

CHALMERS



On turnarounds

A service development investigation from a consultancy firm perspective

Master of Science Thesis

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ABSTRACT

The presented problem was an acknowledged business potential for expanding the technical consultancy firm COWI's services towards the process industry cluster on the Swedish west coast. This investigation regards the Swedish turnaround market for oil refineries and petrochemical plants.

The current market situation, in terms of competitors, customers, contractors and own competences, has been analyzed with an emphasis on developing technical consultancy services towards the industry. The papers delimitations are among others geographical (the Swedish west coast), and industry related (turnarounds in other energy industries are not investigated) Three alternatives for future operations are presented and discussed regarding advantages, disadvantages and risks associated to the analyzed market constituents. Methods used include interviews with both refinery managers and COWI personnel, study visits at oil refineries and petrochemical plants, relevant literature studies regarding business risks, competitive advantage and the industry as well as COWI's internal methods for service development.

Keywords: turnaround, process industry, consultancy services, risks, competition

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Introduction

1.1 Project Background

The refining industry is considered to be one of the most complex industries in the world. It is also characterized by very high production volumes and low profit margins. The largest market for oil refining is held by North America and Asia followed by Western Europe. Leading European nations within the refining industry are among others Germany, France and the Netherlands. Major actors in Sweden are; Preem, Shell, Nynäs and within the petrochemical sector Borealis, Perstorp and AkzoNobel.

Since the beginning of the 20th century refining operations has, in order to meet the increasing demand of volume and high quality products (higher octane numbers, higher yields, better antiknock characteristics and better feedstocks for further refining), developed greatly. Modern refining operations involve processes such as fractioning, conversion, treatment, blending and petrochemical processing.

Within a refinery there are several thousand components (pipes, heat exchangers, bolts, catalysts, pump sealings, towers etc) that are subjects for different types of maintenance, both preventive and corrective but also scheduled. Demands from authorities (Arbetsmiljöverket, PED regulations), insurance companies as well as the nature of the operations forces refineries and petrochemical industries to unconditionally shut down their plant for revision, inspection and scheduled maintenance. This is typically done between every fourth to sixth year.

The planning procedures for these types of turnarounds are extensive and are commonly handled by a permanent staff force of the refinery which can be complemented by external consultants. The refinery bears the total responsibility for the turnaround but most work is performed by the hired specialized subcontractors.

The competence, experience and manpower for the maintenance work such as tube bundle extraction and cleaning, bolt tensioning, catalyst regeneration and mobile machining to mention some, are often limited to a few companies in Europe. The duration of the turnarounds are typically confined to 4-6 weeks. In order to succeed, given the time restraints, the turnarounds need to be accurately planned and coordinated by the plant owner and the entrepreneurs.

Given the facts above, COWI has recognized a possible potential for expanding their service portfolio to offer turn-around services with a corresponding total responsibility for the services performed prior, during and after the shut downs of oil refineries and petrochemical industries. This service would come as a useful complement to their already well established project management branch within this and other industrial sectors as well as an important step towards increased market shares of consultancy services towards refineries all over the world.

1.2 Objectives and Goal

Our first objective is to map the current state of the market, including foremost a service description and customer analysis but also a brief review of the competitors. A further objective is to investigate the already existing competences within COWI, relate these to a given position within the market and to a service and role description for a turnaround.

With the above objectives as a basis, our last objective is to find possible service offering advancements coupled with current customer needs within the oil- and petrochemical refinery sector regarding turnarounds.

The goal with this thesis is to provide COWI with the necessary elements as a decision basis for expanding their services towards the oil refining and petrochemical industry, primarily as a turnkey contractor for refinery turnarounds or otherwise the best alternative solution for expansion within this service sector. If COWI decides to put effort in entering the market of turnarounds as a turnkey contractor, this thesis shall provide necessary elements for an understanding of the market situation and potential within this field of business.

1.3 Delimitations

The limitations of this project can be grouped into five main categories; *geographical, technical, economical, industrial and strategic*.

Due to the location of COWI's main office (in Sweden) in Gothenburg, the geographic proximity of the investigated industries makes it both convenient and natural to start nationally (and at the same time locally due to the concentration in Western Sweden). Furthermore, due to time restraints, it wouldn't be realistic to set a goal of investigating all potential customers present in Sweden.

Although one purpose of the paper is to gain insight in the technical aspects of turnarounds, the results will not include detailed technical information about the different works at the departments within COWI or the turnaround maintenance work performed by contractors.

Economical aspects are of course very interesting for a firm aiming at taking new market shares. However the lack of available information, both from COWI and from the customers but also the competitors makes it very hard to compile reliable results. Also the nature of how the turnaround services are being purchased and performed makes it hard to deliver a generic economical analysis. Furthermore an investment, primarily in time and effort, to acquire market shares is estimated to generate several spin-off and synergy effects and the thesis is limited to present these without monetary value.

The need for turnarounds or related major maintenance activities is not confined to just the oil- and petrochemical industry. This paper aims at only investigating the Swedish turnaround market for the named industry. However the results may yield related energy industries and the paper/pulp industry.

The results of this paper are intended to align with the overall global strategy of COWI. Hence suggestions will not be behind or beyond the current ambitions, although such suggestions might be mentioned.

1.4 Company Introduction

The company Flygfältsbyrån was founded after the Second World War in 1947 with the objective of projecting road infrastructure and airfields. However, neither roads nor airfields were designed; instead buildings and terrestrial infrastructure engineering became the company's main focus. In 2009 the Danish consultancy firm COWI bought Flygfältsbyrån in order to strengthen their organisation and position on the Scandinavian market with the goal to become the leading technical consultancy firm in Northern Europe.

COWI provides a wide range of foremost technical consultancy services, often carried out as large-scale projects within an EPCM-frame (Engineering, Procurement, Construction, Management), with customers being both industry and society. COWI is represented at 13 offices around Sweden with over 800 employees. The global corporate group has offices in 35 countries and more than 6000 employees, experienced from over 50, 000 projects in 175 different countries. Consultancy services are provided within the areas of; *construction engineering, electrical and automation engineering, infrastructure, environment, risk, safety, process & energy as well as project management.*

This work is directed by a COWI AB subsidiary firm, COWI Management AB (further denoted as COWIM), which together with the parent company and another subsidiary firm, AEC AB, forms the basis for the COWI corporate group's operations in Sweden. The services at COWIM comprise project management, operating control, distributive trading of management software and procurement, while AEC handles advanced simulations and calculations as well as resale of software.

2. Method

In order to understand turnarounds at refineries, and the sub-processes thereof, a pre-study of the Swedish refinery market was conducted with the help from an experienced supervisor from COWI. Several refineries were investigated as well as subcontractors and entrepreneurs engaged in refinery turnarounds to get an overall picture of the activities and processes. In addition literature and articles regarding refinery processing, turnaround management and foreign turnaround policies were studied. A market investigation was conducted to understand the similarities and differences between the turnarounds at Swedish refineries and turnarounds abroad. Finally a preliminary list of refineries and petrochemical industries was put together to form the target group of our further studies.

When an overview of the nature of a refinery turnaround, the processes involved and the market, was obtained a set of questions was formulated divided into general- and company specific questions for each refinery in the target group. Contact was established with the refineries and interviews with turnaround managers and/or turnaround/maintenance/reliability engineers were held, based on the set of questions formulated earlier. Focus was directed towards the interest and potential for extended consultancy services as well as the turnaround organization with its different roles. An additional purpose with the interviews was to understand the specific market circumstances in Sweden and for the particular refinery in question.

An in-house analysis of the COWI organization and its departments with their respective competences and experiences from turnarounds was conducted. All department (except for the one in Karlstad) managers within the *industry* division were interviewed to get an overview of each department's competences, their visions and opinions on the market for turnarounds, competitors, how to sustain competitive advantage and business risks. A senior consultant at the department for environmental, risk and safety issues, called the *MRS* departments, was also interviewed in order to understand the risk issues considered prior to larger projects at COWI and which *MRS* consultancy services that meets the process industry's demands. Finally the executive manager of the industry division, who is also responsible for the development of the market group "Oil & Gas", was interviewed regarding development opportunities for services towards the oil and petrochemical industry sector including market situation, threats, visions and strategies for the future of COWI within this field of business.

Interview material was documented continuously as well as findings in literature and academic works. Findings and methods were connected to academic studies and literature from experienced personnel within the business of refining and turnaround management. The material was analyzed and evaluated, according to COWI's guidelines for service development, to extract results and form conclusions and recommendations.

3. Theory

3.1 Competition Theory

The main reason why it is important to acknowledge competitive theory is because it is essential to have a clearly formulated and well-defined business strategy in order to gain competitive advantage and thereby market shares. Every company in every industry has, either directly or indirectly prepared a strategy to compete on the market. This paper aims to provide COWI with necessary facts so that a company strategy regarding this industry can be formulated, or rather developed further, that aligns with the company’s overall policy.

The foundation of competitive strategy is to define the company goals and the corresponding means required to achieve the stated goals. A generic framework for the competitive strategy needs to be formulated. The framework is constituted by four key factors;

- Company strengths & weaknesses in relation to competitors
- Economical & technological potential within the industry
- Values and motivation of key personnel within the company
- Expectations and norm development

In order for a competitive strategy to be feasible the company means should match the stated goals. Furthermore all the key factors should be internally as well as externally consistent. This is done by investigating if the goals are coherent and aligned with the structure of the industry, if the strategy exploits all the opportunities of the industry, if the barriers of entry have been considered and if the company’s own resources have been assigned properly.

Briefly mentioned above is the necessity to investigate the industry structure. Several useful tools have been developed for this purpose. The theoretical basis, in this paper, for investigating the industry structure consists of primarily “Porters five forces” and “Porters National Diamond”. These models are illustrated below (fig 1, 2) (Porter, 1991) (Porter, 1990).

