Master of Science Thesis

Analysis of the Refinery Project Execution Strategy from an Organizational Effectiveness Perspective

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4409868
Analysis of the Refinery Project Execution Strategy from an Organizational Effectiveness Perspective

Studying the impacts of concurrent execution on taskforce satisfaction in the EPC phase of a refinery project

MASTER OF SCIENCE THESIS

For the degree of Master of Science in Construction Management and Engineering (CME) at Delft University of Technology

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August 26, 2016

Faculty of Civil Engineering and Geosciences
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Acknowledgements

It is amazing to sit down and realize how my experiences over the last year have led me to where I am today. This thesis is the end-result of 9 months hard work and dedicated research in the field of project management – organizational effectiveness. With this report, I conclude my graduation internship at Fluor as well as my two years of study at the Delft University of Technology for the master program Construction Management and Engineering.

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However, nothing has been more influential in my life than my family. The prayers and blessings of my family have been indeed very special. You are my inspiration and my strength. Thank you very much for being there all the time.

Delft, University of Technology
August 26, 2016

Harshal Vilas Patil

Fluor B.V.  TU Delft
Traditionally, the preferable method of execution in the industry is to follow the sequential path of activities. In reality, this approach has become outdated with concurrent execution replacing sequential engineering. In EPC projects, concurrent engineering facilitates the overlap of Engineering, Procurement, Contracts and Construction activities. The incentive for adopting concurrency was to reduce the time line of the project and generate earlier cash flows for the client. While concurrency is desirable for the client, it raises concerns for contractors executing the projects. In a competitive market, accepting concurrency in the project has become inevitable in order to survive and succeed. Thus, understanding its impacts on the employees and managing the project without exposing the taskforce to excessive stress or fatigue, is considered to be an important aspect of modern project management. The problem varies for different projects and different industries but the core remains same, ‘people of an organization.’

This graduation research is inspired by the concerns mentioned above in order to investigate the impact of concurrent execution on the taskforce of a refinery project from an Organizational Effectiveness (OE) perspective. This project is selected as a case study because Fluor is implementing the OE charter for this refinery project to improve project performance by positively engaging the taskforce and managing the people aspect of the project.

**Current execution strategy of the refinery project involving concurrent engineering is affecting the taskforce as the EPC phase is in progress**

At the outset, a hypothesis (as above) was proposed to provide direction for testing the assumptions; and to formulate a research question. This research is a case study for a specific project which might not be sufficient to generalize the results. The main research question answered in this report is,

**What are the impacts of concurrent execution strategy on the task force in the EPC phase of a refinery project?**
In order to answer the research question, the research approach was decided based on following four methods:

- **Taskforce Satisfaction Survey**: Measuring the satisfaction level of the taskforce periodically (preferably 3-4 months gap), to understand the trend and the factors influencing the satisfaction level
- **Schedule Analysis**: Investigating the changes in concurrency level of the project and effects on the taskforce
- **BEACON Model Survey**: Evaluating readiness of Fluor’s project strategy towards given concurrency level in execution
- **Interviews**: In depth analysis from interviews with taskforce to understand the ground reality and problems

To investigate the hypothesis and conduct research, a literature study was carried out concentrating on the concurrent engineering and its impact on people and project. Once the investigation was completed with necessary data collection, conclusions were derived with the help of above four methods, leading to the main objective of the research.

**Taskforce Satisfaction Survey**: This survey provided an all-round assessment of the project using Gallup’s 12 questions. Six survey rounds were conducted till date and the trend is analyzed based on the results. Observations made show fluctuating taskforce satisfaction levels which are influenced by the phase of the project at that particular time. Aspects which can be governed by project management such as commitment to quality, materials and equipment; and the expectations at work, scored better than the aspects closely related to the people aspect of project management (i.e. Recognition, encouraging development, relations with colleagues as well as individual progress of employees). Outcome of this activity showed that the taskforce was not satisfied and the score dropped from 4.03 to 3.76 (August’14 – April’16) on a scale of 5, raising concerns for the management. Survey responses were affected by the number of participants and their experience on the refinery project. Additionally, asking an extra question about the time spent by the participant on the project helps the analysis to be based on organized data.

**Concurrency Level Investigation**: Comparing EPC schedules of the project for the period of six months, from October’15 to March’16, the effects of the dynamic schedule on the project and eventually people were determined. Absolute comparison between October’15 and March’16 schedules showed delay in detail engineering phase which was compensated by compressing the contracts and construction schedule to meet the fixed date of completion. These deviations exerted a pressure on the taskforce to deliver a quality product in reduced time, while incorporating numerous rework cycles. Though the investigation did not show a clear level of increased concurrency in overall schedule, individual disciplines showed that the level of concurrency increased due to compressed schedule.

**Readiness for Concurrency - BEACON Model Survey**: Once it was established that the taskforce is facing difficulties with schedule and added concurrency as well as showing decreased level of satisfaction with time, it was essential to investigate whether Fluor project execution strategy is capable of handling the given concurrency. BEACON Model (Benchmarking and Readiness Assessment for Concurrent Engineering in Construction) was referred...
for this investigation with essential modifications. The result of this investigation indicates that current Fluor process is not fully prepared for given concurrency on the project. Fluor management needs to address the critical factors from people element e.g. team dynamics, internal communications, recognition and work life balance. BEACON survey was responded by 21 participants selected from the taskforce.

**Interviews:** The same group of 21 employees including management and lead engineers, from BEACON survey was interviewed to obtain detail knowledge about issues faced by taskforce relating to the concurrent engineering and project execution strategy. BEACON survey on the refinery project execution strategy yielded interesting results but to obtain deeper insights into the real life situation, interviews were conducted. Perception of people towards the project and the problems faced by taskforce in routine work life were discussed during the interviews.

Based on this entire research, conclusions and recommendations were derived for the refinery project and Fluor in general.

Once the analysis of the research output was completed, it was observed that the taskforce is under pressure at present. But, as the research question and hypothesis states that it is explicitly due to concurrent execution in the project strategy, the conclusion is slightly different and encompasses various other factors along with concurrency.

First important conclusion is that the project schedule was already concurrent from the beginning. Delays and unforeseen activities (particularly following late HAZOP strategy and underestimating HAZOP work) introduced an additional concurrency in the schedule. Delays resulted in extending detail engineering design whereas, compressing the contracts and construction duration to adhere to the original end date of project. This superimposed concurrency created the churn in the taskforce with delays and increased work load. People were stressed with unforeseen work and in the hindsight, this affected communication, team dynamics and work life balance of people.

Apart from the added concurrency, there are factors (called as critical factors) which affects the taskforce and project during the project life cycle. Critical factors which impact the taskforce are primarily project dependent, employee dependent and Fluor organization dependent.

- **Project dependent:** Refinery project leadership, project execution strategy, client influence and impact
- **Employee dependent:** Human nature, attitude, personality
- **Fluor Organization dependent:** Support in terms of resources, tools and work space environment

Critical factors mentioned above are important to engage the taskforce positively by creating a solid team dynamics. People have been observed to experience stress, burnout, frustration and communication gaps during the EPC phase of the refinery project. Project management needs to provide immediate attention towards the aforementioned critical factors and implement following measures for the future.
Based on the overall research and inputs from taskforce, four important recommendations for the refinery project management are suggested to engage taskforce and enhance the overall performance in future.

- In future, before implementing a specific strategy or new practice (e.g. late HAZOP), incorporate its consequences on entire project (planning and execution) setup

- Recognition for whole taskforce can be improved and delegated discipline wise to expand the reach of the programme. In parallel, create awareness about small talks, appreciating colleagues and nurture the taskforce for soft aspects of project management

- Facilitate the growth of lead engineers into managerial positions. This suggestion will help them in better management of work and workforce with efficient performance returns

- During research, CSA (Civil, structures and Architecture) discipline is identified as an example of efficient management with solid team dynamics. The Refinery project management should study the setup of this discipline to facilitate future developments in the project team

This research was conducted for an effective duration of six months which also presented limitations in carrying out the investigation on a broader level. Following improvements can be integrated in future research.

- Carry out the readiness assessment of entire Fluor organization towards concurrent execution in order to identify the areas of improvement

- Similar study can be carried out comparing impacts of execution strategy and concurrency of two or more projects on respective taskforce to broaden the scope of research

- This graduation study is a small part of a longitudinal research spanning across life cycle of the refinery project. Further research should be carried out in this direction as the EPC phase is nearing its end and construction phase will commence. This will provide a completely different perspective to this research

Limitation of this research lies in its failure to incorporate the impact of the conditions in which the data was collected and analyzed. For complementing this research, the data should be collected at different phases of project life-cycle to compare the results. It will be very interesting to observe the patterns as the project starts, peaks and eventually ends.
DO NOT GO WHERE THE PATH MAY LEAD,
GO INSTEAD WHERE THERE IS NO PATH
AND LEAVE A TRAIL......

— Ralph Waldo Emerson
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LIST OF ABBREVIATIONS

CE  Concurrent Engineering
CM  Contract Management
CSA  Civil, Structure and Architecture
ECS  Electrical & Control System
EM  Engineering Management
EP  Engineering and Procurement
EPC  Engineering Procurement and Construction
FEED  Front End Engineering Design
HAZOP  Hazard and Operability Study
HPT  High Performance Team
HSE  Health, Safety and Environment
IFC  Issued for Construction
IFD  Issued for Design
ISBL  Inside Battery Limit
IST  Present Case Scenario
MC  Mechanical Completion
MEC  Mechanical
MTO  Material Take Off
ND  New Delhi
OE  Organizational Effectiveness
OSBL  Outside Battery Limit
P&ID  Piping & Instrumentation Diagram
PA  Project Assistant
PAM  Project Activity Model
PC  Project Control
PDDM  Project Documentation and Data Management
PEM  Project Engineering Management
PFD  Process Flow Diagram
PIP  Piping
PM  Project Management
PR  Procurement
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<td>SBET</td>
<td>Site Based Engineering Team</td>
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Chapter 1

INTRODUCTION

This chapter starts by defining the research problem, its context and scope followed by introduction of the refinery project as a case. By integrating the problem statement with the refinery project case, a research question and corresponding sub questions are framed. In addition, research methodology, investigation techniques and the report structure is explained further in this chapter.

1-1 Introduction

In 2014, Fluor B.V. started a major oil refinery project consisting of modification of existing facilities and installation of new facilities. The decision to put Organizational Effectiveness (OE) concept into practice on this project was taken by the management at the beginning. The organizational effectiveness points towards efficient, wise and strategic use of all the organizational resources i.e. Human, Financial and Technological resources to achieve execution excellence. Relating soft aspects of project management to the hard aspects, forms the basis of the organizational effectiveness charter. The OE is the concept of how effective an organization is, in achieving the outcomes that the organization intends to produce.

Fluor B.V., in collaboration with TU Delft, decided to pursue a longitudinal research during the refinery project life-cycle. The objective was to implement the concept of organizational effectiveness in project management to complement the hard aspects of project management (e.g. cost, quality, time). It is essential in future to create a balance in between soft and hard aspects of project management to enhance the project execution. Proposed graduation study forms an integral part of the longitudinal research on the refinery project which is planned to be finished by Q2-2018. This study is aimed towards the interrelationship between the project execution strategy and organizational effectiveness concept in the EPC phase of the refinery project.

Fluor B.V.   TU Delft
1-2 Problem Description

In any project, preferably the processes take place in a sequential manner starting from FEED to EPC and then commissioning in order to facilitate unidirectional flow of information and avoid rework cycles (Prasad, 1996). In EPC phase the order is from engineering, procurement, contract management and then construction. The preferred way is to start the next process once the previous process has been completely finished as per Figure 1-1. This is the traditional execution scenario and has certain drawbacks in terms of scheduling and cost optimization of the project from an investment point of view.

![Figure 1-1: Ideal case scenario in EPC phase of a project](image)

To overcome the drawbacks, the most common procedure currently followed in EPC firms and capital projects is to carry out concurrent engineering (CE). Real life projects always exhibit a concurrent nature which involves the interfaces between engineering, contract management and construction phases. This interface can be technical, managerial, cultural as well as behavioral. Concurrent engineering gained increasingly high importance in 1990s (Smith and Eppinger, 1998). The driver for concurrency is to generate net present value (NPV). Concurrent engineering basically facilitates the overlap of all the three activities in EPC phase in order to reduce the project time frame, time to market as well as generate the earlier positive cash flows for the client/owners. The overlap is shown in the Figure 1-2.

![Figure 1-2: Actual situation during the EPC phase](image)

The significance of Concurrent Engineering is that it prescribes how to realign the traditional sequential way of executing a project based on fragmented stages into a new paradigm of parallel and integrated life-cycle process using multi-disciplinary teamwork approach (Mohamad, 1999, p. 50). The emergence of Concurrent Engineering resulted from the necessity of more effective and innovative approaches which will also shorten the project schedule and improve the overall efficiency (Mohamad, 1999, p. 52). Concurrent engineering primarily deals with the design phase, which further influences the manufacturing or execution process (Koskela, 2003).

It is revealed in a research that design phase in a product development process consumes
5% of the estimated costs but controls 75% of the manufacturing costs (Dowlatshahi, 1994). Hence, implementing concurrent engineering instead of sequential engineering, results in high influence on the costs as well as reduction in project implementation time up to 70% (Chimay J, John M, Anne-Francoise, 2007). This shift from sequential to concurrent engineering faces many hurdles which include multiple assumptions, continuous rework and change management, communication, dependencies and uncertainties in the coordination. The impact of CE on the taskforce and the disciplines plays an extremely important role on a project during the EPC phase.

Concurrent execution more often than not proves beneficial to the client side as it is easier to invest upfront and generate positive revenues by reducing the product time to market (Prasad, 1996). Time is the one of the most important drivers for the client in the oil and gas industry and hence it drives concurrency forward in proposed projects (De Wit, 1988). On the other hand it is not always the case from contractors point of view. Concurrency may have certain adverse effects on the contractors organization and task force if exceeded beyond a threshold. Fierce competition in industry makes it hard for the contractors to say no to the client demands and it is then of utmost importance for the management to find the best possible way to execute projects without putting the most valuable asset of a company i.e. people, under excessive stress.

In order to understand the problem mentioned above, this graduation study is carried out with the help of an ongoing refinery project as a case study.

1-3 Case: The Refinery Project by Fluor

The graduation thesis is carried out in Fluor B.V. on a refinery project which is currently in EPC (engineering, procurement and construction) stage (Table 1-1). The refinery project is a complex project involving client and contractor working together in the same office as well as coordination amongst multiple disciplines working from different offices around the world (Amsterdam, New Delhi, and Cebu). The project started from the FEED (Front End Engineering Design) phase and at present, the EPC phase is in progress (50%). The graduation research is management oriented with further focus on concurrent engineering and interfaces between people on the taskforce. The objective is to understand the execution strategy from organizational effectiveness perspective, during the early EPC phase. The research methodology is aimed at analyzing the concurrency on the refinery project and the impact of simultaneous execution on the taskforce.

For the first time, Fluor is implementing Organizational Effectiveness (OE) charter as an integral part of the refinery project execution plan. The objective of the OE charter is to create a high performance team (HPT). This charter is primarily implemented to provide stress free, respectful and positive atmosphere to the taskforce to enhance the performance of the project. This graduation research is part of the OE charter and TU Delft student is selected as an intern on this project.
## Table 1-1: Case introduction

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**Case description:** The client intends to improve the reliability and profitability of their refinery in order to expand the production capacity of diesel and produce base-stock lube oil for the European market. The scope of work consists of building inside the refinery a new state of the art lube hydrocracker and a vacuum pre-distillation unit, revamping of the existing once-through hydrocracker and enhancing the product storage and loading facilities by extension and upgrading of tank farm and jetties (Fluor, 2016b).

### 1-4 Hypothesis

In order to study the problem, a hypothesis is proposed based on the refinery project case. This refinery project is a live project and thus, it is a single case study. It is not rational to formulate a research question based on a single case and generalize it for the scientific study. Thus, it was decided to conduct the research specific to the refinery project based on inductive hypothesis method (Shalini, Ajith, Eeshoo, 2001). Soundly constructed hypotheses point toward the best way to conduct the research and develop a research design i.e. collection and interpretation of data (Sharma & Battina, 2002). The problem analysis described in the previous section provides the basis to streamline the research and formulate a hypothesis which can be further tested with practical data collection and analysis. The problem statement revolves around the concept of concurrent engineering and the extent to which the project task force functions effectively in terms of employee satisfaction and project performance. Thus, the hypothesis is proposed as;

**Current execution strategy of the refinery project involving concurrent engineering is affecting the taskforce as the EPC phase is in progress**

This hypothesis is a possible explanation of the problem and it is very essential to investigate further by testing it with the help of theory and practical data analysis of the refinery project (Sharma & Battina, 2002). Proposing the hypothesis before the research work helped define the research objective and the key factors necessary for the study. As a result, it was easier to relate literature with the problem statement.
1-5 Objectives and Research Question

The objective of the research is to;

“Analyze the execution strategy of a refinery project in EPC phase from an organizational effectiveness point of view in order to understand its impact on taskforce satisfaction.”

The intention of pursuing this field of research for graduation is fundamentally related to organizational effectiveness and the importance of people in any project. The advancing technologies and methods as well as knowledge and experience, are necessary to fruitfully deliver a project, but are not adequate (Bakker & Kleijn, 2014). The people who join their hands together as a team to achieve the goal of a successful project make the difference. The research strategy is to observe the impacts of concurrent execution in the refinery project on the people and interfaces formed between the three phases of EPC stage. The research eventually aims to provide the critical analysis of the current execution strategy from people’s perspective. As rightly stated by (Bakker & Kleijn, 2014), "The management of projects is all about people: People are key!".

Research Question

What are the impacts of concurrent execution strategy on the task force in the EPC phase of a refinery project?

Sub-Questions To answer the research question, a number of sub-questions were prepared by breaking the scope in a step wise manner and each part was answered as a basis of the research. Answering these sub-questions eventually led to the answer of the research question in the end:

- What is the traditional execution approach for a refinery project?
- How is Taskforce Satisfaction changing over time?
- What changes are observed in the concurrency level in the refinery project schedule since EPC commencement? How does it affect the people?
- Is the organization (taskforce and management) prepared for the given concurrency?

The above sub-questions will be referred throughout the report in order to answer the final research question in a structure manner.

