BUSINESS PROCESS ORIENTATION (BPO) - A CASE STUDY OF A CANADIAN FIRM

by

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION

UNIVERSITY OF NORTHERN BRITISH COLUMBIA

October 2013

ABSTRACT

The first part of this project study is to identify all the processes in the engineering procurement and construction (EPC) organization, with a detail view of how all disciplines interrelate to accomplish an objective of producing an engineering deliverable. Most of the activities involved input from various technical and business units of the organization or even third party supplier or vendor which is external to the organization. The process involves lots of activity mapping between related departments through detailed investigation of the relationship between process operations and the locations of resources made available in the organizational structure and hierarchy of the EPC.

The second part of the project was an attempt to identify the root causes of the problems occurred and its impact on project duration and then finding possible solutions to eliminate similar problems in future. The study is based on the data and information retrieved from the projects completed in the past. The study indicated required manpower shortage, lack of required core skills among personnel hired, delayed payments on invoices led to project delays and increased cost of project execution.

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ACKNOWLEGEMENT/DEDICATION

I want to use this opportunity to thank my supervisor Dr Balbinder Deo his superb professional advice and guidance in the research, analysis and completion of this report. Special thanks go to all my committee members for their support, most especially Dr. Ajit Dayanandan who has never gotten tired of me with all my questions. I want also thank Dr Raymond Cox who was always there to resolve any issue encountered all through my program.

I want to thank my family for all the support all through the program. Above all, I want to give God all the glory for seeing me through.

Chapter 1

INTRODUCTION

Companies in the modern world faces multitude of business challenges. Top performance companies take a methodical approach to meet customer demand and production planning of their products and services. The true drivers of performance of companies are related to how companies manage their business processes, capabilities and decision making processes (Constantine et al., 2009). Many companies, such as; Wal Mart, and Dell Computers have harnessed the power of technology to improve their supply chain, "unlock value", and transform their business models (Kanakamadeala et al., 2003).

Supply chain management refers to all operations involved in moving, handling, assembling and final delivery of products to customers. The first challenge that management face in the supply chain management area is to decide which raw material or tasks it should link with an external provider (off shoring configuration). The entire task is to coordinate the internal and external tasks which are often very complex, because it involves lots of collaboration with vendors and their sub suppliers. Most of the vendors have more than 3 sub suppliers supplying different types of components that make up one unit of package or equipment.

The present study uses 'case study' approach and examines how one can re-engineer the business process and unlock value from the supply chain. The case study is based on actual engineering company that conducts its business operations in the area of Engineering Procurement and Construction (EPC). The real name of the company is suppressed to ensure anonymity of information. As the firm is conducting business operations in Engineering

Procurement and Construction area, so for the purpose of identification we name this firm as 'Engineering Procurement and Construction Company' (EPC) in this project.

The Engineering Procurement and Construction (EPC) Company manage industrial projects in oil and gas sector from conception stage to completion stage. The EPC is 100 years old firm in Canada, with major core projects in western Canada with headquarters in United Kingdom. Its present turnover is around $3 billion. The company banks on customer satisfaction with repeat orders as the prime driver of profit and growth. The firm design plants, refineries, mines and is also involved with designing and managing all types of equipment for all projects and this process involves large scale supply chain operation management from planning stage to delivery to construction management. Apart from the above listed services, the EPC also provide services in general project consulting area that involves most of the engineering disciplines. The EPC has grown over the years to become a multinational engineering consulting firm with presence in five continents with employees of over 22,000 worldwide.

The customers of the firm include Husky Energy, Shell Canada, Suncor Energy, Imperial Oil Venture Resource Ltd., Nexen etc. The company works on turn-key type projects for oil companies and executes projects on time and also under budget. The company builds long term relationships with its customers and this long term relationship helps EPC to reduce the cost of projects and also improve its expertise on the projects undertaken. Most of the projects undertaken by the firm have multiple production cycles and span over time frame of 3 to 7 years.

The knowledge, practical skills and experience gained at each phase of the project helps the company to improve its process by reviewing the lessons learned from the previous phase of the project and this is one of the major reasons why the oil and gas firms depend on EPC for all their capital projects. However, EPC faces a considerable share of its challenges as well. For example, there is a wide range of problems occurring at the EPC related to the long lead time for approval of engineering documents, and for the completion of manufacturing, and these kind of problems extends the project / process time as well as product/ service delivery cycle time. Generally, the standard time for the vendors to start manufacturing is 8 weeks after the purchase order has been issued to the vendor, but it varies sometimes from case to case based on the complexity of the project or equipment. For example, different equipment has different engineering documents and drawings and different lead times. The initial drawings come from the vendor and it takes approximately two weeks for the EPC engineers to review it with corrections and then code it.

Generally, the vendor commences fabrication only when the EPC engineer's code authorizes the vendor to start manufacturing. In addition, sometime lot many changes happen in scope, or modification of specs when the drawings have already gone to advanced stage of approval. High turnover of engineering professionals in some engineering departments add to the overall lead time of the equipment final delivery. Management decision becomes critical when an employee leaves in the middle of any project with a tight deadline with its client and this makes it difficult to predict a reliable delivery date, because it slows the turnaround time of drawings between the EPC and vendors.

The presence of non- value added activities within the delivery cycle, and rework on parts and equipment causes long duration to complete the equipment delivery as well.

Sometimes, the problems are also caused due to the package that an engineer need to modify or increase the capacity of equipment and these problems increase the turnaround duration for drawings. Such problems add to the cost which has to be trended or estimated for approval from clients before actual execution of projects. The problem of long lead time to deliver packages can be resolved or reduced by reviewing all operations or processes within the supply chain to identify the root causes of problems.

This study is based on the common practices followed by an engineering firm involved in design and management of major engineering projects. The process of the organization starts with kick off meeting to review all specs related information with a vendor. These meeting officially start the turnaround time of documents between the EPC and vendors. The vendors will commence manufacturing when the engineering drawing achieves code 2 status. There are lots of activities that are performed between drawings approval and equipment delivery. For example, change of materials by the suppliers of the vendors will require approval from the client, and also deviation of design will require management decision from both the EPC and the client. The existing templates also limit innovation on the part of vendors and the EPC which also add to the current extended duration within internal processes at the EPC. The outcome of these problems is poor change management system, slow decision process and complex information management systems.

Business Process Orientation (BPO)

Business process orientation is a new approach of changing an existing process of an organization or business to increase output or productivity (Chris Barry 2009 Page 725).

Bjlrn Anderson (2007, page 32) also defines business process orientation as logical series of related transactions that converts input to results or output. Business process orientation can be used to redefine the sequence of processes that are dependent on each other and to eliminate or streamline the processes that are not functional.

Business process orientation is a way of altering the current or existing process in organization to increase performance. BPO can be applied to change the current process and make it more efficient. A good functional management environment requires an excellent business process in place to thrive in the ever competitive industrial project market.

BPO can be useful to drive the lean concept to achieve the desired change in a timely manner. Lean could be explained as the process of creating values using fewer resources. Initially, the lean concept was meant for the manufacturing environment, but as the time progressed, it was discovered that lean can be applied to service industry too. The lean philosophy became necessary to drive customer value stream in the process of a production environment for both manufacturing and service industry.

The business process orientation approach centered on the whole organization to measure the effectiveness of all the existing process and identify any bottleneck or where problem exist and design a solution by reconfiguring the business process for better result .Functional process orientation focus on the functional department of an organization. The business process approach takes a holistic approach to look at the big picture of business, while the functional approach looks at the functional process with specific discipline.

Why BPO in EPC?

The major advantage of deploying BPO in engineering organization leads to cost saving and becoming good at what they do, from the design phase to final delivery to construction management team. BPO help in providing guidance to make changes in the current process to eliminate the root causes of problems and simplifying all the communication channels with various departments and disciplines associated with product/service, from design phase to final delivery of packages to construction management team. BPO helps identify the presence of non-value added activities too.

The present study focuses to use business process orientation approach to study the organizational position related structure with reference to the required business for the engineering procurement and construction firm that provides service to its clients. The following are the various defined areas of this study in the EPC organizational process. The listed areas support each other to carry out daily activities and non performance in any one area cascade to the overall poor performance of the entire process.

1 The establishment of project by signing a project charter (Feasibility stage). This is the stage when the project is born at the conceptual stage.

2 Resource acquisition and team building (Transferring employees & Screening/interview). This is the process of recruiting all team members for the project (Human resource planning function).

3 Establishment of Draft schedule (Identify duplicate scope/modified scope). This is the process of classifying the project scope.

4 Project evaluation.

5 Project accounting link to milestone (Align project schedule to invoice). The process of verifying deliverable before invoice payment.

6 Project Monitoring and Control (The process of controlling cost and schedule of the project).

7 Change management & design deviation. This is the process of making changes that will affect the final deliverable; the change could result in the increase in cost and lead time.

Applying lean in EPC will eliminate any trouble areas from their internal process and speed up good package delivery rate to the construction management team. BPO can drive the timely change needed by EPC using the lean concept to reorganize the flow of activities between different departments.

The application of BPO helps understand the process complexities and provide guidance to simplify the process to enable the organization to react differently in delivering packages to modyard and site. Modyard is a contractor location where the equipment module is set together with all related equipment material before shipping to site, while site is the final destination of the equipments to be installed. Business process orientation makes it easy for the organization to measure and evaluate performance indicators and work on continuous process improvement. BPO speeds up the management of operations of all internal process and can help make the process more effective to meet customer satisfaction.

Objectives of the Study

- To examine the current business processes followed by the company (EPC) and identify the bottlenecks, slacks and identify areas of improvement/efficiency.

- To understand and list important causes of project delays and suggest changes in the business process of the company (EPC) to deliver end-to-end efficiency.
- To measure possible cost savings from business process changes.

Chapter 2

Literature Review

There are several definitions of Business Process Orientation (BPO) available from past literature but the essence and meanings of all definitions (more or less) remain the same that is to increase efficiency, eliminate waste, increase productivity, streamline complex processes within an organization etc. BPO conceptual framework can be applied to any organization by taking a detailed analysis of flow of activities between all departments or business units to identify and resolve the problem areas. BPO can be helpful to identify the trouble areas in any organization as it focuses on efficient use of resources (input and output) to meet customer requirements (Arshad, Kashif and Mohammad, 2010).

Business process orientation (BPO) is an approach to improve enterprise supply chain that requires change in a whole system. Several concepts have been developed during the last few years relating to business processes, organizations and performance. Michael Porter introduced the concept of interoperability across the value chain as a major issue within firms (Porter 1981 page 576). Michael Porter's (1985, page 17) 'value chain' concept helps to systematically examine all activities and their mechanism of interaction to provide competitive advantage. Edward Deming developed the "Deming Flow Diagram" depicting the connections across the firm from the customer to the supplier as a process that could be measured and improved like any other process (Walton 1986 page 46).

Many studies available in literature are related to supply chain operations in organizations to identify areas where constraints exist within the supply chain from manufacturing stage to final stage of product distribution to customers. The applications of BPO to solve supply chain problems are mostly available in the production and manufacturing

environment. However, some of the studies available in literature also included service industries, such as the retail industries.

Business process orientation emphasizes delivering value to customers by streamlining and accelerating work patterns (Schutta, 2006; McCormack and Johnson, 2001; Davenport, 1993 page 2). It involves eliminating all the non value activities from the entire value chain of the organization to increase efficiency. The general goal of BPO is to make organizations identify the problem spots and introduce efficiency within its internal process to increase productivity. As per Kevin McCormack and Bill Johnson (2001 page 33-37) BPO is not a new strategy. It is an emphasis on process as opposed to hierarchies of organizational structures with special emphasis on outcome particularly customer satisfaction. It is a tool used to eliminate inefficiency or constraints in an organization. It is used to map all the functional structure of an organization to identify the problem areas that is not contributing to the overall value chain and thus resolving those problems to make its activities more efficient.