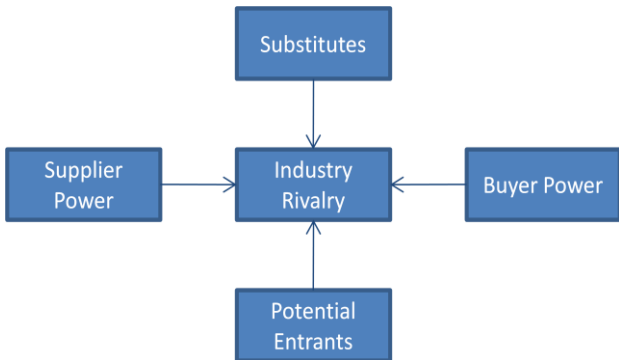


Figure 1: Porters five forces

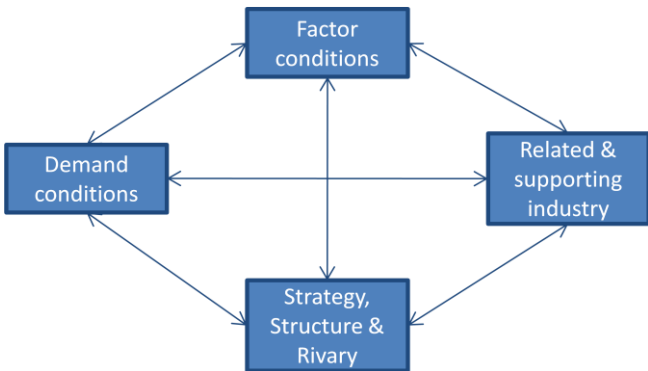


Figure 2: Porters National Diamond

The aim when using these models is to understand the structural features of the industry. This reveals valuable information on where and how a company should find its position. In order to understand the models, a summarized description of each block is needed;

National Diamond

- Demand conditions – The markets requirements on the products/services
- Factor conditions – Fundamental reasons and ulterior motives for the industries placement and development
- Related & supporting industry – Presence or absence of industry clusters
- Strategy, structure & rivalry – How different firms in a particular sector gains competitive advantage

(Porter, 1990)

Five Forces

- Supplier power – Presence of available substitutes, supplier concentration, competition on the supplier side etc.
- Substitutes – Level of and availability of service differentiation etc.
- Buyer power – Customer concentration, buyer economy and price sensitivity, required quantity, dependency etc.
- Potential entrants – Barriers to entry, learning curve advantages, industry profitability, brand equity etc.
- Industry rivalry – Sustaining competitive advantage, develop a competitive strategy, level of inputs etc.

(Porter, 1991)

3.2 Risk Theory

Business is a balance between risks and rewards, loss and gain; it is inevitably necessary to take risks when doing business. If a company is aware of the risks related to their way of doing business, measures can be taken against them to prevent or at least minimize the damage of unwanted incidents.

The importance of evaluating the risk of losing market shares can be understood through a former study made on the technical consultancy industry in Sweden. This states that firms establish themselves internationally through committing small resources to a particular market as a mean of avoiding business risks (Emerald Insight, n.d.). The resource commitment is then gradually increased as knowledge increases and experience and relations on the particular market is gained. It is also important to understand that technical consultancy firms do not face the same risks as a manufacturing firm when striving towards international establishment. Manufacturing firms has to involve fixed capital in assets, machinery etc. to a greater extent and must hence be cautious since movement of these assets over international borders is expensive. Technical consultants on the other hand are not fixed assets by these means and the skills, experiences and relations with the customers are the core assets. These are easily moved across borders.

Salient features of this industry is that relations and customer plant knowledge is of great importance and once established, a new competitor can keep its market position and eventually expand organically and gain shares in other market segments. Larger consultancy firms usually compete with each other on several market segments and such an establishment can therefore have multiple consequences for other firms already operating at the market. Because of the reasons above, it is important to include these business risks when analyzing markets for technical consultancy.

This paper acknowledges three different risk categories, *Strategic, Operational and Financial* (Adam Jolly, 2003). Sorted under the strategic category are risks regarding business relations and competition on the market while the operational risks concerns the execution procedures of a turnaround. Operational risks are today handled by the customers (the refineries) together with entrepreneurs performing the services. *A posteriori* follows that emphasis in the thesis will be on the business related category, though some risks methods with the execution of a turnaround will be briefly handled. The financial category lies outside the scope of this thesis and will be left out.

The incidents and management thereof, covered in this paper is limited to claims from customers and the process of quantifying potential risks for claims as well as the potential of loosing market shares related to turnarounds to other consultancy firms.

The aim with the risk sections; this theory section describing different methods and the part describing risk assessment and management within COWI in the analysis section, is two pieced. Partly the aim is to analyze alternative methods to use for COWI regarding evaluation of new suggested business concepts and quotations and partly to present methods for evaluating uncertainties on the market regarding competition and potential business relation risks. The work is divided as follows:

- Business risk evaluation,
Methods to strengthen positions prior to a quotation briefly discussed below as well as a more comprehensive description of COWI's methods in the risk analysis section
- Risk services provided by the MRS department at COWI,
Described in the company analysis section
- Suggestions for evaluating business opportunities,
Presented in the results section
- Brief descriptions of hazard evaluation techniques used in the process industry
Presented in this section

There are several different methods for risk identification and evaluation, but the key principles for risk management are the same. These are to identify potential unwanted events, the probability/frequency of these, evaluate the potential effects, identify and analyze possible solutions, adopt solutions and keep track of the results. This basically implies to answer every aspect of the following questions;

- What can go wrong?
- What will we do to prevent this?
- How shall we pay if something goes wrong anyway?

Below are hazard evaluation techniques used by, and recommended to, COWI in the process industry mentioned and described briefly along with comments on the methods.

Human Reliability Analysis

This method aims at identifying failures caused directly by humans or the causes for a human error as well as the potential consequences of these errors. It describes the prerequisites for tasks performed by humans, both for the task itself and the basic skills required by the operator, engineer, manager or whom it will concern. It is suited to use as a complement to other methods (Center For Chemical Process Safety, 1992). It requires a lot of information on the plant systems and is hence better suited to use on a project after an inquiry is won, though the human error aspect of risk analysis should be included, but to a smaller extent, as a complement to other methods prior to an inquiry and/or when large responsibility posts apply.

Relative Ranking

Relative ranking is a strategy where several process and activities are compared and weighted against each other to determine and prioritize where to put efforts in further work with hazards. It can also be used to evaluate different options to form a decision basis on which alternative contains least amount of hazards or risk. This method is not considered as an option prior to a quotation since the prerequisites in an inquiry are given, and no options really exist to prioritize between. Though the method is simple and can be conducted by one single experienced engineer. It is considered as an option for evaluating the alternative strategies towards the customers, especially new alternatives suggested in this thesis. A shift towards services containing more business risks for COWI from the now existing relatively protected business approach needs evaluation and a calculated decision (Center For Chemical Process Safety, 1992).

What-If Analysis

This is a brainstorming technique where experienced engineers discuss issues unwanted scenarios and possible hazards. It is not structured as HAZOP or FMEA but requires adaptation to the prerequisites. The method has little rootedness in academic literature, but is widely used in industry, COWI included, with a good reputation. The method requires a team, preferably with different backgrounds and experienced in the process evaluated, to discuss different scenarios. The discussions are documented and works as basic data for decision-making and further actions. The discussions are structured into categories and each category is brainstormed (Center For Chemical Process Safety, 1992).

The team-leader can prioritize the time at hand for each category based on experience. The analysis can also be complemented with interviews with plant personnel. The purpose is to identify hazards and possible scenarios and results in a list of potential issues¹. With experienced engineers in combination with a more structured approach and a follow up team who translates the issues into actions it is considered an easy and cost beneficial method. With a ranking assessment and a translation to monetary effects in between, the method is considered a good option (Center For Chemical Process Safety, 1992).

Checklist Analysis

Used for verifying the status of a system through following a set of predefined steps and lists of items. It is easy to use but the level of detail and the quality of the study is highly dependent on the quality of the checklists used. It often needs a follow up and complement in another technique to be more detailed. A checklist analysis of high quality must be developed by experienced personnel, preferably several experts with different backgrounds from the concerned processes. It is a versatile and relatively cheap method. For an experienced risk engineer it is possible to adapt the checklist and the focus depending on what type of process that is evaluated. This method, based on its relatively low cost and short duration along with the experienced engineers at COWI as well as the lack of need of plant personnel, is considered as a good alternative prior to quotation and evaluating new business options and strategies² (Center For Chemical Process Safety, 1992).

¹ Gert Swensson, Risk Engineer, COWI, interview, 2010-03-30

² Gert Swensson, Risk Engineer, COWI, interview, 2010-03-30

4. Analysis

The analysis section aims to provide the necessary information to fulfill the stated objective of mapping the current market situation in Sweden and to understand the concepts that constitutes a turnaround. This is accomplished by analyzing five constituents severally; the turnaround as a project (service description), the customers (the refineries), the competitors (other companies providing the same or similar services), the company (COWI) and the risks associated with being involved in refinery shutdowns from a service provider perspective. This is illustrated below (fig 3);

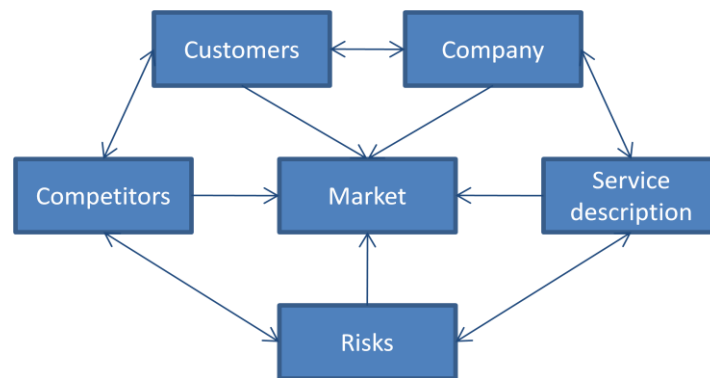


Figure 3: The five market constituents

4.1 Service Description

The first chapter in the service description section briefly describes what types of operations that occur at oil refineries. The product differentiation within the petrochemical sector is substantially higher and hence more difficult to compile in a generic context. However, the same or similar process may be found in a petrochemical plant. The following chapters in this section contain a general description of turnarounds, including typical organizational structures.

4.1.1 Introduction to Refinery Operations

In order to get an overview and a general understanding of the petroleum industry and the operations of processing crude oil (which is the root cause for maintenance activities and therefore also turnarounds), this section has been devoted to briefly explaining the most important issues involved.

Refinery operations has, in order to meet the demand for higher quality (antiknock, volatility, sulfur content etc.) as well as higher quantities of products, improved immensely throughout the 20th and 21st century. The basic reason for refining processes is to convert crude oil into more useful hydrocarbon products such as transportation fuels (diesel, gasoline, kerosene), gases, lubricants, feedstock's for further petrochemical refining, coke and residuals.

