers ranging from 1 to 5 in the likert's scale where 1 indicates extremely disagree and 5 extremely agree CFF and 3 is neutral)

First column is respondent (R) no. as per the questions presented on tables 1 from the Appendix D, subsequent columns represent answers (either of 1 to 5) to questions (P-Q 1), (P-Q 2), (P-Q 3)…etc.

R#	P-Q 1	P-Q 2	P-Q 3	P-Q 4	P-Q 5
1	4	5	3	5	4
2	4	3	4	4	4
3	5	4	5	5	4
4	5	5	5	4	5
5	5	4	4	5	5
6	5	4	5	5	5
7	4	5	3	5	5
8	5	4	5	4	5
9	5	3	4	4	5
10	4	5	4	3	4
11	4	3	4	4	4
12	4	5	5	5	5
13	5	5	5	4	5

Table 9: Answers of Respondents with Respect to Scope of Work CFFs Group

(Answers ranging from 1 to 5 in the likert's scale where 1 indicates extremely disagree and 5 extremely agree CFF and 3 is neutral)

First column is respondent (R) no. as per the questions presented on tables 1 from the Appendix D, subsequent columns represent answers (either of 1 to 5) to questions (S-Q 1), (S-Q 2), (S-Q 3)…etc.

R#	S-Q 1	S-Q 2	S-Q 3	S-Q 4	S-Q 5
1	4	5	4	5	4
2	5	4	4	3	5
3	5	5	5	5	4
4	4	5	5	4	5
5	4	5	4	4	4
6	5	4	4	5	5
7	5	4	5	5	5
8	4	4	5	4	5
9	5	4	4	5	4
10	4	4	4	4	3
11	5	5	5	3	5
12	4	5	5	5	4
13	4	5	5	4	4

Table 10: Answers of Respondents with Respect to Communication CFFs Group

(Answers ranging from 1 to 5 in the likert's scale where 1 indicates extremely disagree and 5 extremely agree CFF and 3 is neutral)

First column is respondent (R) no. as per the questions presented on tables 1 from the Appendix D, subsequent columns represent answers (either of 1 to 5) to questions (C-Q 1), (C-Q 2), (C-Q 3)…etc.

R#	C-Q 1	C-Q 2	C-Q 3	C-Q 4	C-Q 5
1	5	5	4	4	5
2	4	3	3	4	5
3	5	5	4	5	4
4	5	4	3	5	5
5	5	4	4	4	5
6	4	5	5	4	4
7	4	5	5	5	4
8	4	4	3	5	4
9	4	5	5	4	4
10	4	4	5	4	5
11	5	3	4	5	5
12	5	5	4	5	3
13	5	4	4	5	5

Table 11: Answers of Respondents with Respect to Procurement Related CFFs

(Answers ranging from 1 to 5 in the likert's scale where 1 indicates least important and 5 most important CFF and 3 is neutral)

First column is respondent (R) no. as per tables 5, 6 and 7 and subsequent columns represent answers (either of 1 to 5) to questions P1, P2, P3… etc.

R#	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17
1	3	5	4	2	2	5	2	1	5	3	2	5	4	5	5	4	4
2	5	4	3	4	5	3	2	2	1	3	3	5	3	4	3	5	5
3	5	3	3	3	5	3	3	5	3	3	4	5	2	4	3	5	4
4	4	2	2	3	4	1	5	5	5	5	5	5	5	5	5	5	5
5	2	5	5	2	4	5	5	4	4	2	3	4	4	3	4	2	5
6	2	2	2	4	4	3	2	2	2	5	2	4	3	4	4	5	4
7	5	4	5	5	2	5	5	2	5	5	4	4	3	4	2	4	5
8	4	3	5	2	5	4	4	4	4	3	5	5	4	1	5	2	4
9	5	4	5	2	5	5	4	3	1	1	4	1	4	1	4	3	4
10	2	5	5	4	2	4	4	4	4	5	4	4	3	4	4	5	1
11	3	4	4	3	4	1	5	3	3	2	1	4	4	5	4	5	5
12	2	5	5	3	5	5	5	5	4	5	4	1	4	4	2	4	1
13	4	3	4	4	5	3	1	4	4	1	5	2	5	5	3	5	5
14	3	2	4	2	5	5	5	5	2	2	5	4	3	5	4	5	4
15	2	4	2	1	4	4	3	3	3	4	5	4	4	4	5	5	4
16	2	1	5	1	1	5	5	2	1	5	1	5	5	1	4	2	1
17	3	5	2	5	3	2	2	2	2	1	2	5	3	5	4	5	3
18	5	1	1	3	1	4	4	2	5	5	1	4	3	1	5	2	1
19	5	5	2	5	5	5	5	5	4	5	1	2	4	5	2	4	5
20	4	4	3	3	2	5	5	5	5	3	5	4	5	4	2	5	1
21	3	3	4	4	3	2	1	4	4	4	5	3	1	3	1	4	5
22	3	5	3	2	1	5	5	5	3	5	3	5	4	3	4	1	5
23	5	4	5	5	4	4	1	5	5	1	5	4	1	4	5	4	5
24	3	3	3	2	5	1	1	1	5	5	3	4	5	3	2	3	1
25	2	2	2	2	2	1	1	5	3	2	5	1	2	5	3	2	5
26	4	4	4	3	2	1	5	2	2	4	5	4	5	4	1	5	4
27	5	4	5	4	3	2	2	1	1	2	4	5	4	3	2	5	4
28	2	2	2	2	5	4	4	4	4	2	5	2	4	5	1	5	2
29	5	5	5	2	2	2	3	2	5	1	5	2	5	5	2	5	4
30	2	5	5	3	1	5	5	1	5	5	2	5	3	2	4	5	4

Table 12: Answers of Respondents with Respect to Scope of Work Related CFFs

(Answers ranging from 1 to 5 in the likert's scale where 1 indicates least important and 5 most important CFF and 3 is neutral)

First column is respondents (R) no. as per tables 5, 6 and 7 and subsequent columns represent answers (either of 1 to 5) to questions S1, S2, S3… etc.

R#	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
1	5	5	2	3	2	2	2	2	1	5	5	5	5
2	1	5	4	4	4	3	1	2	5	4	3	5	1
3	1	5	3	5	1	5	3	4	5	5	5	1	5
4	1	3	5	3	5	1	2	4	5	1	2	2	5
5	3	5	4	2	4	5	1	4	5	5	3	5	2
6	2	5	3	5	4	4	5	2	3	1	2	5	4
7	5	4	5	2	2	1	5	4	5	1	4	5	2
8	5	4	1	2	2	5	5	4	5	4	4	5	5
9	5	5	5	4	5	5	2	3	5	1	5	1	5
10	2	5	1	2	2	4	4	5	5	1	4	2	5
11	5	4	2	3	5	1	2	3	4	5	1	3	5
12	2	1	5	3	4	5	4	1	4	4	4	5	1
13	4	5	2	4	1	5	2	4	5	2	4	5	4
14	3	5	5	2	4	5	4	5	5	3	4	4	4
15	2	4	2	5	5	4	4	5	5	4	1	5	5
16	5	1	3	5	1	5	4	2	5	2	5	5	1
17	5	5	5	5	4	2	3	5	2	4	2	4	4
18	1	2	5	4	2	2	5	4	5	1	2	5	4
19	5	5	2	4	2	5	2	3	3	2	2	5	2
20	1	5	3	5	3	5	4	5	4	4	4	4	3
21	5	5	4	5	4	2	2	2	4	5	1	3	4
22	3	5	5	2	4	5	4	5	4	2	3	4	5
23	4	3	5	5	4	4	4	4	2	1	5	4	2
24	5	3	5	3	5	4	1	5	2	5	5	4	2
25	4	2	3	3	3	1	4	4	3	3	5	4	5
26	5	4	5	3	5	1	4	2	3	4	4	4	3
27	5	5	2	4	4	2	4	1	4	2	5	5	4
28	2	5	2	4	5	5	2	4	5	2	4	2	3
29	4	4	2	2	4	4	3	5	5	1	4	2	1
30	4	5	4	3	5	5	4	1	3	5	4	5	5

Table 13: Answers of Respondents with Respect to Communication Related CFF's

(Answers ranging from 1 to 5 in the likert's scale where 1 indicate least important and 5 most important CFF and 3 is neutral)

First column is respondents (R) no. as per tables 5, 6 and 7 and subsequent columns represent answers (either of 1 to 5) to questions C1, C2, C3… etc.