Business process orientation is a good business enabler and excellent tool for-business process changes on a regular basis to get the best performance. It has been noticed that companies with strong measures of BPO showed better overall business performance (Kevin 2001, page 51). The idea of the business process orientation is gaining momentum and a constant process improvement is now becoming a mandatory requirement for managerial performance as well (Levi, 2002 page 95). Levi's concept simply states that no organization can survive without constantly looking at its business processes if management actually wants organizations to be competitive. In other words, in conformity with new business philosophy, the organization should be designed to provide both vertical and horizontal information flow as necessary to accomplish the organization's overall goals (Daft, 2001 page 36).

Thomas Davenport and James Short (1990 page 79) described a process orientation within an organization as a key component in the "New Industrial Engineering" area. BPO is a core component for re-engineering and changing and improving complex processes to eliminate problems.

As per Hammer (2002) implementation of business process orientation should also be within a specific time frame to see better results (Michael Hammer 2002 page 1). The duration of implementation of BPO should be planned to measure real impact on productivity. However, it may take longer time to complete the implementation in large organization and short time duration to implement in small organization. A Reengineering effort is a term used by Dr. Hammer to describe the development of a customer focused, strategic business process based organization enabled as a strategy to overcome the problem of cross-functional activities that present major performance issues in firms that involve many disciplines.

Kevin (2005 page 42) states that BPO works better in horizontal organizations because it gets at the core of activities and corporate mindsets. BPO help map out all the related activities within all the departments and identify all the problem areas. The BPO as process tool can easily be implemented in horizontal layers of organizations, because most business activities are interrelated with different business or functional units both at the operational level and at the tactical level.

So far, Business Process Orientation isn't recognized as an independent discipline, it rather represents a generic concept of numerous management philosophies which use process perspective to improve business performance (Lindfors, 2003 page 95). This "new way of

thinking" or "viewing" the organization has been generally described as business process orientation or BPO (McCormack and Johnson, 2001 page 172).

Although in literature there are many definitions of the business process orientation but the McCormack's and Johnson's (2001 page 172) definition of process orientation appears to be more appropriate as it centered more on business process improvement. However, business process orientation should be distinguished from a process-based organizational structure concept that represents the understanding of the business flow, and that is only the first step toward improvement

Some findings also indicate that major way to develop a competitive advantage in value chain as described by Porter (1999) as managing linkages (Kevin, William, 2000, page 18), and the linkages are basically the relationship network of all value activities that shows the flow diagram of all the activities and the durations it take to complete each task and how all the activities connect with each other.

Keeping logistics costs down is the hallmark of retailers, such as Wal-Mart, and they prosper on their ability to keep prices low (Mckinsey quarterly 1996 number 2). Other industries such as retail industry also perform large logistics operation that interconnect many vendors to warehouses using robust inventory application to control and manage movement of goods in real time to achieve the objective of timely delivery. Although business process orientation has been around for some time now, but, a few studies talked about process re-engineering in technical organization to gain productivity.

It has become imperative to note that business process orientation (BPO) can result in a key competitive advantage in the supply chain in new economy (Kevin McCormack & Bill

Johnson, 2001 page 33-37) because it help improve the performance of firm by reducing the turnaround time and cost of activities by creating visible value.

Business process orientation can also be applied to improve the performance of an EPC firm by identifying all the processes within the EPC and by eliminating or simplifying the troubled areas that has issues. Resolving the trouble spots within the process can help improve the process and productivity of the entire organization.

The application of business process orientation analysis to review the entire EPC firm, from design phase of its products and services, including all activities to final delivery of deliverables to contractors involves a holistic look at all the functional areas of its operations. Such approach can easily identify the problem areas in the process. Although fixing a problem might take some considerable time, but application of BPO may resolve the large set of problems and may also help simplify the organizational processes.

The application of business process orientation to EPC can be effective if emphasis is placed on the detailed analysis of process within the technical segment and within the functional side of all related activities from design phase to final phase of equipment delivery. It may also be helpful in reducing the cost of managing packages with a great cost savings to the client, reducing or shortening the turnaround time of activities, adding value to internal processes. It can make the entire supply chain efficient by improving the performance of all disciplines involved with daily operations of the EPC.

Chapter 3

DATA BASE AND METHODOLOGY

This section discusses database and methodology used to identify the inefficiencies in engineering procurement and construction (EPC), Calgary, Canada. The focus of this study is to identify the input-output processes of engineering procurement and contracting (EPC) firm located in Calgary, Alberta. The entire supply-chain of the EPC firm has input-output processes that capture the dynamics of current process. In the analysis of the input and output process, effort is made to identify the current inefficiencies, bottlenecks etc and suggest an alternative efficient business processes.

This study uses both quantitative and qualitative data available for one year delivery cycle of packages or equipments. The data flow diagram (DFD) is used to study the current process and identify the inefficiencies which have affected the bottom line of the organization. The DFD approach was used to measure and capture all details of delays with related impact of all information, which depict the interdependence of all related activities. The applications of data flow diagram exposed all activities with related transactional information and easily identify the problem areas. The analysis of the process provides clear information on the current inefficiencies and actions required to improve the process.

The data required for the study is collected from the EPC current operations, and it includes the information about the vendors. The methodological framework of business process orientation (BPO) is used to identify weakness or inefficiencies in the current process and suggest alternative to improve the current processes. All the data was collected from the EPC project database system and analyzed using the data flow approach to capture information

while considering all various drivers that cause the changes. Historical information of past projects was used in the analysis to identify all the changing variables.

Several approaches such as quality management, continuous process improvement and business process reengineering have been proposed to the case of business process orientation (BPO). One of these approaches is business process management (BPM) which is structured, analytical, cross-functional and is useful for continuous improvement of processes. Its emphasis is on processes as opposed to hierarchies in all areas with special focus on outcome and customer satisfaction.

The data used in this study is based on the critical information that drives the changes in all variables such as

- Various flows of packages from the responsible engineering discipline from January 2012 to December, 2012.
- Duration it takes to complete the manufacturing of the required packages from design phase to delivery.
- Time duration in terms of man hours for operations which is mostly dependent on the number of changes that occur during design, drawing and general calculations of data sheet. All the changes that occur are termed modification factors.

Chapter 4

4. ANALYSIS

The EPC have completed 8 projects in the last five years and 5 projects are in the process that will span over 4 years. The 8 projects completed by the EPC are briefly described in the following section.

Design and construction of open pit mine (Oil sand) - Two projects completed

The EPC designed 2 different types of open pit mines in the oil sand sector and also managed the construction deliverables from the beginning to the end of the project. The 2 projects are located in Fort McMurray Alberta with 38634 & 37172 (table 4.1 &4.2) man hours of work completed in construction, procurement and project execution. Open pit mine project have a basic concept that does not have complex issues to troubleshoot and manage turnaround maintenances like other oil field projects.

Each project is divided into stages and each stage is completed through the completion of distinct activities. The open pit project completed in 8 stages and each stage has its own distinct activities and each activity took some specific time for its completion. The two projects are shown in both tables below identifying the cost of delays based on one employee. Table 4.1 shows a detail break down of lost of man hour which result in cost impact of a project (open Pit Mine) with much of problem area in the project study stage. Table 4.2 is also another open pit mine project in northern Alberta that was executed after completing the project. In table 4.1, all the man hour indicated is based on one employee among the involved discipline, which means the total man hour expanded by one employee in all the departments. As indicated from the chart, much of the cost is incurred in project study.

Table 4. 1

Project # 1- Oil sand project

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	7200
		2	Feasibility Stage	5040
		3	Approval Stage	720
		4	Project Charter	72
			Total	**13032**
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and Interviewing	216
		6	Engaging new hires	264
		7	Orientation	336
		8	Team building	168
			Total	**1992**
3	Project Draft	1	Identify and Duplicate scope	1944
		2	Identify Modified Scope	2160
		3	Identify Milestone	1440
		4	Complete Draft schedule	2880
			Total	**8424**
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	240
		3	Apply the Estimating technique	2160
		4	Complete Estimating	336
			Total	**5616**
5	Project accounting	1	Align payment system to milestone	432
		2	Align project schedule to invoice	144
		3	Verify milestone	720
		4	Complete payment	384
			Total	**1680**
6	Project control	1	Review the final schedule	720
		2	Map all planning/schedule to cost	792
		3	Interface the complete schedule to cost control	768
		4	Monitor Progress Update	366
			Total	**2646**
7	Change Management	1	Change management Analysis	1800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1800
		4	Close change management	508
			Total	**4612**
8	Closure	1	Control	168
		2	Monitoring	196
		3	Closure & lesson learned	96
		4	Audit	172
			Total	**632**
			Grand Total	**38634**

Table 4.2

Project # 2- Oil sand project

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	7200
		2	Feasibility Stage	5040
		3	Approval Stage	672
		4	Project Charter	72
			Total	12984
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and Interviewing	240
		6	Engaging new hires	192
		7	Orientation	144
		8	Team building	144
			Total	1728
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	1920
		3	Identify Milestone	1440
		4	Complete Draft schedule	2880
			Total	8400
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2160
		4	Complete Estimating	264
			Total	5640
5	Project accounting	1	Align payment system to milestone	336
		2	Align project schedule to invoice	552
		3	Verify milestone	744
		4	Complete payment	288
			Total	1968
6	Project control	1	Review the final schedule	480
		2	Map all planning/schedule to cost	288
		3	Interface the complete schedule to cost control	168
		4	Monitor Progress Update	240
			Total	1176
7	Change Management	1	Change management Analysis	1800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1800
		4	Close change management	504
			Total	4608
8	Closure	1	Control	188
		2	Monitoring	216
		3	Closure & lesson learned	102
		4	Audit	162
			Total	668
			Grand Total	37172

Design and construction of Plant - Oil sand: The EPC design and managed the construction of froth treatment plant for oil sand slurry. The project is located 75 km north of Fort McMurray, Alberta. The total man hours expended on the project was 39124(table 4.3). Design of plant project is typically different from open pit mine project, because of the required skill set and the complex nature of module assembly. The total duration of the project from start to

finish was 21 months. The work chart in terms of stages, activities and man hours required for each activity for design and construction of plant in oil sands sector are shown in Table 4.3

Table 4.3

Project # 3 - Design and Construction of Froth Treatment Plant

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	7200
		2	Feasibility Stage	7200
		3	Approval Stage	720
		4	Project Charter	72
			Total	15192
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and interviewing	336
		6	Engaging new hires	336
		7	Orientation	336
		8	Team building	168
			Total	2184
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	2160
		3	Identify Milestone	1440
		4	Complete Draft schedule	2880
			Total	8640
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2160
		4	Complete Estimating	240
			Total	5616
5	Project accounting	1	Align payment system to milestone	120
		2	Align project schedule to invoice	96
		3	Verify milestone	408
		4	Complete payment	196
			Total	820
6	Project control	1	Review the final schedule	312
		2	Map all planning/schedule to cost	720
		3	Interface the complete schedule to cost control	504
		4	Monitor Progress Update	336
			Total	1872
7	Change Management	1	Change management Analysis	1560
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1800
		4	Close change management	504
			Total	4368
8	Closure	1	Control	144
		2	Monitoring	148
		3	Closure & lesson learned	92
		4	Audit	48
			Total	432
			Grand Total	39124

Design and construction of Steam Assisted Gravity Drainage (SAGD) Infrastructure-Oil sand-2 projects: The 2 steam assisted gravity drainage projects are also located in the Fort McMurray, Alberta. The EPC did the feasibility study, front end engineering design and managed all the deliverables to construction management team. The project expanded approximately to 35756 and 32668 (table 4.4 & 4.5) man hours from start to finish, with duration of 23 and 20 months respectively. The work chart in terms of stages, activities and man hours required for each activity for SAGD projects in oil sands sector are shown in Table 4.4 and Table 4.5