This is accomplished through a series of processing operations that can be grouped into three main categories;

- Fractionation/Distillation
- Light, heavy & residual oil processing
- Treatments

Before the crude oil can enter the process it needs to be purified. By chemical or electrostatic techniques salts, water, solids, metals and other contaminants are removed. These impurities along with crude composition (carbon/hydrogen, sulfur etc.) vary in quantity and type depending on type and origin of the crude. A typical classification of crude oil is by the API gravity, which is a measure of relative density compared to water. Hence the refineries need to adjust its processing configurations to suit the specific blend of crude oil.

The first category, fractionation/distillation is done in a so-called fractionating column or tower. Here, by means of temperature and pressure (in order to prevent thermal cracking), the crude is separated into fractions (also called cuts) with different boiling temperatures.

Further refining uses different techniques depending on the product to be produced. Light distillate processing involves, inter alia, catalytic naphtha reforming (which in turn encompasses hydroprocessing, cracking, polymerization, dehydrogenation etc.), isomerization (conversion of paraffins into isoparaffins by means of transforming the molecules while having exactly the same atoms) and alkylation (transfer of alkyl groups between molecules).

Furthermore heavy distillate processing consists of catalytic hydrotreating for removal of contaminants and conversion of olefins and aromatics to saturated elements as well as hydrocracking which is used to produce mainly transportation fuels by cracking the hydrocarbon compounds by means of high pressure and hydrogen. Lastly, residual oil processing is performed in order to utilize as much as possible of the crude. This is done by de-asphalting the residue, visbreaking and coking which both are thermal cracking procedures. The third category, treatments, involves the different means of producing hydrogen, the removal of aromatics such as benzene from for example gasoline, further removal of contaminants from finished or intermediate products, sulfur recovery and acid gas removal from hydrocarbon streams (Aitani, 2004).

4.1.2 Turnaround Service Description

The definition for a general turnaround from Tom Lenahan's book "Turnaround Management" explains in a succinct way what such a project implies;

'an engineering event during which new plant is installed, existing plant overhauled and redundant plant removed' (Lenahan, 1999).

A turnaround is a large-scale project and requires planning long time in advance of actual project execution. It can comprise thousands of activities and several hundreds of workers as well as large quantities of material and equipment, but can also for smaller plants be less extensive. It is highly dependent on plant size and the scope of the turnaround.

When performed in large-scale industry, such as oil refining, the project is most often duration/time driven since the cost due to income losses (production fall off) and workforce wages are extremely high each day of the plant being out of production. Oil refining is a business on a global market and Swedish refineries are not solely producing for the domestic market but also for export and storage (trading).

This, along with high investment costs for refinery equipment, has led to effective planning and management of turnarounds as an ever more critical business process. For the majority of the Swedish refineries the turnaround know-how is an important strategic competence. In other countries refineries have chosen to outsource the entire turnaround, from planning and management to performed services³.

In this type of industry far from all maintenance work can be performed continuously. This is due to the need for decontamination and blinding of the systems for safety reasons as well as the fact that the different processes and equipment in the refinery are connected to create a product flow through the system. In other words, work on specific refinery equipment and/or a tie-inn can force a shutdown of other functions.

There are also legal demands on inspection, regulated by the Pressure Equipment Directive adopted by the European parliament and council in 1997, which requires the shutdown of plant production. The Swedish refineries mainly have an inspection based shut-down policy, while in other countries risk based maintenance and turnarounds are common⁴. Earlier, the industry has faced maintenance intervals, and hence down time, as short as 12 to 24 months with ever more often recurring maintenance activities as the plants outmodes. With the high revenues at stake it is the process industry that has been driving the maintenance intervals to be four, six and even up to eight years. The length of the intervals is derived from accredited inspector's estimation of plant reliability together with the plant management's analysis of maintenance to reach cost optimization and competitive advantage.

The possibility of setting the desired intervals for the plant turnaround operations is also a result of the changed view upon maintenance management. New guidelines have forced the legal regulations for pressurized vessels to be more flexible. More flexible inspection intervals demand more responsibility regarding safety of the operations from the plant management. Typically the large recurring turnaround events in oil refineries and process industry in Sweden takes place every fourth to sixth year. For instance, Preemraff Lysekil recently acquired an extension of the inspection interval from four to six years while Shell Raffinaderi AB currently has a four year turnaround interval but is working towards an eight year cycle.

Each plant has its own organization and methods for turnarounds and thus there is no easy way of describing a turnaround. Despite this a general description based on findings in literature along with interviews with turnaround managers at Swedish refineries will be presented below.

³ Tomas Hjertenstein, interview 2010-02-10

⁴ Aad van Bedaf, Maria Frönell, interview 2010-02-22

To describe the total turnaround cycle it is here, for convenience, broken up into four different phases: *Initiation, Preparation, Execution and Termination.*

Initiation

It is determined long time (several years) in advance at which year the turnaround shall be executed, governed by reasons discussed above. However, the exact time and duration of the shut-down is not determined before the project is initiated. It is either the turnaround manager or plant management who initiates the project, up to three years in advance of the estimated execution date. With the initiation comes a dialogue between either the initiator(s) and the refinery market department, discussing at which point during the year, usually spring or autumn, the turnaround should be planned for. The decision is based on strategy plans as well as possibilities and convenience to build up product stock for the upcoming event.

Due to lack of competent contractors, turnarounds at two refineries in Sweden are hard to execute simultaneously. Earlier the management at the different refineries were able to discuss and jointly decide upon timing of turnarounds, though this is now prohibited by Swedish antitrust laws.

If no employee holds the permanent position of turnaround manager one is appointed by a steering group which in turn are formed by a senior business manager. If the position exists, the turnaround manager will participate in forming the steering group. The steering group defines objectives and strategies regarding manning, planning and procurement for the turnaround. The turnaround manager along with the steering group also sets policies for competence demands and function descriptions for all personnel with management, coordination, planning, procurement, economy and other administrative functions. Furthermore a rough list of the activities to be performed during the turnaround is defined along with a list of personnel appointed to and required for specific functions along with authority delegation for the preparation work. Besides the rough activity plan a set of “milestones” for upcoming tasks are specified. The initiation phase also contains reviews of prior turnarounds based on experience and reports from these.

Preparation

The preparation phase is, in terms of time, by far the largest part of a turnaround. The preparation team appointed by the steering group starts by reviewing the initial rough work list and validates it. During the approximately one and a half year long preparation phase all activities are planned for execution up until approximately six months prior to the shut down of the plant. Time intervals are of course highly dependent on refinery size and scale of the turnaround. At this point the turnaround manager freezes the work list, e.g. no further activities are allowed to be added to the scope. The planning needs some lag-time for unforeseen events, not all maintenance work during a turnaround are known prior to the execution. The work is basically divided into bulk work, planned activities, project work not related to the maintenance activities (tie-ins) and activities that are not anticipated. The latter since the need for several activities will not be visible until the plant is shut down and opened. Accidents may also render unplanned work.

Specifications for each job are identified, both for pre-shutdown work and during-shutdown work. Due to long lead-time for refinery equipment, pre-ordering and procurement of such is carried out 12-18 months in advance.

All work to be handled by contractors and possible contractors for this work are identified and requests for quotations are sent to all potential contractors. Quotations are then evaluated and compared. Based on all planned activities, cost estimations are made and scaled to the turnaround budget along with a system for expenditure/cost control. Regulations, security and safety issues are set and handled as well as methods for quality surveillance and control (QA & QC). There is also a need for a plan for site logistics during the turnaround, which is formulated at this stage.

When the work list and all other plans are developed they are brought to discussion to the steering group. Meetings are held regarding all specific activities with each contractor discussing the scope and time as well as personnel and material requirements. Work permissions and clearances needs to be handled for the contractors as well as assuring that all personnel involved holds compulsory certificates and training-courses for refinery work. Work permits for specific refinery equipment can only be released by the production department and will not be handed to contractors until safety can be guaranteed and the plant is steamed out.

Typically in Sweden, the production team still “owns” the plant during the turnaround event and even if a contractor carries out all work, they will still need permissions for each section from the production department.

Before the execution phase a lot of physical preparation work on the plant is conducted. A large part of this is scaffolding and, where its appropriate, removal of insulation can be carried out. Furthermore there is often a need to build temporary facilities, such as offices, lunchroom, washing rooms, toilets etc. as well as pre-manufacturing of piping parts and temporary systems for steam, electricity generation and compressors.

Execution

The shutdown of the plant is performed in sequences by the plant production team through following a shutdown plan from the preparation phase. The plant might need steaming, or decontaminating, to get rid of hazardous hydrocarbons, which then is handled by the plant production team prior to permit releases for each section. After the plant is decontaminated and cooled as well as isolated (through blind spading or similar) for safety reasons the execution team can start their work. This is illustrated in a general flow scheme below; showing the pre-execution- as well as the execution phase and who is responsible. In the categories labeled *customers*, external consultants are often added to the organization. The flow-scheme (fig 4) presents a general work task description for a heat-exchanger and should give an understanding of the complexity for a single task during a turnaround.