1-6 Structure of the Thesis Report

This graduation research starts by exploring the problem faced by industry and specifically Fluor. Chapter 1 introduces the methodology followed in the research including three separate investigation techniques to be implemented. Chapter 2 investigates the literature to understand the concept of concurrent execution in EPC phase of the project. This further
elucidates the relation between organizational effectiveness and project execution strategy. Further, Chapter 3 investigates the trend in taskforce satisfaction measured at various points in project life cycle. Chapter 4 explores the dynamics of the live schedule to investigate the level of concurrency on the project. The readiness of the Fluor organization towards the given concurrency is investigated in chapter 5. In chapter 6, interviews are explained with the results. Summarizing the research study, chapter 7 presents the combined analysis of whole research from organizational effectiveness and people’s perspective. Inter-relations between different assessments and critical input of the author with practical experience of being on taskforce for whole duration is incorporated in the conclusions and recommendations.

1-7 Research Methodology

The graduation research was set up with the help of a hypothesis and the analysis will be done in order to verify the validity of the hypothesis. Four methods of data collection i.e. taskforce satisfaction survey, project schedule analysis, concurrency readiness (BEACON model) survey and interviews, were used to test and analyze the hypothesis (Figure 1-3). Outcome of these methods eventually led to the conclusion and answer of the research question. Data collection is carried out throughout the research duration depending on the process and feasibility.

The methodology used for this research resembles the grounded research theory by Glaser and Strauss (Glaser & Strauss, 2009; Strauss & Corbin, 1967). The Grounded Theory is a qualitative research method which formulates the theory through the analysis of data collected, rather than other way around (Halari, 2010). This theory is mainly used in the field of sociology, social sciences, psychology but also it is applicable in the field of project management. Creswell supports the theory with following points which were found relevant to the approach followed for this graduation research (Creswell, 2013).

- Identify the level of theory that is available; if there is insufficient theory, the research can be done under the realm of Grounded Theory
- The objective is to focus on the process and identify how it unravels
- Interviews, observations and documents are the primary sources of data
- Data collected from various sources is structured
- Identify the emergence of patterns from the structured data

1-7-1 Choice of the Investigation Methods

The aforementioned four methods used for data collection in this research are selected based on the research direction, field of research and found to be fit for purpose. Details are provided below.

Taskforce Satisfaction Survey: This is a proven methodology to measure employee engagement in a project or organization. Taskforce satisfaction survey was carried out since the beginning of the project and similar trend was continued further in this research.
Figure 1-3: Research approach
survey actually assisted in the research as it is an integral part of the thesis to understand the mindset and feelings of people towards the project and functioning of management. Taskforce satisfaction survey provided periodical measurement of satisfaction based on Gallup’s 12 aspects to further guide the research in the organizational effectiveness direction.

Schedule Analysis: Just looking at the project schedule it was not possible to say whether there is high concurrency or low concurrency as well as if it is changing with the time or constantly maintained in the EPC phase. Hence, the schedule analysis was carried out to understand the movement of the schedule and major activities in the EPC phase. The difference between the two schedules assisted in understanding the changes in concurrency.

BEACON Survey: Once the observation regarding the changes in concurrency and the decline in satisfaction was noted, it is decided to see if there is a relation among present execution strategy, concurrency and perception of taskforce towards the concurrency. Hence, the BEACON model survey was conducted. The purpose of BEACON survey is to see how an organization is adopting to the given concurrency and what improvements or weak points can be found to improve the overall situation from an organizational point of view.

Once the data is collected, the analysis can be related to the performance, progress and most importantly, the impact of the present method of execution on the taskforce. The outcome can then be related to the team effectiveness and impact on taskforce. In case the outcome is critical with respect to current progress, then detecting such errors will help in rectifying the strategy and improving the performance.

One of the important aspects of the research is to study the concept of concurrent engineering on a real project and analyze its impact on the work process in EPC from the perspective of organizational effectiveness. All the available information, details and reports from Fluor and client database relevant to the research are studied to understand the working of the engineering, contract management and construction teams in the EPC phase.

The conclusion of the research focuses on the aspects which need attention to keep the taskforce happy and motivated. Also, understanding the effects of current project execution strategy on the people; and factors particularly contributing towards the churn or problems in the taskforce are addressed for the refinery project. The influence of the project management on the project team, which is governed by hard aspects in present industry, will be assessed based on a real ongoing project. The analysis will pave the way for managing the taskforce in an efficient manner by balancing the organizational effectiveness and the technical (hard) aspects of the refinery project.

The period of consideration for the data analysis is mentioned as below:

- Taskforce satisfaction survey: Measured regularly since the start of the project and the latest round six was conducted in April’16. Depending on the feasibility to carry out survey and the alignment with project in terms of schedule and vacations, the time period between two surveys varied from 3-4 months though the preferable frequency was on a quarterly basis.

- Project schedule analysis: Period of six months between October’15 to March’16. The starting point is chosen as October’15 because the refinery project EPC phase started from the same month. The standard schedule prepared by Fluor for the project represents October’15 as the EPC baseline with detailed schedules for the complete EPC
phase. This baseline is the proposed schedule which is expected to be followed in case of perfect execution. As the master’s thesis lasted until June’16, the data analysis can be done only when the data collection is frozen at a certain point. Six months period seems appropriate given the duration of the thesis to predict a trend in the schedule. Ideally the data is collected on a monthly basis but for absolute comparison and analysis, initial and final schedule is selected

- BEACON model survey/interviews: In the month of May’16 the survey was conducted followed by interviews
- Interviews were conducted on the project taskforce consisting of 21 people, in the month of June’16 as a final measurement of the taskforce

1-7-2 Taskforce Satisfaction Survey

The taskforce satisfaction survey is based on Gallup’s Q12. The Gallup’s Q12 consist of 12 specific questions that are used to measure employee perceptions of engagement in their workplace (Wang, 2014). “Gallup tested thousands of questions on millions of employees to find the right questions with precise wording that provided the highest correlation to business results which are regularly measured by most of the companies — profitability, productivity, turnover, and safety” (SAIC, 2011). Surveys are conducted on a 5-point Likert scale (1 strongly disagree and 5 strongly agree) (Avery, McKay & Wilson, 2007). Taskforce satisfaction survey questionnaire with the twelve aspects is shown in Table 1-2 (SAIC, 2011).

Taskforce satisfaction surveys were conducted since the beginning of the FEED phase of the project and till date, six surveys have been performed. The trend observed through the six surveys is crucial for primary investigation of the temperature on the taskforce and for relating this method to further research. Two out of six rounds were carried out during the thesis duration. First round was conducted just at the beginning of the EPC phase on the refinery project i.e. October’15. The next round was conducted at the end of March’16. The purpose of conducting this survey in a span of six months was to observe the changes in the employee satisfaction level in the designated period of the thesis research.

Survey Monkey portal is selected to conduct and analyze the online surveys as it is the authorized medium for survey study in Fluor B.V., in addition to being extremely user friendly to learn.

1-7-3 Schedule Analysis

In this project, there is a given concurrency in the baseline schedule of EPC and it is part of the project execution strategy. Given the dynamic nature of the project and the schedule, the extent of overlap in activities is subjected to changes with the progress. Thus, it is essential to observe the changes in the schedule and changing overlaps of major activities in the project. In order to gain insight in the dynamics of the schedule, an analysis is performed with the help of existing real schedules of the refinery project. The end product of this activity illustrates the variation in the schedules of the EPC phase of refinery project by tracking the start and finish dates of selected milestones and related activities.
Table 1-2: Taskforce Satisfaction Survey questionnaire

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectations</td>
<td>I know what is expected of me at work</td>
</tr>
<tr>
<td>Materials and Equipment</td>
<td>I have the materials and equipment which I need to do my job right</td>
</tr>
<tr>
<td>Do Best</td>
<td>At work I have the opportunity to do what I do best every day</td>
</tr>
<tr>
<td>Recognition</td>
<td>In the last seven days, I have received recognition or praise for doing good work</td>
</tr>
<tr>
<td>Cares about me</td>
<td>My supervisor or someone at work seems to care about me as a person</td>
</tr>
<tr>
<td>Development</td>
<td>There is someone at work who encourages my development</td>
</tr>
<tr>
<td>Opinions Count</td>
<td>At work, my opinions seem to count</td>
</tr>
<tr>
<td>Mission/Purpose</td>
<td>The mission or purpose of my company makes me feel my job is important</td>
</tr>
<tr>
<td>Quality</td>
<td>My associated or fellow employees are committed to doing quality work</td>
</tr>
<tr>
<td>Best Friend</td>
<td>I have a best friend at work</td>
</tr>
<tr>
<td>Progress</td>
<td>In the last six months, someone at work has talked to me about my progress</td>
</tr>
<tr>
<td>Learn and Grow</td>
<td>This last year, I have had opportunities at work to learn and grow</td>
</tr>
</tbody>
</table>

In this method of investigation, the important component is to formulate a list of major activities which are carried out in EPC execution phase of a standard refinery project. Integrating the database available in Fluor’s global knowledge portal, inputs from the senior management from each discipline and literature study, the list of major and relevant activities was formulated. The activities for tracking the schedule changes were composed of major milestones and are critical to project execution.

As explained before, EPC baseline schedule (October’15) and the latest updated schedule (March’16) are selected for the analysis. Both schedules are separated by a period of six months and it is extremely important to track the movement of major activities during these six months. MS Project tool is found to be suitable for mapping out the activities on time and sequence parameter to analyze project schedules. MS Project is preferred over Primavera due to the fact that user interface of MS Project is easier to understand and fulfills the requirements.

1-7-4 BEACON Model Survey

Third part of data collection and analysis was to conduct the survey with selected 21 members of the refinery project task force. The survey is based on the BEACON Model (Benchmarking and Readiness Assessment for Concurrent Engineering in Construction). The purpose of this survey is to check whether the Fluor procedures are compatible for the given concurrency on
the refinery project at present and assess the impacts on the taskforce. Formulating a valid and effective questionnaire for the interview and survey is the backbone of this method and hence the BEACON model (Khalfan, 2001) is referred to in order to create the questionnaire. Survey Monkey portal is preferred for conduction of BEACON survey online.

As evident from the name, the model basically assists in determining the readiness of an organization towards implementing concurrent execution principles in the future projects by virtue of evaluating the organization with respect to four key elements and seventeen critical factors as shown in Figure 1-4. The BEACON model is further explained in chapter 5.

![The BEACON Model](image)

**Figure 1-4:** The BEACON Model (Khalfan, Anumba, & Carrillo, 2001)

As a matter of fact, the BEACON model questionnaire has a standard set of questions to actually assess the readiness of that particular firm for accepting the concurrent execution. Fluor, on the other hand, has been implementing concurrent engineering strategy on the projects for a long time now, so it is ideally not possible to use the BEACON questionnaire as it is, to assess the readiness. The need for Fluor and this research thesis is to understand
whether the concurrent execution is creating impacts on the task force and if yes then what are the aspects where the impacts are observed. Key features of BEACON Model are mentioned below to justify its selection for this investigation.

Key features of BEACON model (Khalfan et al., 2001):

- The BEACON model assessment survey questionnaire is particularly prepared for the refinery project
- It consists of four key elements and seventeen critical factors necessary for applying CE, which are only partially considered by other models
- Assessment of the 17 critical factors using the model will enable the development of guidelines for the effective and more appropriate implementation of CE in construction or other projects
- The model enabled the construction industry to identify aspects of its project delivery process that require improvements to facilitate CE implementation
- The survey and assessment could be carried out either in the form of structured interviews; alternatively, an electronic version of the questionnaire could be completed by remote respondents
- Even for organizations which have implemented the CE, the model can act as a useful tool for self-assessment on the four key elements: people, process, project, and technology

1-7-5 Interviews

Once the above three methods are completed, one on one interviews with the 21 participants selected for BEACON survey from the taskforce were carried out in the month of June’16.

The interviews were semi-structured with a standard questionnaire prepared in advance. Candidates were allowed to answer the questions in detail and they were given the option to not express their opinion on a subject if they found it unrelated or vague. Participants were contacted personally to schedule the interviews and brief explanation of the research objective is provided for more information. Interviews were scheduled for 45-60 minutes on an average. In most cases, the interviews were carried out in the workspace of the participants.

1-8 Scope of Work

The graduation research will be carried out during EPC phase of the refinery project. The focus will be completely on the engineering design team, contractors/sub-contractors and construction team in EPC phase. The research scope will incorporate Fluor team, client team as well as all the main and sub-contractors.

In the current stage of the refinery project i.e. EPC phase, detailed engineering is in progress in parallel to procurement, contract management and construction support. The focus of
the research during the study period will be on the engineering, contract management and construction disciplines only. The procurement work will be integrated with the engineering discipline for the thesis scope.
In this chapter, the concepts of concurrent engineering and organizational effectiveness are explained from literature research. Main objective of this chapter is to provide theoretical insight of the key concepts of the graduation research. Creating a solid foundation for the problem statement and understanding theoretical relation between concurrent execution (hard aspect) and organizational effectiveness (soft aspect) for further practical assessment is the expected outcome of this chapter. Multiple scientific resources and previous research are accessed for better understanding of the subject.

2-1 Concurrent Engineering

The notion of Concurrent Engineering (CE) was coined in the 1980s of the last century as a medium to optimize the development time of products (Anumba, Kamara, & Cutting-Decelle, 2006) (Prasad, 1996). Concurrent engineering is a production management philosophy, a paralleled approach-replacing the sequential engineering strategy in order to achieve desired time-saving goals (Prasad, 1996). Concurrent engineering promotes overlapped processes instead of sequential product and process design.

The first proper definition proposed by Winner et al. (1988) referred to concurrent engineering as, “a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support” (Winner, Pennell, Bertrand, & Slusarzuk, 1988). The absolute objective of concurrent engineering is to achieve consumer satisfaction by considering all aspects of the product life-cycle i.e. quality, cost, schedule and user requirements.

In simple language, concurrent engineering is an art of performing engineering tasks in parallel and concurrently (Khadimally, 2015). Concurrent engineering is regarded as an important tool for reducing the time-to-market for new products. Blackburn et al. (1994) distinguish between time and information concurrency. Time concurrency refers to activities that are performed in parallel by different people or groups. Information concurrency refers to the degree to which information is shared among the involved parties (Loch & Terwiesch, 1998).
In order to explain the significance of concurrent engineering, it is essential to understand the earlier concept of sequential engineering and the subsequent development;

In the traditional sequential engineering (SE) process, the overall task is divided into multiple small tasks depending on the nature of work. These tasks are then allocated to the respective specialists for execution. In recent years, the problems associated with the traditional approach in construction industry are discussed widely but the fact which is overlooked in general is that traditional approach may lead to several generic process flows (Dupagne, 1991). Few of the important downsides of traditional engineering are mentioned below (Koskela, 2003).

- In the design phase the limitations of subsequent phases are not taken into consideration (poor anticipation of requirements of next internal clients)
- Redundant constraints for subsequent phases are set in the design phase (poor anticipation of requirements of next internal clients)
- Sometimes insufficient feedback for specialists is one of the drawbacks

These drawbacks in the process flow may result in,

- Suboptimal solutions
- Poor constructability and operability
- Large number of change orders (and thus rework in design and construction)
- Lack of innovation and improvement

Apart from the above mentioned points, sequential engineering drawbacks include concerns about the additional time consumed with delays and extra efforts required to make changes in subsequent stages. This in turn incurs additional costs making the product inefficient in terms of development. Since, from the beginning, the downstream requirements are not considered in this process, many a time the final product is found to be defective leading to increased costs, efforts and decreased quality (Xiong Guangleng 1996). This approach is also called as ‘over the wall engineering’ (Figure 2-1), wherein the fragmentation of the different activities leads to misperceptions and misunderstandings (Evbuomwan & Anumba, 1998).
**Product lifecycle management (PLM)**

*Sequential Engineering is often called “across the wall”:

Concurrent engineering overcomes these shortcomings by providing a managerial framework for effective, systematic and parallel integration of all functional disciplines required for the desirable production in the least amount of time and resources (Morris & Pinto, 2004). The initial objective for proposing concurrent engineering was to reduce the life-cycle period and accelerate the production in a New Product Development (NPD) process. At present, the concept is widely used in multidisciplinary undertakings, for example, construction, oil and gas, process industries etcetera. Fierce competition in the business environment has pressurized the organizations to achieve the results faster, better and cheaper (Morris & Pinto, 2004).

As rightly said by Koskela, in comparison to the sequential engineering, concurrent engineering incorporates iteration cycles, which are transferred to the initial phases through teamwork (Koskela, 2003). In an ideal scenario, concurrent engineering should facilitate the compression of the design time, increase of the number of iterations, and reduction of the number of change orders.

The overall CE philosophy rests on a single, but powerful principle that promotes the incorporation of downstream concerns into the upstream phases of a development process. This would lead to shorter development times, improved product quality, and lower development/production costs (Yassine & Braha, 2003). It is very important to estimate the upstream information variability and downstream sensitivity in order to implement successful overlapping of activities. It has to be determined how sensitive the tasks downstream are, to anticipate the impact of every change on further process and final outcome.

Concurrent engineering tackles the issues existing in sequential engineering by integrating
the departments and facilitating the continuous and complete information exchange. The difference between SE and CE is illustrated in Figure 2-2. It is evident from the figure that CE results in saving time to market compared to sequential engineering. Concurrent Engineering has effectively led to shorter development time and better performances in the industry (Nadia, Vince, & Donald, 2006). The client naturally observed benefits of parallel execution strategy and hence the concept of CE took over the traditional method in industry.

(a) Sequential Engineering

(b) Concurrent Engineering

Figure 2-2: Sequential engineering vs. Concurrent engineering (Prasad, 1995)

Concurrent engineering aims to use opportunities for design improvements as early as possible by integrating product and process development so that the amount of redesign is minimized.
This leads to minimization of total cost by approaching the condition where 90% of the
cost is unavoidable for the product realization. The essential difference between concurrent
engineering and traditional product development is that concurrent engineering regards prod-
uct development as an integrated and concurrent process, which continuously improves the
process (Xiong Guangleng 1996).

2-1-2 Challenges in Overlapping Design and Construction

Concurrent engineering have various benefits when implemented properly. However, over-
lapping of two (or more) dependent phases successfully without increasing reworks, risking
quality and safety is a big challenge. One of the most important challenges in applying con-
currency is to identify the optimal point of overlap between two activities to avoid excessive
rework (Andueza, 2014).