Table 4.4

Project # 4 - Design and Construction of Steam Assisted Gravity Drainage (SAGD)

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	5760
		2	Feasibility Stage	7200
		3	Approval Stage	720
		4	Project Charter	48
			Total	13728
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and Interviewing	144
		6	Engaging new hires	72
		7	Orientation	120
		8	Team building	168
			Total	1512
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	2160
		3	Identify Milestone	1440
		4	Complete Draft schedule	792
			Total	6552
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2160
		4	Complete Estimating	336
			Total	5712
5	Project accounting	1	Align payment system to milestone	408
		2	Align project schedule to invoice	144
		3	Verify milestone	504
		4	Complete payment	336
			Total	1392
6	Project control	1	Review the final schedule	480
		2	Map all planning/schedule to cost	648
		3	Interface the complete schedule to cost control	360
		4	Monitor Progress Update	336
			Total	1824
7	Change Management	1	Change management Analysis	1800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1800
		4	Close change management	504
			Total	4608
8	Closure	1	Control	144
		2	Monitoring	120
		3	Closure & lesson learned	108
		4	Audit	48
			Total	428
			Grand Total	35756

Table 4, 5

Project # 5 - Design and Construction of Steam Assisted Gravity Drainage (SAGD)

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	500
		2	Feasibility Stage	8200
		3	Approval Stage	720
		4	Project Charter	48
			Total	9468
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	418
		3	Transferring Employees	546
		4	Advertising vacant positions	336
		5	Screening and interviewing	144
		6	Engaging new hires	72
		7	Orientation	120
		8	Team building	308
			Total	2112
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	2160
		3	Identify Milestone	2100
		4	Complete Draft schedule	880
			Total	7300
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2160
		4	Complete Estimating	336
			Total	5712
5	Project accounting	1	Align payment system to milestone	408
		2	Align project schedule to invoice	144
		3	Verify milestone	504
		4	Complete payment	336
			Total	1392
6	Project control	1	Review the final schedule	480
		2	Map all planning/schedule to cost	648
		3	Interface the complete schedule to cost control	360
		4	Monitor Progress Update	336
			Total	1824
7	Change Manageme	1	Change management Analysis	3800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1660
		4	Close change management	444
			Total	4408
8	Closure	1	Control	144
		2	Monitoring	128
		3	Closure & lesson learned	108
		4	Audit	72
			Total	452
			Grand Total	32668

Design and construction of Mine-Metals Project – Saskatoon: The design and construction of metal mine in Saskatoon is a project that is located 86 km east of Estevan. The man hours expended in the project was 39800(table 4.6) and the duration it took to complete the project was 18 months. Electrical engineering department was one of the major areas that delayed the delivery of these packages. The work chart in terms of stages, activities and man hours

required for each activity for Design of Metals Mine Projects –Saskatoon is shown in Table 4.

6

Table 4. 6

Project # 6 - Design of Metals Mine Projects –Saskatoon

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	6220
		2	Feasibility Stage	8200
		3	Approval Stage	640
		4	Project Charter	48
			Total	15108
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	388
		3	Transferring Employees	546
		4	Advertising vacant positions	336
		5	Screening and Interviewing	144
		6	Engaging new hires	110
		7	Orientation	120
		8	Team building	308
			Total	2120
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	2160
		3	Identify Milestone	3420
		4	Complete Draft schedule	880
			Total	8620
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2265
		4	Complete Estimating	367
			Total	5848
5	Project accounting	1	Align payment system to milestone	408
		2	Align project schedule to invoice	144
		3	Verify milestone	504
		4	Complete payment	336
				1392
6	Project control	1	Review the final schedule	480
		2	Map all planning/schedule to cost	648
		3	Interface the complete schedule to cost control	370
		4	Monitor Progress Update	386
			Total	1884
7	Change Management	1	Change management Analysis	1800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1660
		4	Close change management	444
				4408
8	Closure	1	Control	144
		2	Monitoring	108
		3	Closure & lesson learned	96
		4	Audit	72
			Total	420
			Grand Total	39800

Design and Construction of Tank Farms-Oil sand: The location of the project was 75 km north of Fort McMurray, Alberta. The project was for construction of storage tank that can hold up approximately 150,000 liters of bitumen slurry before transporting to the upgrader in Edmonton. The man hour expanded on the project was 30884(table 4.7) from start to finish and the project duration was 21 months. The project management department delayed the decision of either proceeding with the project or not. The work chart in terms of man hours for Design and Construction of Tank Farms in oil sands sector are shown in table 4. 7

Table 4. 7

Project # 7 - Design and Construction of Tank Farms in oil sands

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	4320
		2	Feasibility Stage	2160
		3	Approval Stage	720
		4	Project Charter	72
			Total	7272
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and interviewing	240
		6	Engaging new hires	216
		7	Orientation	144
		8	Team building	120
			Total	1728
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	1944
		3	Identify Milestone	1440
		4	Complete Draft schedule	2640
			Total	8184
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	336
		3	Apply the Estimating technique	2205
		4	Complete Estimating	367
			Total	5848
5	Project accounting	1	Align payment system to milestone	408
		2	Align project schedule to invoice	144
		3	Verify milestone	334
		4	Complete payment	336
				1222
6	Project control	1	Review the final schedule	480
		2	Map all planning/schedule to cost	648
		3	Interface the complete schedule to cost control	370
		4	Monitor Progress Update	386
			Total	1884
7	Change Management	1	Change management Analysis	1800
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1730
		4	Close change management	444
				4458
8	Closure	1	Control	48
		2	Monitoring	48
		3	Closure & lesson learned	120
		4	Audit	72
			Total	288
			Grand Total	30834

Design and Construction of Froth and heat exchangers-Oil sand: The location of the project was cold lake north eastern Alberta. The project expended total man hours of 10704 and project duration was 13 months. The project involved the design and construction of second train to optimize the performance of the froth treatment plant. Supply chain and document control processes were the causes of late delivery of packages to the client. The firm has also been able to execute one power project- which is mainly the front end engineering design in the united state of America which was supported by the group in Calgary. The front

end of the project design phase expended approximately 32093(table 4.8) man hours. The work chart in terms of man hours for Design of Froth & Exchangers project in oil sands sector are shown in Table 4.8

Table 4.8

Project # 8 - Design of Froth and Exchangers project

Stage #	STAGE NAME	Activity #	Activity Name	Man hours
1	Project study	1	Conceptual stage	5040
		2	Feasibility Stage	2160
		3	Approval Stage	528
		4	Project Charter	72
			Total	7800
2	Project Resourcing	1	Listing the skills required	168
		2	Listing the professionals with the Skills	168
		3	Transferring Employees	336
		4	Advertising vacant positions	336
		5	Screening and Interviewing	192
		6	Engaging new hires	120
		7	Orientation	96
		8	Team building	245
			Total	1661
3	Project Draft	1	Identify and Duplicate scope	2160
		2	Identify Modified Scope	1944
		3	Identify Milestone	1440
		4	Complete Draft schedule	2640
			Total	8184
4	Estimation	1	Identify CWP	2880
		2	Classify deliverable to level 3	936
		3	Apply the Estimating technique	2265
		4	Complete Estimating	327
			Total	5808
5	Project accounting	1	Align payment system to milestone	720
		2	Align project schedule to invoice	552
		3	Verify milestone	528
		4	Complete payment	72
				1872
6	Project control	1	Review the final schedule	720
		2	Map all planning/schedule to cost	672
		3	Interface the complete schedule to cost control	576
		4	Monitor Progress Update	192
			Total	2160
7	Change Management	1	Change management Analysis	1440
		2	Cost Impact Analysis	504
		3	Schedule Impact Analysis	1800
		4	Close change management	504
			Total	4248
8	Closure	1	Control	168
		2	Monitoring	48
		3	Closure & lesson learned	72
		4	Audit	72
			Total	360
			Grand Total	32093

DEPARTMENTS IN THE ORGANIZATION

The EPC has various departments in the organization with most of the daily operational activities closely related in terms of the final deliverable to clients. The organization has four functional departments and these are; project management, supply chain management, project control and accounting departments that service all the core business units, and eight technical departments. The supply chain department works with all the other departments in the organization. The departments that currently exist in the organization are;

Project management: the department manages all the project deliverables (project scope) from the beginning to the end. The department comprises five senior project management staffs and four junior project management assistants that support day to day operations.

Supply chain: the department manages all the supply chain related activities of the project starting with-procurement plan and final delivery of equipment/packages to project execution or construction management team. The department has the largest number of full time employees, which manage all the purchases and material control of all equipments.

Project control: the department manages all the planning and cost of the project from the beginning to the end of the project. The department manages all the estimating, planning, costing and change management related activities of a project.

Accounting: the accounting department manages all the account receivable and payable of a project from the beginning to the end of the project. The department receives all invoices from vendors and performs all verification and reconciliation of actual work performed to milestone payment. The department is responsible for preparing all staffs timesheet on all project cost reporting system.

Mechanical: the mechanical engineering department manages all the activities related to mechanical engineering scope and review/approval of drawings. The department comprises of mechanical engineers and specialist that review and approve all mechanical scope of projects.

Electrical: the electrical engineering department manages all the activities related to electrical engineering scope and review/approval of drawings. The department comprises of electrical engineers and specialists that review and approve all electrical scope of all projects.

Instrumentation: the instrumentation engineering department manages all the activities related_to instrumentation & control engineering scope and review/approval of drawings. The department comprises of instrumentation engineers and instrumentation specialists that review and approve all instrumentation scope of all projects.

Piping and stress: the piping engineering department manages all the activities related to piping engineering scope and review/approval of drawings. The department has over 16 piping engineers and 4 stress engineers that are responsible for managing all piping scope of all projects.

Process: the process engineering department manages all the activities related to process engineering scope and review/approval of drawings. The department manages all process scope of the project with over 14 process engineers and specialists.

Document control: the document control department manages all document and technical drawing transmittals between vendors and engineers. The department interfaces all drawings to engineers and vendors via electronic system.

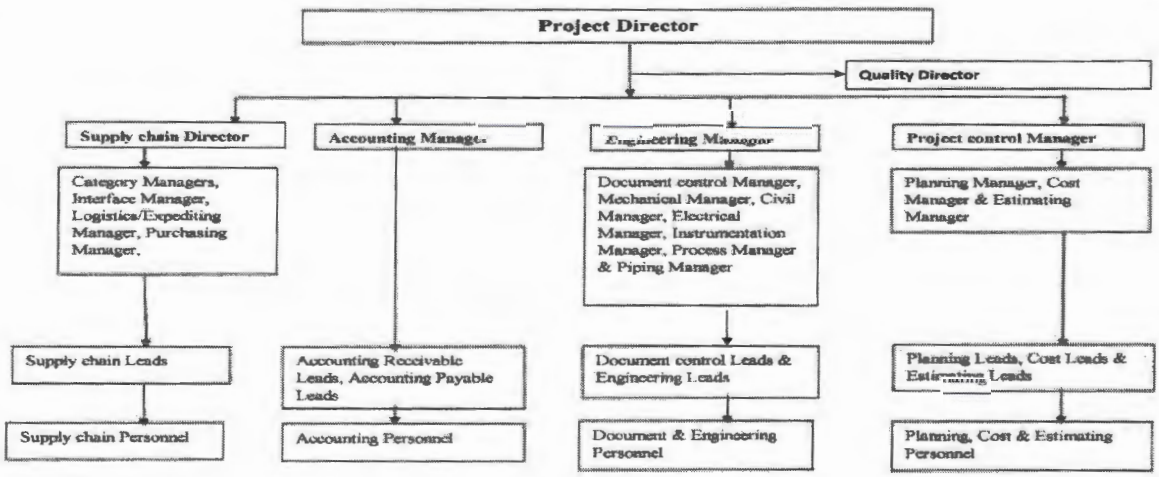
Civil & structure: the civil engineering department manage all the activities related to civil/structure engineering scope and review/approval of drawings. The department manages all structural scope of the project with over 18 engineering personnel.