R#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
1	4	4	2	5	4	2	5	5	4	5	2	2	4
2	4	5	1	2	4	5	5	2	4	5	4	2	5
4	5	4	3	5	3	5	5	4	3	4	5	4	2
5	2	5	5	5	2	5	5	1	3	5	3	3	4
5	2	5	5	2	5	3	5	3	2	4	4	2	5
6	3	3	4	4	5	3	1	3	4	4	5	3	1
7	5	4	5	3	2	4	5	5	3	1	4	2	3
8	2	4	4	2	3	5	4	4	1	4	5	2	4
9	5	4	5	3	5	2	2	5	5	4	5	3	5
10	4	4	1	4	2	5	4	4	5	5	4	4	4
11	2	5	2	4	5	3	2	4	4	4	1	5	2
12	3	3	5	3	5	5	4	3	2	4	3	5	5
13	2	5	3	5	5	3	3	2	5	4	5	5	4
14	2	3	5	3	4	5	5	5	4	3	5	5	4
15	3	4	3	5	4	4	5	5	4	4	2	5	2
16	5	2	3	3	4	5	4	5	2	2	4	4	5
17	2	3	4	1	5	5	4	5	2	5	5	4	5
18	5	3	4	5	3	2	1	4	4	1	3	5	5
19	4	5	2	4	5	5	5	3	4	2	3	4	3
20	4	5	4	5	5	1	4	3	4	5	4	5	5
21	1	1	2	4	4	3	5	2	4	3	2	3	5
22	5	5	4	2	5	1	4	3	4	5	3	5	1
23	5	4	5	3	4	4	5	4	3	1	3	4	4
24	2	3	3	3	2	4	2	5	4	5	2	4	5
25	5	5	3	5	3	3	4	5	4	3	3	4	4
26	4	4	4	3	4	1	5	2	4	5	1	5	5
27	1	5	3	4	4	5	1	5	4	2	4	4	2
28	5	5	3	5	5	1	5	5	5	5	5	5	5
29	5	4	4	5	5	4	1	4	5	3	5	2	5
30	5	5	5	4	3	5	5	2	4	5	5	5	4

Chapter 4

Data Analysis & Discussion

4.1 Introduction:

The data analysis and discussion are the fourth part of this research after all related data was collected. In this section, the research subject will be discussed and explained in a very analytical manner. It will include the examination of the company current situation and practices compared to the best practices around the world as it is recommended by the researchers in the literature review section. In addition the data that collected from the sample will be analyzed in detail and compared with actual performance of the company. Furthermore, the investigation in this section will not only look at the problem from the surface, but it will also discover the issues which are hiding beneath the problem's skin. In fact, this sophisticated analysis will help to give a full picture of the problem with a close view for the other issues that surrounded the topic. However, all these analyzed data and discussed details will be meaningless if it is not been scientifically validated. Therefore, the validation process will be applied in this section by comparing the information that observed from other studies results and stated conclusions by different researchers as it shows in the literature review section. At the end of this part, a solid conclusion about the subject would be built and used to firstly approve or reject the study hypotheses, secondly find out the real problem of the subject, and finally draw the solution map for the problem.

4.2 Analysis of Grouping Sensitivity Survey Data:

As it is been explained earlier, the grouping method was applied in order to get much clearer guide in how to study the CFF in term of groups rather than individual CFF. This route of study is found in several such as Belassi and Tukel (1996) and Fortune and White (2006). The proposed groups are Procurement CFF, Scope of work CFF, and Communication CFF. These nominated groups are extracted from what it is been captured during 2009 GPC lesson learned. A survey is conducted to evaluate the reliability of this information in term of importance and relatedness of these subjects to GPC overhaul projects. The survey is distributed to sample who are only occupying management or senior positions which is in this case are 14 out 30 personnel from the original pre-decided sample (47% of the original sample).

The selection on this survey is intended to ensure the knowledge maturity of the respondents that related to overhaul projects and also to the principal of project management as process and procedure. The knowledge maturity in this survey is required, because each respondent should at

least know the area of knowledge in the project management system which includes Project Integration, Scope, Time, Cost, Quality, Human Resources, Communications, Risk, and Procurement Management beside the previous experience in GPC overhaul projects. Therefore, the sample is selected in this survey based on the seniority and experience of each individual. The sample illustrated as shows in the following table.

Table 14: Profile of Respondents in the CFF Grouping Survey.

Respondents	Designation	Organization	Respondents	Designation	Organization
1	Project manager	GPC	8	Engineering Manager	Contractor
2	Engineering Manager	GPC	9	Procurement Manager	Contractor
3	Procurement Manager	GPC	10	Site Superintendent	Contractor
4	Site Superintendent	GPC	11	Senior Planning Engineer	Contractor
5	Senior Planning Engineer	GPC	12	Site Manager	Sub-Contractor
6	QA/QC Senior Engineer	GPC	13	Senior Mechanical Engineer	Sub-Contractor
7	Project manager	Contractor	14	Senior Electrical & Instrument Engineer	Sub-Contractor

The survey answers are captured on the below table as per the questionnaire in index D.

Table 15: Survey Results of CFF Groups Sensitivity to Project Failure

Groups Sensitivity to Project Failure					
I#	**P-Q1**	**P-Q2**	**P-Q3**	**P-Q4**	**P-Q5**
AV	4.54	4.23	4.31	4.38	4.62
I#	**S-Q1**	**S-Q2**	**S-Q3**	**S-Q4**	**S-Q5**
AV	4.47	4.10	4.49	4.38	4.62
I#	**C-Q1**	**C-Q2**	**C-Q3**	**C-Q4**	**C-Q5**
AV	4.66	4.34	4.68	4.38	4.62

In order to have clear statistic picture, a graph of CFF Groups questions in X axis with the mean value of likert scale in Y axis is plotted and is given in fig.1 below.