In concurrent execution, the information flow goes through multiple iterations between up-
stream and downstream activities. This can be a disadvantage as it leaves less time for
revision and quick information exchange (De la Garza & Hidrobo, 2006). Lack of complete
information in concurrent projects leads to assumptions which, if not correct, may lead to
large number of changes and reworks which can effectively compromise the quality, time and
cost of execution (De la Garza & Hidrobo, 2006). In concurrency, a head start is provided
to the downstream activities while the upstream activities are not finished. However, there
a downside to this approach. If the upstream information is premature and incur major
changes, there is a huge risk of wasting valuable resources on the downstream activities and
excessive rework in future (Yassine & Braha, 2003).

In certain circumstances, it can happen that the need for speeding up the project execution
results in exerting pressure on the team to deliver the outcome. This pressure can affect
the probability to choose most optimal design solution and in turn reduce the efficiency and
quality (Andueza, 2014; De la Garza & Hidrobo, 2006). Implementing concurrent engineering
is a big challenge but given the benefits, it is worth the efforts.

2-2 Organizational Effectiveness

In the current industry, one factor which is gaining more and more importance than any
other factor is the people who are integral part of the organization (Sims, 2002). Industry
is realizing that in this fierce competition, the most trustworthy asset which can sustain the
success and improve the chances of survival, are the people working for the organization. The
effectiveness and success of an organization therefore lies on the people who form and work
within the organization (Olaniyan & Ojo, 2008).

In the refinery project, Fluor introduced the organizational effectiveness charter which states
that, “Organizational Effectiveness (OE) is the concept of how effective an organization is in
achieving the outcomes the organization intends to produce” (Fluor, 2016b). Organizational
effectiveness can also be defined as the, “extent to which an organization achieves its goals”
(Steers, 1977). Most important component in achieving the goals to maximum extent is the
taskforce or the people. Another interesting explanation of organizational effectiveness put
forward by Fallon and Brinkerhoff is, “a company’s long term ability to achieve consistently its strategic and operational goals” (Fallon and Brinkerhoff, 1996).

As we move further into the twenty first century, it’s becoming absolutely clear that the effective management of an organization’s human resources is a major source of competitive advantage and may even be the single most important determinant of an organization’s performance over the long term (Sims, 2002). In the OE charter, Fluor emphasizes ten particular aspects which will eventually lead to achieving the objective with high efficiency. The ten factors are, participative leadership, effective decision making, open and clear communication, valued diversity, mutual trust, managing conflicts, clear goals, defined roles, positive atmosphere, and coordinative relationship (Fluor, 2016b).

In this research, organizational effectiveness is incorporated in the form of people element, where taskforce satisfaction will hold the key to the research. Finding out the relation between the concurrent execution and organizational effectiveness is important to facilitate further research.

2-3 Inter-relation between Concurrent Engineering and Organizational Effectiveness

Positive collaboration of the concurrent engineering and the organizational effectiveness is the one factor which can contribute effectively in creating a successful project. In this section, the positive influence of organizational effectiveness on the concurrent engineering and the impact which concurrency creates on the organization are described to provide insights into the two concepts and their inter-relation.

Organizational effectiveness is one of the key elements in implementing concurrent engineering effectively and efficiently. Organizational support is extremely important for smooth functioning of concurrent engineering. Concurrent engineering needs following three soft aspects of employee engagement from the organization in order to sustain the success of concurrency (Nadia et al., 2006).

- **Empowering Teams**
  Granting autonomy and decision making power to teams indicates the trust of management on their employees. They are the most knowledgeable professionals and are in best position to make quick and responsible decisions. This process boosts up the speed of the execution and avoids delays due to unnecessary waiting and layered decision making.

- **Facilitating Communication**
  "Communication is the cornerstone of success in Concurrent Engineering" (Prasad, 1996). Concurrent engineering functions best in an environment where the communication and collaboration among the disciplines, departments, and people is smooth and efficient. Hence, an organization should facilitate high-frequency, face-to-face and two-way communication but it is equally reciprocated by people (Nadia et al., 2006).

- **Implementing Team reward Mechanisms**
  A system that rewards the team as well as individual performances and facilitates regular
performance appraisal is essential for concurrent engineering. Rewarding and providing constructive feedback to the taskforce goes long way in motivating the taskforce and people.

Hence, with the help of collaboration between concurrent engineering and organizational effectiveness will pave the way for a faster, better and safer execution.

Organizational effectiveness does complement the implementation of concurrent engineering but on the contrary, the concurrency may have some serious impacts on the taskforce and the people in the organization. In general, projects start to overlap more and more activities when in order to reduce the project delivery time. However, the degree to which the activities may be overlapped, and in turn the level to which various disciplines may overlap, depend on the type of information exchanged, and the degree of dependency between those activities (Bogus, Molenaar, & Diekmann, 2006; Srour, Abdul-Malak, Yassine, & Ramadan, 2013). Concurrency definitely helps in compressing the schedule but it brings a certain element of risk with the strategy (Staats, 2014). Overlapping activities may lead to increased communication and interfaces on the project. Bigger the number of interfaces and the interactions, higher is the chance of errors in knowledge transfers and data management. These errors lead to the rework cycles which may result in the excess work load on the task force and stress in the work-life balance of individuals.

Impacts of the increased concurrency on the taskforce facing continuous changes and compressed schedule are observed in form of negative atmosphere, motivation levels decreasing as well as work pressure increasing, leaving the people factor dissatisfied in the organization. This dissatisfaction is the trigger which led to introduction of the organizational effectiveness charter. Hence in conclusion, it is clear that the concurrency is efficient for the market considering the hard aspects of project management but on the other hand, it increases risks of fatigue to the employees of the organization leading to a bigger problem. This particular aspect will be investigated throughout this graduation research.
In this chapter, the results of the first investigation method - Taskforce Satisfaction Survey, have been explained and analyzed as a separate investigation method. The purpose of individual analysis is to observe the changes in the satisfaction levels of the taskforce as the project progresses and comprehend the reasons behind the variation with rational argumentation.

3-1  Result

Gallup's taskforce satisfaction surveys were conducted for the refinery project since the beginning of FEED phase of the project. Till date, six surveys have been conducted and the results are displayed in Table 3-1. ‘Gallup’s 12’ questionnaire is shown in the Table 1-2 for reference. As the project moved forward from FEED to EPC phase, taskforce grew in numbers which was also reflected by the number of responses increasing in subsequent surveys. These surveys included responses by the client team members as well as Fluor team members from New Delhi, Cebu and Amsterdam.

At the end of round six, results from Table 3-1 show that the responses to the surveys were increasing with each round. Round 6 of the taskforce satisfaction survey received 224 responses, which is almost 45% of the taskforce at that time. In EPC phase, the construction team is growing exponentially as the site is mobilized. Looking at the average scores at the end of each survey, it is visible that the satisfaction level is fluctuating with a standard deviation of 0.13 and in general it is decreasing with the time spent, barring odd increments. Lowest score for each aspect from all the surveys is represented by red colour. The variation of the twelve aspects is elucidated in Figure 3-1 with the help of bar charts. A continuous decline in satisfaction level was observed as the project progressed. This was more evident with regards to soft aspects related to individual growth and satisfaction. It was interesting to see that the aspects that scored better than the average, typically represented the hard aspects of project team such as commitment to quality, materials and equipment, the expectations at work and the purpose of job.
### Table 3-1: Taskforce Satisfaction Survey- results

<table>
<thead>
<tr>
<th>Answer Aspects</th>
<th>Aug-14</th>
<th>Nov-14</th>
<th>Feb-15</th>
<th>Jul-15</th>
<th>Nov-15</th>
<th>Apr-16</th>
<th>$\sigma^\dagger$</th>
<th>$\Delta_{6-5}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectations</td>
<td>4.46</td>
<td>4.39</td>
<td>4.29</td>
<td>4.43</td>
<td>4.26</td>
<td>4.39</td>
<td>0.072</td>
<td>3%</td>
</tr>
<tr>
<td>Materials and Equipment</td>
<td>4.01</td>
<td>4.11</td>
<td>4.07</td>
<td>4.17</td>
<td>4.07</td>
<td>4.13</td>
<td>0.051</td>
<td>1%</td>
</tr>
<tr>
<td>Do Best</td>
<td>3.90</td>
<td>4.01</td>
<td>3.90</td>
<td>4.05</td>
<td>3.81</td>
<td>4.00</td>
<td>0.082</td>
<td>5%</td>
</tr>
<tr>
<td>Recognition</td>
<td>3.57</td>
<td>3.57</td>
<td>3.44</td>
<td>3.37</td>
<td>3.21</td>
<td>2.88</td>
<td>0.240</td>
<td>-10%</td>
</tr>
<tr>
<td>Cares about me</td>
<td>4.07</td>
<td>4.20</td>
<td>3.88</td>
<td>4.09</td>
<td>3.78</td>
<td>3.73</td>
<td>0.172</td>
<td>-1%</td>
</tr>
<tr>
<td>Development</td>
<td>3.85</td>
<td>3.79</td>
<td>3.67</td>
<td>3.74</td>
<td>3.62</td>
<td>3.47</td>
<td>0.124</td>
<td>-4%</td>
</tr>
<tr>
<td>Opinions Count</td>
<td>4.16</td>
<td>4.23</td>
<td>3.93</td>
<td>4.01</td>
<td>3.83</td>
<td>3.72</td>
<td>0.177</td>
<td>-3%</td>
</tr>
<tr>
<td>Mission/ Purpose</td>
<td>4.23</td>
<td>4.25</td>
<td>4.19</td>
<td>4.31</td>
<td>3.91</td>
<td>3.90</td>
<td>0.164</td>
<td>0%</td>
</tr>
<tr>
<td>Quality</td>
<td>4.32</td>
<td>4.37</td>
<td>4.14</td>
<td>4.28</td>
<td>4.03</td>
<td>4.07</td>
<td>0.129</td>
<td>1%</td>
</tr>
<tr>
<td>Best Friend</td>
<td>4.03</td>
<td>4.11</td>
<td>3.95</td>
<td>3.98</td>
<td>3.21</td>
<td>3.37</td>
<td>0.350</td>
<td>5%</td>
</tr>
<tr>
<td>Progress</td>
<td>3.49</td>
<td>3.68</td>
<td>3.59</td>
<td>3.81</td>
<td>3.67</td>
<td>3.47</td>
<td>0.117</td>
<td>-5%</td>
</tr>
<tr>
<td>Learn and Grow</td>
<td>4.30</td>
<td>4.35</td>
<td>4.23</td>
<td>4.36</td>
<td>3.98</td>
<td>3.93</td>
<td>0.173</td>
<td>-1%</td>
</tr>
<tr>
<td>Average</td>
<td>4.03</td>
<td>4.09</td>
<td>3.94</td>
<td>4.05</td>
<td>3.78</td>
<td>3.76</td>
<td>0.130</td>
<td></td>
</tr>
<tr>
<td>Total Responses</td>
<td>69</td>
<td>84</td>
<td>106</td>
<td>163</td>
<td>157</td>
<td>224</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.28</td>
<td>0.26</td>
<td>0.25</td>
<td>0.29</td>
<td>0.31</td>
<td>0.39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† standard deviation

On the other hand, the soft aspects related to project management received lower scores. Recognition, encouraging development, relations with colleagues as well as individual progress of employees etc. are some of the aspects that scored on a lower side.

The results show that there was an initial increase in the satisfaction level of the workforce followed by a sudden decrease near the end of the FEED phase which was indicated by the pressure of finishing the FEED phase. The survey outcome rose to 4.05 when the FEED phase approached its end to be followed by the EPC phase. Subsequently, the satisfaction level fell in the EPC phase.

For the refinery project, EPC phase effectively started in the month of October, 2015. The last two rounds of surveys were conducted in the EP phase of the project and it is clearly visible that the satisfaction score is declining strongly. This change is very important to analyze, in order to find the relation between the satisfaction level of people and the phase of project at that point.

Fluor B.V.

TU Delft
Figure 3-1: Taskforce Satisfaction Survey results trend
Figure 3-2 shows the comparison of last two rounds of surveys and the corresponding change is shown in Table 3-1. Major variation is observed in the recognition aspect with a 10% decrease and an overall low score is obtained in the latest survey compared to the former.

Standard deviation of the Gallup’s 12 aspects shows a significant increase (0.39) in round six of the survey. Specifically, with 7 aspects scoring an individual low, it is a worry for the project. It basically signifies that certain areas are functioning well and the taskforce finds it to be satisfactory compared to the ones scoring low. This gives an idea about the improvements that can be done and the aspects need attention to keep the taskforce happy.

![Figure 3-2: Comparison - November-15 vs. April-16](image)

All data collected above is part of a programme to conduct periodical surveys throughout the project life cycle. The outcome of these surveys show a trend which is either increasing or decreasing based on the respective aspects and project phase. These six surveys might be inadequate to reach any concrete conclusion but these surveys definitely provide a direction to the project management. Data collected till date is already revealing trends in the level of satisfaction of taskforce with the changing stages of project. Furthermore, future surveys will help in consolidating a pattern for scientific analysis. Statistics and results mentioned in this section are analyzed in the next section from project point of view and the approach of the taskforce towards the project management.

### 3-2 Analysis

Looking at the trend generated by the survey results (Figure 3-1); there is a strong feeling of decreasing satisfaction among taskforce over time. When the project was in FEED phase, taskforce was newly formed and there was scope to contribute towards all possibilities on the preliminary design phase. Individuals were more motivated to learn new concepts, different strategies while exploring and working with client team. As the project gained stability towards end of FEED phase, designs and strategies were fixed and a direction was defined with less scope to exploring new dimensions. This led to increased workloads for delivering the FEED product and roll over to EPC phase simultaneously. The EPC phase which is basically a production phase, majority of activities are started, schedules and engineering
design are finalized for further construction. Workload increases with the pressure to deliver on time. This gradual change observed in the project provides an explanation for the gradual decline in the satisfaction level of the task force.

As the task force was new in FEED phase, it was bonding and getting together as a team. It was a challenge as well as an opportunity for the task force to create solid team dynamics and learn new things from each other as well as the project. In the EPC phase, the innovation ceased to be an added value and only ‘Do as directed’ principle took over which naturally happens in any production phase. In addition to that, as the detailed engineering phase is coming to an end, the work is in peak flow and keeping the taskforce busy with the project work leaves less time for training and personal development. ‘Learn and Growth’ also depends on the individual nature of the employee. Refinery project is a challenging project with opportunities to learn new things throughout the project life-cycle. An employee might see this as a positive opportunity whereas others may find it as a problem and hence the responses vary based on the attitude, experience and personality of the respondent.

Apart from that, in the EPC phase, different disciplines reach critical phases of execution at different times. Hence, the responses vary depending on the team’s workload at that particular time. These arguments help in explaining the low scores in the last six months for Gallup’s aspects namely, individual development, learn and growth, progress in career and opinions count. These aspects primarily represent the soft aspects of project management and hence it is significant to address these results in future.

In contrast, aspects such as expectations from job, resources available and quality of work show a healthy score and minor deviation in all six rounds. This outcome can be attributed to the fact that project management is transparent and the information is conveyed properly to each discipline with emphasis on safety and quality of work. This serves as a positive sign to maintain and improve performance.

One aspect that definitely raised concerns for the management is the recognition. This project implemented the weekly recognition moment as a part of the organizational effectiveness charter. Initially people liked the programme but the affinity gradually declined. One explanation for this can be the habitual nature or routine of the process. It tends to lose charm if done in the same manner for two years without a startling change. People might not feel special anymore with such recognition. One aspect of importance is the possibility that multiple recognitions for few employees might cause disappointment and demotivation among the rest, in turn defying the purpose of the programme. Everyone works hard on this project and hence it is important to recognize each employee for his or her contribution to the project. It is apparent from the survey score that majority of the taskforce does not feel that they receive the required recognition.

On the other hand, management appreciated the success of the programme from an organizational point of view. A programme or charter cannot substitute the day to day appraisal and a ‘pat on the back’. This programme also has certain limitations in terms of number of people that can be recognized in this huge taskforce. The nominations received for weekly recognition depend on the leader you work with. Human nature plays a big part in this. Some leaders have a nature of appreciating work of others and motivating the taskforce while many do not do so.

Some aspects which need to be incorporated after analyzing the survey results strictly based
on the scores and trend. Following points provide an insight about the survey scores, employee status and taskforce staffing and de-staffing:

- Taskforce is currently growing in one direction of construction discipline. There might be different expectations for the newly joined employees compared to the original taskforce.

- The major factor influencing the survey results is the changing number of responses after each survey. People are added to the taskforce and when they are faced with the survey, every individual has his own stage of adjustment in the team. This significantly affects the outcome of the response.

### Tuckman's Team & Group Development Model

![Tuckman's Model](image)

**Figure 3-3: Tuckman’s Model (Hubbard, 2015)**

Focussing on the fact that each individual needs time to adjust to the taskforce and perform his best while getting settled in team. In most popular theoretical frameworks of teamwork, Bruce Tuckman’s ‘Stages of Group Development Model’ mentions four stages of team formation (Figure 3-3) (Hubbard, 2015). New people joining always start from *forming stage* in a team whereas existing members may be in *storming* or even *performing* phase which leads to diverse responses and diverse experiences for each individual.

- When the FEED phase started, the work related to upfront work for disciplines like process engineering was based in New Delhi and Amsterdam. At present, the work is
site oriented with construction mindset of the employees. This makes a huge difference as the job is different and the characteristics of people working are different.

- Along with the original taskforce, there are always an additional number of people in each survey who joined the project at advanced stages. These new people might perceive the project and organizational effectiveness aspect from a different point of view as they are not used to it. Variation in expectations leads to varying level of satisfaction. This makes a significant difference in the survey scores.

- Staffing and de-staffing also affects the outcome of the surveys. Some specialist just work for a limited time on a specific part of the project without significant exposure to the taskforce bonding. Responses from such specialist employees influence the survey results as they are having no interaction with team to answer questions related to taskforce dynamics.

This mix of responses skews the analysis regarding the actual satisfaction level of the taskforce. Taskforce satisfaction survey scores are not sufficient to reach an absolute conclusion but further research and investigation with the help of interviews is necessary to understand the real problems of taskforce and its satisfaction. It may be too early to arrive at negative conclusions from the survey results, but with more surveys and data, this trend will help future research and analysis. Refining the survey approach for data collection is an extremely important recommendation for future rounds. Additional questions regarding the time spent on the project might segregate the responses based on actual satisfaction of employees related to their experience with project.