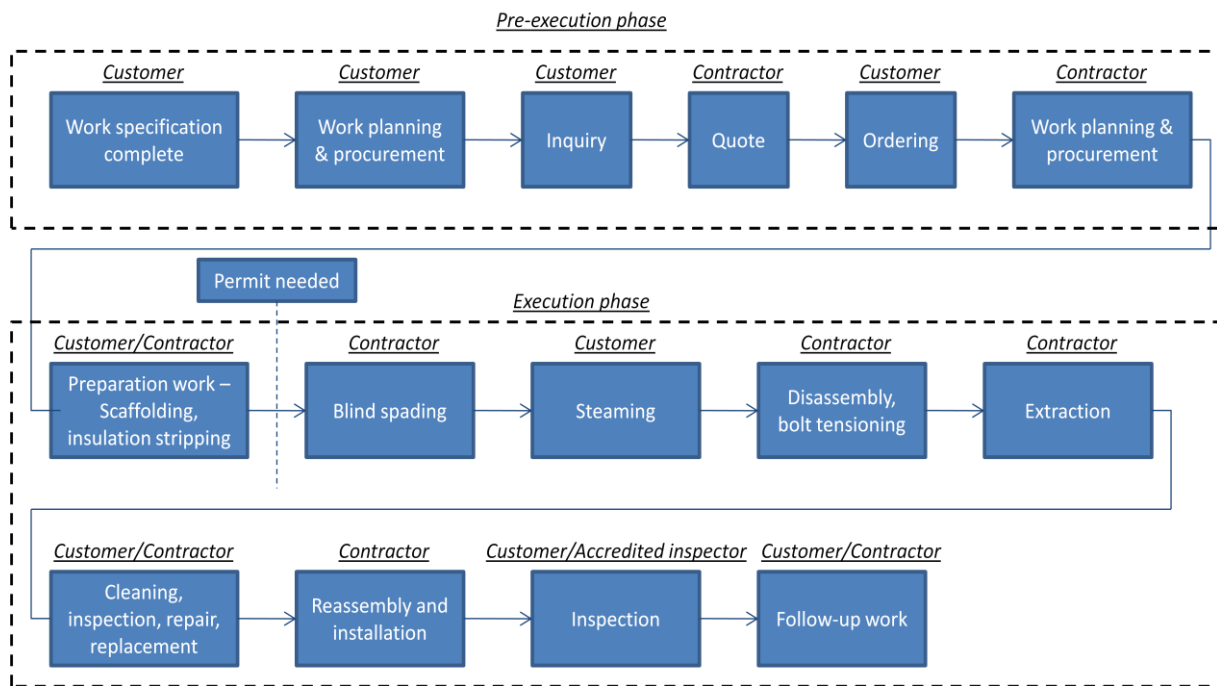


Figure 4: Flow scheme of events for typical turnaround activity, for example cleaning & repair of a heat exchanger

The execution team, mainly consisting of contractors, performs all activities according to the work list: installation of new plant equipment (tie-ins), overhaul of old and removal of redundant. Due to the large number of both refinery and contractor personnel coordination, control and status reporting of work by managers at different levels are of utmost importance. Managers are also responsible for budget follow-up and cash flow reporting (for a detailed role description see appendix A). Most activities are governed by the completion of prior ones and often require the involvement of several different contractors/disciplines. The activities are sequence planned at the preparation phase by a refinery planning team and the contractors hired to perform the specific activity construct a further detailed plan, governed by the time limits set in the activity plan.

Regulated work, governed by PED regulations, is supervised or controlled by accredited inspectors while all hot-work is supervised by accredited surveillance personnel. Work activities are checked with respect to quality systems, either through the refinery's methods, contractor's own QA/QC methods or both.

When all scheduled and unforeseen activities are performed and checked-out the plant start-up will be executed following a predefined start-up plan. During start up pressure, leak and instrumentation testing takes place along with trip and alarm tests to ensure the safety and performance of the plant.

From conducted interviews it is found that there exists a misconception of when a turnaround is completed. From one point of view it is completed when the plant is operable again. However, others argue that a turnaround is completed when the plant is producing high/right quality products again, which might differ greatly from the point where it is operable.

It is also found that the start-up phase itself is underestimated and neglected in the planning phase. Mainly regarding checkouts, loop tests etc. The execution phase generally takes between a couple of weeks to a couple of months depending on plant size and magnitude of the turnaround.

Termination

When start-up is performed final removal of equipment, residual material and redundant plant parts will take place as well as final cleaning of the plant site. Managers then hands out questionnaires and organize debriefing meetings with all contractors and entrepreneurs to evaluate the work performed. From these meetings and reports the performance is analyzed and evaluated to form a final report of the turnaround to be a basis for the initiation phase for the next planned turnaround.

Organization

Of considerable interest for the refinery, hired entrepreneurs and consultants is the critical issue of the turnaround organization. The understanding and insight in the organization is of great importance to be able to develop new business strategies towards turnarounds. This section aims to present a typical organizational template for turnarounds.

Currently the Swedish turnaround market, with an absence of related service industry clusters, forces the refineries to keep a large proportion of the managerial staff in-house. However, there are several options to consider when developing a turnaround organization. Usually the turnaround organization is divided in two parts, a large management team and an even greater work team, mainly consisting of contractors. It might also be divided into separate organizations for the standard “bulk” work and for specialized project work. Within this frame, several constellations can be adopted.

The first issue to consider is whether or not to use refinery personnel as turnaround management. Alternatives to this option are to hire either a management consultancy company or to let a primary contractor perform the managerial work. A fourth option is to hire support consultants to advise a refinery management team in areas such as planning, work preparation, procurement and project, IT, inspection and quality coordination.

Advantages and disadvantages of each option are a function of cost, quality, availability and competence of the specialized firms providing the services and the plant staff in question.

The second issue regards by whom and how the maintenance work should be executed. For this, due to the complexity of the work scope, more alternatives than for the management part are available.

The different options are briefly explained in the list below;

- Employ one or two turn-key contractors for the entire turnaround
- Employ one primary contractor for the main part, and let this firm hire and manage sub-contractors for the remaining work
- Employ one or two primary contractors for the bulk work and several specialist contractors for smaller tasks
- Employ one contractor for each specific work
- Let a staffing company provide all the resources to fulfill the turnaround work
- Solely use refinery personnel (often not possible)

Furthermore, due to a number of reasons, the contractors and sub-contractors presented above can be chosen by different means. These are typically by either work type (one contractor for instrumentation, one for water-jet cleaning etc.), by entire sections within the refinery plant or by unit (for example one contractor takes responsibility for the services of heat exchangers and hence needs to perform blind-spading, bolt tensioning, bundle extraction and transportation, possible replacement of tubes and cleaning then reassembling).

When evaluating the advantages and disadvantages of each choice of contractor package, one should strive to accomplish a relatively flat organization and to keep tight relations between management and contractor. Furthermore it is favorable to keep few management layers and a minimum (under the saturation point) of personnel both in- and ex-situ and to acquire as skilled craftsmen as possible (it is worth mentioning because the frequent lack of available workforce).

Consequently, from the above discussion, the number of constellations between management and workforce arrangements is huge and decision of which to choose ultimately falls upon the plant management.

The choice is in turn governed by certain constraints, namely time and duration of the turnaround, the refinery's geographical location and specific refinery/country culture/tradition, financial means available and along with the size and complexity of the planned operations and finally related industry within the region (available amount of personnel and competences).

Shown below is a general turnaround organization chart (fig 5);

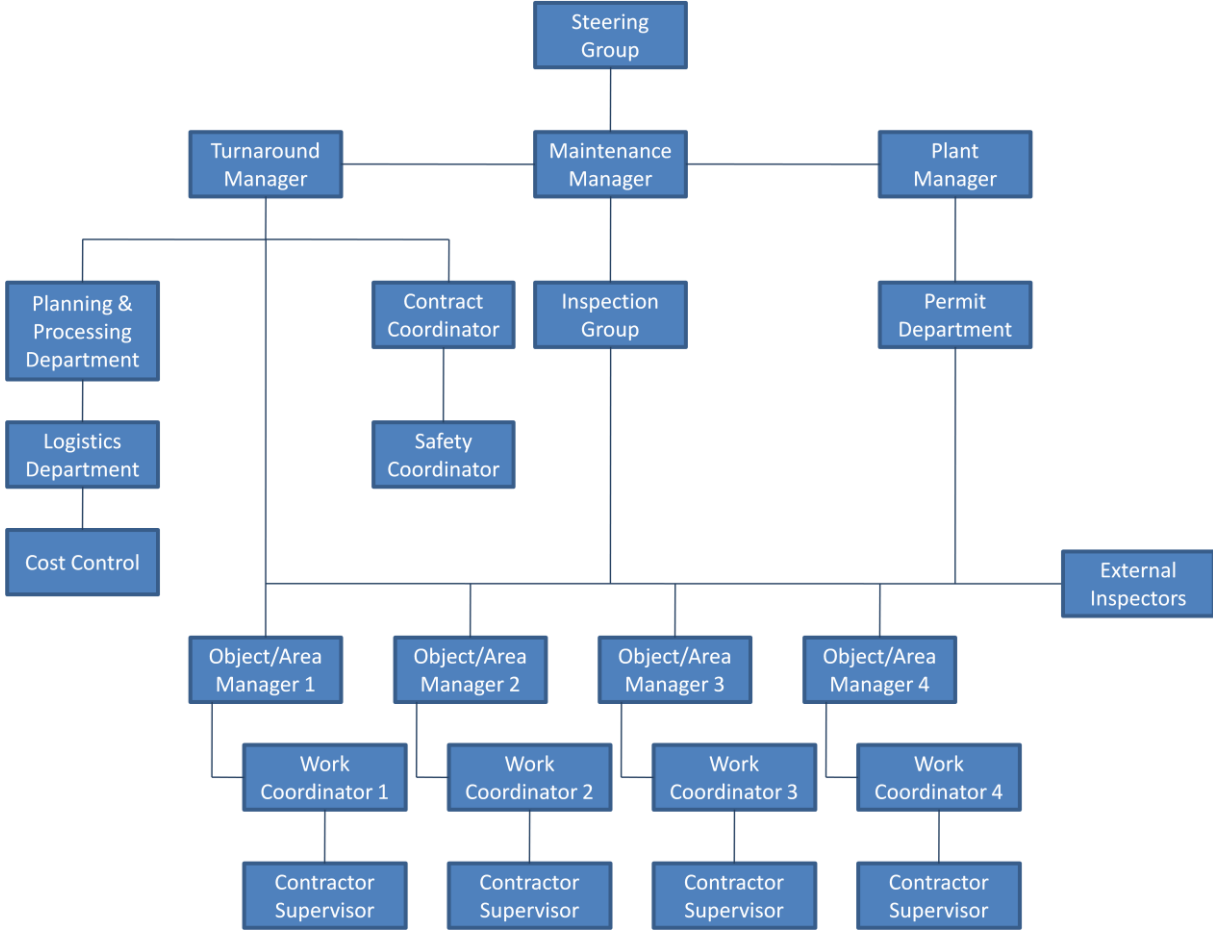


Figure 5: A general turnaround organization

(Lenahan, 1999)

4.2 Customer Analysis

As mentioned in the introductory chapter, the customers are divided in terms of what they produce. Oil refineries (Preem & Shell) mainly produce transportation fuels while the petrochemical industry (Borealis & Perstorp) produces a variety of products such as ethylene, propylene, benzene etc. However, both customer types are forced to perform plant shutdowns and conduct similar turnarounds.