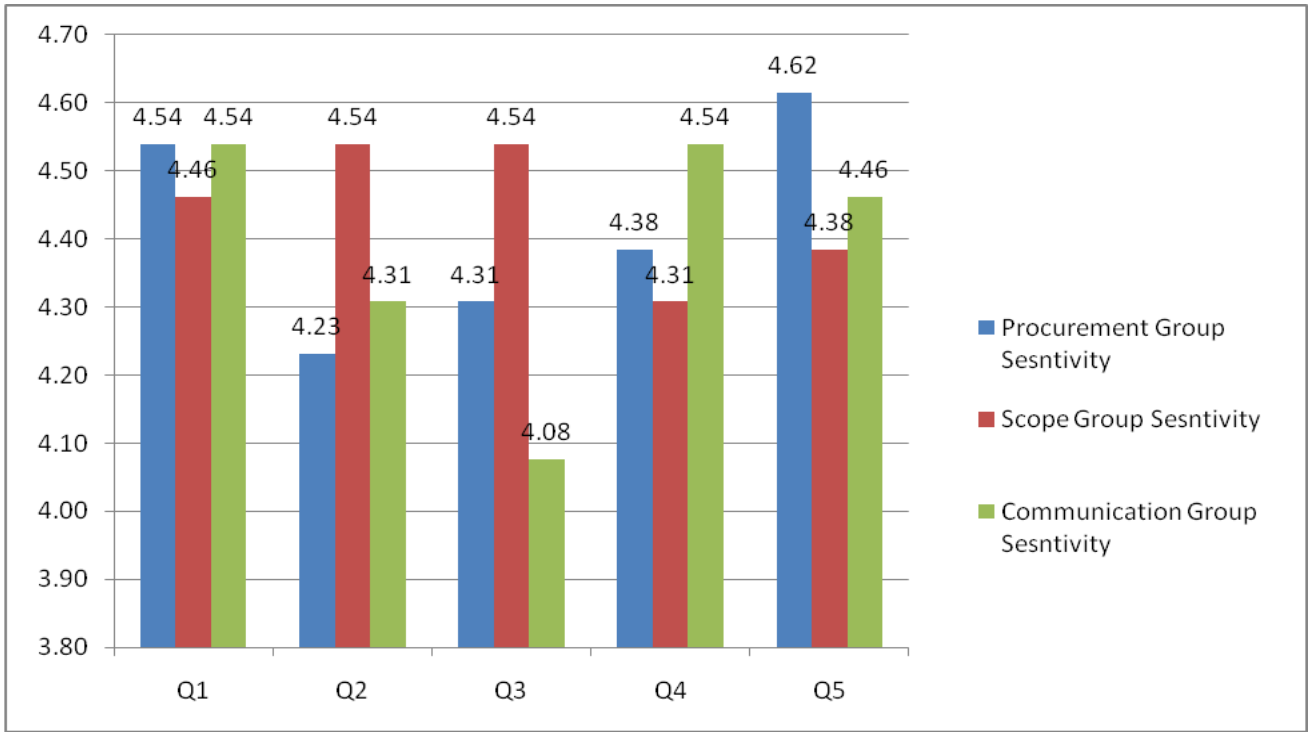

Fig. 1: Plot of CFF Groups Questions Versus Value in Likert Scale

4.2 .1 Procurement Group Data Analysis:

By having an overlook view of the respondent's answers, it will sincerely confirm that all the proposed groups by likert scale are very important and relevant to GPC overhaul projects. For instance, the first question in the procurement section, which is aimed to test the importance of the procurement factors to the overhaul projects, indicates average rate of 4.54 which is considered as very high rate by likert scale. This is reveals that the overhaul project team in agreement with the proposal of considering procurement as one the important area toward project success/ failure. Furthermore, the respondents are also confirming through their average rate of 4.23 for P-Q2 that GPC procurement system is unable to meet the overhaul projects requirements. This is obviously pointing out that the current GPC procumbent system is very weak and can not be sufficient to GPC overhaul projects and could lead to major damage for the GPC overhaul project framework. The proposition of having project failure due to poor procurement system is supported by the GPC overhaul project team's answers for P-Q3. In their rating for P-Q3 as 4.31, they are confirming that GPC procurement is one the causes that behind the delay on GPC overhaul projects. In addition, they also highlighted the urgent need for immediate implementation of a change or an improvement

to the current GPC procurement system in order to reduce the risk of any possible delay to their overhaul projects. This need was noticed from their answers of P-Q4 & P-Q5 respectively with average rate of 4.38 and 4.62.

4.2 .2 Scope of Work Group Data Analysis:

Similarly and not far from the rating of the procurement questions, the scope of work queries were answered. For example, S-Q1 the average rate was found to be 4.47 which is almost stands on the extreme range as per links scale. S-Q1 is directly pointing to the importance of the scope of work factors to overhaul projects, and as shows from the survey rating that this group of CFF plays key role in the project failure, because of the proportional relationship between scope size and the project time constrain. In other word, if the scope keeps increasing and time is kept constant as in the case of GPC overhaul projects, the ultimate result with no speculation is a crucial delay to the entire project. Therefore, it will be very necessary to have a sufficient system to manage the project scope which is not the case in GPC overhaul projects as per S-Q2 rating result. GPC overhaul project team have indicated through their average rating of 4.10 to S-Q2 that the project scope management system in GPC overhaul project can not meet the project requirements. As per 2009 Work Scope Addition & Deletion Report, the scope of the 2009 overhaul project had been increase about 30% from the original scope by adding any time work type and unplanned works without proper scope verification procedure. This fact is strongly supports the result of S-Q2, and it is explaining S-Q3 result (Avg rate 4.49) of why the current GPC scope management system is one of the main factors to overhaul projects delay. Moreover, the statistic result of S-Q4 which is 4.38 reveals how serious the need for major change in the current GPC overhaul scope management system. In fact, the GPC 2009 overhaul flawless study had urged GPC management that without delay to implement very strict procedure for adding any additional work to the original scope which is really on the same platform of S-Q4 findings and S-Q5 result (Average rating 4.62). This recommendation along with S-Q4 & S-Q5 results signify the critical role that scope management plays in completing the overhaul project on time or earlier.

4.2 .3 Communication Grouping Data Analysis:

Finally, the result of the communication grouping section survey questionnaire is identified in this section of the data analysis. The questions under communication section have explored the extent of communication CFFs role that can play as a steering wheel to project success if they are managed well. The survey for C-Q1shows that the average rating is 4.66 in relevant to importance of

communication to project success, which is in this case is extremely high. Usually the communication in any project is vital point, because it is tool to monitor the project activities and their progress. For instance, without project progress reports the project issues can not be captured and managed by the project team. Therefore, it is very important to have very reliable communication system that manages project information effectively and efficiently. Unfortunately this fact is not been addressed in GPC overhaul projects as it shows in the results of C-Q2 & C-Q3. The average rate of 4.34 for C-Q2 reflects that the communication system in GPC is not meeting the overhaul project requirement because the unavailability for the instant update of the project information. So, any failure in having an adequate communication system will absolutely negatively affect the project completion. As matter of fact, the communication system in GPC overhaul projects is the backbone factor for this kind of project due to the time limitation and work criticality. Can you imagine the consequence or the disaster that could happened especially to projects within oil and gas industry, if some of the critical information are unavailable and they are required for immediate action?

Based on the above reasons, the highest average rate of 4.68 for C-Q3 among all previous answers by the GPC overhaul team, it can be understood. Moreover, this high rate for the communication system impact on the project delay can explain the urgent need for introducing new change and improvement to the current GPC communication system as per C-Q4 result (4.38). GPC overhaul team had strongly suggested in their average rate for C-Q5 which is 4.62 that change and improvement to for the communication system should be by developing the team communication skills and launching better project communication system.

4.3 Individual Gradation Data Analysis of the Critical Failure Factors:

After the grouping sensitivity survey is completed, the second survey is conducted to rank each critical failure factor under the three determined CFF groups from the first survey. These critical failure factors are original identified on table 2, and based on that list the survey is done using likert scale from 1 to 5 (1 is least important, 5 is highly important, and 3 is neutral). The result of this survey is captured and discussed in details with respect to each group in the upcoming sections.

4.3.1 Analysis of Procurement Related CFFs:

The analysis of procurement related CFFs is performed to evaluate the average value for each of CFFs under procurement. These values are listed in the below table.

Table 16: Procurement CFFs Gradation Survey Results

Gradation Values of Procurement Critical Failure Factors																
I#	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**	**P16**	**P17**
AV	3.47	3.60	3.63	3.00	3.37	3.47	3.47	3.27	3.47	3.30	3.60	3.73	3.63	3.70	3.30	4.03	3.67

Table 17: Procurement Factors Ranking List

Procurement Factors Ranking List		
Ranking No.	**Procurement Factors**	**Code No.**
1	Unsuitable type of contract.	P16
2	In appropriate contractor selection criteria.	P12
3	Incapable contractor.	P14
4	Lack of experience of subcontractor	P17
5	Absence of procurement plan control and monitoring system.	P3
	Poor project material delivery system	P13
6	Inadequate contractor resources planning.	P2
	Inefficient contract planning and management.	P11
7	Insufficient contractor resource availability.	P1
	Delay in solving contractual issues.	P6
	Delay payment on contract.	P7
	Poor monitoring of subcontractors claims.	P9
8	Non-availability of contractor previous projects records in term of delay and claims.	P5
9	Conflict of contractual documents.	P10
	Insufficient contractor’s cash flow	P15
10	Nature of client (privately funded vs. publically funded)	P8
11	Inefficient project bidding method.	P4

In order to clearly appreciate the values variation, a graph of CFFs in X axis with the mean value of likert scale in Y axis is plotted and is given in fig.3 below.