3-3 Conclusion

Taskforce satisfaction survey provided measurement of employee satisfaction which is necessary in order to enhance productivity, profitability and employee retention of the project through organizational effectiveness ("Gallup’s Q12," 2016). Taskforce satisfaction surveys are conducted to check how engaged the taskforce is on the project and the level of satisfaction during the project lifecycle. This chapter partially answers the sub-question: How is Taskforce Satisfaction changing over time?

In general, this chapter provides an all-round analysis towards the taskforce satisfaction and changing level of satisfaction with changes in project strategy or phase. It was observed in the analysis is that the taskforce satisfaction decreases during the EPC phase of the refinery project. In Figure 3-1, first three aspects (expectations, materials and equipment and do best) are showing least variation over the six rounds whereas all other aspects showed a gradual decline over time. Sixth round of survey shows least satisfaction amongst all the rounds and even seven out of twelve individual aspects have lowest score in round six. This primarily shows that the current phase is extremely stressed and hectic for the taskforce since the beginning of EPC in terms of their satisfaction level. In previous section the possible explanations for the variations and changes in the survey results are discussed in detail. Further, as the construction phase is starting, it will be interesting to see the result of the next surveys.
In future, these surveys need to be continued to generate the trend till the end of this project. At the same time it can be concluded that the current recognition programme needs to be discontinued to be replaced by a new format. Two simple solutions can be:

- The process of recognition can be made more transparent with justification towards the weekly winner of the recognition
- It is possible to recognize a member from each discipline separately each week to uniformly recognize the taskforce. This approach will expand the spread of programme to all the levels of taskforce

It is equally important to create awareness about the individual behavior towards taskforce through trainings or regular mention at team gatherings. Further recommendations about the techniques which can be implemented by the project management to smoothen the process of team formation and taskforce satisfaction are addressed in overall recommendations (chapter 8).

For further reference, some of the suggestions by taskforce are attached in the Appendix F about project strategy, employee satisfaction and miscellaneous factors observed in routine life. Next chapter will concentrate on the refinery project schedule and the concurrency level.
In this chapter, the standard EPC workflow has been explained to develop the list of activities necessary for investigating the schedules. Furthermore, the result of the second investigation method i.e. schedule analysis has also been explained and analyzed as a separate investigation method. The purpose of schedule analysis was to observe the changes in the real schedule on the refinery project during the research duration and compare two data points to observe absolute deviation and comprehend the reason behind the changes. The schedule comparison in Gantt chart was also prepared to visualize the changes.

4-1 Theoretical Study - EPC Phase Workflow

Schedule analysis is one of the most important elements of this research study. The crucial prerequisite behind the methodology to track and compare two different schedules in MS Project was the list of the project activities which incorporated critical activities, milestones and sequential workflow. Formulating the order of activities performed on the refinery project, and refining it to an extent where all the activities were critical to the execution strategy and schedule, turned out to be the starting point of the schedule analysis.

Understanding the concept behind execution of a refinery project, activities involved in the EPC phase and the interdisciplinary relations at each step of project was an interesting exercise and a learning curve. It was very important to keep the activity list sequential and generic, suitable to any standard refinery project. Current strategy of project execution already accounted for the concurrency since the beginning of EPC phase and hence it was not desirable to directly utilize the project schedule. The reason being, that the specific execution strategy followed for the refinery project would have influenced the standard activity sequence necessary to assess the schedule. Apart from that, understanding the working of a mega project in EPC phase with the help of Fluor’s global data was essential for further research. Thus, formulating a list of critical activities involved in the project in a sequential manner
without any overlap or concurrency was performed with the help of Fluor’s global project procedure manual and literature research.

Once the direction was clear, theoretical study of standard working procedure of the engineering/procurement, contract management and construction based on the global Fluor guidelines was initiated. Activities from the above-mentioned three phases were studied in order to create a framework for the schedule tracking method. The framework was first prepared with the assumption that the execution is carried out sequentially with mutually exclusive activities. The flow of activities from each department is plotted as a flow chart to establish their chronological order that is required in realizing a refinery project. Once the ideal sequence of activities integral to the EPC execution by Fluor global standards was ready, the list was assessed further to refine the sequence and rectify the errors. Literature study, Fluor database research as well as experts (Fluor professionals) from each field were involved in this process to obtain a more authentic view into the real life execution of a refinery project.

4-1-1 Sequential EPC Execution

The primary list of activities performed during EPC phase on a higher level of execution is prepared with the help of following database:

- Fluor standard project procedure manual (Fluor, 2016c) and Fluor project management manual (Fluor, 2016a)
  
  Project activity plans (PAM) from all the disciplines involved in the project i.e.
  
  - Process
  - Civil / Structural / Architectural (CSA)
  - Mechanical / Equipment
  - Piping
  - Electrical
  - Control Systems

- 'Typicals’ were the standard activity flow charts, which were prepared on three levels depending on the details required by the project. The ‘typicals’ were prepared by the project planners from the Fluor B.V. Level 1 was the highest level with only major activities while level 3 included each activity from the discipline necessary to be performed with minute details. For this research, level 1 Typical is referred with the help of certain insights from level 2 Typical.

- Expert inputs from the department of Engineering management, Project planning and the refinery project team. All these discussions helped with small corrections in the flow chart which was prepared on the basis of first two theoretical sources. After three rounds of corrections and consultation with the Fluor area manager (refinery project), Fluor piping director and Head of project planning department, the final list of activities to be included in the study was ready. The list has been represented as a flow chart in a sequential manner with the activities in the project that should be performed, in best case scenario.
The final list of activities is represented by Figure 4-1 which is implemented while analyzing and comparing the schedule of October’15 baseline and March’16. This is the final list but the process involved multiple iterations and changes with each step and new insights. Appendix E explains the important steps with definitions from Engineering, Contract Management and Construction disciplines. Along with the theory, very first theoretical list of activities in EPC phase as well as penultimate list in flow chart formation is attached in Appendix E.

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FEED</td>
</tr>
<tr>
<td>2</td>
<td><strong>EPC Phase: Refinery Project</strong></td>
</tr>
<tr>
<td>3</td>
<td>Engineering - Procurement (EP)</td>
</tr>
<tr>
<td>4</td>
<td>P&amp;ID’s 1FD (HAZOP comments included)</td>
</tr>
<tr>
<td>5</td>
<td>HAZOP review</td>
</tr>
<tr>
<td>6</td>
<td>Plot plan IFD</td>
</tr>
<tr>
<td>7</td>
<td>30% (3D model review)</td>
</tr>
<tr>
<td>8</td>
<td>Plot plan IFC</td>
</tr>
<tr>
<td>9</td>
<td>Confirmed vendor data</td>
</tr>
<tr>
<td>10</td>
<td>60% (3D model review)</td>
</tr>
<tr>
<td>11</td>
<td>P&amp;ID’s IFC</td>
</tr>
<tr>
<td>12</td>
<td>90% (3D model review)</td>
</tr>
<tr>
<td>13</td>
<td>Piping ISO IFC</td>
</tr>
<tr>
<td>14</td>
<td><strong>Contract Management</strong></td>
</tr>
<tr>
<td>15</td>
<td>Bidders Pre-qualification</td>
</tr>
<tr>
<td>16</td>
<td>RFP package issue to bidders</td>
</tr>
<tr>
<td>17</td>
<td>Commercial and technical evaluation/Award Recommendation</td>
</tr>
<tr>
<td>18</td>
<td>Award</td>
</tr>
<tr>
<td>19</td>
<td>Mobilization</td>
</tr>
<tr>
<td>20</td>
<td><strong>Construction</strong></td>
</tr>
<tr>
<td>21</td>
<td>Civil work</td>
</tr>
<tr>
<td>22</td>
<td>Equipment placing and installations</td>
</tr>
<tr>
<td>23</td>
<td>Piping/Mechanical work</td>
</tr>
<tr>
<td>24</td>
<td>Electrical &amp; Instrumentation work</td>
</tr>
<tr>
<td>25</td>
<td>Pre-Commissioning and Turnover</td>
</tr>
<tr>
<td>26</td>
<td>Mechanical completion</td>
</tr>
</tbody>
</table>

**Figure 4-1:** Standard refinery execution sequence

---

1In the proposed plan end of FEED phase rolled over to EPC and hence the start date of EPC is displayed as May’15 but in reality the baseline schedule of EPC was released in October’15 due to changes and corrections suggested by client. Hence October’15 is the baseline schedule for the refinery project.
4-1-2 Summary

Creating a workflow for the EPC phase was important because the activities which act as milestones in the EPC execution strategy were considered for the schedule tracking in the next phase of research. Once the initial theoretical study of the activities was finished, the flow charts were refined with the help of the discipline experts and department managers. MS Visio is used to create the flow chart.

4-2 Result

Applying the EPC workflow theory on monthly schedules of the refinery project, each activity or milestone from the list was referred back to corresponding real schedule. Actual duration, start date and finish date of each activity from October’15 and March’16 schedules (level 1, 2 and 3) was retrieved and processed in MS Project. Figure 4-3 is the Gantt chart as retrieved from MS Project, illustrating the comparison of the two schedules for respective activities. It is observed from the schedules that the concurrency is implemented from the beginning of this project and is changing with the time.

In the Gantt chart, the orange colour depicts the October’15 schedule which is the baseline execution schedule and grey colour represents the latest released update of schedule in the month of March’16. Fixed start and end dates in both the schedules was the first important observation. Secondly, it was clearly visible that while the detail engineering was started on schedule, it was delayed with the progress that led to a subsequently delayed start to piping isometrics IFC (issued for construction).

Contract management started working earlier on this project with the pre-qualification of bidders where the input from engineering was not influencing the activity. As the next activities were performed in contracts, delays in engineering work were observed and on comparison, the duration for completing subsequent activities was observed to become shorter with squeezing of the schedule.

Similar effects were also observed in the construction schedule of the refinery project. Delay in engineering phase logically created a delay in starting the construction, as the information necessary to continue the work was delayed. In case of construction it was specifically observed that the duration for finishing major activities got compressed, leaving a much shorter duration to finish the activity than the baseline schedule. Following Table 4-1 provides the relevant data on the duration of each activity in the given two schedules:

<table>
<thead>
<tr>
<th>Discipline</th>
<th>October 2015 Baseline Schedule</th>
<th>March 2016 Latest schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>438 days</td>
<td>463 days</td>
</tr>
<tr>
<td>Contract Management</td>
<td>367 days</td>
<td>323 days</td>
</tr>
<tr>
<td>Construction</td>
<td>548 days</td>
<td>477 days</td>
</tr>
<tr>
<td>Total</td>
<td>738 days</td>
<td>738 days</td>
</tr>
</tbody>
</table>
It was also observed that as the project proceeded ahead with the EPC phase, the level of concurrency was not exactly increasing or decreasing. The activities got delayed and hence to keep the end date fixed for client, contracts and construction disciplines were compressed. It can be seen in Figure 4-2 that the concurrency between engineering and contracts is squeezed whereas the construction shows decreasing concurrency with engineering and contracts.

![Figure 4-2: Deviation in concurrency level](image)

The essence of carrying out this schedule analysis and learning EPC workflow was to understand the shift in the schedule and the major reasons for the revisions in the schedule. The research objectives and the further analysis was made clearer once the difference between the two schedules was shown. This assessment provided a solid ground to test the hypothesis proposed at the start, and the next step was proposed to study the impact of dynamic schedule on the taskforce from their point of view.

Schedule comparison between October’15 and March’16 schedules is shown in Figure 4-3. In the next section, discussion is carried out about the schedule analysis and the possible cause-effect from taskforce perspective.
### CONCURRENCY LEVEL INVESTIGATION

#### Schedule Analysis - Oct'15 vs. Mar'16

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>1st Half 2014</th>
<th>1st Half 2015</th>
<th>1st Half 2016</th>
<th>1st Half 2017</th>
<th>1st Half 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Refinery Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FEED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EPC Phase: Refinery Project</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Engineering - Procurement (EP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>P&amp;ID's IFD (HAZOP comments included)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>HAZOP review</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Plot plan IFD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>30% (3D model review)</td>
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<td></td>
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</tr>
<tr>
<td>8</td>
<td>Plot plan IFC</td>
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<td>Confirmed vendor data</td>
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<td>12</td>
<td>90% (3D model review)</td>
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<td>Contract Management</td>
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<tr>
<td>15</td>
<td>Bidders Pre-qualification</td>
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<tr>
<td>16</td>
<td>RFP package issue to bidders</td>
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</tr>
<tr>
<td>17</td>
<td>Commercial and technical evaluation/Award Recommendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Award</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Mobilization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Civil work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Equipment placing and installations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Piping/Mechanical work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Electrical &amp; Instrumentation work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Pre-Commissioning and Turnover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Mechanical completion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4-3: Gantt chart - schedule comparison**
4-3 Discussion

Looking at the Gantt chart (Figure 4-3), the initial thinking was about the presence of concurrency, whether it was sufficient for the taskforce and further steps that can be taken in either case. Upon the completion of the analysis, it was observed that the schedule is already concurrent and is changing with the project progress.

This discussion includes the views and understanding that were discovered during the informal talks related to the direct/indirect impacts of the schedule change on the project and people. The initial assumption that high concurrency creates a problem in the project is not distinctly visible in this investigation but actually, concurrency was observed to be increasing and the initial concurrency was found to be lower than the present concurrency. Thus, the impact on the taskforce can be either due to the initial concurrency itself or the added concurrency in the EPC phase. Once the analysis was done, informal discussions were carried out on the project taskforce to understand the viewpoint of employees on the schedule changes, concurrency, and ground reality on the project. These talks were conducted anonymously and provided a deeper insight into the specific problems, possible reasons and effects faced by people.

Discussions are summarized below:

4-3-1 Strategic Reasons for Delay and Schedule Changes

- Engineering is influenced by the agreement of the refinery project with the client for following a particular execution strategy in the FEED and EPC phase which focusses extensively on safety and quality as the two prime drivers of the project.

- Fluor is cooperating with larger than average client team on the taskforce having a different organizational structure than Fluor.

- HAZOP review is conducted during the EPC phase of the project as opposed to the standard Fluor strategy. Fluor standard procedures prefer to conduct it immediately after the FEED phase for any project.

- FEED to EPC roll-over effectively delayed the start of EPC, as FEED phase was not ideally finished.

- In terms of HAZOP corrections, 50% additional corrections were received as compared to the normal expectations (Source: Fluor assessment report). These extra comments in HAZOP required extra time to address than estimated and eventually delayed the detail engineering design.

- This delay in detail engineering design led to compression of the contracts and construction schedule, in order to keep the end date of mechanical completion fixed.

- Construction execution schedule is prepared later than the EP schedule (Source: Fluor taskforce) and faces a mismatch in some activities (negative float) with the EP schedule.
4-3-2 Impact on Taskforce

- Underestimating the HAZOP work generated extra work for process, creating stress and time pressure.

- Process engineering discipline generated the information for further downstream disciplines. A delay in getting this information out, created a domino effect in the engineering team with overall delay in the work.

- This delay exerted stress on all the disciplines to deliver the information working with insufficient data input. Taskforce experienced burnout of some experienced employees (Source: Fluor Taskforce). While discussing the subject of stress and pressure, the subject of burnout was frequently mentioned by the individuals.

- Schedule changes and delays consumed the initial float in the planning (for unforeseen situations) affecting the taskforce response towards unforeseen activities.

- Contract management department faced time constraint with the changing schedules. Contracts rely on the information provided by engineering for further negotiations in market. Time is the most important criterion for contracts for negotiating with the market for optimum quality and cost.

- Compressing the schedule for contracts has raised concerns in the contracts department. Contracts team is under pressure due to these changes.

4-4 Conclusion

The impacts of schedule change and the varying level of concurrency are wide spread on the taskforce and are related to the taskforce satisfaction as well as the present execution strategy. Thorough analysis and explanation of the above-mentioned key points has been provided in chapter 7. This method of investigation was important for understanding the status quo of the refinery project and the major factors affecting the execution. This analysis provides a basis to prepare interview structure and relate the technical aspects to organizational aspects. At the end of this chapter, an attempt has been made to answer the sub-question: What changes are observed in the concurrency level in the refinery project schedule since EPC commencement? How does it affect the people?

In reality, the project started on schedule (October’15) assuming a certain initial concurrency as per the project execution plan. During EPC phase, specifically in detailed engineering design, project encountered delay. Delay was partially due to the poor estimation of manhours from the project management as well as underestimating the time required for HAZOP review. Subsequently the activities got jammed and delayed. In order to keep the final deadline of the project, contracts and construction schedules were compressed. Thus, the project is facing delay but to keep the end date (MC), further schedule and activities are compressed in the schedule. This led to the superimposed concurrency on the project in addition to the initially applied concurrency. This added concurrency is the one of the main reasons for the work pressure and declined satisfaction of the taskforce towards the project.
Hence, to answer the sub-question, as mentioned in the chapter, it is clearly observed that the project is experiencing more and more concurrency in the execution phase. These changes are creating challenging situations for taskforce to comply with the superimposed concurrency levels while keeping the end date fixed.
Chapter 5

READINESS TOWARDS CONCURRENCY

In this chapter, results of the BEACON model investigation method are explained and analyzed as a separate investigation method. The investigation includes preparing a survey for the refinery project, selecting respondents to conduct the survey and analyzing the results of the survey. The purpose of carrying out this investigation is to understand whether the project procedures followed at present in Fluor are adequate to the proposed level of concurrency on the refinery project and its eventual effects on the taskforce. Following section explains the concept of BEACON model and justifies the selection of BEACON model in this research.

5-1 BEACON Model

The BEACON model design is adopted from the Readiness Assessment for Concurrent Engineering (RACE) model and compliments the Concurrent Engineering Readiness Assessment Model for Construction (CERAM) model to assess the readiness of industry for implementing the concurrent engineering in execution strategy of projects (Khalfan, 2001). The BEACON model will be used as a referenced model to facilitate the interview questions for concurrency assessment on the refinery project. The reason behind opting BEACON model for reference is that, The BEACON model (Figure 1-4) includes both, people and project elements in the investigation as compared to the previous models (RACE & CERAM).