Engineering design: the engineering design department manages all the activities related to design engineering scope and review/approve report technical report. The department manages all design and technical scope of the entire project using various means to correct all technical issues in the project.

4.2 ORGANIZATION CHART

The project director manages all the project scope with five silo managers .The managers manage their respective department. Some of the department has leads who manage all the employees as a first line manager. All the five managers' shares same level of authority and the leads also have same level of authority (figure 4.1)

Figure 4.1
The EPC Organizational Chart



4.3 The business process for a typical project is presented in the form of figure 4.2

Figure 4.2
Current process at EPC with flowchart of activities

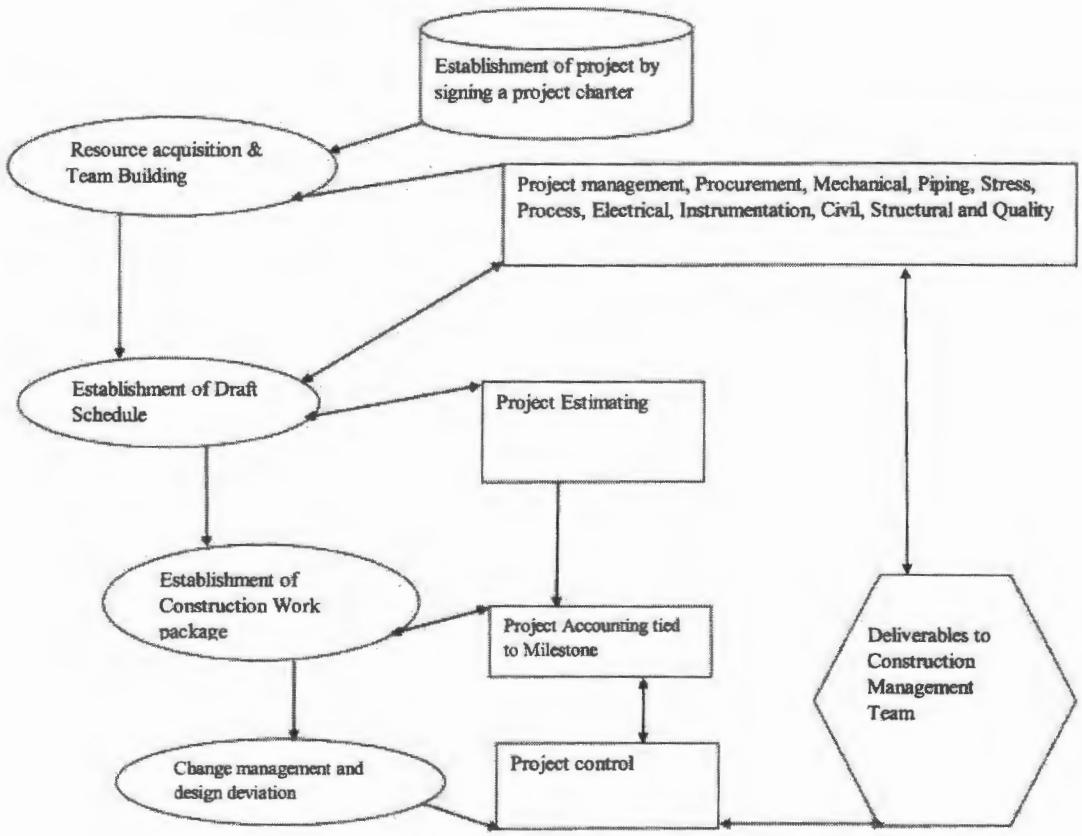


Figure 4.2 depict organization flow diagram of the EPC

Above is the complete activities flow diagram of the EPC and all the trouble silos.

Establishment of project by signing a project Charter

1. Conceptual stage
2. Feasibility Stage
3. Approval Stage
4. Project Charter

There are four activities that produce the project chapter as listed above.

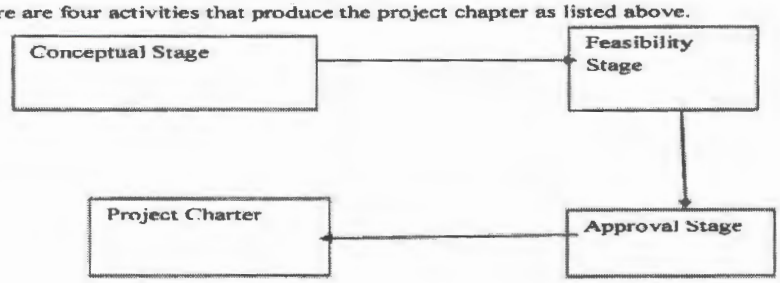
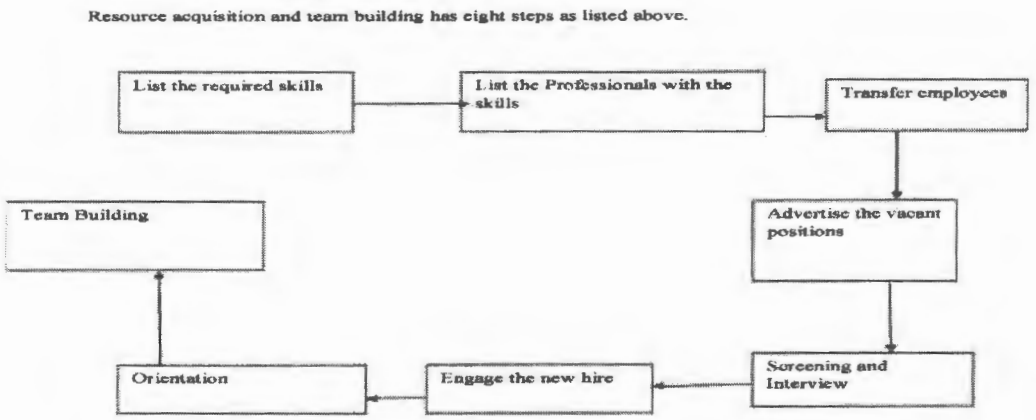


Fig 4.2.1 project management activity diagram

Resource Acquisition & Team building

1. List the skills required
2. List the professionals with the skills
3. Transfer employees
4. Advertise the vacant position
5. Screening and Interview
6. Engage new hire
7. Orientation
8. Team building

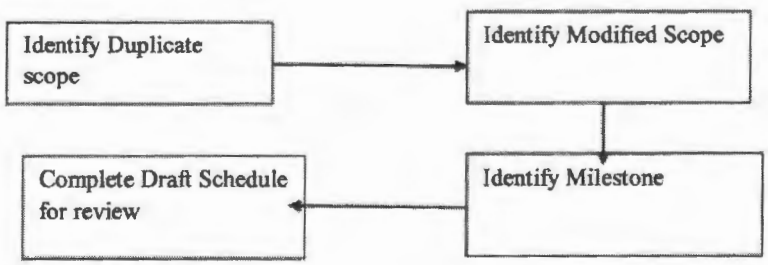
Fig 4.2.2 Resource & team building activity diagram



Establishment of Draft Schedule

1. Identify Duplicate scope
2. Identify Modified Scope
3. Identify Milestone
4. Complete Draft schedule for review

Fig 4.2.3 project scheduling activity diagram

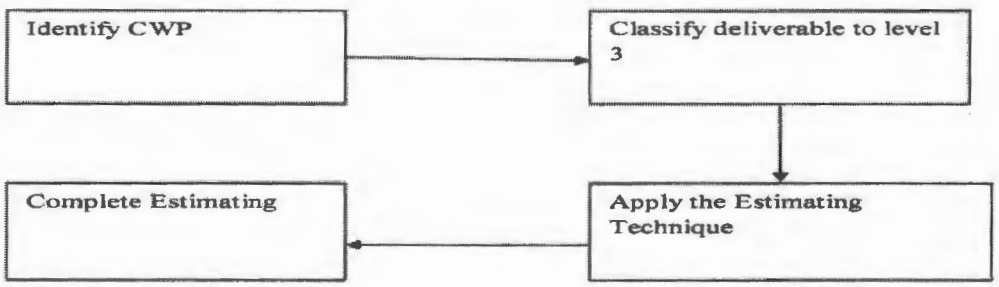


Project Estimating

1. Identify CWP
2. Classify deliverable to level 3
3. Apply the Estimating technique
4. Complete Estimating

Fig 4.2.4 project estimating activity diagram

Project estimating has four stages in the department, identifying the CWP and applications of estimating techniques are the problem areas

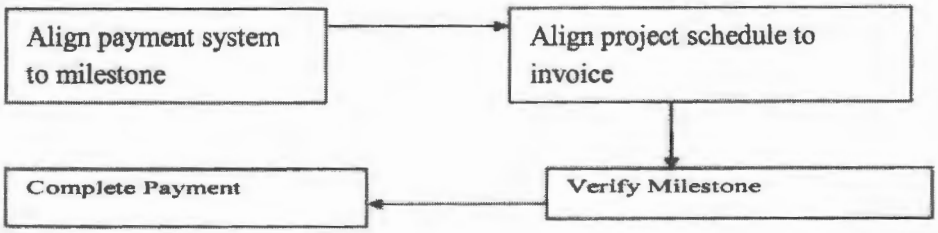


Project Accounting tied to milestone

1. Align payment system to milestone
2. Align project schedule to invoice
3. Verify milestone
4. Complete payment

There are four stages in accounting departmental activities listed above. The areas with problem are alignment of payment system to milestone and invoice milestone verification system.

Fig 4.2.5 project accounting activity diagram

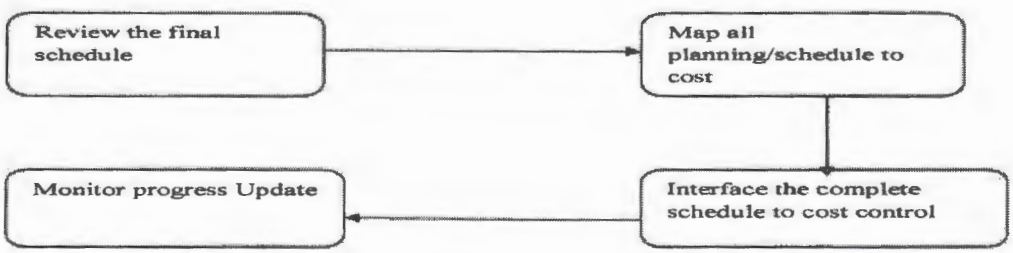


Project Control

1. Review the final schedule
2. Map all planning/schedule to cost
3. Interface the complete schedule to cost control
4. Monitor Progress Update

Project control has four stage processes within the departmental functions. Lots of man hour waste and schedule bust occurs in project control.

Fig 4.2.6 project control activity diagram

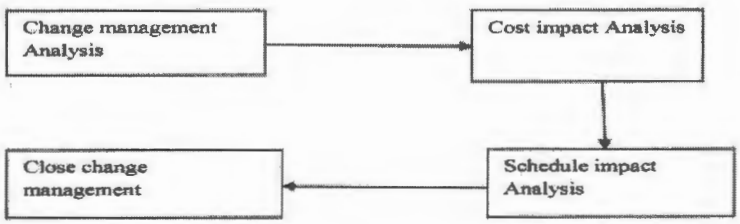


Change Management and design deviation

1. Change management Analysis
2. Cost Impact Analysis
3. Schedule Impact Analysis
4. Close change management

Fig 4.2.7 project change management activity diagram

The change management has four steps as listed above.