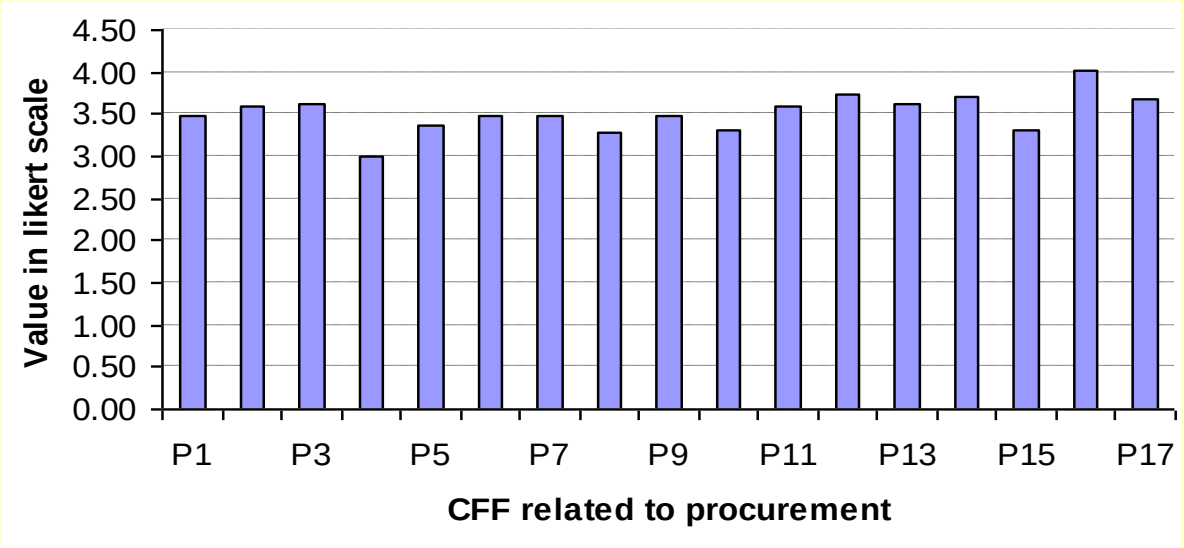

Fig. 2: Plot of CFF Related to Procurement Versus Value in Likert Scale

As show in the table 16 P 16 has received the highest average rate among the surveyed CFFs in the procurement section which is 4.03. Actually, P16 is the implementation of unsuitable contract for the intended project. In other word, the contract for GPC overhaul project is not suitable for the work objective which is in this case is the completion time. The current contract for GPC project is mix of fixed rate and unit rate contract. For instance, the unit rate terms are applied for all of the hired equipment. So the longer period the equipment is hired, the more profit the contractor can make. Therefore, it is not beneficial for the contractor to finish the project on time or earlier in order to meet GPC overhaul objective. The second factor on the ranking list is related to inappropriate contract selection criteria (P12) with average rate of 3.73. This is totally agrees with the reviewed result of the Major Overhaul Tender document. The reviewed result indicates that the selection of main contractor is based on the lowest price and not on the contractor efficiency and work quality or other reliable selection criteria that ensure quick completion of the project. The third factor on the list is the incapable contractor which is looking at the contractor from the point of experience to handle such work and his maturity in the oil and gas project business. As per the contractor pre-qualification in the tender document, the contractor experience in the overhaul project is less than 11 years which is should not be as an acceptable limit for such critical work. In fact, the work criticality of the overhaul project gives no room for any contractor with less than 15 to 20 years of experience as minimum to be hired for such project. Thus, GPC should avoid any contractor with less experience

to manage their projects, because the work learning carve that required to manage project with very sophisticated activities is very long for an inexpert contractor which could result for project delay. Similarly, the lack of experience for the subcontractor could also lead to negative result on the project program. And this is what exactly has been discovered from the survey when P 17 is listed on the fourth place among the other CFFs with average rate of 3.67. The rating of this factor by the respondents seems to be normal, because of the low probability of completing a critical project like GPC overhaul by inexperienced subcontractor on time/earlier. Following of the previous factor the poor project material delivery system (P13) & absence of procurement plan control and monitoring system (P3) factors come on the fifth place with average rate of 3.63. Having a poor system for material delivery could play a vital role on delaying the overhaul schedule for many reasons due to logistic location of the GPC plant. As it is mentioned on the 2009 overhaul lesson learned report that some of the critical delivered material either are not as per specs or they have major defects. These problems are many times reported during the progress reports of 2009 GPC overhaul project. The reasons behind those problems are the absent of proper inspection process for the delivered material and also the unavailability of personnel with technical background (Mechanical, Instrument, and Electrical engineering background) to carry out the inspection. Usually these problems are detected after the defective materials are shipped from GPC onshore transit store to the main offshore store. The process of reordering, returning, and replacing of those defective items with new ones takes very long duration due to the logistic difficulties comparing to the available time that required to execute the project. Relatively, the absence of monitoring and controlling system to manage the procurement plan can be called as the root cause of the insufficient material delivery system. The existing of such system could be used as early indicator system to avoid any possible delivery for any kind of defective material, because of the precaution behavior that the monitoring and controlling system can present before the material arrived to site. Further from the two previous factors, the inefficient contract planning and management (P11) and inadequate contractor resources planning (P2) factors took the 6^{th} place among the remaining factors with rate of 6.60. Appearance of weak contract planning and management in any project could develop time lagging to project execution. For example, improper planning for the contract process particularly for the specialized subcontractor could impact the project time frame significantly due to delay on finalizing the contract with contractors/subcontractors. In many occasions had showed in the 2009 GPC overhaul management reports that late agreement with subcontractor has pushed the GPC overhaul team to trim the scope of the specialized subcontractor to fit the total overhaul program. Based on that, no complex math required to figure out the consequences if this scope is impossible to be reduced. Equally, the consequences are very high if the competency of managing specialist's contracts is not on place.

Close monitoring and control of the specialist/subcontractor performance goes mainly through strong management of the contract. The Implementation of the contract's terms and conditions on time and effectively, is normally assuring better compliance of the contractor to the contract's scope and requirements which minimize the space for any possible dispute that can affect the project time.

The second factor that ranked on the same sixth place was inadequate contractor resources planning. In fact, the contractor resources plan is ranked in GPC 2009 lesson learned documents as a mid high risk and the responsibility is assigned to GPC project manager to closely review and improve the contractor resources plan to avoid any delay on the project time due to this reason.

Continuing on the factor ranking list, it is found that four factor are sharing the 7th rank with rate of 3.47. The first factor was insufficient resource availability (P1), and the root cause of this factor was the previous factor which was the inadequate resources plan. Then the second factor was delay in solving the contractual issues (P6). This is include the delay of formal submission of scope change request by GPC, incorrect time sheet claims for manpower/equipments, incompliance with some technical documents submission procedure. The third and fourth factors were delay on contract payment (P7) and absent of monitoring subcontractor claims (P9). These two factors are purely financial issues. As of all of us aware of the current worldwide financial depression, many of the contractors had faced very difficult time to manage their cash flow in order to secure on time payments to their subcontractors. As matter of fact, any delay on the contractor's payment will definitely prevent the contractor from securing the required resources for the project on time. On the other hand the claims from the subcontractors' ends will surely shoot up. Nevertheless, the GPC bureaucratic payment system had dramatically added more weight to the current contractors' financial problems due to the long process that required for payment release. Also the lack of direct communication between GPC and the subcontractors had created a gap in following and monitoring the resolutions of claims between contractors and his subcontractors which could severely disturb project completion date.

Moving further on the ranking list, the non availability of contractor previous project records in term of delay and claims (P5) had come on the eighth place with average rate of 3.37. Non availability of such record during the tendering stage had blocked GPC from better evaluation of the contractor capability to complete the project on time and with less number of claims.

Further down on the list, the rank number nine is fulfilled by two factors with rate of 3.30; namely are the conflict of contractual document and the insufficient contractor's cash flow. Although those factors are considered to have minimum effect on the project time, but these factors could turn to

critical ones if they were combined by some of the previous factor such as the factor of contractor payment delay and the factor of slow contractual issue resolution.