BEACON model is divided into four quadrants to represent four elements of the model, which are people, process, project, and technology (Khalfan, 2001; Khalfan et al., 2001). The first quadrant contains four critical factors related to people aspect of the organization and are used to assess the team level issues within the organization. The second quadrant contains five critical process factors used to assess the process maturity level of a construction organization while the third quadrant is comprised of three critical project factors used to assess the client’s requirement and design related issues. The fourth quadrant presents technology related five...
critical factors used to characterize the introduction and utilization of advanced tools and technology within the organization (Khalfan et al., 2001; Khalfan, Anumba, & Carrillo, 2005). Detailed explanation of the critical factors and the model is provided in Appendix A.

The key advantage of the model is that it does not only include the process and the technology aspects as covered in other models but also introduces two new dimensions, people and project elements. These elements were covered to a limited extent in existing readiness assessment models and tools but were not adequately emphasized. The reasoning behind including the people and the project elements is that both of them are as critical as the process and the technology elements and should be distinguished (Khalfan et al., 2001). This is one of the unique characteristics of the BEACON model.

Thus, in this survey and analysis, all the 17 critical factors of BEACON Model (Figure 1-4) which are essential to investigate the concurrency on a project for any firm are adopted as a reference. A tailor-made questionnaire for the Fluor task force with the help of schedule analysis and survey output is prepared. The questionnaire setup for the survey was made with a step by step approach. Given 17 critical factors of BEACON model were understood with the context from literature and utilizing the time spent on the project for understanding the situation as well as ideas from previous two assessment results the questionnaire was prepared. Each factor in the questionnaire includes the relevant question from the project addressing the exact issue. 21 employees were selected on the basis of their area of expertise, the role of responsibility on the refinery project and time spent on this project. Identifying appropriate individuals, who have understanding of the project and could effectively complete the questionnaire, from the large taskforce was very important (Khalfan et al., 2001). The Likert scale is chosen for analyzing the interview questions.

Once the survey was completed by the interviewees, immediately interviews were scheduled. The intention behind carrying out this investigation was to understand the reasoning behind the problems which are affecting the taskforce and get an insight about the factors which are priority for the management in order to create organizational effectiveness and strive for taskforce satisfaction. A result of the survey and further analysis is carried out in next section. BEACON questionnaire specifically prepared for this research and the project is attached in Appendix C along with the designation of the 21 candidates selected for the survey.

5-2 Selection of Survey Participants

Participants for the BEACON survey are selected based on the research objective and the design of survey questionnaire. This particular survey needed a high level perspective on the four elements of BEACON Model relating to Fluor procedures and overall functioning. Time spent on the refinery project as a part of taskforce, position of responsibility and overall experience as a professional are primary determinant in selecting the participants. Apart from that, some small factors such as difficulty to get few participants to take part due to schedule misalignments also influenced the final selection of the participants.

In the end, 21 taskforce members were finalized for the BEACON survey and subsequent one on one interview. Mainly, the leads from each discipline were preferred to ensure that the survey provided rich data with diverse perspectives for research. They have an idea of the execution strategy as well as they are connected to management and ground level taskforce
simultaneously. The survey only included taskforce members of Fluor from the refinery project and client team was not invited for the same.

Selected participants included employees from management side as well as the non-management taskforce. Following Table 5-1 shows the division of the participants.

<table>
<thead>
<tr>
<th>Division</th>
<th>Participant’s Area of Specialization</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>Project Management</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Engineering Management</td>
<td>4</td>
</tr>
<tr>
<td>Non-Management</td>
<td>Engineering</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Procurement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>1</td>
</tr>
<tr>
<td>Total Taskforce</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

The high number of engineering participants in the survey is reflective of their actual proportion on oil & gas projects (Halari, 2010). Having broader group of participants involving all the engineering disciplines and EPC areas, the knowledge base of survey becomes more solid. This same group was continued for interviews in the next part of this graduation research.

5-3 BEACON Survey Result

BEACON model survey results are displayed in Table 5-2. Refinery project and indirectly Fluor project procedures are evaluated on four major elements i.e. People, Process, Project and Technology element. The details and definitions are provided in Appendix A for each critical factor of BEACON model. Scores are on a scale of 1 to 5 (1 strongly disagree and 5 strongly agree) and the respective original scale for BEACON is attached in Appendix B with brief explanation for reference and analysis purpose. The percentage in bracket represents the compatibility of the element on this refinery project for the given concurrency (BEACON score is out of 5 and hence by multiplying the score by 20 will give the percentage result).

The statistics also shows the scores separated for management response and taskforce response except management. Overall the scores are on the positive side of 50% but definitely raise concerns for some specific critical factors. Further analysis and significance of above outcome is discussed in next section.

Figure 5-1 shows the number of responses for each score on Likert scale recorded in the BEACON survey. The average score of the survey is 3.22 with standard deviation of 0.26, which looks very average on a scale of 1 to 5. This might create a suspicion about the overall outcome of the survey. But from Figure 5-1, it is noticeable that the number responses are distributed throughout the scale of the survey. There can be two reasons for this average score. First is that the score is actual and the project is scoring average on the BEACON factors which then makes the analysis straightforward.
Table 5-2: BEACON Model survey result

<table>
<thead>
<tr>
<th>No.</th>
<th>Beacon Factors</th>
<th>Total Taskforce (21)</th>
<th>Management (5)</th>
<th>Non-Management (16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Process Element</td>
<td>2.99 (59.8%)</td>
<td>3.13 (62.6%)</td>
<td>2.96 (59.2%)</td>
</tr>
<tr>
<td>1</td>
<td>Management systems</td>
<td>2.69</td>
<td>2.90</td>
<td>2.60</td>
</tr>
<tr>
<td>2</td>
<td>Process focus</td>
<td>3.41</td>
<td>3.60</td>
<td>3.40</td>
</tr>
<tr>
<td>3</td>
<td>Organizational Framework</td>
<td>3.19</td>
<td>3.00</td>
<td>3.23</td>
</tr>
<tr>
<td>4</td>
<td>Strategy deployment</td>
<td>3.16</td>
<td>3.13</td>
<td>3.16</td>
</tr>
<tr>
<td>5</td>
<td>Agility</td>
<td>2.52</td>
<td>3.00</td>
<td>2.40</td>
</tr>
<tr>
<td>B</td>
<td>People Element</td>
<td>3.29 (65.8%)</td>
<td>3.09 (61.8%)</td>
<td>3.35 (67%)</td>
</tr>
<tr>
<td>6</td>
<td>Team formation and development</td>
<td>3.40</td>
<td>3.20</td>
<td>3.47</td>
</tr>
<tr>
<td>7</td>
<td>Team leadership and management</td>
<td>3.30</td>
<td>3.00</td>
<td>3.40</td>
</tr>
<tr>
<td>8</td>
<td>Discipline</td>
<td>3.25</td>
<td>3.10</td>
<td>3.30</td>
</tr>
<tr>
<td>9</td>
<td>Teams in an organization</td>
<td>3.20</td>
<td>3.07</td>
<td>3.24</td>
</tr>
<tr>
<td>C</td>
<td>Project Element</td>
<td>3.26 (65.2%)</td>
<td>2.83 (56.6%)</td>
<td>3.40 (68%)</td>
</tr>
<tr>
<td>10</td>
<td>Client focus</td>
<td>3.43</td>
<td>3.30</td>
<td>3.47</td>
</tr>
<tr>
<td>11</td>
<td>Quality assurance</td>
<td>3.45</td>
<td>2.60</td>
<td>3.73</td>
</tr>
<tr>
<td>12</td>
<td>Facility design</td>
<td>2.90</td>
<td>2.60</td>
<td>3.00</td>
</tr>
<tr>
<td>D</td>
<td>Technology Element</td>
<td>3.37 (67.4%)</td>
<td>3.51 (70.2%)</td>
<td>3.32 (66.4%)</td>
</tr>
<tr>
<td>13</td>
<td>Communication support</td>
<td>3.35</td>
<td>3.30</td>
<td>3.37</td>
</tr>
<tr>
<td>14</td>
<td>Co-ordination support</td>
<td>3.35</td>
<td>3.40</td>
<td>3.33</td>
</tr>
<tr>
<td>15</td>
<td>Information sharing</td>
<td>3.38</td>
<td>3.70</td>
<td>3.27</td>
</tr>
<tr>
<td>16</td>
<td>Integration support</td>
<td>3.45</td>
<td>3.73</td>
<td>3.35</td>
</tr>
<tr>
<td>17</td>
<td>Task support</td>
<td>3.30</td>
<td>3.40</td>
<td>3.27</td>
</tr>
<tr>
<td></td>
<td>Total Average</td>
<td>3.22 (64.4%)</td>
<td>3.18 (63.6%)</td>
<td>3.23 (64.6%)</td>
</tr>
<tr>
<td></td>
<td>Standard Deviation</td>
<td>0.26</td>
<td>0.32</td>
<td>0.31</td>
</tr>
</tbody>
</table>

![BEACON survey chart](image)

Figure 5-1: Number of responses vs. Response scale
Secondly, some question may prove difficult to understand or answer for the participants because of the area of work, expertise or lack of clear opinion; and that may compel them to go for a neutral score of 3. Thus, for the analysis in the next section, it is assumed that the survey is scored with complete understanding by each participant. In the next phase of interviews with the participants, more information about the research objective and BEACON survey is provided as a measure to get deeper insights and sincere responses.

5-4 Analysis

In this research, the aim is to assess the impact of project execution strategy and concurrency on the taskforce from people’s perspective. In this BEACON model, our prime focus was on the people element and to understand what is the present situation regarding these 17 critical factors. BEACON analysis shows to what extent people feel prepared for concurrency in the project.

Looking at the average score of each element which falls in the range of 3.0 – 3.5, the project is performing in the range of characterized to management aspect of BEACON criteria (Figure 5-2). This indicates that the survey respondents do not perceive the present Fluor strategy completely ready for the given concurrency in execution. An organization scoring more than 4.0 or managed level in BEACON scale is deemed as prepared for concurrency. Thus, from this investigation, it can be said that the taskforce as well as management do not feel prepared for the concurrency on the refinery project.

![BEACON Survey Radar Diagram](image)

**Figure 5-2: BEACON survey result for refinery project**
Process element involving the organizational framework, project strategy, management system etc. scored the lowest, raising critical concerns for project management. In contrast, technology element involving support from organization towards communication, information sharing, integration and task scored better than all others, which shows that the technology support is doing well. Coming back to people element, the project scores 3.29 which is average performance (Khalfan, Anumba, & Carrillo, 2002) and needs attention from both management as well as employees in order to work efficiently and effectively in the present market with any given level of concurrency.

Management vs. Non-management Comparison

Similar comparison when carried out between management and non-management responses to BEACON survey (Figure 5-3), it is observed that the non-management participants scored more on people element with respect to management. This shows that the perception of non-management participants (compared to the management participants) is more optimistic towards the People element of BEACON (team bonding, atmosphere at work or work life balance) which certainly is a positive aspect for the project. Overall, the scores from the survey suggests that non-management taskforce feels more prepared for concurrency than the management.

One more interesting observation noticeable in Figure 5-3 is about the quality assurance aspect from project element. The question asked was, ‘Commitment to quality is affected by the current execution strategy and schedule changes in EPC?’. Substantial difference in the scores indicate that the non-management taskforce feels that the current execution strategy is affecting commitment of the people towards quality of the deliverables. Continuous changes and the delays are eventually taking away the focus of the team from delivering high quality product. Management on the other hand slightly disagree with the same.

The relations or impacts of the elements, other than people element i.e. project, process and technology, on the taskforce is not distinctly visible in the BEACON model survey results. Fluor as an organization can preferably conduct this test to check the readiness of present Fluor procedure towards the concurrency demand by industry. This research is primarily concentrated on the human factor but for Fluor, investigating all four elements in depth would be beneficial for future undertakings.

5-5 Conclusion

This chapter briefly provided the assessment of the refinery project using BEACON model. BEACON model survey was conducted to investigate whether the current execution procedure is suitable to handle the given concurrency in the refinery project. This chapter partially answers the sub-question: Is the organization (taskforce and management) prepared for the given concurrency?

The refinery project by Fluor scored 3.22 in the BEACON survey for readiness towards concurrency. This score falls in between the Characterized and Managed levels of BEACON Model. This score primarily indicates that the present execution procedures are not fully prepared to handle the given concurrency according to the participants from the refinery project. Fluor is a contractor organization, when referred to the previous research in the construction industry (Khalfan et al., 2002), the criteria for a contractor organization to be
able to adopt concurrent execution successfully was to at least score above 4.0 (Managed level).

This project is performing well in People element with along with technology element. The areas which need attention are from the process element related to the management, strategy as well as organizational framework. In the people element, team functioning scored below average which need to be addressed from people’s point of views. This includes looking into the internal communications, relations between team members, recognition of employees and work life balance.

5-6 Reflection on BEACON Model Survey

BEACON Model was designed in 2000 by Khalfan and Anumba (Khalfan et al., 2001) for construction industry. Though the concurrent engineering was widely practiced in other industries including product design, it was not common in construction sector. Construction industry practices at that time were not completely supporting the integration of concurrency in the construction process (Muya et al., 1999).
BEACON model was designed to assess whether the construction industry is mature to adopt concurrent execution as an integral part of the project execution strategy in future. In present scenario, as mentioned before, Fluor is executing project concurrently since long time. Hence, the BEACON assessment questionnaire can no longer be used as it is to investigate the preparedness of Fluor towards given concurrency. This is one of the limitations of this model is current scenario.

The fact which is neglected in this analysis is that the 17 critical factors of BEACON model do not consider the status quo of the project. The model is supposed to be implemented before adopting the concurrency and hence it fits the original description in the literature. In this research, the model is implemented in the middle of the EPC phase when the project progress was at 50%. This might influence the responses by the participants as the taskforce was extremely busy at the time of the survey with the model reviews, P&ID IFC etcetera. The participants were from diverse disciplines and everyone was facing different issues at that particular time depending on the area of expertise and position of responsibility. This variation might have affected the responses and similar group of participants may respond to the survey differently in the beginning of the project or after finishing the project.

In future, the results of the BEACON survey can be validated by conducting the survey in the beginning of the project with periodical measurement to find the correlation between the response from taskforce and the respective phase in the project life-cycle. Including more number of participants and analyzing the results with respect to smaller groups such as discipline, age, experience etcetera might prove helpful in understanding the pattern. In short, it is necessary to consider people factor in present times while conducting as well as analyzing the outcome of any research unlike earlier times were more focus was used to be on the technical aspects.

In all, it was discovered that the BEACON model is very helpful and solid in assessing the maturity level of any organization to accept concurrency in system. In future the above mentioned recommendation can be implemented to make it more suitable for the current market conditions.

The next chapter focuses on the interviews conducted after the completing first three investigation methods.
Chapter 6

INTERVIEWS

Once the investigation was completed with the above three methods, interviews of the 21 participants selected for BEACON survey were conducted. The information obtained from the previous methods show that the taskforce satisfaction decreased in the last six months and the concurrency was superimposed as the project moved forward. BEACON survey showed that, ideally there were various critical factors that needed focus in order to improve the response to the concurrency in EPC. But, as the objective of this whole research is to study the people and the effects of project execution strategy on the taskforce, it was important to relate all the results to the research objective.

In order to do so, it was important to talk to people and gather the information with particular approach in mind. Based on the experiences gained by working with the taskforce on the project and considering the results from the taskforce satisfaction survey, schedule analysis and the BEACON survey scores, a set of questions were drawn up. The questionnaire was directed towards a specific goal which was to understand what were the opinions of the taskforce towards the project execution strategy and what problems were faced by them in the EPC phase related to concurrency and project execution.

The idea behind the interviews was to understand the viewpoint of people about their own performance, the issues they see or face due to performance of other people. The questionnaire has been provided in the next section.

6-1 Interview Questionnaire

The questions are divided into three sections. The sections are divided based on the nature of the questions. The questions asked were mainly related to the refinery project, employee performance and behavior; and performance of Fluor as an organization towards the employees (Sageer, Rafat & Agarwal, 2012).
Project Dependent Factors

1. What is your opinion about leadership style? Explain?
2. What was your first reaction to the October baseline schedule? Optimistic, realistic or other?
3. Any insights about HAZOP review strategy? Effect on the taskforce or yourself?
4. What is your opinion about the changes/reworks on this project? How does it affect you and/or the taskforce?
5. From schedule, it is understood that we are facing delays. From your experience, what do you think are the possible reasons or your perception about it?
6. How does rework and delays make a difference to you and/or the taskforce?
7. What is your opinion about the charter “The Best Project Ever”?
8. What is your opinion about the project communication? Meetings or other mediums? Information provision by management?
9. Do you have sufficient time to address/absorb the unforeseen activities?
10. How do you perceive client role on this project? Explain?
11. What do you expect from recognition programme and how do you evaluate current programme? Explain?

Employee Dependent Factors

12. How do you perceive the results of the taskforce satisfaction survey? Explain?
13. What is your experience with the team bonding on this project? Is it getting better or going down? Explain?
14. How do you rate this project compared to your previous projects on the aspect of stress at work? Explain?
15. How is overall communication in the team? Explain?
16. From the project sources, it is observed that some employees left the project due to distress/burnout, what is your opinion about it being on this project? What can be the different aspects from your point of view leading to the excess stress?

Fluor Organization Dependent Factors

17. Do you have right backup from organization to perform your job? Explain?
18. How is Fluor supporting with tools and resources?

The interviews were conducted one on one and the participants were given freedom to explain in detail about any particular aspect related to the above questions or relevant aspect. Some of the participants did not answer all the questions due to insufficient knowledge or no clear opinion. Direct interviews with the people involved, helped in better understanding the actual thinking of people towards the project.
6-2 Interview Results

In order to analyze the results of the interviews, a matrix was prepared where the factors asked during interviews were plotted against the interviews. All the factors were selected based on the interview questions and were also divided in three section as shown above. The purpose was to represent which factors were responded more by the participants. The analysis of the interviews has been included in the next chapter as a part of combined analysis of the entire research. Hence, only the results have been explained in this section summarizing the interviews in tabular format.