The customer analysis section aims to clarify customer preferences, needs, organizations and respective turnaround history. The information presented in this section was gathered through dialogues with turnaround- and/or maintenance managers at the different production sites. Further information was given by refinery reliability engineers and project managers from COWI with experience from the turnaround industry. A complementary role description of each role within the turnaround organizations is attached in appendix A.

4.2.1 Preem

Preem holds, through the refineries in Gothenburg and Lysekil, approximately 80% of the refinery capacity in Sweden and 30% of the Nordic market. This makes Preem the largest producer and market leader (except for gasoline) of oil products, mainly transportation fuels but also lubricants and heating oil. Around two thirds of the total production is exported.

Preem is since 2005 a public company with the largest individual owner being the Saudi businessman Mohammed Al-Amoudi (who founded Midroc and is the largest singular owner in PEAB). The larger of the two refineries is Preemraff Lysekil with a capacity of processing over 11 MMT of crude oil yearly, which corresponds to almost twice as much as its sibling in Gothenburg⁵.

Preem and COWI (former FB) have a long history of working together. The relation dates back to the sixties when both were part of a consortium. The relation had a bump in 2003 when FB delivered what was perceived (by both parties) a substandard work. However this is now believed to be forgiven and forgotten and COWI has been given further assignments as Preem's main consultancy firm.

Turnaround Information

Both Preemraff Gothenburg and Lysekil conducted their last turnarounds in 2007, which included not only the legislated inspections but also large process modifications in order to improve refinery performance. The upcoming turnaround for Preemraff Gothenburg is scheduled to 2011. Both refineries have applied for a longer time interval between turnarounds, from 4 to 6 years. Simultaneously they now work with consolidating the turnaround organizations into one, in order to streamline human resources and enhance experience feedback.

For turnarounds, Preem strives towards exclusively placing own personnel on management positions, with the argument that positions with budget responsibility and valuable experiences should stay inside the company. The management positions can however be hard to fill due to the immense pressure on object/area managers during turnarounds. Coordinators on the other hand can, to great extent, be external staff. The coordinator positions are today filled by contractor- and consultancy managers. There are no constraints on outsourcing other administrative roles such as procurement, planning and risk assessment personnel (of which the first two require less plant knowledge). The procurement of contractors is handled exclusively for each turnaround. Preem has chosen to employ several specialist contractors for each work. Furthermore, Preem responded positively towards presented suggestions for service development regarding more complete service packages for turnarounds.

⁵ Financial document, (protected), Preem AB

Slightly mentioned above, both the Gothenburg and the Lysekil refinery work with experience feedback to improve their turnaround performance. This is partially done by collecting all statistics of the work performed (time, cost, quality, incidents etc.) in a joint database called Maximo. Furthermore, directly after the completion of the turnaround a feedback meeting is held including both refinery personnel and entrepreneurs.

The turnaround is organized cross-functionally between areas and objects, each area having an area manager and object managers for the different objects within that area. This is partially shown in the organization chart (fig 6).

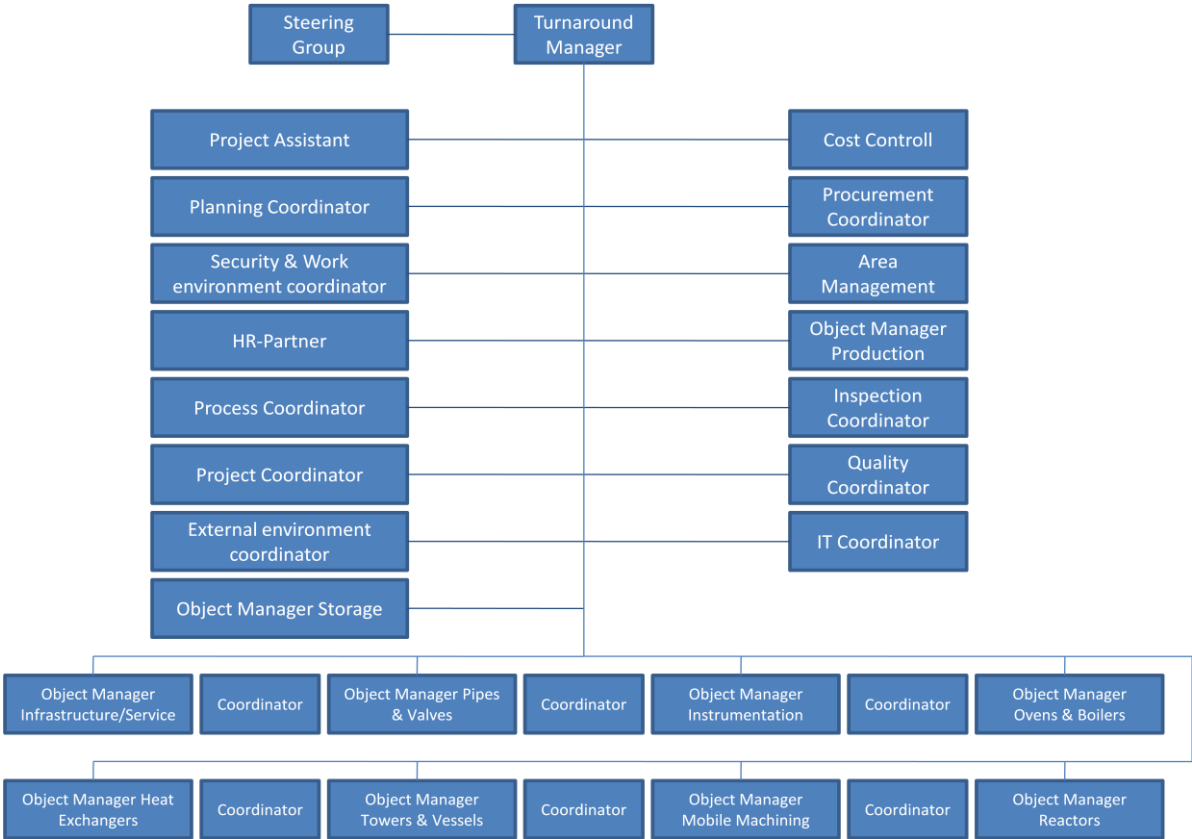


Figure 6: Preems organization chart

4.2.2 Shell

Unlike Preem, Shell is a global company operating in more 140 countries. The Swedish operations are essentially oil refining through the subsidiary Shell Raffinaderi AB, located in Gothenburg, and extensive gas station services through Shell Detaljist AB. The company is fully owned by the British holding company, The Shell Petroleum Company Limited, within the Shell Group which in turn belongs to Royal Dutch Shell plc.

The shell corporate group, with more than 100.000 employees, is majority owner in another 30 refineries and 17 chemical plants around the world and minority owner in yet another 17 refineries. Besides the refinery operations, trading and shipping of petroleum products Shell also provides consultancy and research services within the business and to other companies.

In addition to transportation fuels, Shell Raffinaderi AB also produces heating and lubricant oils, LPG and bio-fuels. As of 2006, Shell Raffinaderi AB in Gothenburg accounted for almost 14% of the Swedish refinery market. The company's previous experiences of COWI are consultancy planners, assisting the in-house crew of turnaround planners. Currently Shell Raffinaderi AB is on the market for sale along with the gas stations in Sweden. This is not the first time Shell wants to leave the Swedish market, though the interest from potential buyers is painfully absent. The exit barriers from the refinery/gas station market are very high, so a shutdown of the operations is not to be expected.

Turnaround Information

Due to most documents being classified and restricted within Shell, not much information regarding the turnarounds at Shell has been gathered or can be published. Though it is known that Shell Raffinaderi AB, to a great extent, is controlled from the Netherlands. Shell global also has their own consultancy firm that provides Shell Raffinaderi AB with support for turnarounds, in terms of project managers and senior technical advisors etc. However, there is reason to believe that these consultants are expensive, hence a not as restricted company policy would be beneficial for both the refinery as well as for the local consultancy firms.

When using external consultants these are experienced to be "set aside" in the turnaround organization, knowing little about the overall processes. Shell Global also has a turnaround group with experts that leads and assists on larger turnarounds at the Shell refineries, including the one in Gothenburg as well as a rotation system for managers leading to incoherence in the management of the plant. The latest TA took place in 2007 and the current time interval is set to six years, though Shell is striving towards an eight year turnaround cycle.

Shell uses a turnaround organization similar to the one at Preem, presented below, with area and object managers. The figures illustrate, firstly the specific turnaround organization that is mainly constituted by employees from the departments listed under the plant manager. Unfortunately, nothing is known on the procurement of contractors. The use of external consultants seem rather small compared to the other investigated potential customers due to the use of Shell Global's own consultancy team. On the other hand Shell Raffinaderi AB is on the market for sale and with a new future owner business potential might appear. Shells organization chart is very similar to Preems (fig 6), although the areas are not as clearly illustrated in Preem's organization chart. Figure 8 is a complement to figure 7, showing the departments and functions from the normal operations that are involved in turnarounds