Finally the rank number 10th and number 11th are occupied by two factors which are the nature of client (privately funded vs. publically funded) and the insufficient project bidding method. These factors (P8) & (P4) were respectively rated with average rate of 3.27 & 3.00. The effect of both factors found to be very minimal in term of project delay.

4.3.2: Analysis of Scope of Work Related CFFs:

Scope of work related CFFs are also tested under likert scale and the results are given below in Table 17, as follows.

Table 18: Scope of Work CFFs Gradation Survey Result

Gradation Values for Scope of Work Critical Failure Factors													
I#	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**
AV	3.47	4.13	3.47	3.53	3.50	3.57	3.20	3.47	4.03	3.00	3.53	3.93	3.53

Table 19: Scope of Work Factors Ranking List

Scope of Work Factors Ranking List		
Ranking No.	**Scope of Work Factors**	**Code No.**
1	Absence of structured process for adding work	S2
2	Adding anytime work with overhaul work	S9
3	Change of scope due to absence of real cutoff date.	S12
4	Unclear objectives for the project	S6
5	Undefined scope	S4
	Improper project works/packages estimate	S11
	Unreasonable project master and implementation plans.	S13
6	Pre-project preparation design to be considered in the early phases of the project development cycle.	S5
7	Unanticipated work	S1
	Inadequate design specification	S3
	Uniqueness of project activities.	S8
8	Insufficient time available comparing to work required to be done.	S7
9	Improper estimation of capital cost which leads to scope reduction.	S10

Another representation of the grading of CFF is given in fig. 3 for further clarity.

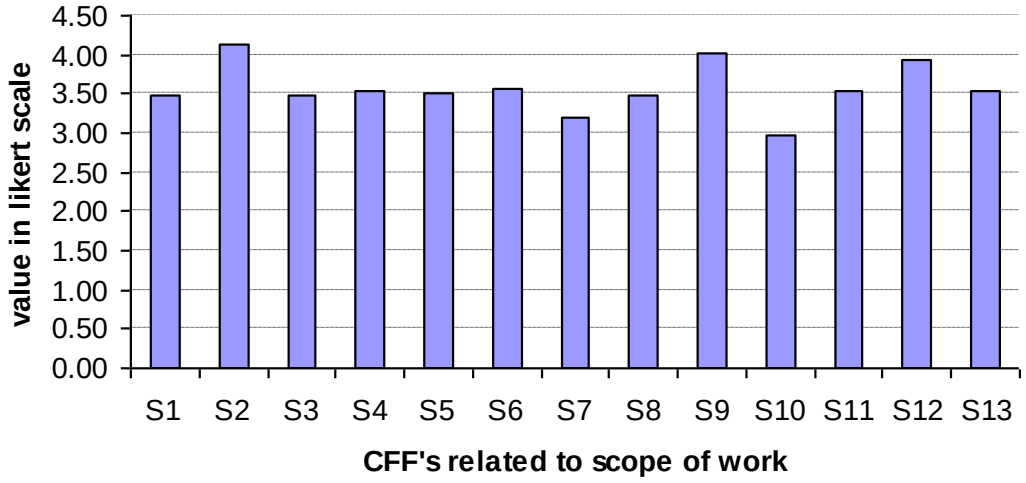

Fig. 3 Plot of CFFs Related to Scope of Work Versus Value in Likert Scale

As per table 17, the absence of structured process for adding new work (S1) has received the highest score with average rate of 4.13. Unfortunately, GPC projects are suffering from this issue very deeply. In fact, this point was mentioned in the lesson leant report as the bottle nick for the overhaul success. The absence of such process leaves no chance for the added work to be challenged as work that meets the overhaul works criteria.

Furthermore, adding anytime work to overhaul scope (S9) has ranked on the second place among the work scope factors list with average rate of 4.03. As matter of fact, if these works were eliminated at beginning from the overhaul scope and considered as maintenance works can give more time to the overhaul team to focus and produce better quality of work on the critical scope. Not only that, but also it could help to complete the overhaul project earlier.

The next factor that came on the 3rd place was the absence of cutoff date for adding scope (S12) with average rate of 3.93. The procedure of having cutoff date for changing scope is a key role in any overhaul projects, because it gives clear picture for the overhaul team about the project scope and allows them to have a sufficient time to plan their work efficiently.

Factor (S6) which was the unclear objectives for the overhaul project had come on the 4th place after the factor (S12) with rate of 3.57. The project objectives were not firmly emphasized among the overhaul team. In other word the project objectives should be clearly and repetitively explained to the project stakeholder to eliminate any gray areas that could persuade wrong decision related to scope.

Going further down on the scope of work factors list, it will be noticed that three factors had received the same rating of 3.53 which brining them on the 5th place among the other listed factors. These factors namely are undefined scope (S4), improper project works estimate (S11), and unreasonable project master and implementation plan (S12). In fact, these factors are relatively connected, so it is not surprised to have close or even the same evaluation rating. For example, if the scope keeps changing due to unjustified scope deletion and addition and due to unforeseen works, the scope will be identified as undefined scope. As result of the undefined scope and in addition to the contractor limited experience, the estimate for the work packages, project master plan, and project execution plan will have characteristic of weak, chaos, and unrealistic estimate.

Factor (S5) was the consideration of the pre-project preparation design on the early phase of the project development cycle. Factor (S5) was ranked on the 6th place with rate of 3.50. Although, all of the engineering designs were carried out separately and before pre-planning phase; however, sometimes few of them were done just a month before the execution phase due to last minute change in the scope. This kind of practice could carry a lot of surprises during the execution, because of the time rush toward completing engineering design and so eventually lead to major delay on the project schedule.

Looking again on the scope of work factors ranking list, there will be three other factors from the remaining ones having the same rate of 3.43 and located on the 7th place from the list. These factors are unanticipated works (S1), inadequate design specifications (S3), and uniqueness of project activities (S8). These factors can be considered as minor factors because they are part of overhaul project nature. In other word, these factors should be normally anticipated during the planning phase and a sufficient time allocated for them as contingency time.

Finally, the last two factors on the list were the insufficient time available comparing to work required to be done (S7), and improper estimation of capital cost which leads to scope reduction (S10). These two factors were evaluated to be respectively on the eighth and ninth place with rate of 3.20 & 3.00.

From the first glance and without further analysis, it can be concluded that factor (S7) is only a result of the previous factors such as (S2), (S4), (S9), (S11), (S12), and (S13). On the other hand factor (S10), it is simply not relevant to GPC overhaul project delay, because as per the GPC previous overhaul management reports there is no single event of scope reduction.

4.3.3 Analysis of communication related CFFs

Communication related CFF's are verified under likert scale and the results are given in Table 19.

Table 20: Communication CFF's Gradation Survey Result

Gradation Values for Communication Critical Failure Factors													
I#	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**
AV	3.53	4.03	3.53	3.70	3.97	3.60	3.83	3.73	3.67	3.73	3.63	3.83	3.90

Table 21: Communication Factors Ranking List

Communication Factors Ranking List		
Ranking No.	**Procurement Factors**	**Code No.**
1	Un-established communication procedure within the project organization.	C2
2	Lack of communication between stakeholders	C5
3	Lack of sharing information.	C13
4	Incompetent project documentation management system.	C7
	Late and incomplete feedback	C12
5	Poor coordination with subcontractors.	C8
	Inadequate Communication skills	C10
6	Unsuitable selection of communication means	C4
7	Cultural differences (due to multi-nationalities recruitment)	C9
8	Ineffective co-ordination of project manager.	C11
9	Inadequate social and informal mechanisms for a collaborative working environment	C6
10	Poor liaison with local authority	C1
	Insufficient Project communication media infrastructure	C3

Further representation of the above results presented in the form of graph in fig. 4.