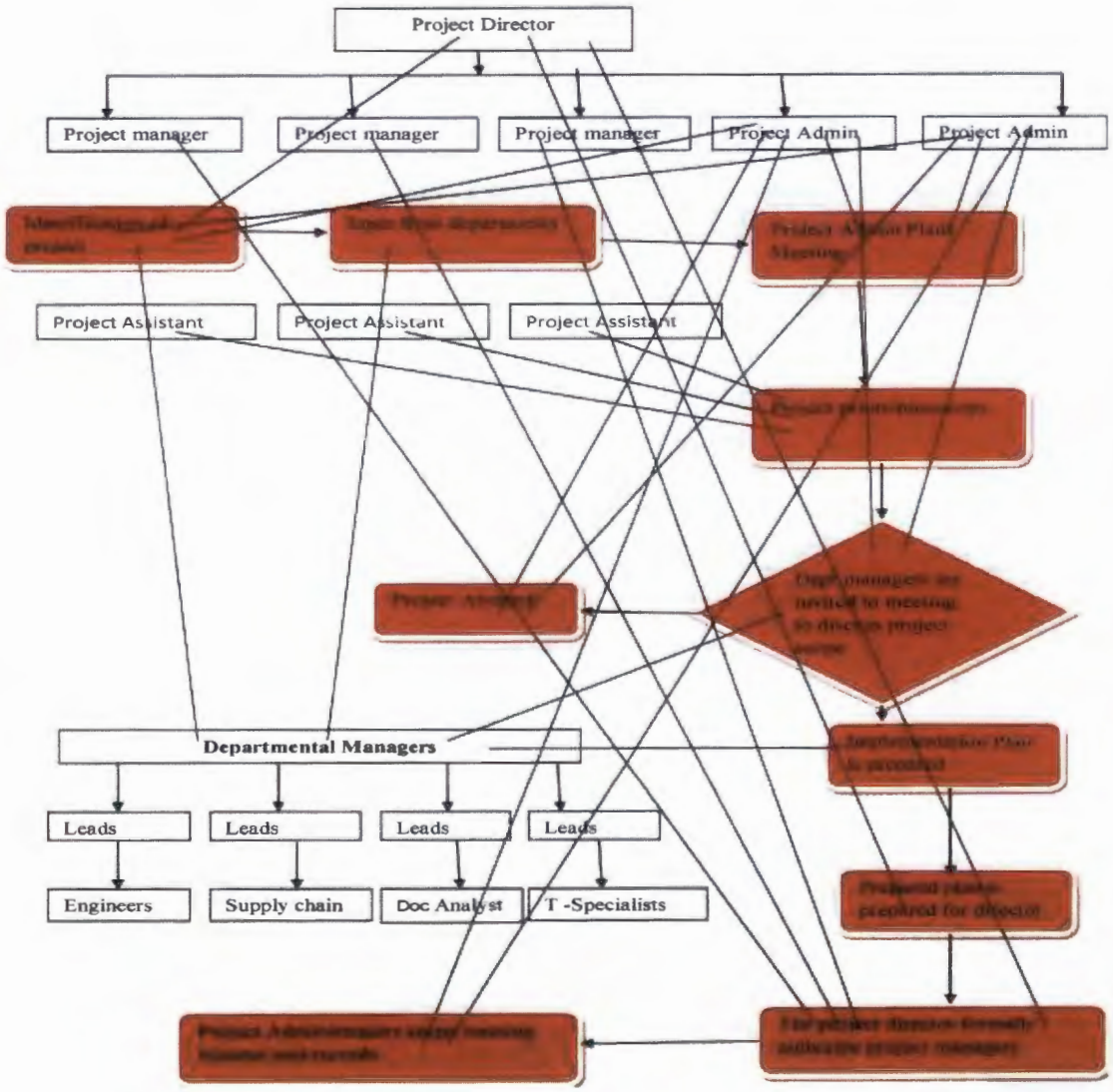
Past Project: The 2 open pit mine project had some challenges with estimating and mile stone verification within the accounting department, because the wrong estimating technique was applied which resulted in delay of developing a clear project budget.

4.4 PROCESS & MANAGEMENT POSITION INTERACTION

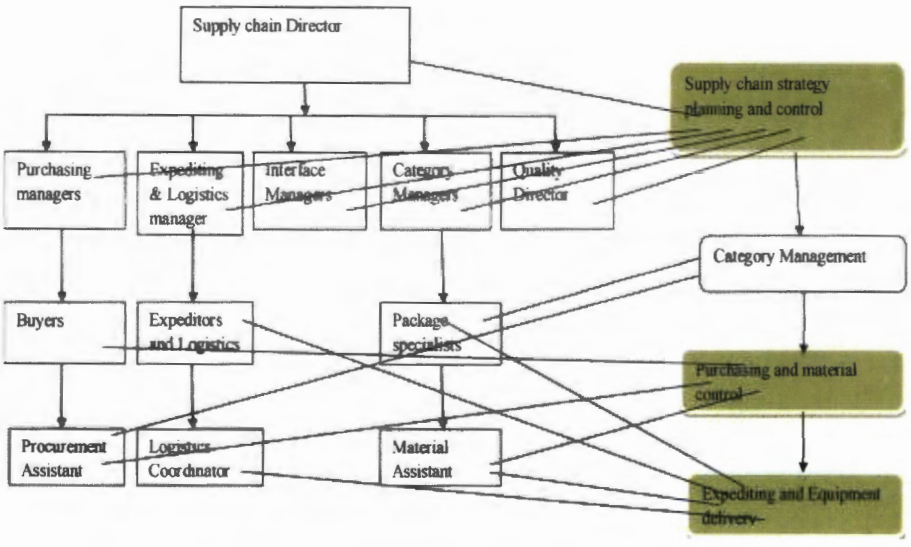
Project Management department: The process in the department starts with **identification of projects** which involve the project director and 2 project administrators. The second step of the process is the request of inputs from respective disciplines / department managers involved in the project. The third step is the planning of the meeting which is coordinated by the 2 project administrators and the fourth step is the preparation of meeting room, photocopy and print job which involves 3 project assistants. The project decision at the meeting should be published as

either rejected or accepted and the stakeholders for this meeting are departmental managers. The departmental managers provide various inputs on the overall project scope based on requirements.

Fig 4.3 Depicting complete work flow diagram

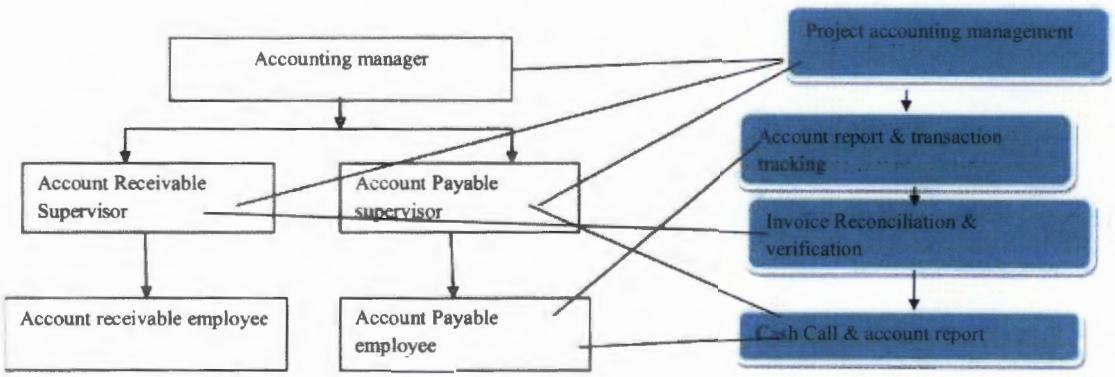


Supply chain management: The supply chain strategy planning and control process step involves the supply chain director and all supply chain principal managers as stakeholders. Category management is the second process that involves package specialists and material assistants. Category management process step starts with classification of all silo and materials to meet the overall project goal. Purchasing and material control is another step where all purchasing of equipment and services occurs. Material control is another major step or activity that occur to track all the individual tags after creating it in the internal system, the discipline involve in the steps or activities of the process are purchasing manager, buyers and material assistants. Expediting and equipment delivery is the last process step in this department before closing the purchase order. The personnel involve with the activities of these process are expediting manager and logistics manager. Fig 4.3.1 Supply chain department disciplines



Project accounting: The accounting management plan is the first step that involve the accounting manager and both the accounting receivable supervisor and payable supervisor.

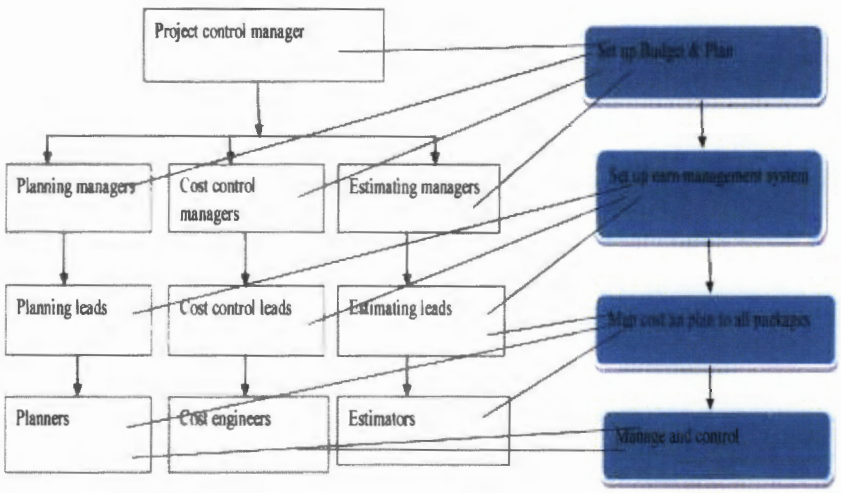
Accounting report and tracking is the second step in the accounting process that involve preparing all the project accounting report weekly for the client, the report give the real state of actual sunk cost. Accounting receivables and payable employees are all involve in the activities of these process. Invoice verification and reconciliation is another process where all the invoice discrepancies are cleared and aligned for signature as per all milestone policies of the project philosophy; accounting receivable employees are responsible for the complete process. Cash call and account report is the last step of the process in accounting department, were by all payment are prepared and paid on a designated day, all accounting payable employees are responsible for all the activities of the process. Fig 4.3.2 Account department disciplines



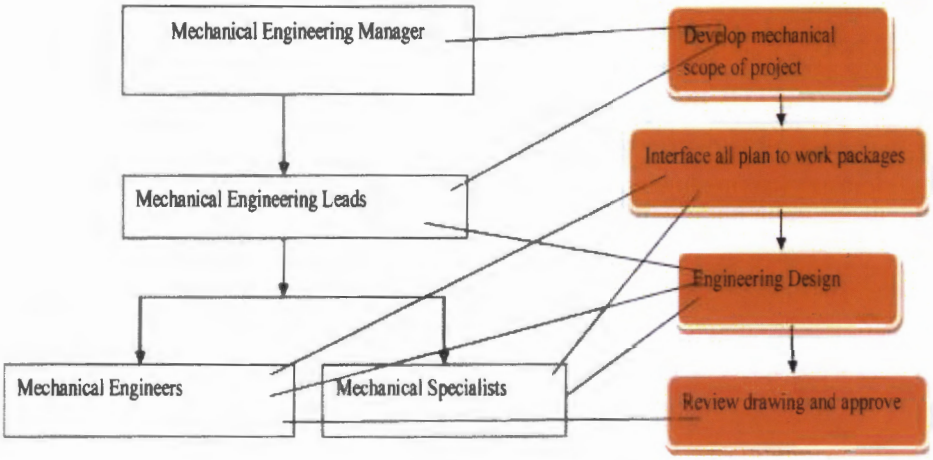
Project control: The process step starts with setting up plan and budget which involves the project control manager, estimating manager, planning manager and cost manager. The second step of this process is setting up the earn value management system to capture the actual amount spent and compare it to plan forecast, all leads are involved in these steps. Project control department reconcile cost and plan to determine the project strategic mile stone. All the

various units in project control are involved with budget and planning control through trending. Trending is a process of adopting all changes related to cost and schedule to revise the project scope.