Table 6-1 summarizes the factors which were discussed during the interviews in a matrix form. This matrix basically provides in brief, the frequency of each factor discussed in the interviews. A critical factor consisted of several aspects covered under a broader term for analysis and simplification. Each critical factor has been explained in the combined analysis from the people’s point of view in order to verify the importance and evaluate the project performance qualitatively in the refinery project case. These critical factors were based on the questions asked during interviews hence, Table 6-1 contained few factors which were discussed earlier. In Table 6-1, the X’s explicitly represent that the participant had a clear opinion about that critical factor and that particular aspect was discussed in depth to understand the reasoning behind the opinion. Hence, the total number of responses to each factors are provided in Table 6-1.

Table 6-1 shows that there are three categories to classify the factors. The simple reason behind the division was to understand the factors from an employee’s point of view (Sageer et al., 2012). The factors were separated Based on which aspect can influence or steer that particular factor in future. As an example, the personality aspect can only be influenced by the employee himself rather than project management whereas the recognition programme or project execution strategy is definitely influenced by the project management team. Similar to that, the third category is of the factors which are not in the authority of the project management or employee but are implemented for the overall organization such as the resource allocation, work space or organizational support for staffing or de-staffing.

Throughout the interviews it was observed that the perception of taskforce towards the project and the factors described above, was widespread, for example participants were sometimes extremely satisfied with the aspects where as some were disappointed about certain aspects. In order to represent the key points in the answers given by the taskforce during these interviews, a word cloud was created as a picture representation and it has been attached in Appendix D for reference.
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Chapter 7

COMBINED ANALYSIS AND DISCUSSION

In this chapter, an effort has been made to converge the entire research carried out in the thesis and analyze the refinery project execution strategy comprising of concurrent engineering. The factors which were adopted from the interview questionnaire have been explained further in detail while taking into account the analysis of the first three investigation methods. Further, the analysis provided the basis for discussion which has also been elaborated in this chapter. Based on Table 6-1, the factors are explained in the next section.

7-1 Factors Affecting Taskforce

This section describes the factors which affect the taskforce of the refinery project. The factors are divided as, project dependent critical factors, employee dependent critical factors and Fluor organization dependent critical factors (Table 6-1).

7-1-1 Project Dependent Critical Factors

1. Leadership Style

The refinery project has mirrored the organizational structure of the client organization. Hence, the leadership (project management) setup in this project is different from a standard hierarchical setting. At the helm of the project is the project director followed by project manager and a team of engineering managers.

The positive aspect of such a leadership / system is that the project director looks from the perspective of people while the project manager handles the project aspect. Overall balance is maintained in the team with soft and hard aspects addressed properly.
The concerns that have been raised about leadership were mainly due to the overall delays in the project schedule. This delay has forced the project management to be more directive in nature in the execution phase to push forward the activities and target the results.

2. Project Execution Strategy

Project execution strategy included all the factors which can be managed in the project itself and it was discussed thoroughly during the interviews. There were multiple viewpoints regarding the project which were creating the churn in the taskforce and this was evident from the interviews. Sub-factors of this particular subject are discussed below with explanation.

- **Concurrency level**: Taskforce (non-management) and management had different opinions about the level of concurrency and the schedule. It was observed through the schedule analysis that the project was delayed and some activities were getting more concurrent whereas some of them were not. Similar behavior was mentioned by the taskforce depending on the discipline or area they work for. Concurrency on this project varied as the EPC phase is in progress. Delays and changes caused the normal schedule to compress which introduced an additional concurrency in disciplines like Electrical and Instrumentation. On the other hand, the management feels that the concurrency level was normal but some specific strategies (Table 6-1) other than concurrency, affected the project execution.

  The outcome of the readiness to concurrency survey suggested that Fluor is not ready for concurrency on this project and similar opinions were put forward by the taskforce members who are part of the revamp areas with higher concurrency. Participants from the grassroot area have a positive opinion regarding the concurrency as the grassroot area is managing the work efficiently by staying ahead of schedule.

- **HAZOP strategy**: Conducting HAZOP reviews during the EPC phase was one of the key reasons for delay and rework. Fluor agreed to do HAZOP in EPC phase contrary to the standard procedure (before starting the EPC). It was based on the project plan and client request in the agreement. It was observed that the taskforce unanimously agreed to the fact that this was not a wise decision in the beginning by Fluor and that it resulted in a domino effect leading to issues such as team distress and foreseeable delay. On the other hand, the reason behind following this strategy was to increase the quality and safety of the whole design. But, the effect of this single activity on the whole schedule was not anticipated or analyzed beforehand and this particular comment was also echoed in the audit report of the project.

  The HAZOP work was underestimated and the corrections were 150% of the expected review which eventually consumed the float time and process department was under extreme time pressure to finish the work. Delay in getting the HAZOP reviews out created a domino effect on the dependent disciplines with delay in information for further process.

  Major effects of this factor include delay in downstream information flow, and delay in staffing and de-staffing plans of the process engineering. The negative side also included the effect on the cost and man-hours spent on the extra work which affected the schedule of the project.
• **FEED to EPC rollover:** On this project, the FEED phase was overlapped with the EPC phase during the completion period of FEED. In the hindsight, the impact of this approach led to the fact that the effective EPC start was 3 months later than the actual start. Some of the experienced employees had a strong opinion about the fact that it was important to completely close the FEED phase and then only move to the EPC phase. FEED phase needed an extension and closeout for proper execution. But this is a subjective opinion and may be considered in future while evaluating the project strategy. Moving to EPC phase without a solid design from FEED has led to under procurement of bulk materials and the management of change with the incoming additions become complex in nature for the employee to tackle.

• **Rework/Changes:** After the HAZOP strategy, reworks throughout the project stood out as a critical factor for taskforce dissatisfaction. On this project, almost 650 change orders were issued. The problem with increasing changes is that it directly affects the taskforce in routine work. Changes create frustration in the taskforce as the priority of the task keep on shifting. Changes come across as a misalignment of management from taskforce’s point of view. Increasing amount of changes or revisions in any particular task or activity at work causes the taskforce to lose the motivation by doing it again and again instead of moving forward and it has direct impact on the quality of the work produced. Priority list of the work is disturbed by the changes from previous work which eventually causes delays in the work at hand, leading to frustration and stress for an individual.

While relating this factor to project execution strategy, the interviewees revealed that the initial planning was not sufficient to incorporate high amount of changes and presently it has resulted in consuming the planned float time and eventual delays. This consumed float time leaves with no time to absorb unforeseen activities coming in the execution phase which leads back to frustration and stress in the taskforce.

• **Man-hour analysis:** The assessment of the project by the management reveals a 55% increase in the man-hours estimated for the refinery project. These statistics are definitely eye opening for the management. In this topic, one more fact which was revealed during the interviews is that the project controls and planning discipline has consumed significant amount of man-hours equivalent to 3 times the normal number of employees working on the project (Fluor assessment report).

• **Project drivers:** The refinery project is reimbursable with client aiming for the safest and high quality product. The positive point in this project is that the whole team is working to create a high quality product with the safest execution from start to finish. During the interviews, majority of the respondents agreed to the fact that this project is taking the quality and safety standards to a higher level than the projects they have been part of previously.

### 3. Organizational Structure

Discussing about the organizational structure of the project team, similarity was observed with the structure of client team. In order to work together in the same office with client, it was important to organize the team in a manner as to complement the client counterparts.
The response from the taskforce regarding these aspects was that majority of the people are finding this setup strange, and at times inconvenient to work with. Having a number of engineering managers from different disciplines increased the communication in the engineering and management. Most affected people due to this setup are the leads of all the disciplines. Repetition and communication to all the engineering managers for similar thing created frustration on some level as well as stress in the work and it was unanimously agreed by the engineering discipline leads when asked in the interviews. This aspect needs to be addressed in future projects.

4. Client Role

Client is playing a very important and influential role in this project unlike normal projects executed by Fluor. Following paragraphs represent the perception about client in this project team with the help of interviews and surveys as well as the time spent by author on the taskforce.

Positive impact of client is observed during FEED and EPC phase. Client team is very knowledgeable and experienced. Client is very attentive and supportive in sharing the knowledge and clarifying the doubts regarding the design as to comply with client rules and regulations. Sitting with the taskforce, client is helping the team in delivering a product of very high quality. Having client team in the same office helps in avoiding miscommunications and delays incurred due to communication procedures. Thus, there is a positive side which is helping the taskforce in improving the knowledge and working together towards a unique project. The relationship of Fluor with the client is satisfactory and the cooperation is beneficial to the project.

When it comes to the downsides of the client, first word that was mentioned by the taskforce is that the client is very challenging and the most challenging one the taskforce have worked for. The client team is exceptionally large on this project which has affected the organizational structure of the project and influences the taskforce. Having such a big team adds to the communications and meetings. The slow decision making and lack of practical approach on this project has affected the schedule and the man-hours of the project as highlighted by the interviewees. Excessive focus on detailing and reviews has affected the engineering disciplines in adverse manner. It creates extra changes and thus delays in the work schedule. Eventually it leads to frustration in the taskforce. The engineering disciplines and particularly process engineering is not satisfied with this one specific attitude of the client.

5. Recognition Programme

As discussed before in chapter 3, the recognition program currently followed on the project received mixed feedback during the interviews (Table 7-1).
Table 7-1: Recognition aspect – Interview discussion

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<tr>
<th>Pros</th>
<th>Cons</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>1. Novel initiative by Fluor</td>
<td>1. Losing the charm, need change</td>
<td>1. Not a substitute to daily appreciation by colleagues</td>
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<td>2. Appreciation towards the taskforce is</td>
<td>2. Repetitive recognition</td>
<td>2. Difficult to recognizes everyone given the huge taskforce</td>
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<td>motivating people</td>
<td>3. No involvement of the taskforce</td>
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<td>3. Great initiative but needs improvement</td>
<td>4. Limited coverage due to nomination by leads</td>
<td>3. Difficult to satisfy each and every human being on the taskforce</td>
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<td>5. Routine process/lacks the genuine appreciation</td>
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<td>6. Cultural difference</td>
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<td>7. Lead by example (motivating talks, appreciation)</td>
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Thus, the expectation of the taskforce from the project is very simple. People need genuine recognition and appreciation. Cultural difference is visible in the fact that in some cultures (American system), it is considered genuine to recognize publically. Whereas in other cultures (for example Dutch), public recognition is not suitable and a personal message of appreciation might be perceived as a genuine approach. Rewarding and recognizing the contribution of employees motivate people to be committed to the project (Nadia et al., 2006). Rewarding employees will always create a sense of belief and respect in their minds which can ensure satisfaction at work (Sageer et al., 2012).

7-1-2 Employee Dependent Critical Factors

In this section, the factors which are not in the control of project management or Fluor B.V. are discussed with the inputs incorporated from the taskforce and research.

1. Human Nature

Human nature or personality of each individual is found to be key aspect of the organizational effectiveness phenomena. In this project, the taskforce is huge and includes multi-cultural and multi-national individuals with all kinds of personalities. People from different nationalities and cultures perceive things differently and it is very important to understand this while
working on a big project. The aspect which impacts the project dependent activities most is
the people working in the team (Sageer et al., 2012).

An employee’s perception towards taskforce, attitude towards learning, communication skills
etcetera creates a significant impact on the taskforce. Following responses from the taskforce
highlight the problems existing in the refinery project taskforce:

- People work in isolation without proper communication with the taskforce or different
disciplines. Fail to gain a broad understanding of the project for better and smooth

collaboration.

- Some people during severe stress or work load, fail to raise their voices or ask for help
due to their behavioral instinct. Such case has been observed in practice on this project
when one of the participants mentioned the incident about his close colleagues who left
the project due to burnout. One of the reasons for burnout of the person was that he
was facing some issues internally but did not try to speak out or ask for help until it was
late. This example emphasizes the fact that it is very important to share the problems
with the management or colleagues to ensure that help is provided in time to avoid such
incidents.

- Majority of interviewees agreed to the fact that day to day motivation or few positive
words make a huge difference in motivation level. However it is observed only to a
limited extent and it is necessary to create awareness in this matter to truly satisfy the

taskforce in terms of recognition factor.

- It is equally important to show respect and trust the employees or colleagues. Several
times during the interviews, factor of trust and respect was discussed with regard to
isolated incidents happened on the project.

- One more aspect where human nature plays important part is in the field of learning and
growth of an individual employee. Very contradictory opinions were recorded during
the interviews on the process of learning and growth. As observed from the taskforce
satisfaction survey, the analysis shows that learning and growth depends on the stages
of the project. However, the other side of the coin, which is basically eagerness and
attitude to learn new things and improve, is neglected by many.

- During interviews, some of the participants mentioned about lack of information flow
from management regarding project progress and information about decisions taken by
management. Contrary to that, there were responses which praised the management
for well managed communication in the taskforce. It is important to mention here that
the responses were personal for each participant and speaking about the information
transfer, it was found that management prepares an executive summary providing facts
information about the project on regular basis which is available to all and people can
stay updated about the project.

Management is obligated to provide all the information individually to the taskforce but
it is a two way path and the staff should always show willingness and attitude to absorb
the information, learn and stay updated on the project developments. The executive
summary released by management on a regular basis should be read and understood by
the lead engineers for the broader perspective on the project. Employees who are aware
and proactive in communication with management showed positive gesture during the interview and vice-versa.

But, considering the nature and amount of work at hand, sometimes it is truly difficult for some employees to invest time in reading and in such situations, management can provide very short information in general meetings or gatherings.

Thus, in this research the main focus is on people and soft aspects and the human nature as explained above with practical observations, plays an extremely crucial role in creating a successful project. This aspect should be duly considered while investigating the impacts of the project execution strategy on the taskforce.

7-1-3 Fluor Organization Dependent Critical Factors

The last category includes the factors which are managed on a broader scale by the organization irrespective of the project management or employees.

1. Organizational Backup (Tools, Man-power, Taskforce Setup)

- The project is provided with all the necessary tools and advanced programs by the organization. On the BEACON scale, the project scored 3.37 in the technology element. Similar response was received during the interviews, where the taskforce is satisfied with the current resources available but an improvement in the technological aspects is always expected with the state of the art tools available in the industry.

- On this refinery project, higher number of employees suffered burnout at work compared to previous projects by Fluor, as mentioned by all the interviewees during the interviews. In such a situation, support from Fluor management as well as from the department of the employee plays a crucial role. When inquired of the same in the interviews, the respondents stated that the support from departments is always available with maximum priority in such cases. However, in one or two cases it was not possible to provide immediate replacement and support to the corresponding discipline due to constraints of the organization and lack of availability of suitable professional at that particular instant.

- One fine example of the proper team management is observed in the CSA discipline. The distribution of responsibility in the CSA team is managed in such a manner that the team always has a member suitable to take responsibility in absence of any other member. The reason behind the functioning was the decision of lead engineer to allocate the responsibilities based on the specialization and capability of the individual. CSA department provided able support in form of suitable manpower. This particular example can be referred for future project to manage the small teams involved in the project.

- In the present office, the taskforce is located on two separate floors due to the project setup. During interview, this aspect was discussed by majority of the respondents. The reason behind that was related to the communication and accessibility for the people.
This setup has led to some frustration for the disciplines with difficulties in direct communication. This aspect is again not possible to control as the lack of space and the overall arrangement for all the project in the office is decided by the Fluor management and hence, such elements stand out of project management’s scope.

7-2 Reflection

In previous section, the inputs from the taskforce and the interview participants were analyzed systematically to provide the overview of the factors which are important for people on the taskforce as well as for the management to understand. In this section, thoughts have been explained about the refinery project and efforts were made to critically examine the research.

Objective of this research was to study how people are being affected by the execution strategy of the refinery project and what are the impacts of concurrent execution strategy on the taskforce. The Taskforce Satisfaction Survey carried out shows that the scores are decreasing in the EPC phase. Similarly, BEACON survey also projected a picture where it is interpreted that current Fluor procedures are not fully compatible to manage the given concurrency on the project. In schedule analysis, the initial assumption was that to see the changes in overlapping of activities with the progress. Schedule analysis showed that the concurrency was present in the baseline schedule and due to engineering delays, the EPC activities got more concurrent in order to keep the end date fixed.

In this whole analysis the results are pointing in the direction of the problems which are present in this project and people are not happy with the execution. Interviews were conducted where people were talking elaborately about the project and the problems experienced during the project which varied from project management to human nature. But, in this entire research, one factor which is not considered anywhere is the present situation of the project and the position of each individual who contributed in this research in terms of project work phase, work pressure and mindset at that particular time.

Above mentioned aspects influence the outcome and the responses from the taskforce. With the help of S-curves obtained from the refinery project team, efforts are made to explain what may be happening on the project apart from the combined analysis in previous section. S-curves represent the progress of the project in total as well as for individual disciplines. The project is halfway through EPC phase and engineering disciplines like Process, Piping, Mechanical, CSA and ECS are following their own progress path as per the planning.

When the interviews were conducted in the month of June’16, all the participants were going through their own schedule and work pressure was separate for different disciplines. Some disciplines were just finished with difficult part (e.g. process) and were ready to look forward to new phase while some disciplines were in the middle of their schedule with hectic schedule and continuous work ahead (e.g. ECS, piping etc.). This difference indirectly creates an influence on the responses provided by the participants from different disciplines. Those who see a bright light ahead and see their work being converted into a real structure, exhibit positive approach towards the things whereas others, who are still working in the most important phase and yet to finish the work may exhibit less positive approach.
The project is in an important phase and the work is at its peak with engineering aiming to finish the 90% review while construction starting the work on site. Hence, the taskforce is under pressure to deliver quality product in short duration. This may a create a mindset where the work feels difficult due to insufficient information in hand, pressure to forward information downstream, continuous changes and corrections as well as no motivation to look forward. The response of the survey and interview participants naturally gets influenced and the problems are visible including high concurrency or unrealistic schedule etc. The same group if interviewed after the completion of the project might present a completely different picture of the same project with optimistic attitude. This is the fact which was found to be interesting while being on the taskforce.

The schedule of the project shows that the concurrency is increasing the overlaps between EPC and it may be perceived as a failure of the project management and project planning. But in reality, the original schedule was realistic as mentioned by most of the participants and due to certain delays in HAZOP reviews, the additional and unforeseen concurrency was superimposed on the taskforce leaving a perception of a failed planning. It is important to understand the added concurrency could have been avoided by considering the future impacts of the late HAZOP strategy but it is not right to blame the planning of the project for the concurrency. This was not possible to interpret with the help of BEACON survey results, which concluded that the Fluor procedures are not prepared for the original concurrency.