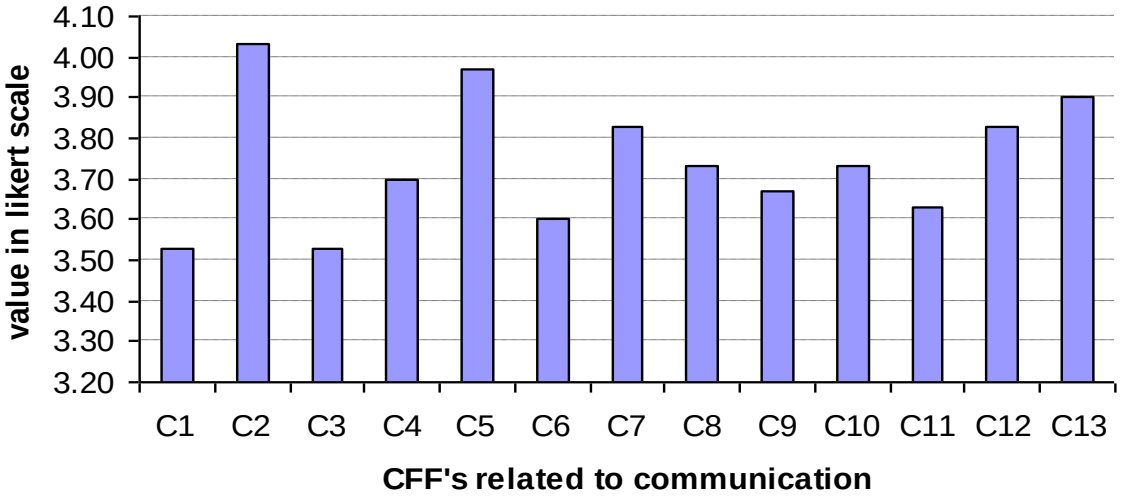

Fig. 4 Plot of CFF Related to Communication versus Likert value

From the above table 19 and fig.4, it is clear that highest likert scale accounts for 4.03 followed by 3.97, which correspond to C2 and C5. C2 indicates un-established communication procedure within project organization and C5 indicates lack of communication between stakeholders. Both factors are very critical in any projects. For instance, the unavailability of communication procedure within the project organization creates a lot of difficulties in capturing the important information in proper way. As result of that, there will be no record of any changes, agreements, and responsibility between the client and the contractors which opens the doors for disputes, claims, and blames among the project team. So, it is very important to have clear project communication procedure in place from the beginning of any project. On the other hand, the lack of free communication between stakeholders on GPC overhaul projects has developed a gap between the project stakeholders requirements/expectations and project deliverables. This gap was addressed and considered in GPC 2009 lesson learnt report as one of the reasons for project delay because of the increase in the amount of unforeseen works during the project execution stage.

The third factor on the ranking list with average rate of 3.90 found to be the lack of sharing information between the projects team itself (C13). This factor prevented GPC project from team expertise contribution toward better management of the overhaul project in term of technical problems resolutions and schedule control.

Continuing back on the ranking analysis, there are two factors had received a rate of 3.83 which put them on the 4th place. These factors are the incompetent documentation system management (C7) and the late and incomplete feedback (12). The absence of competent documentation system management in GPC project had caused a significant delay on GPC project, because of the time required to retrieve important approved documents such as material submittals approvals, drawings, and method of statement which could lead in many occasions resubmission of these documents over and over. Similarly, the second factor had caused certain amount of delay because of late response from the client to the contractor or because of the insufficient feedback which required to be revisited with more details.

Another two factors had also received the same rate of 3.73 and taken the 5th place on the list; namely, are poor coordination with subcontractor (C8) and the inadequate communication skill (C10). Although, the current GPC contract protocol does not give enough freedom to GPC project manager for direct communication with subcontractors, but the project manager communication and management skills should govern the situation by persuading the main contractor to open such channels with his subcontractor to ensure better coordination between two parties. As it has been explained earlier, how the communication skills of a project manager can play a key role on resolving some of the contractual obstructions that can affect the project progress; similarly, the communication skills should be developed and improved among the project team. Having competent communication skills within the project team could save a lot of time and efforts and ensure better project deliverables.

Factor number six on the ranking list is identified to be the unsuitable selection of communication means by the project team (C4) with score of 3.70. As per the GPC 2009 flawless study, it was mentioned several times that the wrong selection of communication means could negatively affect the project time. For instance, many times had been recorded during the GPC weekly meeting that the required information was verbally conveyed from one person to another without any record, or by email where the required communications mean was face to face, because of the immediate requirement of instruction to be implemented at site and so on. In fact, such practice could lead to serious situation where the incorrect selection of communication mean can be the root cause of unpleasant event during the project period.

The factor of culture differences due to multi-nationality recruitment (C9) had come on the 7th place with score of 3.67. The culture differences factor is usually creates some communication boundaries between peopled due to differences in people behaviors, languages, and believes. All these differences can develop a lot of miscommunication issues among the project team where the

consequences of such problem within a critical project like the gas plant overhaul projects can be turned to significant disaster in term of lives, money, and time.

The next factor after C9 was the inefficient coordination of project manager (C11) with rate of 3.63. The coordination role of project manager is the key factor for any project success. The coordination role of project manager should not be limited to the internal parties, but also should reach to the external entities which could be in many times the show stopper for the project activities. Based on the above facts it can be easily understand how important and critical the coordination role of project manager. However, the review outcome of GPC overhaul reports and documents indicate that this role had been well managed by the GPC overhaul project manager and no major complain was identified about his performance in this matter.

The Factor (C6) had come on the 9th place with rate of 3.60. Factor C6 is about inadequate social and informal mechanism for collaborative working environment. Although this factor came on the 9th place, but it still has a rate that is higher than neutral score which is 3. This could be referred to the level of the team work within the project team which could be low as per the survey score. So, there should be some involvement to boost up team work sprit either by some management workshops or by some changes in the project team members. As matter of fact, the higher the team work sprit, the better result will be on the project.

Then finally, factor C1 and factor C3 had come on the last place with same score of 3.53. C1 indicates poor liaison with local authority. The effect of factor C1 is very limited, because GPC overhaul project is only dealing with one local authority with limited interference to project schedule. On the other hand C3 indicates the insufficient project communication media infrastructure factor. In generally the GPC communication media infrastructure is reasonable and project relay on these media; however, there is more room for improvement by using the new available technology in the market.

Chapter 5

Conclusions & Recommendations

5.1 Introduction:

Finally as in any structured research the last piece will be normally the conclusion and recommendation part where the outcomes of this research will be addressed. All facts and findings about the research subject in general and the problem in specific will be highlighted. Moreover, this information will be rationally evaluated to determine the strong and deficient areas of the current project management practices and process at the examined organization. As result of the previous step, it will be quite easy to set up a number of actions that could act together as an effective and practical solution for the research problem. In the same time these actions will take into account the positive points of the current GPC practices which will help to have more dynamic and better resolution for the weak areas and more efficient enhancement for the strong areas. All the recommended solutions will be developed in a very sensible way in order to be implemented and activated without any difficulties. Finally, as part of the research knowledge credibility, all the deficiencies and limitations which have been identified either in some parts of the research process or in the entire research phases will be stated, in order to be avoided in any future related study.

5.2 Study Outcomes & Conclusion Overview:

The objective of this study is to find out the reasons behind GPC overhaul failure through deep investigation in the project critical failure factors. All these factors are collected from different literature reviews. Moreover, the collected factors found to be so many and change from one project to another. Therefore, it is decided to group these factors into three major groups which are relevant to GPC Overhaul projects following same school of thought of previous scholars like Belassi and Tukel (1996) and Fortune and White (2006). This method found to be very fruitful and successful in this research. The groups that proposed are based on the received documents from GPC and the comments and observations that recorded on these documents by the GPC overhaul project team. Furthermore, these groups are tested through questionnaire survey conducted on the selected members of GPC overhaul project team including only managers and senior engineers. The survey questionnaires measured by using likert method similar to Fiberesima and Abdul Rani (2011) survey measurement. As result of that survey found that all the three selected groups are the most aeries that

in the GPC overhaul projects required to be improved. Based on that fact, the collected factors were categorized under these groups which namely are procurement, scope of works, and communication group factors. After the factors have been put into these groups, the direction of the study had become much clearer and more focused.