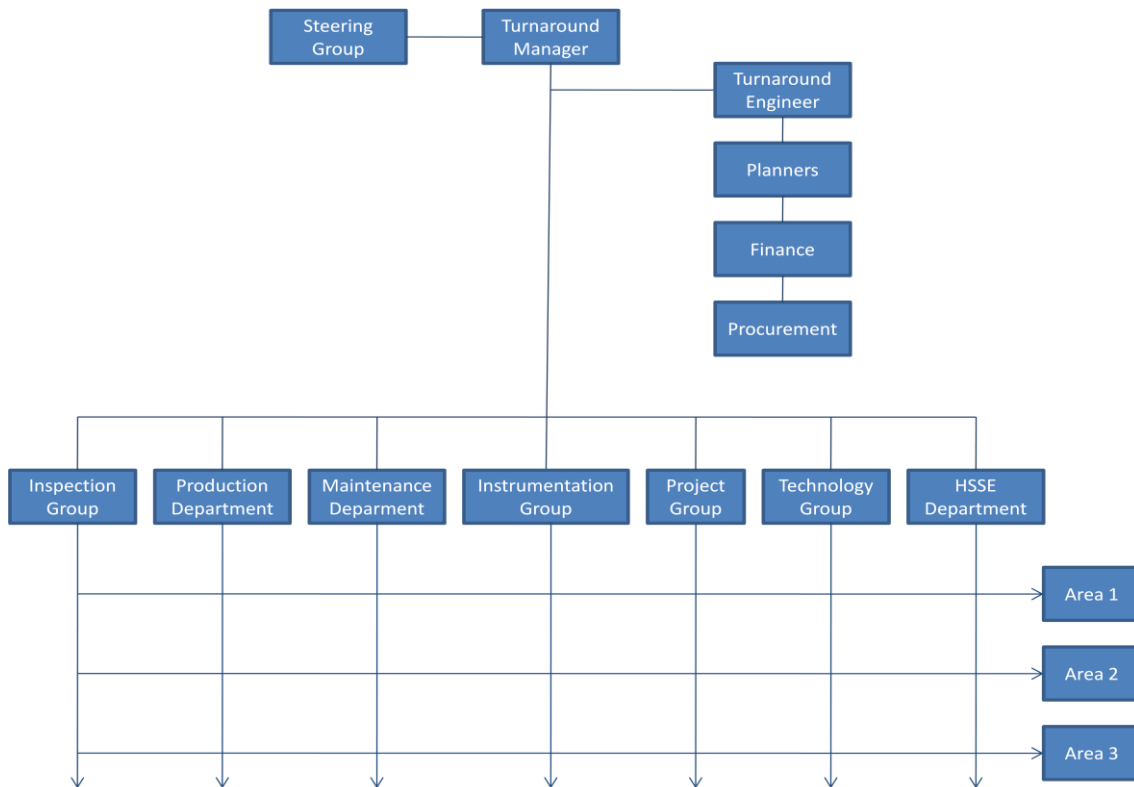


Figure 7: Shells organization chart

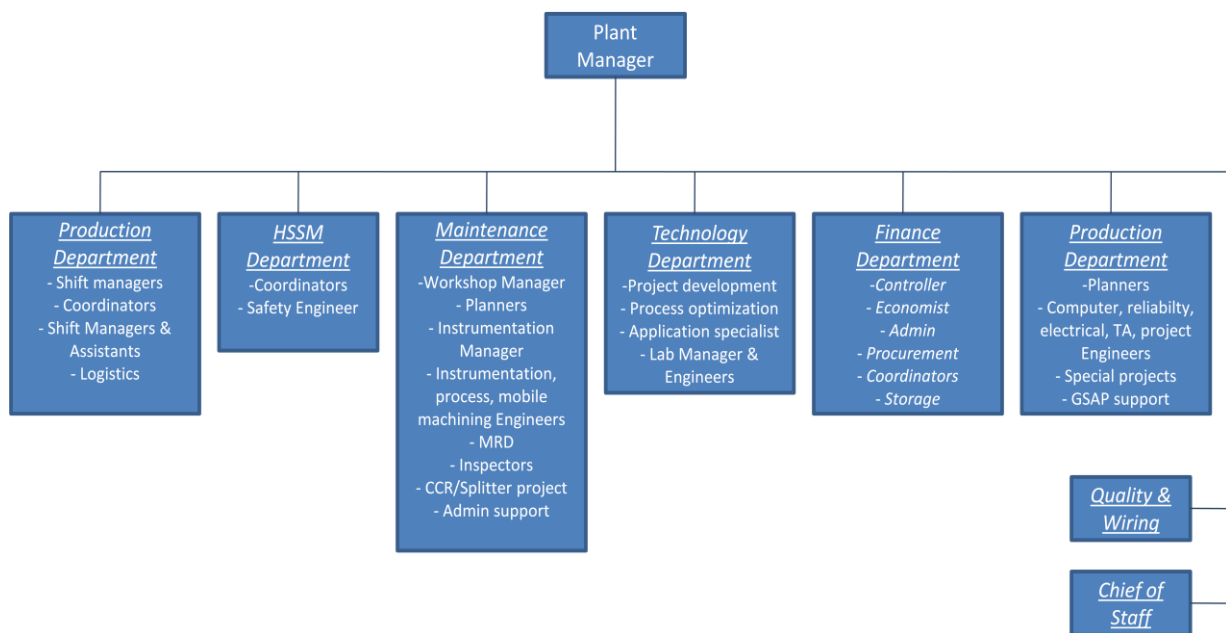


Figure 8: Departments from normal operations involved in turnarounds

4.2.3 Borealis

The Borealis Group has production facilities in the US, Brazil, Sweden, Finland, Belgium, Austria, Germany, Italy and the United Arab Emirates. Our investigation mainly concerns the cracker facility in Stenungsund but some facts of the neighboring polyethylene facility will be presented. The Borealis cracker facility is in many ways the vital nerve for the petrochemical industry cluster located in Stenungsund. The main feedstock for the cracker plant are naphtha, ethane, butane and propane. This makes it one of Europe's most flexible cracker plants. The products produced, mainly ethylene and propylene, are later used as feedstock for further refining in Borealis polyethylene facility.

Turnaround Information

The Borealis cracker uses a six year interval between turnarounds, which is perceived as the upper limit for the plant. The last turnaround was conducted in 2009, and hence the next is planned to 2015. Experienced problems were creep cracks in the steam systems, requiring four extra days for mechanical completion, a total of 39 versus 35 according to plan. The time from off- to on spec was 57 days while the planned time was 43.

Like the Shell refinery in Gothenburg, the plant aims at employing a risk based approach towards plant shutdowns and thereby be able to exclude certain parts of the maintenance work during these periods. The Borealis group is also striving towards standardizing their turnarounds at the different plants around the world through a general corporate turnaround handbook, a trend also seen at Preem & Perstorp.

Their current "house-consultant" for construction and process engineering as well as project management is Jacobs, and has been since 2004. Jacobs is entitled to the majority of work under €7 M. Fortunately work directed towards or under a turnaround does not need to follow their framework agreement. One experienced disadvantage with Jacobs project management practice is that for parallel projects, the project manager is involved in the design phases of the projects but when it comes to the implementation phase a coordinator takes over the responsibility, creating discontinuity and knowledge gap. Also the administration is perceived as copious and the way in which Jacobs spreads their costs are mysterious. The Finnish branch of Borealis are also about to sign framework agreements with Jacobs.

A substantial difference between the oil refineries in Gothenburg and Lysekil compared to Borealis, in terms of turnarounds, is that Borealis has outsourced their entire maintenance department as well as all short-time planning. Borealis are signed with BIS (Bilfinger Berger Industrial Services) to both prepare and perform, through coordinators, workforce and equipment, the majority of maintenance work. For the remaining parts, firms such as Midroc and SIS are hired.

Today Borealis has some engineering competences left in the organization, long-time planners as well as project manager resources from the global Borealis Group (for large scale projects, seldom used). The engineering projects performed by Jacobs are implemented within the own turnaround organization, but with a separate budget. This makes it hard to keep track on the costs. Furthermore, area managers within the own organization have split interests if also employed in the regular maintenance organization. To ease the burden on maintenance work outside the turnaround scope area managers tend to squeeze in extra, non-planned, activities in the turnarounds.

Borealis has earlier employed COWI for planning work and is said to have a continued need in the future towards turnarounds, approximately two or even three planners on a 14 months basis. A potential for risk & safety services is also recognized as a part of the upcoming turnaround in 2015 along with economical analysis of the turnaround projects. Due to the above reasoning of split interests by in-house project managers, Borealis wishes to hire project managers on consultancy basis in the future.

The turnaround organization at Borealis Cracker is divided into a pre-study organization and a TA project organization. The first is presented below (fig 9).

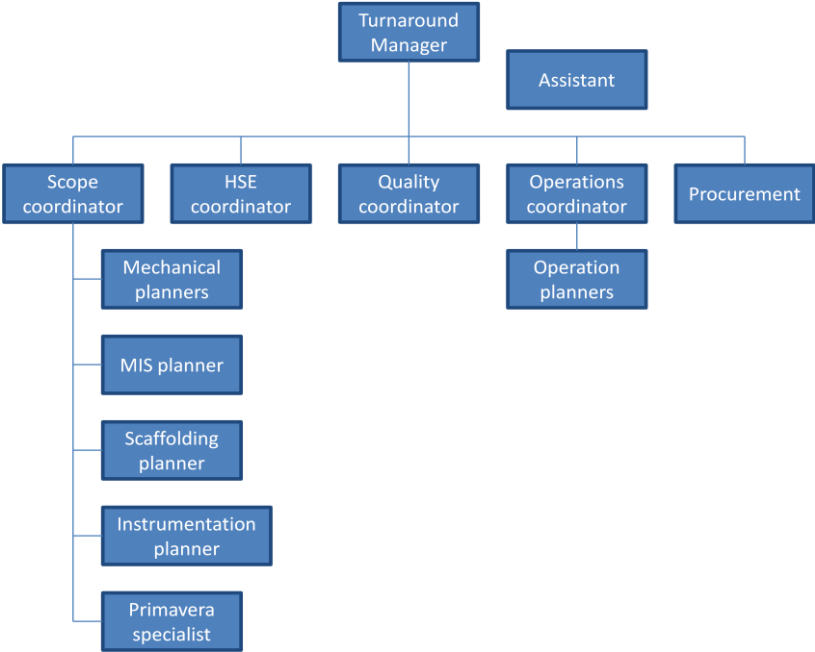


Figure 9: Borealis pre-study organization for turnarounds

However, plant personnel now work with increasing the understanding and transparency of planning and preparation of turnarounds on all levels within the organization. This is partially done through education in basic planning by COWI consultants.

Unlike Borealis, Perstorp has kept its maintenance department in-house, and are said to be pleased with that decision. Contractor services are procured separately for each specific discipline. However, for their last turnaround there was a shortage of contractors, making it hard to get the required amount of workforce. Prior to turnarounds, two planners work with the preparation planning of which one can be an external consultant. Furthermore, an expressed need is consultancy services regarding work environment safety.

Perstorps turnaround organization (fig 11) is, like the other customers, a traditional project organization, but smaller.