Similarly, the Taskforce Satisfaction Surveys also show that the scores are decreasing but the increased number of surveyees in last two rounds as well as the mix of the old and new members does have in impact on the results. There are certainly many aspects which need to be addressed by the management but it is not all to negative in the taskforce as the results project.

During the nine months spent on the taskforce, one of the examples which was observed frequently, was that the employees who do their own designated work often get busy in solving the problems in some other related task or correcting their previous work after changes. Many a time this has led to frustration as they did not get sufficient time to complete their own work. It needs to be understood that this project underwent more than average number of changes and it definitely had affected the team dynamics with frustration among disciplines and people.

In the section 7-1-3, an example of CSA being the planned discipline is listed. It is indeed the fact that the work distribution approach and team dynamics is excellent in CSA, but from s-curves it is observed that the discipline significantly availed high number of man-hours than proposed and planned which partially helps in stating that the man-hours were consumed and that helps in the project. Support from department is very important in such scenarios.

In the end, the research does provide the outcome which put forward valid questions in front of the refinery project management but the missing part is that it fails to incorporate the impact of the conditions in which the data was collected and analyzed. S-curves show the different stages of engineering disciplines at any given time supporting the argument. for complementing this research, the data should be collected at different phases of project lifecycle to compare the results, it will be very interesting to observe the patterns as the project starts, peaks and eventually ends.
7-3 Conclusion

In the previous sections, thorough analysis of the factors affecting the taskforce and critical approach towards the research is done. This chapter specifically represents the characteristics of the refinery project by Fluor, hence the literature reference specific to this analysis is not available. After entire analysis, it became evident that in any project, the people factor is extremely important and the refinery project has significant concerns especially in the project execution strategy which is severely impacting the taskforce. The analysis carried out for taskforce satisfaction survey, schedule analysis and BEACON model survey contribute towards the combined analysis.

Table 7-2 shows the outcome of the analysis carried out before in a matrix form. The matrix includes the factors which affects the taskforce and the rows represents the most common effects experienced by people on the refinery project. The matrix is designed by considering the factors which were repeatedly mentioned in previous investigation as well as during interviews. Project execution strategy encompasses most of the project dependent critical factors which is also visible in the matrix as it influences all the effects experienced by taskforce.

<table>
<thead>
<tr>
<th>Project Dependent Critical Factors</th>
<th>1 Leadership Style</th>
<th>2 Project Execution Strategy</th>
<th>2a Concurrency Level</th>
<th>2b HAZOP Strategy</th>
<th>2c FEED to EPC Rollover</th>
<th>2d Rework/Changes</th>
<th>2e Man-hours Analysis</th>
<th>2f Project Drivers</th>
<th>3 Organizational Structure</th>
<th>4 Client Role</th>
<th>5 Recognition Programme</th>
<th>Fluor Organization Dependent Critical Factors</th>
<th>6 Human Nature</th>
<th>Fluor Organization Dependent Critical Factors</th>
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<td>Stress/Burnout</td>
<td>Frustration/Lack of Motivation</td>
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Table 7-2: Cause vs. Impact matrix

From the matrix, it is observed that the stress factor in the taskforce is mainly influenced by project execution strategies barring a few, as well as due to human nature and support from the Fluor as an organization. Apart from work delay, all the other effects are partially influenced by the behavior and attitude of the employee. Client is playing a significant role in this aspect as this client is mentioned as the most challenging client the participants worked for. Similarly, the impacts of each factor is explained in depth with respective areas of impact.
on the taskforce. In the reflection part, the research is critically examined to present a complete view of the research and possible opportunities to conduct further research in the field of organizational effectiveness.

The matrix represents the list of critical factors which create impact on the taskforce. The list is formulated from the refinery project case study as a part of this research but these factors more or less are similar for most of the oil & gas projects as well as other engineering projects. This list can further be referred to as the quick guide in case the project needs an investigation focusing on soft aspects of project management or employee engagement.

In all, the research part is concluded with this chapter and next chapter ends the report with conclusions and recommendations.
This chapter concludes the report of the graduation thesis. The main findings are summarized in order to answer the main research question and provide the conclusion of the hypothesis proposed in the beginning of the research. Furthermore, recommendations for Fluor towards the refinery project execution as well as future research are proposed towards the end of the chapter.

8-1 Conclusions

How is the Taskforce Satisfaction changing over time?

This sub-question is partially answered in chapter 3. The Taskforce Satisfaction Survey results indicated that the taskforce satisfaction gradually declined in the EPC phase of the refinery project. Till now, six rounds of the survey have been conducted and they project a trend (Figure 3-1) in the Gallup’s 12 aspects. Survey results show that the change of project phase is directly related to taskforce satisfaction. Soft aspects related to individual growth and satisfaction, showed decreased satisfaction in comparison with the hard aspects related to the project expectations and quality of work, over the period of two years.

What changes are observed in the concurrency level in the refinery project schedule since EPC commencement? How does it affect the people?

The refinery project has implemented the concurrency in its baseline (October’15) schedule and hence the effect of only concurrency was hard to investigate. The important fact is that the changes and delays in the detail engineering design have compressed the schedule of contract management and construction which eventually created additional concurrency in
the schedule by the end of March’16. thus, the first observation in this chapter was that the project is facing increased concurrency in the EPC phase with the progress.

Impacts of original concurrency are not distinctly visible but the superimposed concurrency has definitely created impact on the taskforce. Analyzing from organizational point of view, the domino effect due to underestimating the work (especially HAZOP) has created stress in the engineering disciplines. Contracts department is experiencing the compressed schedule from both sides leading to severe work load. Continuous changes and inability to cope with the pressure is partially contributing to the burnout of experienced professionals on the taskforce and affecting the progress of the execution.

Basically, the initial reasoning behind carrying out this analysis was to see the impacts of concurrency, but it is observed that more than the concurrency, delays and eventual superimposed concurrency have been influencing the distress in the taskforce and this is one of the outcomes of this chapter. The information about the impacts on the taskforce due to unforeseen activities and delays (leading to added concurrency) was gathered with the help of informal discussions with the taskforce members.

Is the organization (taskforce and management) prepared for the given concurrency?

Plain and direct answer to this sub-question is that current Fluor procedures are not prepared for the given concurrency level on the refinery project. The outcome of the survey (Table 5-2) shows that the project is scoring 3.22 (on a scale of 1-5) in the survey conducted for the discipline leads and project management (21 respondents in total). BEACON survey has scored highest on the technology element whereas the lowest score was registered for the process element involving management and organization of the project. The investigation shows that Fluor as an organization needs to focus on the people aspect. The project scored above average in the people element with a score of 3.29 which still needs an improvement to be able to satisfy the BEACON criteria for concurrency preparedness. Communication in the taskforce, recognition aspect, work life balance and team dynamics are four critical factors of people element and in order to be ready for concurrency, the survey score should be above the managed level (4.0 >) on the BEACON scale.

While this survey provided valuable output with the factors which can be improved, there are some areas where the survey can be improved. As the survey is based on the responses of participants at a particular time, there are possibilities of having responses based on the mindset of the participant at the given moment. Hence, the possibility of such results is to be considered while forming a conclusion.

Summarizing the complete research and performing the combined analysis of project execution strategy on the taskforce and the interviews, the research question is answered.

8-2 Answer to the Research Question

What are the impacts of concurrent execution strategy on the task force in the EPC phase of a refinery project?
Based on the Table 7-2, major impacts of concurrent execution strategy on the refinery project taskforce are listed as below. These impacts represent the outcome of the research analysis but in reality, the concept of concurrency as a part of project execution strategy has widespread impacts on the taskforce and people.

- Stress/Burnout
- Frustration/Lack of motivation
- Delay in work
- Communication issues

In this thesis, determining the impacts of only concurrency on the refinery project proved to be difficult as the project schedule was already concurrent. Hence, the impacts of superimposed concurrency are analyzed where the original concurrency of the project increased due to unforeseen situations and delays in detailed engineering design phase. The objective of the research was to investigate the impact of present execution strategy involving concurrency on the taskforce. Table 7-2 in brief display the answer to the research question as well as the research objective.

This project is definitely unique as the client is sitting in the same office with exceptionally large team which itself shows the importance of the project. Fluor agreed to follow client’s strategy for this project in order to deliver a product with very high quality and extremely safe execution throughout the project life cycle. Further elaborating, the aim of the research was to analyze the project and understand the problems faced by the taskforce in the EPC phase of the project. Investigating the taskforce satisfaction and project execution strategy with the help of scientific techniques; the most important question that, what is the meaning of the results; sociologically what significance does this research make?

The answer is that the taskforce is under work pressure in the present stage. During last six months, the time spent on the project floor helped understand the situation, atmosphere as well as team dynamics. People are facing challenges in the work with time pressure and high amount of reworks. As the taskforce is growing, the time to bond with new colleagues and develop the trust is not available with the people. Delays caused by few activities such as HAZOP for example is underestimated and eventually it caused a big churn in the organization, specifically the process department was under stress to deliver the output.

One may wonder that the reason behind the pressure, stress and burnouts occurring must be the project execution strategy and project planning but research showed that along with the project execution strategy, added concurrency played an important role in forcing the taskforce to work faster while delivering quality product. This in turn led to stress and frustration of employees. Apart from the added concurrency, individual nature, personality, ability to handle stress, attitude towards work and relationship with the taskforce plays equally important role which might add to the stress or work pressure resulting in burnout in some cases.

Thus, the final conclusion can be summarized in two lines; the project execution strategy with given concurrency is definitely keeping the taskforce under pressure and busy but the soft aspects of human nature such as eagerness to learn, communicate and appreciate people...
play equally important role and hence the direction of the project management should be towards creating a positive atmosphere with proper planning along with focus on developing soft aspects of the employees through training and awareness.

Based on the research and investigation conducted during the graduation thesis, the hypothesis for the refinery project case was formulated. The hypothesis is as below:

"Current execution strategy of the refinery project involving Concurrent Engineering is affecting the taskforce as the EPC phase of the refinery project is in progress."

The conclusion to the hypothesis states that the current execution strategy on the project and the concurrency observed in the EPC phase, is affecting the taskforce satisfaction adversely and the refinery project is facing negative impacts in certain areas due to the chosen strategy. For example, the impacts include delays in the engineering schedule, increased work load on the process engineering disciplines due to extended HAZOP review and in some cases burnout of the taskforce members due to inability to handle stress and pressure situations.

But the concurrent engineering is not the only aspect which is affecting the taskforce. In reality, the added or superimposed concurrency in the EPC phase also contributed to the stress and work load on the taskforce. Hence, the hypothesis is verified partially. In the next paragraph, visible effects on the taskforce are mentioned in brief.

The taskforce is under stress and few taskforce members left the project due to severe stress and burnout. This hypothesis does answer the research question but it is not adequate to assign the adverse factors experienced by taskforce completely to project execution strategy. There are other aspects which contribute to the stress and burnout of the people on the project. Such aspects are also important to consider while studying the impacts on the taskforce from organizational effectiveness point of view.

## 8-3 Recommendations

### 8-3-1 Recommendations for the Refinery Project

#### 1. Lessons Learned

Being a unique project, project management should implement the lessons learned from past projects for future activities with the help of informatory session or seminar on the refinery project.

In the beginning of the EPC phase, lessons learned from past were incorporated on the refinery project. Management should evaluate the project performance based on those lessons learned till now to see the effectiveness.

#### 2. Recognition Programme

Current recognition programme needs a change in the format for motivating the taskforce.
• Recognize the employees separately for example discipline or area recognition to increase the spread of the recognition programme and satisfy the taskforce. This option would enable the area manager or discipline lead to recognize the team member as well as justify the selection to other team members with constructive feedback for future.

• In case the current format is continued, justify the process of selection during the safety moment and create transparency in the procedure. It may be possible to allow the winner to celebrate the reward with his team. That way, members contributing to someone’s success will be recognized as well providing a positive boost to team work and bonding.

• During the weekly safety moment, create awareness about the importance of small talks and pat on the back. Appreciate people surrounding us for the excellent work done and do not depend on the recognition programs for appreciation. Lead by example with the help of experienced employees.

3. Growth of Lead Engineer

One novel initiative can be implemented starting from this project. Provide training and exposure to the discipline leads and grow them into managerial role along with technical skills. This will help the leads managing the discipline team and motivate them to perform to their highest potential. Boosting leads to enhance their soft skills can be further continued to the taskforce in the next phase. This recommendation is included in this research as it is equally important to develop the taskforce for future endeavors. This research focuses on the people in the industry and guiding them to develop their soft skills will always prove beneficial to the taskforce while managing the project.

4. CSA (Civil, Structure and Architecture) Discipline Structure

It is observed that CSA discipline is structured systematically in order to reduce excessive dependency on any specific individual and perform to the same potential without depending on a team member. Project management may take initiative to understand the structure of the CSA discipline in order to educate other disciplines in future.

5. Team Bonding Events

Taskforce is satisfied with the yearly group events organized by the project and enthusiastic about the concept. Such events should be continued to cheer the taskforce and enhance team bonding with leisure activities.

6. Taskforce Satisfaction Survey

As mentioned in chapter 3, taskforce satisfaction survey should be continued till the completion of the project with additional filter for determining the time spent by employee on the project and then comprehensively analyze the trend.
7. HAZOP Strategy

Implementing HAZOP in the later phase of the project may not have pleased the taskforce altogether causing delays and stress. In future, while agreeing to follow specific strategies as per the requirement, extensive analysis of the activities affected by the strategy should be performed while incorporating all the disciplines in the decision making and providing sufficient margin in the schedule for unforeseen events or known unknowns.

8-3-2 General Recommendations for Future Research

- In future, the BEACON model analysis with the original questionnaire should be performed by Fluor organization to evaluate the readiness of the organizational procedure towards the concurrency and competition in the market.

- In this research, many aspects such as culture, work share process as well as client team was not involved. This research was specifically conducted for Fluor Amsterdam taskforce on the refinery project. In future, all these aspects can be integrated on a broader scale for the research.

- This approach can be generalized for other projects completed or in progress by Fluor or any other organization. Comparing the refinery project with other projects involving with different client, strategy and budget will yield some interesting outcomes in the field of organizational effectiveness.

8-4 Contributions of the Research

Concept of concurrent engineering was developed in 1990s and extensive research was carried out on it throughout the industry. Yet, limited research is carried out associating the concept of concurrency to taskforce satisfaction and organizational effectiveness. Present research tried to relate the impact of concurrency on the taskforce with the help of a refinery project case study and practical data analysis.

BEACON survey was designed to assess the readiness of construction industry towards implementing concurrency, but it was not developed any further once concurrent engineering became part of industry. In this report, an attempt was made to modify BEACON model with case specific questions to assess the already implemented concurrency. The aim was to check the performance of the case towards concurrency based on the exact 17 parameters from original BEACON model.

Overall, this research has opened up some new avenues in the EPC industry relating concurrency to taskforce satisfaction as well as evaluating the compatibility of any organization for concurrency to improve the strategy in future.

8-4-1 Areas for Further Research

This research is small part of the longitudinal research in the field of organizational effectiveness. This research was carried out in the crucial phase (20% - 50%) of EPC phase in the
refinery project. Hence, the outcomes may have been influenced by the extremely busy and stressful working environment.

In future, further research can be carried out at different phases and time durations which will provide continuous data for final analysis. The research may yield results showing a trend in the responses against the time line of a project. This can prove to be an important study in future.
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Appendix A

BEACON Model Theory

Introduction

The BEACON model is designed to assess the readiness of a construction organization for the adoption of Concurrent Engineering (CE). The questionnaire assesses the organization under four key elements, which are Process, People, Project and Technology (Khalfan, 2001). All 17 critical factors from the four key elements are described below for better understanding of the model and the approach followed for the survey in the research.

A Process Element

1. Management Systems

The purpose of assessing the Management systems is to ensure that the management systems are designed and implemented to enable project teams to be successful in their objectives, and are improved continuously through feedback and periodic reviews. Management systems include planning, scheduling, controlling and tracking of a project development process, resource planning, contract management, performance management, financial accounting system, risk management, contingencies etcetera.

2. Process Focus

The aim of checking the process focus is to verify that the development process is documented and flexible enough to adapt to changes in the client’s requirements, personnel etc. It ensures that the process is evaluated and improves periodically through analyzing past decisions and reusing past processes.
3. Organizational Framework

The objective of evaluating the organizational framework is to confirm that there are organizational policies which assist in controlling and monitoring of a project development process, and support teams to do resource allocation, conflict resolution, and improve individual and team performance.

4. Strategy Deployment

The purpose of assessing the strategy deployment is to ensure that the business strategy is clear, consistent and focuses on the improvement of a project development process. It also ensures that teams are set up to address client’s requests, and to identify & prevent future problems.

5. Agility

The aim of evaluating the agility is to confirm the ability of an organization to respond gracefully to changes in a project development process, and making sure that the assets are reused. It also evaluates whether the corporate memory of the organization is maintained and made available to all members of the project development team and sub-teams.

B People Element

1. Team Formation and Development

The basic purpose of assessing the team formation and development is to confirm whether the organization has strategies for team formation and development, and is arranging training sessions for team members to upgrade their technical skills. It also assesses whether each member of the project development team and sub-teams understands his/her responsibilities, has common purpose, and interacts with others on continuous basis.

2. Team Leadership and Management

The objective of evaluating the team leadership and management is to ensure that selection of team leaders is on the basis of their technical and managerial skills. It also ensures that the team leaders are responsible for the completion of a project and have authority to enlist new members and take team related decisions.

3. Discipline

This is intended to verify that all members of a team abide by the disciplinary rules and regulations, and are committed to and share team rules. It ensures that team members submerge their individual agendas and stick together when difficult issues rise.
4. Teams in an Organization

This checks the extent to which there are diverse disciplines and specialist groups working as sub-teams. It ensures that the teams have authority and can easily communicate with each other. It also ensures that there are policies to measure team performance and to plan and conduct peer-reviews within the teams.

C Project Element

1. Client Focus

The client focus factor ensures that the client is a part of the project development team throughout the design and construction phase of the facility. It also ensures that all project decisions are prioritized based on client’s needs, and all members of the teams understand the client’s requirements and respond appropriately to changes in client’s requirements.

2. Quality Assurance

The objective of checking the quality assurance is to confirm that project standards and quality assurance activities are adopted and maintained. It also confirms that there are policies to ensure required project quality and analyze feedback from the construction site.