The second stage after selecting the factors' groups, it was the grading process of the determined factors under each group as it shown in the discussion section. The result of factors grading were based on the questionnaire survey that distributed to GPC overhaul project team including GPC, Main Contractor, and subcontractor members using likert scale. The results of the factors gradation are captured in tables 16, 18 & 20. As matter of fact all the determined factor are valid and applicable to GPC overhaul project, but with different degree of effect. Therefore it is decided to select the most five important factors in each group that expected to be the major factors behind GPC project delay. Moreover, the method of short listing these factors will effectively help to have more realistic and reasonable solution framework that can be practically and gradually implemented to resolve GPC problem. This factors selection is based on GPC documents such as the Tender Document for the Major Overhaul Main Contractor Selection, Work Scope Addition & Deletion Document, Train1 2009 Major Overhaul Management Report, 2009 Work flawless study, and 2009 Major Overhaul Lesson Learned Document.

5.3 Study Recommendations:

Based on the above discussion a total of fifteen factors were identified in the next sections based on the criticality and application of each factor within its related group. This kind of further filtration of these factors will help GPC to have very clear and practical solution plan that can be easily implemented in GPC future overhaul projects. Furthermore, these factors have been finally consolidated in one Matrix table reflecting the factors grouping system. This Matrix table is aiming to identify four main areas which basically are factors/problems, recommendation/solution, implementation date, and action authority/responsibility. The matrix is presented in table 24:

5.3.1The Most Five Important Procurement Factors

As per table 22, the most five important procurement factors were listed with their coding system and their substantiated references from the study literature review.

Table: 22

Most Five Important Procurement Factors			
Ranking No.	**Code No.**	**Procurement Factors**	**Literature Review References**
1	P16	Unsuitable type of contract.	Ghosh and Jintanapakanont (2004)
2	P12	Inappropriate contractor selection criteria.	Saqib et. al. (2008)
3	P14	Incapable contractor.	Salleh (2009)
4	P17	Lack of experience of subcontractor	Ghosh and Jintanapakanont (2004)
5	P13	Poor project material delivery system	Saqib et. al. (2008)

Based on table 22, five factors were identified for further resolution discussion. The first factor was P16 the unsuitable type of contract. Unfortunately, the current contract for GPC overhaul project which is unit rate contract is not suiting the early completion of the project. So, it is recommended to implement the Turn Key/Lump Sum contract with incentive provision instead of the current one. The recommended action should be taken place six months before the project contract tendering stage, and it should be with the responsibility of GPC Overhaul Project Manager in coordination with GPC Contract Dept. Manager. The second factor was P12 which is inappropriate contractor selection criteria. It is recommended to put more strict criteria related to project completion time in line with contractor capacity. These criteria should be finalized six months before the project contract tendering stage. The responsibility of such action should be under GPC Overhaul Project Manager and in coordination with GPC Contract Dept. Manager. The third factor was P14 which is the selection of incapable contractor. To avoid such problem is suggested to set up a strict technical evaluation process related to the Main Contractor experience and capability. The recommended solution should be ready for implementation three months before the project contract tendering stage. The responsibility of implementing the proposed solution should lay on GPC Overhaul Project Manager shoulder in coordination with GPC Contract Dept. Manager. The factor of Lack of experience of subcontractor was also considered as one of the most five important factors the related to procurement domain. As solution, it was suggested to produce a list of certified/approved subcontractors that only to be selected from. Eight months before the project contract tendering stage, this list should be ready for implementation. The responsibility of such implementation should

be by GPC Overhaul Project Manager in coordination with GPC Contract Dept. Manager and GPC Tendering Committee. The last factor in the critical procurement factors list was Poor project material delivery system. It was recommended to assign a dedicated team to manage the delivery of project material before and during the initiation stage. The responsibility of implementing recommended solution should be in line with GPC Overhaul Project Manager authority in coordination with GPC Procurement Dept. Manager.

5.3.2 The Most Five Important Scope of Work Factors

As it shows in table 23, the most important five factors related to scope of work were identified with for further discussion.

Table: 23

Most Five Important Scope of Work Factors			
Ranking No.	**Code No.**	**Procurement Factors**	**Literature Review References**
1	S2	Absence of structured process for adding work	Salleh (2009) & GPC Documents
2	S9	Adding anytime work with overhaul work	Salleh (2009) & GPC Documents
3	S12	Change of scope due to absence of real cutoff date.	Ghosh and Jintanapakanont (2004)
4	S6	Unclear objectives for the project	Baccarini (2009)
5	S4	Undefined scope	Ghosh and Jintanapakanont (2004)

Absence of structured process for adding work has considered as one of the most five critical factors within the area of work scope management. Absence of such process has opened the door for adding any kind of work without any control which plays a key role on delaying the overhaul projects. To overcome this problem, it was suggested to develop a project steering committee that is responsible for initiating the process of approving any additional works. This committee should be in place at least three months before the project initiation stage. Creating of this committee is under the responsibility of Project Sponsor (GPC Plant Manager). The second factor that GPC should pay more attention is including anytime works to overhaul work scope. As mitigation to this problem, it was

recommended to initiate a technical team within the overhaul project team to review and challenge the work scope of the overhaul project before approval. This technical team should start their duties at least a month before/ during the project initiation Stage. Developing of such team is the responsibility of GPC Overhaul Project Manager. Changing of scope due to absence of real cutoff date has come on third place. As resolution to this problem, it was suggested to set up a cutoff date for adding any new scope of work at least one month before the project planning stage, so no additional works can be added without going through the project steering committee approval process. The implementation of this recommendation is the responsibility of the GPC Overhaul Project Manager. The fourth factor in the critical list was the unclear objectives for the project. It is recommended that to set up a clear project objective at beginning, and reinforce it among the team members throughout the project lifecycle. This suggested action is expected to be executed by the Project Sponsor (GPC Plant Manager) and at least one month before the project initiation Stage. And the last factor but not the least is the undefined scope. It is recommended that to allocate only 5% from the total scope for any additional works that could come after the scope cutoff date. This recommendation will help to give more control and certain boundary for the additional works. The recommended solution should be implemented a one month before/ during the project initiation Stage and by the Project Sponsor (GPC Plant Manager).

5.3.3The Most Five Important Communication Factors

Similar process that done previously in listing the most important factors in the areas of procurement and scope of work, it was followed for the Communication section as it is shown in table# 24.

Table: 24

Most Five Important Communication Factors			
Ranking No.	**Code No.**	**Procurement Factors**	**Literature Review References**
1	C2	Un-established communication procedure within the project organization.	Yu and Kwon (2011)
2	C5	Lack of communication between stakeholders	Salleh (2009)
3	C13	Lack of sharing information.	Yu and Kwon (2011)
4	C7	Incompetent project documentation management system.	Yan (2009)
5	C12	Late and incomplete feedback	Saqib et. al. (2008)

Looking at the critical communication list table# 24, the un-established communication procedure within the project organization was identified as the first factor in that list. As recommendation to this problem, it was suggested that a project communication procedure to be developed a six months before the project initiation stage. This action should be implemented by GPC Overhaul Project Manager. The second factor in the list was the lack of communication between stakeholders. To mitigate this factor, it was recommended to set up a project stakeholders meeting in monthly basis to review the all the project issues. It was also suggested that the implementation of this solution should be one month after the project initiation stage and within the responsibility of GPC Overhaul Project Manager. On the other hand, Lack of sharing information has been identified in the third place within the critical list. To avoid such problem, it was recommended to implement a new project information system which allows project's stakeholders to be aware about the project progress and changes at any time of the project life cycle. The implementation of such action should be twelve months before the project initiation stage and under the responsibility of the Project Sponsor (GPC Plant Manager) with coordination of GPC IT Dept. Manager. The next factor in the list was incompetent project documentation management system. To overcome such problem, it was suggested to assign a dedicated team to manage the project documentation. This team should be in place a three months before the project initiation stage. The responsibility of creating such team is lay under the liability of GPC Overhaul Project Manager. Finally, the last factor within the communication critical list was the late and incomplete feedback by the project team during their regular communication. It was strongly recommended that a series of in house communication courses to be held throughout the project lifecycle. Arranging of such courses, it will effectively develop and enhance the project team communication skills. The suggested action should be executed by the Project Sponsor (GPC Plant Manager) with coordination of GPC Training Dept. Manager.