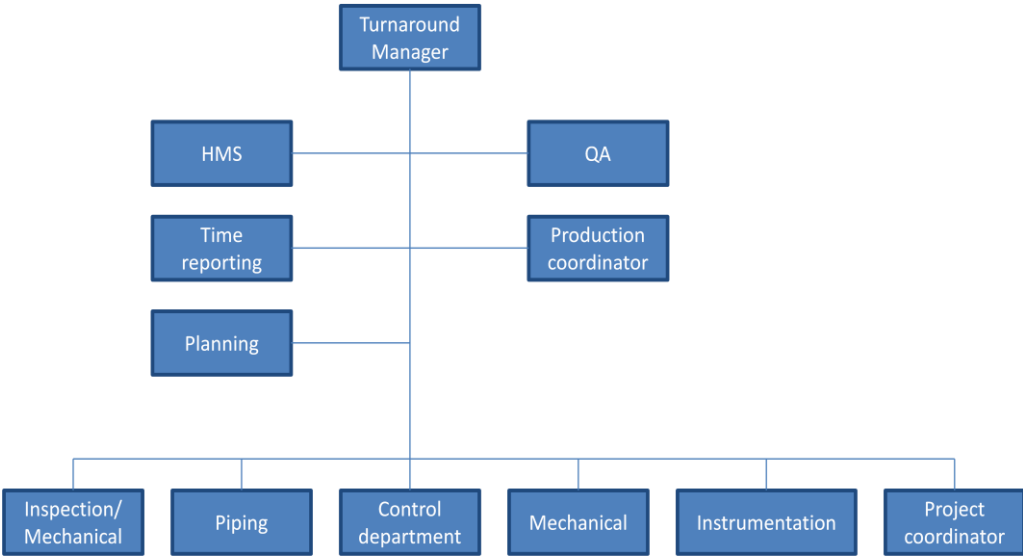


Figure 11: Perstorps turnaround organization chart

4.2.5 General Customer Summary

None of the investigated customers experience a need for turnkey contractor services. The reason for this is mainly a large in-house staff, a need for control over the plant and large risks. Also the customers are generally not willing to pay for allowances and other travel costs and from a customer point of view the turnarounds are a strategic competence. Furthermore the customers experience a lack of competence regarding maintenance personnel and in some cases have trouble to find qualified workers. Generally the industry is moving towards longer turnaround intervals but customers do not yet know how this will affect their relations with and use of technical consultants regarding the turnaround work.

However some specific work tasks has been mentioned in terms of lack of in-house skills or as more likely than others to be subject of outsourcing to technical consultants. The most prominent are:

- Planners
- Schedulers
- Coordinators
- Risk and safety engineers
- Investment analysts
- Experts for education of own personnel regarding Planning
- Experts for education of own personnel regarding Safety, Risk and Environmental issues
- Experts for education of own personnel regarding software

All customers stress the importance of keeping control over the maintenance activities and all roles with larger budget responsibilities. Customers also stress the importance of plant knowledge when participating in turnaround work. Hence customers value long term relations and engagement in their plant. It is also very often these relations between customers and individual consultants that lead to new projects. Framework agreements that are signed between a customer and a competing engineering consultancy firm do not apply for work directed towards turnarounds.

4.3 Company Analysis

A part of COWI's vision and business strategy is to always be open to new ideas and opportunities as well as to strive towards expanding their service portfolio in a strategic manner. COWI strives towards offering EPCM (Engineering, Procurement, Construction and Management) projects, e.g. multidisciplinary projects were COWI basically delivers turnkey solutions. Though COWI generally does not employ contractors to perform the “physical work” and do not have a vision for this in the future. COWI's vision is, if not conducting EPCM projects, to be involved as early as possible in multidisciplinary engineering projects. The ambition to perform the majority of work as EPCM projects is also a part of the background to this paper. Today COWI's involvement in turnarounds is in many cases on an individual consultant basis with no common strategy for turnarounds as multidisciplinary projects. Since Flygfältbyrån became COWI AB new opportunities have arisen, as the company is now a part of a global corporate group, hosting around 6000 employees.

COWI Sweden is divided into three different market segments/divisions; *Industry, Infrastructure, Construction engineering and Real Estate* and the stand-alone company *AEC*. Each market segment consists of service segments, though each service segment can be represented in several of the market segments. This study falls under the Industry division, including its service segments as well as the stand-alone company COWI Management sorted under this division in the organization plan [fig 12]. The service segment *Environment, Risk and Safety* under the division *Infrastructure* will also be included in this study, due to its relevant competences.

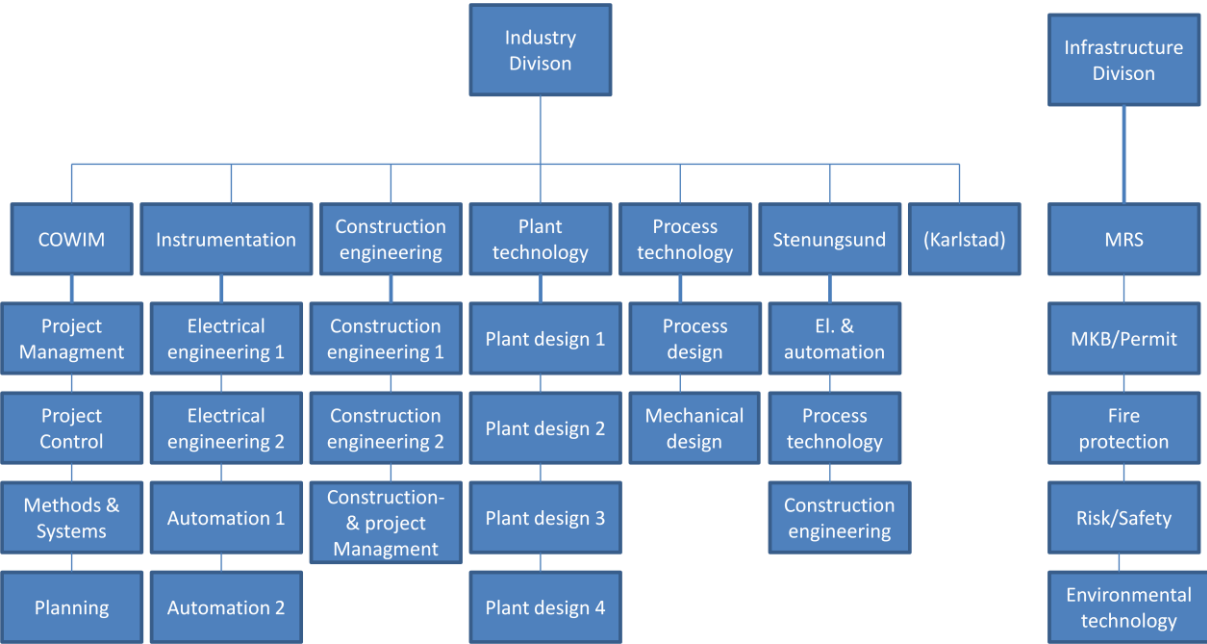


Figure 12: COWI's industry division along with the MRS department sorted under the infrastructure division

COWI has good relations and work experience with several of the companies in the chosen customer group. COWI's relationship with these customers spans over a long period of time and hence knowledge of organizations and plant design are substantial. It is also often these relations that generate business opportunities on turnarounds. Basically a plant (customer) that needs resources in many cases asks for a specific consultant that they have prior experience with, rather individuals than services are sold. This makes the relationships, often between a consultant and a customer rather than between the consultancy firm and the customer, highly valuable. For COWI, that has long time relations with the customers treated in this paper, it works positively as entry barriers for the competitors but the consequences of a lost employee becomes greater. It also creates a barrier for COWI to train young inexperienced consultants, an option that exists on EPCM projects mainly conducted in-house instead of at the customer. The Swedish reference list towards the refinery market includes reconstruction and upgrade projects of hydro-treaters, new process unit, structural, civil, mechanical, piping and electrical design along with project management and time/resource planning, risk, quality assurance, procurement and contractor work coordination for turnarounds, to mention a few. In international terms, COWI's references from the refinery industry ranges from the markets in Sweden, Denmark and Norway to Jordan, Qatar, Saudi Arabia and Oman.

COWI has ongoing projects at both Swedish and Danish refineries and have plans to both extend their services in these countries and acquire larger market shares in Norway and eventually in the Middle East. The work typically comprises services such as; process and plant design, TA planning, risk assessment and construction design.

In a broader perspective, COWI as a global player in the energy consultancy market aims at expanding their engineering service portfolio to yield a greater proportion of the oil supply chain, from offshore production to refinery operations and storage. This is one part of the industry division's expansion strategies for gaining competitive advantage. Other strategic advancements related to this work regarding refinery turnarounds are the possible expansion of these to yield similar industries such as nuclear power-, pulp & paper- and distant heating plants along with bio-fuel production and piping for medium transportation.

Below is a brief description of each department. The information presented was given solely by the department directors at COWI.

Process Technology

The department of process technology hosts the construction competences of mechanical- and equipment design as well as process design (modifications) and tie-in projects. The department is divided into three groups with different specializations; process design refinery/petrochemical, process design energy (for example long-distance heating) and mechanical design.

Within these groups almost everyone has some connection to pre-turnaround work. The work performed by the process technology department regarding turnarounds typically starts 1-2 years in advance, and the department has worked together with almost all the refineries in Sweden. In addition to the engineering capabilities the department can and have also assisted the refineries procurement organizations. They are also involved in the start-up of the refineries after all the maintenance and new process modifications have been installed. Depending on the scale of the turnaround between 1-2 employees are engaged and for larger modifications 5-6.

Plant Technology

The department is divided into four groups, each with a responsible group manager answering to the department manager. There is no conceptual difference between the groups; it is simply for the convenience of the right number of people under each manager.

The work comprises pipe construction and pipe layout and the department participates in turnarounds with these engineering skills. Approximately six months prior to plant shutdown the pipe construction work begins with between 6-12 pipe engineers, depending on plant size and the scope of the turnaround. In some turnarounds the department has also participated, under the refineries own organization, with procurement of materials. The department has been involved in turnarounds at all the major Swedish refineries and is also a frequent player at the Swedish nuclear plant regarding pipe work during shutdowns.

In singular cases project managers from the department has also filled the role as area manager during the turnaround. Besides the planned work on turnarounds the department also handles pipe work that appears unexpected during the turnaround. The department is optimized for in-house, multidisciplinary (EPCM), project work and 75 % of the departments work is of this kind, the other 25 are own projects towards industry.

Instrumentation

The instrumentation department at COWI is divided into two main categories; automation and electrical engineering organized under two and three designated groups respectively. The automation engineering groups are in turn divided into field instrumentation and programming specialists while the focus for the electrical engineering groups are to prepare the specifications for new installations (switchgears, engines etc.).