3. Facility Design

The aim of the facility design is to verify that preliminary designs of the facility are prepared and discussed before entering into the final design and construction phases and relevant past designs are also consulted and used to design the current facility. It also ensures that the design of the facility is flexible enough to address any changes, and encourages repetitive and standard construction procedures.

D Technology Element

1. Communication Support

Communication support is concerned with ensuring that the interaction between team members by electronic mean and all team members are connected to each other in a network. It also explores the extent to which team members use e-mail facilities, exchange project data over a network, and use computers for virtual meetings and interaction.

2. Co-ordination Support

The aim of evaluating co-ordination support is to confirm that the project data is available electronically in the form of central project model, which facilitates co-ordination of all members of teams. It ensures the availability of systems that are used to support project monitoring, conflict recognition, resolution, negotiation, and trade-offs among the teams.
3. Information Sharing

This seeks to verify that the information required for the project development process is accessible in electronic form and is managed by an appropriate data base management system. It ensures that the advantage of multimedia technology is taken, master model of resource information is also used, and full corporate memory of relevant project information and decisions is maintained.

4. Integration Support

The aim of evaluating the integration support is to confirm that all members of teams are integrated through a shared integrated information model and all members of the teams use a common operating system. It also confirms that data translation techniques are used, and data exchange standards are supported.

5. Task Support

This aspect ensures that the simulation tools, design information from past, advanced tools are used for facility design. This particular point also ensures that the available technology is improved with timely evaluation of support tools to determine their effect on the project performance.
Appendix B

BEACON Model Maturity Levels

For all of the elements, five levels have been adopted from the RACE model (CERC Technical Report, 1992), which indicates the level of maturity of an organization with respect to the quality of project development process, team working, completed project itself, and technology employed within the organization. These five levels are Ad-hoc, Repeatable, Characterized, Managed, and Optimizing. The Ad-hoc Level indicates that an organization does not have any idea about CE practices or is not ready to adopt CE whereas Optimizing Level shows that the organization is ready to adopt CE or is already practicing CE within its project delivery process (Khalfan et al., 2002).

- **Score 1 Ad-hoc**
  This level is characterized by ill-defined procedures and controls, and by confused and disordered teams that do not understand their assignment or how to operate effectively. Informal interaction with the client is observed, management of the project development process is not applied consistently in projects, and modern tools & technology are not used consistently.

- **Score 2 Repeatable**
  Standard methods and practices are used for monitoring the project development process, requirements changes, cost estimation etc. The process is repeatable. There are barriers to communicate within the project development team. Interaction with the client is structured but it is only at the inception of the project. Minimal use of computer and computer-based tools observed.

- **Score 3 Characterized**
  The project development process is well characterized and reasonably well understood. A series of organizational and the process improvements have been implemented. Teams may struggle and fall apart as conflicts are addressed but a team begins to respect individual differences. Most individuals are well aware of client’s requirements but client is not involved in the process. Moderate use of proven technology for increasing group effectiveness observed.
- **Score 4 Managed**
  The project development process is not only characterized and understood but is also quantified, measured, and reasonably well controlled. Tools are used to control and manage the process. The uncertainty concerning the process outcome is reduced. Work is accomplished by the project development team and conflicts are addressed. Client is involved throughout the process. Appropriate utilization of available technology and computer-based tools observed.

- **Score 5 Optimizing**
  A high degree of control is used over the project development process and there is a major focus on significantly and continually improving development operations. Team performance is regularly measured, and performance measures are continuously validated. Client is a part of project development team from inception and all project decisions are prioritized based on client’s needs. Optimal utilization of appropriate plant and technology & technology-mediated group work is observed.
BEACON Questionnaire and Participant Details

Questionnaire

1. Management systems
   - Strategy of delaying HAZOP is adopted after considering its impact on whole planning?
   - Project baseline schedule was realistic?

2. Process focus
   - Project has implemented lessons learning from past?
   - Project is moving in right direction?

3. Organizational framework
   - Adequate organizational support is offered to resolve conflicts within the teams?
   - Project execution framework focuses on improving team performance?

4. Strategy deployment
   - Client involvement is increasing as the project is in progress?
   - Client involvement is beneficial for the project execution?
   - Teams involve few dedicated members to identify and prevent future problems?

5. Agility
   - EPC planning is flexible to accommodate changes and rework caused by concurrency?
6. **Team formation and development**
   - Intensity of interactions in team is increasing with the progress of project?

7. **Team leadership and management**
   - Leads are taking the responsibility to accomplish tasks in keeping with schedule?

8. **Discipline**
   - All team members abide by the rules and regulations of the project organization?
   - Team is working more efficiently as the project is making progress?

9. **Teams in an organization**
   - Team bonding is enhanced during EPC phase?
   - Work life balance is affected by the current execution strategy?
   - Work load is equally distributed in a team?
   - It is easy for teams to communicate and share information with each other?
   - Feedback is provided on the performance of an individual in team?
   - Recognition programme is fit for purpose?

10. **Client focus**
    - Prioritization of all project decisions is based on client’s requirements?
    - Client requirements are met in a more effective manner as the project is making progress?

11. **Quality assurance**
    - Commitment to quality is affected by the current execution strategy and schedule changes in EPC?

12. **Facility design**
    - Project organization accounted changes and rework in the initial schedule?

13. **Communication support**
    - Communication in the team is transparent?
    - Necessary support is available for communication purpose in team?

14. **Co-ordination support**
    - The project workflow management is improved with time since the EPC beginning?

15. **Information sharing**
    - Common platform is available for information sharing of the project?
    - Inter disciplinary information sharing is intensified by the concurrency?
16. **Integration support**

- Integration between various disciplines is improved with time?
- Key interfaces in project are defined from start of EPC baseline?
- Changing schedule in EPC phase is affecting the progress of site team?

17. **Task support**

- Task force is provided with advanced tools and computer systems required?

**Details of the Survey / Interview Participants**

<table>
<thead>
<tr>
<th>Number</th>
<th>Discipline of the Interviewee</th>
<th>Position</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Process engineering</td>
<td>Process Engineering Manager</td>
</tr>
<tr>
<td>2</td>
<td>Electrical and Instrumentation</td>
<td>Instrument Lead Engineer</td>
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<tr>
<td>3</td>
<td>Project Controls and Planning</td>
<td>Project Controls Manager</td>
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<tr>
<td>4</td>
<td>Civil, Structure and Architecture</td>
<td>CSA Area Lead</td>
</tr>
<tr>
<td>5</td>
<td>Construction</td>
<td>Interface/SBET Manager</td>
</tr>
<tr>
<td>6</td>
<td>Project Management</td>
<td>Deputy Project Manager</td>
</tr>
<tr>
<td>7</td>
<td>Engineering Management</td>
<td>Project Engineering Manager</td>
</tr>
<tr>
<td>8</td>
<td>Engineering Management</td>
<td>Engineering Manager</td>
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<tr>
<td>9</td>
<td>Civil, Structure and Architecture</td>
<td>Lead Engineer</td>
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<td>Project Controls and Planning</td>
<td>Senior Project Controls Specialist</td>
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<td>Material Control</td>
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<td>Piping</td>
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<td>Mechanical</td>
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<td>19</td>
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<td>21</td>
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<td>Engineering Manager</td>
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**Participant Selection Process**

4 essential qualities of participant: Adler and Ziglio mentioned in their article that there are essentially four qualities that define a participant’s selection for survey or interview. In this research, these guidelines proved to be helpful for filtering out the final 21 candidates out of the taskforce (Adler & Ziglio, 1996)

- Knowledge and experience with issues under consideration
• Capacity and willingness to participate
• Sufficient time to participate
• Effective communication skills

**Sample Size Explanation**

According to Dalkey, the rate of error decreases as the number of participants increases. On an average, fifteen to seventeen participants are statistically optimum with average error of only 0.5 and the graph below explains the variation (Dalkey, Brown, & Cochran, 1969). This research incorporated 21 participants which satisfies the standard need for analysis.

![Effect of Group Size](image)

**Figure C-1**: Effect of Group Size (Dalkey et al., 1969)

Another reason to have more than fifteen participants is to expand the scope of data collection and diversity with different perspectives. This will help in suitable representation of the research analysis.
### BEACON Model Survey

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<th>Questions</th>
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<th>Aspects</th>
<th>Score</th>
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<td>5</td>
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<td>1</td>
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<td>3</td>
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<td>Teams involve few dedicated members to identify and prevent future problems?</td>
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<td>Work load is equally distributed in a team?</td>
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<td>It is easy for teams to communicate and share information with each other?</td>
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<td>Teams in an organization</td>
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<td>Feedback is provided on the performance of an individual team?</td>
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<td>A recognition programme is fit for purpose?</td>
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<td>Prioritization of all project decisions is based on client's requirements?</td>
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<td>Commitment to quality is affected by the current execution strategy and schedule changes in EPC?</td>
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<td>4</td>
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<td>Facility design</td>
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<td>Communication in the team is transparent?</td>
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<td>3</td>
<td>7</td>
<td>9</td>
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<td>Communication support</td>
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<tr>
<td>Necessary support is available for communication purpose in team?</td>
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<td>2</td>
<td>11</td>
<td>6</td>
<td>1</td>
<td>3.30</td>
<td>C.ordination support</td>
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<tr>
<td>The project workflow management is improved with time since the EPC beginning?</td>
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<td>1</td>
<td>11</td>
<td>8</td>
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<td>6</td>
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<td>Integration between various disciplines is improved with time?</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>11</td>
<td>0</td>
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<tr>
<td>Key interfaces in projects are defined from start of EPC baseline?</td>
<td>0</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>3.10</td>
<td></td>
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<tr>
<td>Changing schedule in EPC phase is affecting the progress of site teams?</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>9</td>
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<td>3.30</td>
<td>Task support</td>
<td>3.30</td>
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<td>Task force is provided with advanced tools and computer systems required?</td>
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<td>9</td>
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</table>

**Average Score** 3.22

**Standard Deviation** 0.28

**Response Summary**

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<td>238</td>
<td>258</td>
<td>29</td>
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</tbody>
</table>
Figure D-1: Word cloud
Engineering/Procurement

The major activities involved in engineering/procurement phase are as following:

- **Process Flow Diagram**: The PFD (Process Flow Diagram) is a schematic pictorial representation of the basic process flow showing major equipment, piping, and controls necessary to clarify the process, heat, and material balance conditions and control concept. The PFD serves as the basis for other engineering documents and activities including system sketches, layout design, P&ID’s (Piping and Instrumentation Diagrams), data sheets, and line sizing, and also may be used in proposals to potential Clients.

- **P&ID’s (Piping and Instrumentation Diagrams)**: The Piping and Instrumentation Diagram (P&ID) is a schematic representation used to facilitate the design process, convey intent, or construct and communicate information to the Client and all involved disciplines. A P&ID depicts the equipment, instruments, piping, and any miscellaneous items, with corresponding design data of a processing unit, utility system, a utility distribution system, or an off site system serving a processing unit.

- **Plot Plan**: A plot plan is an architecture, engineering, and/or landscape architecture plan drawing which shows the buildings, utility runs, and equipment layout, the position of roads, and other constructions of an existing or proposed project site at a defined scale (Wang, 2015). The plant layout specifies the geographical arrangement of the units, buildings, equipment etc.

- **3D Model Review**: Model reviews, conducted with the Client, are to ensure the design accurately reflects the detailed definition of the project scope of work and design input requirements. They are held at approximately 30, 60, and 90 percent of design completion.
• **Request for Quotation (RFQ):** packages are the initial documents issued to bidders to obtain price quotations for specific equipment or material. The RFQ document is used to obtain price, delivery, commercial terms, and technical information. It serves as instructions to the bidders, identifying technical and commercial requirements, in order for the bidders to prepare and submit quotations for the supply of goods. Proper communication with all individuals involved in the package bidding process is essential in order to prepare and submit the RFQ package for quotation.

**Contract Management**

Department of contract management has the overall responsibility for the contracting assignment on a project. Contract management department execute major responsibilities such as the acquisition (pre-award) and management (post-award) of the contractual aspects of all services required on the project it is important to understand and recognize that the Contract Management organization has to perform the task, whether they are for engineering, procurement, consultants, or construction services. Following are the key activities defined by Fluor management which are to be essentially carried out by contract management:

Key activities (Fluor, 2016a) related to the Contract Management organization and responsibilities are depicted in the flow chart attached.

- **Contracts Planning:** This section consists of activities related to planning the project contracting with procedures involved. This section considers the interfaces occurring during the project with other disciplines and in some cases with external parties.

- **Front-End Activities:** In this section the responsibility of contracts department is to establish contract definitions as well as fix the structure and format of the contracts. One of the most important activities in this phase is to conduct pre-qualifications of contractors in order to float the tender for the project. Contract terms and conditions are also a part of the front end activity to be conducted before hand.

- **Pre-Award Activities:** Pre-award activities include assembling the project bidders list to facilitate further activities such as Request for proposal (RFP) kick-off meeting on the project. RFP preparation and bidding phase comes after the kick-off meeting eventually leading to bid evaluations on technical and financial front to award/recommend the contract to selected bidders. In the end, the letter of intent or award is handed over by the contract management department to the deserved bidder and finishing the pre-award activity.

- **Post-Award Activities:** Once the award is finished, post-award activities are taken care by the contract management department which may continue till the construction phase of the project depending on the changes in contract, change management on the project and the change of scope or any other requirement by client. In this phase mainly schedule management of contracts, status reporting on the awarded contracts, invoice processing as well as claims handling are performed. Towards the end, contractor performance evaluation is carried out by contract management for future reference and project close-out is facilitated.
For the best case EPC execution sequence, major activities from the above are considered depending on the scope and the feasibility. The activities are finalized on the basis of the activity plan proposed by the Fluor contract management section and with the help of expert interviews of contract management department manager and refinery project contract manager. The expert insights were necessary to filter the most important activities from the standard activity plan. Only activities which are significant to the refinery project in general are included in order to maintain the homogeneity of the study. The activities are represented in a sequential manner to be performed in case of best achievable project execution scenario.

Construction

Construction department has the biggest responsibility to realize the design and plan with perfect execution to make the whole planning into a reality. Construction work generally is divided in two part, home office construction and field construction. Home office construction includes the preliminary activities such as preparing the execution plan for construction, preparing site procedures, constructability reviews. The field construction activities are the activities of interest to this research. It starts with site preparation and mobilization. Then temporary construction facilities are set up with equipment, tools and consumables mobilized to the site. The next part is the actual construction including planning and scheduling of materials and costs. The construction work also includes site administration and interface with plant activities.

For the thesis, in the best case execution scenario the activities are considered on the basis of the importance and the high level of occurrence which will influence the execution schedule and project performance on a whole. For the sequential flow chart formation, the activity plan of construction department is used as a basis to create primary list. Then the list is filtered with the help of project procedure manual and refinery project execution plan. The last step was to interview the construction manager and project planner from the refinery project to validate the list and the sequence as well as correct the final errors.

List of Activities

Following pages display the initial list of activities of engineering, contracts and construction department in a refinery project followed by the updated penultimate list before finalizing the list for research.
Process flow diagrams

HAZOP

HAZOP

30% (3D model review)

Plot plan & layout studies

Piping Isometrics (P&)

Equipment list and datasheets

Equipment and plant layout

Equipment MTO

Instrument data sheets and IFC

Piping design drawings

Foundation locations (structure)

Instrument locations (CS)

Power drawings (electrical)

UG piping drawing and MTO

Equipment purchase order

60% (3D model review)

Final piping MTO

E&CS MTO

Structural steel model, drawing and MTO

Electrical cable routing & MTO

90% (3D model review)

Piping Isometrics (P&)

FLC

- equipment list
- instrument index
- cable list
- load list
- concrete drawing
- steel model

Figure E-1: Initial list-Engineering
Figure E-2: Initial list-Contracts
Indirect field cost estimate preparation

Construction work packages creation and/or additional installation work packages (in case of large projects)

Prepare conceptual and detailed turnover plan

Figure E-3: Initial list-Construction
Figure E-4: Penultimate list-Engineering
Bidder Pre-Qualification / Specific RFP Bidders list

RFP package Issue to Bidders

Commercial and Technical Evaluation

Bidding Summary/Recommendation/Negotiations (Incl. Executive Summary)

Award

Figure E-5: Penultimate list-Contracts
Figure E-6: Penultimate list-Construction
Appendix F

Taskforce Satisfaction Survey
Suggestions

1. Alignment among engineering and construction teams is lacking. This should be addressed sooner rather than later.

2. Management needs to put more emphasis on career development.

3. Lead Office visits during milestone meetings can augment the work.

4. I don’t have much activity for this project. I provide support as a needed basis when automation activity is necessary. Appreciate for including me as part of this great team.

5. We should have more practical exposure and approach in doing the regular work. Shall be recognized and the work done shall be accounted.

6. Management needs to put more emphasis on career development.

7. Avoid the blaming culture, if someone in the ND office makes a mistake it is not fair to blame the AMS person for a mistake he has nothing to do with.

8. It is hard to get a formal decision, which holds me back to perform the work.


10. Opportunity to work in site shall be provided.

11. As a site based worker I am increasingly frustrated at the lack of progress in the commencement of works and RAHC project start up in earnest!!

12. Need more to and fro discussion with lead for better flow of work. Too much firefighting work needs to be avoided.

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13. Invest in better communication, infrastructure (IT and alike) and office needs

14. It’s useless to do this surveys as New Delhi office doesn’t give any freedom to write bad feedback

15. Need working internet at site.

16. People / personal development on the project is not of prime importance. Leaders (office, department etc. etc.) are focused on steady stay, NO attention for personal development even though discussed at several occasions. It’s always backs to the individual employee and after discussion the subject for the last 3 years I’m losing my confidence

17. HAZOP resolution needs resources and focus. Low priority items will become high priority changes

18. This is group work not team work

19. More team building activities, get-together involving all disciplines are required

20. It is a very bad habit and bad culture to sit late at office. Many people sit late but doing nothing just to impress his boss

21. It is a great project and good learning so far. My pleasure to be a part of RAHC

22. Faster network/servers. The servers are really compromising the 3D Designing work by making the Tools (like SP3D/SPR) very slow in use. If the network/servers where fast enough it does not take hours to update 1 drawing or to restart the program after it crashes (which it does a lot)