In conclusion, all the recommended actions and solutions that identified in this section can be labeled as action plan framework that can be used by GPC as a solution road map to their problem. Moreover, this framework will allow GPC to effectively monitor and control the improvement process which aim to ensure better result and more success in their future projects.

5.4 Limitations and scope for further study:

This study is carried out considering the respondents from GPC, contractor, subcontractor companies who have the most frequency of doing the overhaul works. The validity of the results can be still increased by studying similar works by increasing the domain of the data collected for similar overhaul works, so the chance of repeatability of the said results in the conclusion is high.

Project failure, in this work, is regarded as the dealy in the scheduled time of the work. There are other criteria for project failure, which also can be addressed. Finally the grouping system that used in the analysis methodology was limited only to three areas

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Appendices

Appendix A: *Student Declaration Form*

Appendix B: *Form of request for Questionnaire Survey*

To Whom It May Concern,

I would like to take a few minutes of your time requesting that you go through the following set of questions that will assist me, Saleh Ahmed Alhashmi, in:

1. Completing my research for my Dissertation in MSc Project Management which will also be contributing to academic literature.
2. Assisting GPC in performing overhauling jobs much better.

This is an invitation for you to participate in a research that aims at identifying critical success / failure factors of overhaul project of GPC. You are chosen to participate in this research for the following reasons:

1. Finding out what you think about the overhaul projects in GPC, which will assist me in understanding your viewpoint and give me feedback that I can work with to better service you.

All the information collected from the participants will be kept confidential and will only be made available to the researcher. From the information you will provide, an assessment of the procedure you went through will be analyzed and a recommendation will be provided. If meeting with the personnel is difficult, and you would rather respond to these set of questions via email or phone, please feel free to inform me of such. Your name will be kept confidential, and if answering any of the questions puts you in discomfort then do not answer them.

If you agree to participate in this research, please sign at the bottom of the page.

Thank you for your time, and I look forward to hearing from you.

Salah Ahmed Alhashmi

If you agree to the points above, please sign below:

Appendix C: First Survey Questionnaire Format

Information about your Organization

Organization Name:

Location:

Industry:

Number of employees:

No. of overhauling projects performed:

Duration of the work and location:

Information about the Interviewee

Please note that this information will remain confidential and will not be shared with anyone other than the interviewer.

Name:

Department:

Role in the project:

Below mentioned questionnaire is required to be answered, please refer to table 1 below for coding of questionnaire questions for responding in the likert scale ranging from 1 to 5 (1 indicate extremely disagree, 5 indicate extremely agree and 3 is neutral), given subsequently.

Table 1: Critical Failure Factors Groups Questionnaire:

Sl. No.	**Questions Related to Procurement Section (P)**	**Questions Related to Scope of Work Section (S)**	**Questions Related to Communication Section (C)**
Q1.	Do you think that the Procurement factors are important to the overhaul projects?	Do you think that the Scope of Work factors are important to the overhaul projects?	Do you think that the Communication factors are important to the overhaul projects?

Q2.	Do you think that the current procurement system in GPC is unable to meet the requirement of the overhaul projects?	Do you think that the current Scope Management system in GPC is insufficient to suit the overhaul project needs?	Do you think that the current communication system in GPC overhaul projects is ineffective?
Q3.	Do you consider the current GPC procurement system as one of the main factors that cause delay to overhaul projects?	Do you consider the current GPC Scope Management System as one of the main factors that cause delay to overhaul projects?	Do you consider the current GPC Communication Management System as one of the main factors that cause delay to overhaul projects?
Q4.	Do you feel that there is an urgent need to change/improve the current procurement system?	Do you feel that there is an urgent need to change/improve the current Scope Management system?	Do you feel that there is an urgent need to change/improve the current communication system?
Q5.	Do you think launching a new procurement system that is project wise oriented will help to complete GPC overhaul project on time or earlier?	Do you think implementing more strict/more efficient procedure system on changing project scope will help to complete GPC overhaul project on time or earlier?	Do you think developing project team skills and changing the current project communication system will help to complete GPC overhaul project on time or earlier?

Table 2: Table for marking in likert scale 1 is extremely disagree, 5 in extremely agree and 3 is neutral (Refer to previous Table 1 for "Critical Success Groups Questionnaire")

SI No.	**Likert marking For Procurement Section**	**Likert marking For Scope of Work Section**	**Likert marking For Communication Section**
Q1.			
Q2.			
Q3.			
Q4.			
Q5.			

Appendix D: Second Questionnaire Format

Information about your Organization

Organization Name:

Location:

Industry:

Number of employees:

No. of overhauling projects performed:

Duration of the work and location:

Information about the Interviewee

Please note that this information will remain confidential and will not be shared with anyone other than the interviewer.

Name:

Department:

Role in the project:

Below mentioned questionnaire is required to be answered, please refer to table 1 below for coding of questionnaire questions for responding in the likert scale ranging from 1 to 5 (1 indicate least important, 5 indicate most important and 3 is neutral), given subsequently.

Table 1: Table for coding CFF's

Sl. No.	**Procurement related** (P*)	**Scope of work related** (S*)	**Communication related** (C*)
1.	Incapable contractor.	Change of scope due to absence of real cutoff date.	Inadequate Communication skills
2.	In appropriate contractor selection criteria.	Absence of structured process for adding work	Un-established communication procedure within the project organization.

3.	Unsuitable type of contract.	Adding anytime work with overhaul work	Cultural differences (due to multi-nationalities recruitment)
4.	Inefficient contract planning and management.	Improper estimation of capital cost which to lead to scope reduction	Ineffective co-ordination of project manager
5.	Insufficient contractor resource availability.	Undefined scope	Unsuitable selection of communication means
6.	Inadequate contractor resources planning.	uniqueness of project activities	Lack of communication between stakeholders
7.	Delay in solving contractual issues.	Improper project works/packages estimate	Lack of information sharing
8.	Absence of procurement plan control and monitoring system.	Inefficient Pre-project preparation design to be considered in the early phases of the project development cycle.	Poor liaison with local authority
9.	Poor monitoring of subcontractors claims.	Unreasonable project master and implementation plans.	Poor coordination with subcontractors
10.	Delay payment on contract	Unclear objectives for the project	Late and incomplete feedback
11.	Conflict of contractual documents.	Inadequate specification	Inadequate social and informal mechanisms for a collaborative working environment
12.	Non-availability of contractor previous projects records in term of delay and claims.	Unanticipated work	Incompetent project documentation management system.
13.	poor project material delivery system	Insufficient time for work	Insufficient Project communication media infrastructure
14.	Inefficient project bidding method	-	-
15.	Insufficient contractor's cash flow	-	-

16.	Lack of experience of subcontractor	-	-
17.	Nature of client (privately funded vs. publically funded)	-	-

* Coding-Pi indicate CFF's i ranging from 1 to 17 in procurement related factors (P1 is the first CFF under procurement related factors)

*Coding-Si indicate CFF's i ranging from 1 to 13 in scope of work related factors.

*Coding-Ci indicate CFF's i ranging from 1 to 13 in communication related factors.

Following coding is adopted for easy analysis of data in MS excel.

Table 2: Table for marking in likert scale (1 is least important, 5 in highly important and 3 is neutral (Refer previous table for expansion of coding)

Code	Likert marking	Code	Likert marking	Code	Likert marking
P1		**S1**		**C1**	
P2		**S2**		**C2**	
P3		**S3**		**C3**	
P4		**S4**		**C4**	
P5		**S5**		**C5**	
P6		**S6**		**C6**	
P7		**S7**		**C7**	
P8		**S8**		**C8**	
P9		**S9**		**C9**	
P10		**S10**		**C10**	
P11		**S11**		**C11**	

P12		**S12**		**C12**	
P13		**S13**		**C13**	
P14					
P15					
P16					
P17					