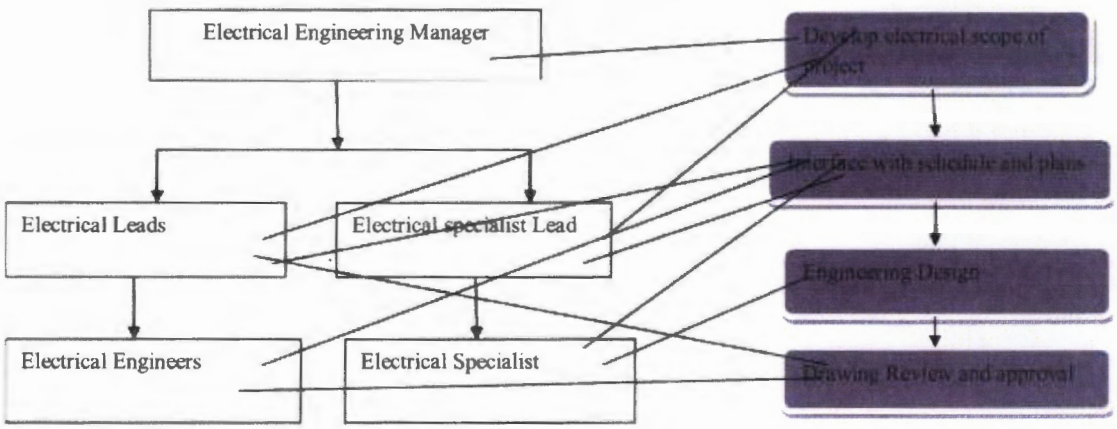
Fig 4.3.3 Project control departmental disciplines



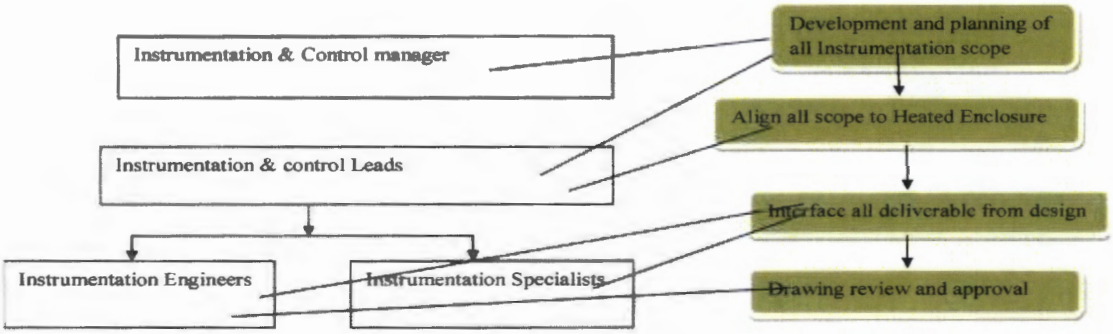
Mechanical engineering: The development of the mechanical scope of the project involves the mechanical engineering manager and team leads. Interfacing all plans with work packages is the second step in this process that involves leads, mechanical engineers and mechanical specialists. Engineering design work on all design aspect of all mechanical engineering which ultimately is based on the project minimum requirements. The package engineers review and approve all drawing before the vendors commence manufacturing. Fig 4.3.4 Mechanical engineering departmental disciplines



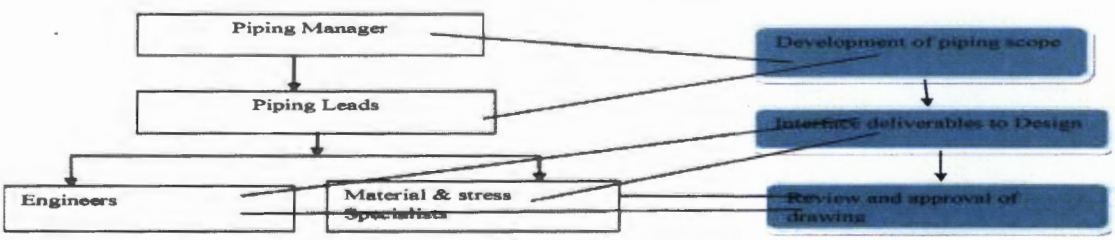
Electrical engineering: The development and plan for electrical scope is the first process step which involves the leads and electrical engineering manager. The interface with schedule and plans of all electrical packages, enable all electrical discipline to interact on a daily bases concerning all electrical engineering deliverables. Engineering design is the step where the electrical specialists provide the design and scope for the project. The last step in this department is the review and approval of drawings before manufacturing commence. Fig 4.3.5 Electrical engineering departmental disciplines



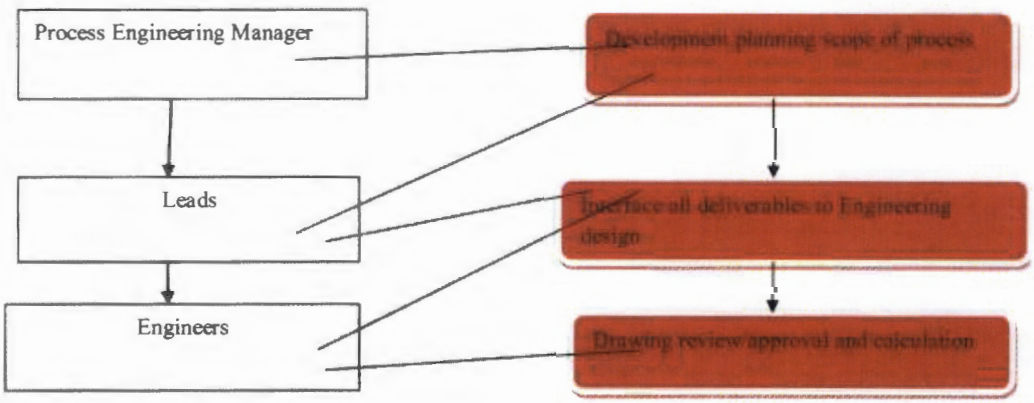
Instrumentation & Control: The development and planning of project instrumentation scope, which the manager and leads provides input for this process. The second step is the aligning of instruments into heated enclosure and all the leads are involved. The next step is interfacing of all deliverables from design which involves both the engineers and specialist. Drawing review and approval is the last step in instrumentation department that involves all the package engineers where all drawings are coded based on the specific requirements before manufacturing starts. Fig 4.3.6 Instrumentation & control departmental disciplines.



Piping engineering: The first step in the process is the development and planning of all piping scope in the project which involves the piping manager and the leads .The second step is the interfacing of all the deliverables with engineering, the stress and piping specialists and engineers collaborate on all standard requirements to benchmark and compare information from similar types of project for the client to make effective decision. The last step is the review and approval of drawings. Fig 4.3.7 Depict Piping engineering departmental disciplines.

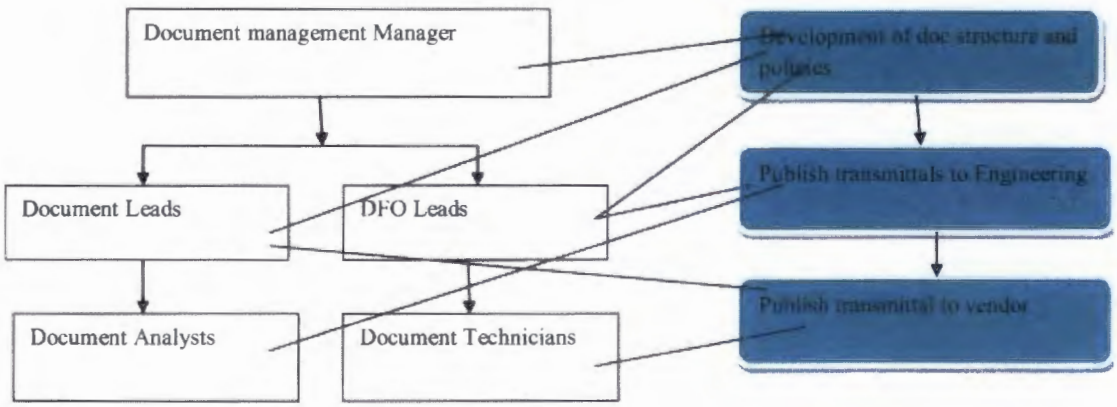


Process engineering: The first step is the development and planning of process scope which involves the process manager leads. All the process scope is usually determined at the first step of the department. The second step is interfacing with engineering deliverables and this involves input from all the engineers and their leads. The last step is the review and approval of drawing after completing all calculations and the engineers are responsible for the last step of the process. Fig 4.3.8 Depict Process engineering departmental disciplines.

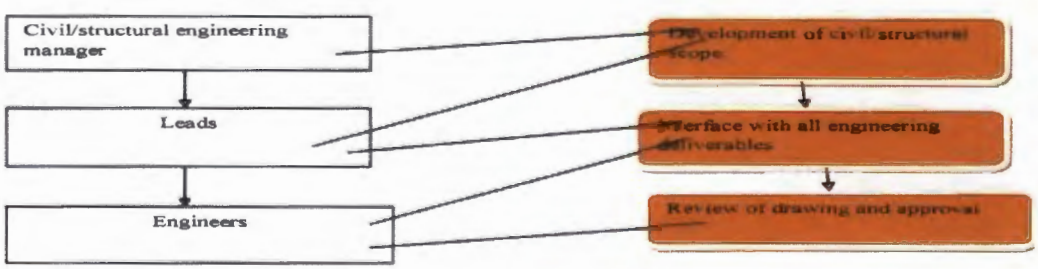


Document management: The first step is the establishment of the document structure and policies which involves the document manager and the leads. The second step is publishing transmittals to engineering group for review, the transmittals are sent through an internal system known as fusion. All the activities in this process are done by document analyst and DFO leads. The last step is publishing of transmittals to vendors. The document leads and

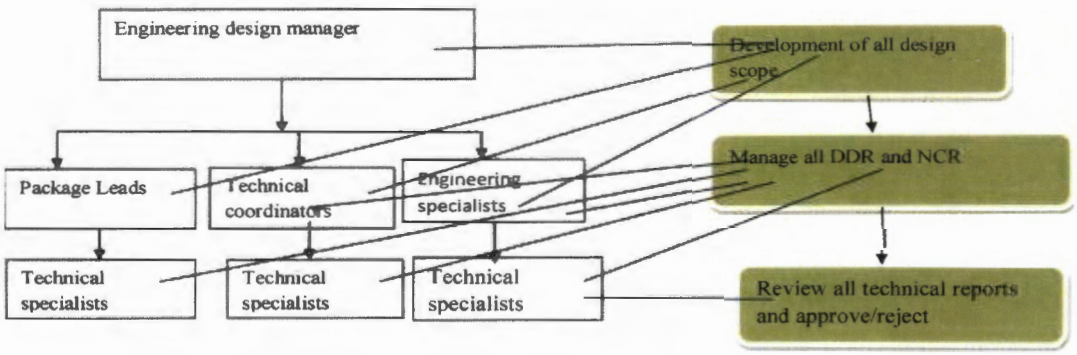
document technician are involved with sending transmittals to vendors. Fig 4.3.9 Depict document control departmental disciplines.



Civil/structural engineering: The first step of the process starts with the development of civil and structural scope of the project, the manager and leads are involved with the planning scope. The second step is interfacing all construction work packages to engineering deliverables and the leads and all the engineers are involved in this process. The last step is the review of drawings and approval and the engineers are primarily responsible for this process step. Fig 4.3.10 Depict civil engineering disciplines.



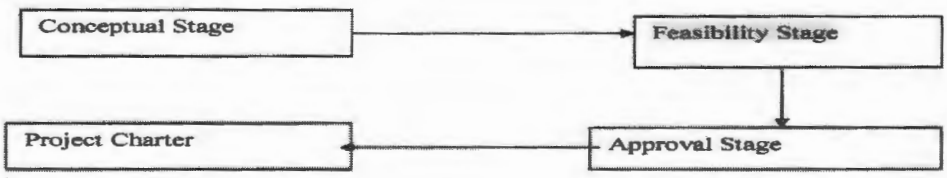
Design engineering: the first step in the process is development of all design scope of the project which involves the design manager, package leads, technical coordinators and engineering specialists. The second step is managing all deviation design request (DDR) and non-conformance report (NCR). Change in material during manufacturing of equipment result in this type of report. The engineering specialists, technical coordinators and technical specialists are responsible for managing DDR and NCR. The last step is reviewing all the DDR & NCR reports for either approval or rejection. Technical specialists are primary responsible for this process. Fig 4.3.11 Depict design engineering departmental disciplines.

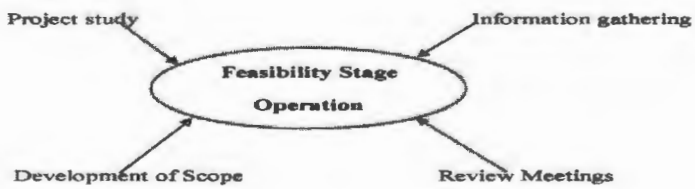


4.5 PROBLEM AREAS OBSERVED IN THE PROCESS

The project management department manages project deliverable and resources. The feasibility study and identification of project scope takes long duration of time because the project manager is not involved on time. The reason he/she was not involved in the feasibility stage was because project manager is not authorize to be part of feasibility process to protect unbiased information or feedback. Input from different departments to project scope also takes time due to the shortage of man power when specific information is required which is generally due to vacation planning problems. The problem is as a result of unplanned vacation planning /schedule in most of the key resource departments and transfer of personnel to other departments.

Fig 4.4 .1 Flow diagram in project management area





1 Long duration of project study without clear time line

2 Slow information gathering due to shortage of manpower

3 Long duration of developing scope of work

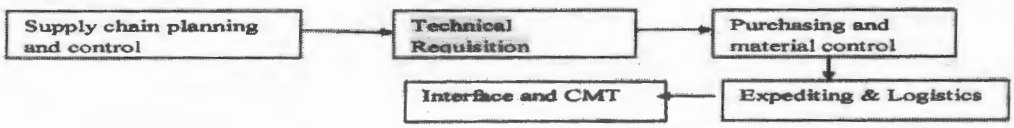
4 Unending regular review meetings

The problem with the establishment of project by signing a project charter is feasibility stage and non commitment of resource to provide input for the project charter, which is due to lack of man power in Calgary labor market. It takes long duration to complete the feasibility study; this issue drives the probability of the project existence to be very low and complex. The success of this type of project depends on how thorough and effective the feasibility was done. The existences of issue like long duration and high turnover among the staff develop into a major constrain and it is part of the labor shortage problem in Canada. 5-6 months duration of feasibility study is one indicator that shows the existence of the problem. High turnover is one area with one major symptom that could be a good indicator that delays project charter mile stone. The development of an effective template, which will capture the complete scope of the feasibility work and eliminate any opportunity of causing a long term problem. Establishing a clear gate phase on all time line can help save 2 months from inception. An excellent check list should be develop listing all required expertise in any feasibility study, which will help the firm have a clear proactive plan in place to deal with any contingencies of resource planning.

The supply chain strategy planning and control scope are developed at these process level which involves all the silo managers. The issue at this stage is the duration it takes to develop the supply chain scope of work. Purchasing and material control process takes longer duration because of late arrival of technical requisition to material assistant. Expediting and equipment delivery pitfall comes from disconnection between construction management team and project execution. The problem can be resolved by reducing the number of interface between

executions and expediting. The singular point of contact between the vendor and the project team should be the expeditor to streamline the flow of communication

Fig 4.4 .2 Flow diagram in supply chain area



1 Long duration of initiating technical note

2 Poor justification of need delay sign off

3 Lack of expediting mechanism to register and sign off

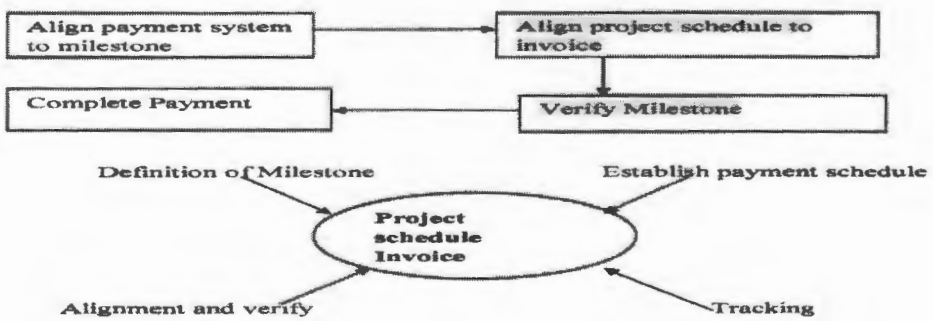
4 Long duration of preparing technical requisition

The problem area is the technical requisition which takes lots of time to prepare technical note for purchasing, because it takes lots of analysis based on criticality of material as specified by project standard. The process takes over 3 months to complete. The root cause of the problem is lack of evidence to justify the requisition.

The problem can be eliminated or reduced by establishing time line for all technical requisition and processing change order even after any changes, it saves over 2 weeks from the current 6 weeks. The process will require reducing the number of meetings to 3 instead of the current countless numbers of meetings and establish a standard check list to capture both complex and simple requisition, which will help speed up the current processes

Account departmental process issue is in the invoice reconciliation and verification. It takes long duration to process invoice which involves input from all responsible discipline which is not specific, these add to the current lead time causing the problem. The process can be streamline by eliminating all non value activities.

Fig 4.4 .3 Flow diagram in account department area



1 long duration it took to define milestone

2 long duration it took to establish payment schedule

3 High rate of turnover of staffs of this department

4 Poor tracking to capture all actual

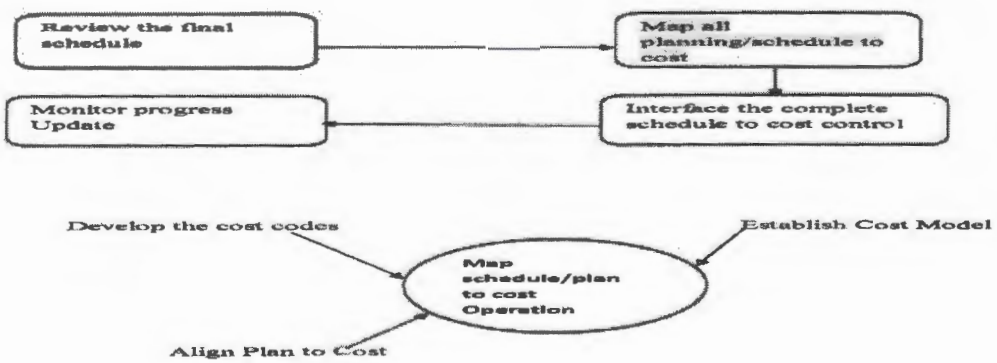
The problem starts with Payment definition without physical verification is a major problem in this stage which makes it difficult to match real payment by actual work performed. The process delay mile stone verification by 3 months which is against the norm of industry

practices. Milestone variance from the actual is a sign or good indicator to the growth of the issue. The gap keeps getting wider from the planned to the actual happening which is making it difficult to capture the milestone to execute payment.

The lack of standardized variables to capture verifiable milestone payments is a major root cause. The solution will be to develop a comprehensive checklist to define the cost accounting or expenses to milestone payment system to be standard 30 days, which can implemented by combining both verify milestone with align project schedule.

The project control departmental process problem is the actual time it takes to set up budget and complete scope of plan. Estimating a good budget is time consuming because of the number of discipline involved, the process can be streamline to be efficient by reducing the duration of providing input by all responsible disciplines that are involved.

Fig 4.4 .4 Flow diagram in project control area



1 Lack of manpower to develop the cost codes

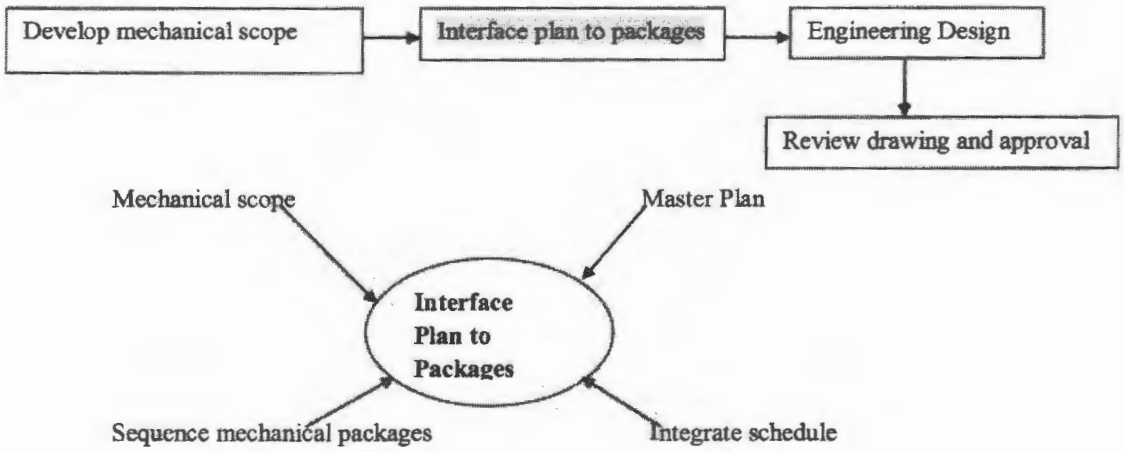
2 Duration it takes to establish the cost model

3 Long duration to align plan and cost

The problem is the long duration it takes to develop all the cost codes and budget. Extension of cost model is one sign that indicate the growth of this problem, it takes an average of 4 months to prepare complete project control dashboard. Wrong forecast and wrong cost impact on all activities is the major root cause in this stage. Link up the cost movement to all planning and manage all segmented scope accruals. Monitor and control of all indicators will help eliminate or reduce all non value activities and justify any change that will drive the schedule and budget. The action will reduce time line to produce budget from the current 4 months to 3 months.

Mechanical engineering departmental process issues is interfacing all plan with work packages The process work along with all silos to identify and sequence all deliverables to meet design specification. The problem of long duration can be reduce by mapping all mechanical scope to the detail plan of the project and then request trend for any change of scope or modification. 70% of the mechanical scope can run parallel and can also be accelerated base on criticality of time.

Fig 4.4 .5 Flow diagram in mechanical engineering area



1 Long duration of establishing the mechanical scope

2 Duration of developing the master plan

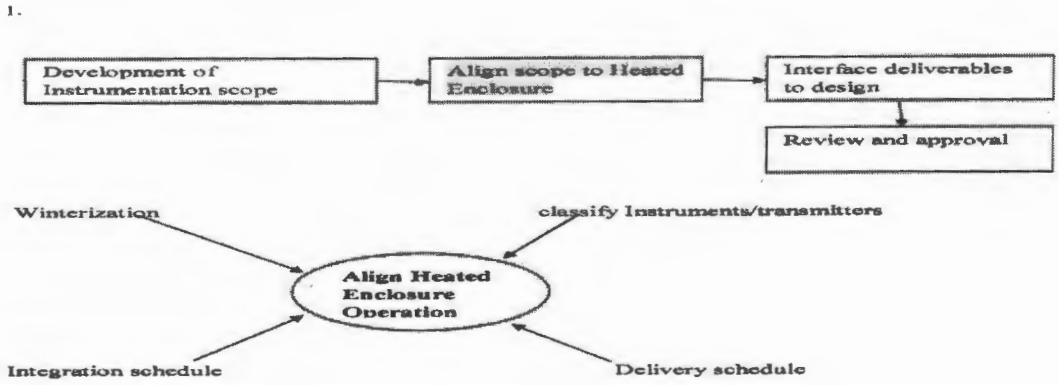
3 Duration it took to sequence all mechanical packages

4 Cost of integrating the schedule which will affect the cost of available man power.

Problem is mechanical engineering scope duration and interface of deliverables to meet master plan schedule. The causes of the problem are high rate of turn over which is due man power shortage in Alberta. Combining scope development with planned interface will reduce the current lead time of 3 months to 2 months.

The instrumentation departmental process problem is aligning all scope to heated enclosure takes long duration, because the complete lead time to align and deliver enclosure after approval drawing is 6 weeks. One of the major issues is dependency on one supplier to supply all the instruments will bump out the delivery schedule, because these will add to the lead time and makes the internal process complex. The problem can be resolved by pre-qualifying more suppliers to provide the instruments.

Fig 4.4 .6 Flow diagram in account department area



1 Expenses associated with all winterization packages

2 Cost and duration of man hour to identify all non heated enclosure instruments

3 Cost of man hour to complete the integration

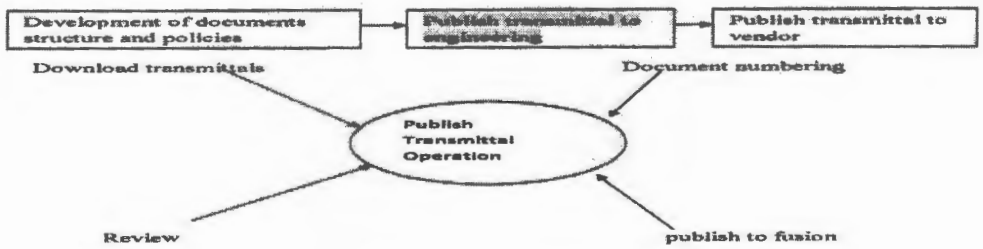
4 Cost of expediting delivery of all transmitters

The Problem in instrumentation is the alignment of instruments to heated enclosures which takes over 6 weeks and impact project execution schedule. The root cause of this problem is duration it takes to identify winterization instruments, which are located in different parts of the world. Cost of man hour is another process that has problem in the operation, because of the cost of instrumentation experts. Establishing a push strategy will eliminating or reduce the problem and also establish a strategic relationship with a sole supplier and streamline the delivery time from the current 6 weeks to 3 weeks.

Document control departmental process issue is publishing of wrong transmittals to engineers which generally increase the lead time of completing document review. The

problem can be resolve by creating a good tracking system to capture all revision from both engineers and suppliers.

Fig 4.4 .8 Flow diagram in account department area



1 Long duration to download and network problem

2 Duplications of document number

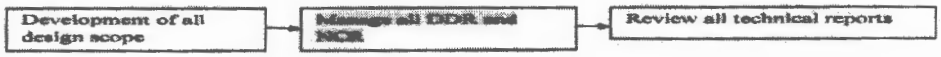
3 Long duration it takes to review all documents

4 Wasted man hour to locate wrong publish documents to fusion

The problem with document control is the time it takes to download transmittals and wrong document numbering. It takes an average of 4 weeks to complete all transmittals of engineering documents. Creating an internal system to track all live transmittals will reduce the current duration to 2 weeks. The tracking system will have the capability of reminding the engineer in an emails when documents arrive collaboration systems.

The engineering design department process issue is managing all DDR (deviation design request) and NCR (Non conformance report). Routing of these reports through all discipline could take 6-8 weeks which impact the final delivery of the packages. The report should identify all involved discipline and route it specifically to discipline that will review and provide signature.

Fig 4.4 .3 Flow diagram in engineering design department area.



1 Longer duration it takes to generate DDR and NCR

2 Wrong registration of discipline with different distribution

3 Delayed processing of information and related expenses with project execution

4 Cost of rejecting DDR and NCR

The problem is the duration it takes to generate ddr and ncr, which is mostly caused by both the vendor and engineer exploring all alternatives to avoid it. The registration of wrong disciplines on the distribution list is another cause of delay. The problem can be reduced or eliminated by establishing applicable template to remove all non related discipline when processing NCR or DDR; the action will reduce the lead time to 2 weeks from the current 5 weeks.

Table 4.9: Details of delays and cost impact based on one departmental employee

#	Name of Stages	Problem	Nature of problem Caused	Delay (Days)	Cost in $
1	**Project management**	Man power Resource?	Long duration of project study	10	12800
		lack of man power	slow information gathering	10	6400
		lack of man power	slow definition of project scope	10	6400
		Late deliveries	Endless long review meetings ,due to transfer of job scope to many hands	10	6400
			Total	40	32000
2	**Supply chain**	Cost over run	Delays in initiating technical note- due to project review from engineering	2	720
		Change of scope	poor justification of needs	2	1440
		Late deliveries	No expediting mechanism for sign off	3	2160
		Late deliveries	Long duration in preparing tech requisition –due to delay in approval from client	3	1080
			Total	10	5400
3	Project accounting	Late Payment	Long duration to define milestone	15	12600
		Late Payment	Delays to develop payment schedule-unclear payment terms in the contracts and lack of performance milestone	10	2800
		cost over run	High rate of staffs turn over	5	2800
		Late Payment	poor tracking system	5	1400
			Total	35	19600
4	project control	scope changes	lack of manpower to develop codes	10	4000
		scope changes	Long duration to develop cost model-due to long scope review to capture all details	5	2000
		cost over run	Long duration to align plan to cost-due to regular scope changes	5	2000
			Total	20	8000
5	Mechanical Engineering	lack of man power	Long duration to develop scope	5	1800
		lack of man power	long duration to develop master plan	5	1400
		Late deliveries	duration to sequence deliverables	5	1800
		Late deliveries	lack of man power to integrate-due to few staffs with such expertise	5	1600
			Total	20	6600
6	Instrumentation	Late deliveries	lack of man power to work	5	2000
		lack of man power	cost of man power	3	2000
		Late deliveries	Delays of integration- due to few staffs with such expertise	5	1000
		Late deliveries	Delays in delivery-due to impact delays from previous activities	2	1000
			Total	15	6000
7	Document control	network overload	Delays in down load	3	528
		lack of man power	Duplication of document numbering	2	352
		lack of man power	delays in reviews	2	352
		Late deliveries	wrong upload to fusion-due to wrong numbering and distribution list	3	1056
			Total	10	2288
8	Change management	Late deliveries	Delays to generate NCR & DDR-due to analysis by the vendor and package engineer	5	2400
		Late deliveries	wrong registration with disciplines-wrong transmittal from the package engineer	3	1200
		Late deliveries	Delays in processing information-due analysis and verification with all involved parties	3	1440
		lack of man power	Delays caused by rejection DDR & NCR-due to late decision	4	960
			Total	15	6000
9	Civil/structural	lack of man power	Late identification of scope	3	0
		Late deliveries	Late review of drawing-due to few staffs/manpower	2	0

The formula used in calculating the cost impact is based on the variables below. All the cost of delays is derived from contract employees who are not permanent staff.

Cost of employee per hour = CE/hr and is based on experience

CE= cost of employee

Number of hours per day = 8.00 hour

Number of delays days = N

Number of employees = NE

Cost of impact =CE*8*N*NE

Take for example:

Number of hours per day = 8hr

Number of employee = 10

Cost of employee of electrical discipline =$65/hour

Cost impact of delays =65*8*10

Cost impact of delays for one working day =$5200

The cost of delays for one day in any of the electrical engineers is =$5200

Project delay occurs in almost all our engineering group, but never cross the deadline provided by the client. The major cost impact is absorbed by the operating revenue of the organization.

Finally, the figures related to delay in terms of days and their cost impacts indicate that the functional structure of the organization is not fully aligned with the business processes that a project goes through. Therefore, functional structure if exactly gets fitted to the business process can help reduce the delays and hence the reduction in the cost impact. Also, availability of the experts within the functional structure having required and needed skills can further reduce the delays in the delivery of services to its clients.

Chapter 5

Conclusions

The research project undertaken related to EPC company indicated that the lack of manpower is the actual root cause of the problems that delayed the completion of project activities in the project management department and its cost impact stood at $32000.00 as shown in table 4.9.

The supply chain department issue was the long duration it took to prepare technical notes, because of the delay in multiple input and justification analysis from all related disciplines. Another major problem was the lack of expediting mechanism to monitor the signing off trails of all engineering request to vendor (tracking system) which makes it difficult to capture all update, this is due to the fact that lots of design change occur after the commencement of manufacturing and all information should be relayed to the supplier in a timely manner. The cost impact identified from delays in supply chain department stood at $5400 as shown in table 4.9.

The project accounting department related problems, stem from high rate of staff turnover due to shortage of manpower and it caused poor tracking system to manage routing of invoice and high cost of retaining employees. The cost impact for these delay stood at $19600 as shown in table 4.9. The project control department issue is found to be due to the lack of specialized skills to develop project codes used to track planning and cost for progress/spends reports. The cost impact identified from delays in project control which stood at $8000 as shown in table 4.9. Both mechanical and instrumentation engineering both resulted in cost impact of $6600 and $6000 as shown in table 4.9. The cost impact for both document control and change management amount to $2288 and $6000 as indicated in table 4.9

The result from the analysis of this study shows that the detailed study of positions in the organization structure and their relationship to the activities performed in the business process has helped to highlight the trouble areas in the entire operation of the organization. All the related activities involved in this study have shown that there is a possibility of reducing the average time of duration for various activities which will ultimately increase the efficiency and productivity in the organization.

Looking at the entire organization and identifying the eight (8) areas with problems give a better mechanism on how to apply business process orientation to reconfigure all positions in the organization structure in relation to the activities being performed in the business process of the EPC to obtain great performance and value.

The reduction in time duration of all the engineering deliverables will reduce the risk of cost build up as indicated in table 4.9. These improvements can actually result in a great dollar savings for the organization, because every time deliverables are delayed, it affect the activity completion date which ultimately affect the coordination of work packages and other deliverables to construction management team and contractors (There is a great cost associated with the delays in activities). Some of these costs arise from labor hours, payment for hired equipments etc, and such cost related numbers are clearly driven by the numbers of contract staff on the project who are paid based on their actual hours worked. The current practices of standard rates on lump sum contracts in the labor market have forced the organization to accept the type of work force which has a unionize structure with long term agreement to establish consistency with regard to service delivery to their client.

The application of the concept of business process orientation was able to identify most of the root causes of the delays that have been witnessed in the organization by identifying the number of delays in terms of days. The approach has made it possible to calculate the cost impact of these delays in days in all the eight problem areas identified.

The reconfiguration of the process –positions relationships in all the trouble areas can help save cost and can make the organizational operations more efficient that can easily be measured in terms of performance. The estimated number of days that could be saved by streamlining the positions to the process or vice versa could be 165 days, and it is pretty big savings in terms of project man hour for a service delivery organization.

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