Regarding turnaround projects the instrumentation department has like the majority of the departments at COWI been involved, almost since the beginning of time. The electrical and instrumentation design work typically starts one year before the turnaround and the customers does not vary significantly from the other departments. The instrumentation department in Gothenburg does not host any designated project managers or any procurement personnel, neither does the department typically get unplanned, urgent assignments during turnarounds.

However workforce coordinators have assisted the customer's organizations. Refineries usually have an internal workforce of programmers, which to some extent rules out the department's involvement in this sector. The amount of engaged workforce in turnaround related work is between 2-3.

COWI Management

COWI Management, further denoted COWIM, is the nest of COWI Sweden's project managers, planners and software license sales. COWIM differs from the other departments through the fact that it is organized as a separated, stand-alone, company, with the aim of providing 50% of its resources to COWI and the other half to external customers. In that sense its function is both as a regular vertical department in the firm structure but also a horizontal, which makes the entire company a matrix organization. The company is organized into two main groups; *project management* and *project control*. The latter is then divided into two blocks, *methods and system support* (software licenses) and *planning*.

From a turnaround perspective, COWIM's core competences have been supplied to almost all refineries on the Swedish market. Besides project managers and planners the company also has the resources to offer workforce coordinators and procurement consultants. As preparation work COWIM also sells educational packages regarding project management and project planning and control two the refineries, educating the personnel involved in turnarounds. Involved personnel towards turnarounds vary between 1-3.

Construction Engineering

The construction engineering department is one of COWI Sweden's most well-renowned departments. Its function is to conduct construction computations and act as technical advisors in construction matters. The department is divided into two construction design groups and one construction administration group.

Related to turnarounds, the department assists the refineries with the engineering of new constructions and to a large extent with unexpected, acute work such as land located pipe breaks. These types of works typically arrive with 2-3 days up to a weeks' notice, which indicates the customers trust and the department's competence. In addition to computational engineering services the department supplies field engineers and has the possibility to supply project managers and workforce coordinators for construction matters. This becomes useful during turnarounds for example when heavy lifts are to be carried out and land bearing strength analyses and lifting plans are required. Typically there is only 1-2 senior consultants involved in acute work towards turnarounds from the construction engineering department.

Stenungsund

The COWI department Stenungsund consists of three sub-departments; Construction, Process technology and Instrumentation, e.g. departments also represented in Gothenburg, and employs approximately 30-40 individuals. Because of the customer (petrochemical refineries and Preem's larger Swedish refinery) cluster located in Stenungsund COWI gains competitive advantage by having a physical office in the area.

The personnel at the Stenungsund office works close to the industry in Stenungsund and are involved in several projects and turnarounds at the different sites. The Stenungsund office is not to be seen as a separate department, as the others it is one piece in a large company. Consultants located at the main office in Gothenburg are also "sold" from the Stenungsund department. The sub-departments are involved in the same ways as their respective sibling departments in Gothenburg described above in this section.

MRS

The department is divided into four groups; MKB/Permit, environmental technology, risk/safety and fire protection. The department exclusively employs senior consultants and the total workforce is today constituted by 15 employees.

The MRS department work comprises environmental-, risk- and safety investigations and analyses for a variety of customers, foremost the process industry which currently occupies approximately half of the departments staff. Work related to turnarounds is to provide educational services regarding work environment issues. Further works performed towards the process industry are to conduct HAZOP analysis followed by SIL classifications, environmental impact assessments and fire protection inquests. The department currently hosts three consultants with direct turnaround experience from the industries in Stenungsund and Preem. Additionally, work environment and external environment coordinators can be provided. Within its field, the MRS department is believed to be prominent, hosting educational seminars for business organizations annually.

Hence focus in this paper lies on quoting on and evaluating business opportunities, hence the work done by the MRS department prior to a large scale commitment will be presented below.

Risk Management at COWI

COWI’s MRS department uses a standard procedure scheme, of which examples are found in most literature on risk evaluation/management. The procedure is presented below. (fig 13)

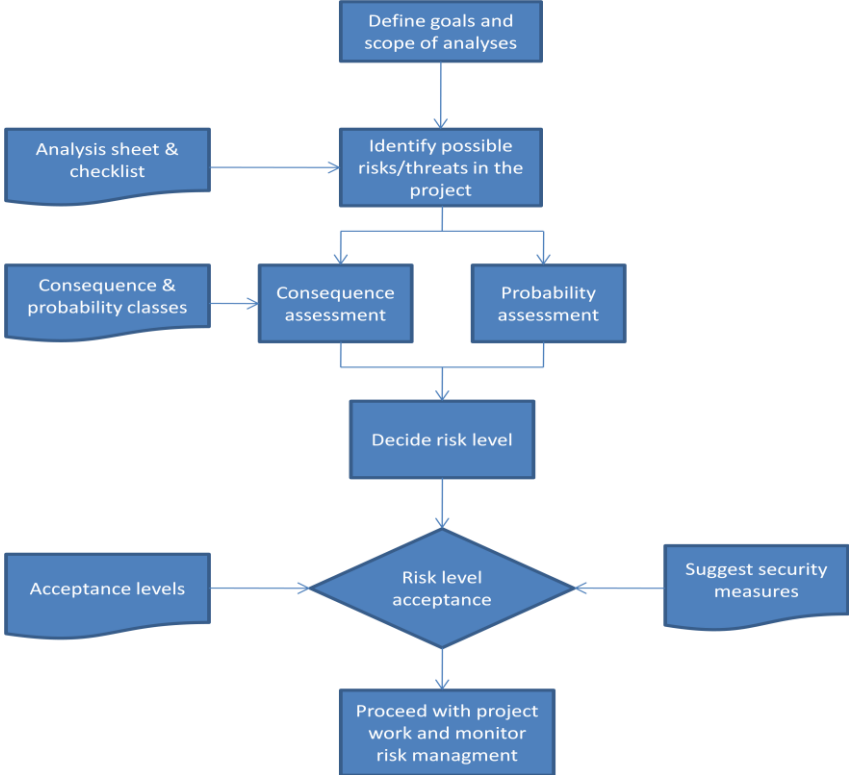


Figure 13: Risk assessment procedure

Construction of a risk analyses report and the use of a risk analyses meeting is mainly connected to what is classified as high-risk projects at COWI. These are the large and multidisciplinary projects where several COWI departments are involved. Managers and engineers from these departments, as well as the business manager responsible for quoting, are attending and discuss the categories presented below (fig 14) under the supervision of a risk engineer at COWI.



Figure 14: Project risk topics

The risk engineer also holds a checklist for risk identification of known and important risks that has been gathered from experience over time. The different threats are classified and discussed under eleven different categories. These are: *Economy, Project Organization, Work Environment and Safety, Risks Regarding Changes, Technical, Partner and Supplier, Environmental, Time, Permits, External Factors* and *Contract and Scope*. The method is, following from the theory section on risk, a combination of *What-if Analysis* and *Checklist Analysis*. This is also, with respect to time, resource, flexibility and input data demands, the method found best to suit the purpose.

The consequences of events are graded according to a predefined scale depending on expected economical effects for the firm, an example is shown below (table 1), though the scale depends on the scale of the project.

Table 1: Risk ranking table

Consequence [C]			Probability [P]	
Time delay	Budget Overrun	Other Consequences		
1 = < 1 week	1 = 0.1-0.2 Mkr	1 = Very small	1 = Hardly ever occur	<1/100 projects
2 = 1-2 weeks	2 = 0.2-1 Mkr	2 = Small	2 = Probably will not occur	1/(50-100) projects
3 = 2-4 weeks	3 = 1-5 Mkr	3 = Medium	3 = Might occur	1/(11-50) projects
4 = 1-2 months	4 = 5-10 Mkr	4 = Large	4 = Probably will occur	1/(2-10) projects
5 = >2 months	5 = >10 Mkr	5 = Very large	5 = Most probably will occur	>1/2 projects

The risk assessment results in a color coded risk matrix with the different activities, or unwanted events, sorted within it (fig 15). Were in this risk matrix the activities or events land governs the need for taking measures against them.

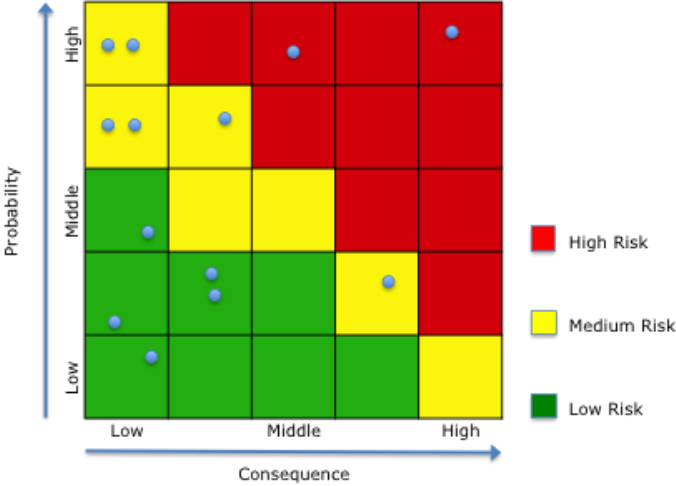


Figure 15: Risk ranking matrix

All activities, their respective color code and an identification number are listed in a log along with suggested or decided measures, status, planned finish date, actual finish date and responsible manager (table 2). This log is given to the managers to support the quoting of a job as well as the execution. Managers responsible for activities update the log with the status of suggested measures against threats and sign off when finished.

Table 2: Listed risks and countermeasures

Project Risk Analysis Contract bidding at Example AB										
Project: Example						Latest Revision: yyyy-mm-dd				
Part: 1. Contract/Scope						Participants: MJK, ESJ, ERK				
Risk is classified according to: Low(L), Medium(M), High(H)										
No.	Risk Description	Possible Causes	Consequences	Current Protection	C	P	R	Recommendation	Resp.	Status
11	We are quoting a low price to secure the job	We want the job to strengthen future position Large competition, thin market	Loss-job/ Less profit	Only a few competitors who actually can do the job Calculated risk. We rather win the job with a smaller profit than losing it. Focus on getting pay for changes	L	M	M	Comitt project time and resources for changes school the organization regarding management of	MJK	Medium Risk
12	Example AB does not devote enough personell to the project	We do not know which manpower Example AB will use	will not finnish in time which will result in "bad-will" for us	Risk we can not controll	M	M/H	H	Be explicit in contract/quote what is included in our commitment	ESJ	Low Risk

COWI, which use and also sells licenses and support for the software Primavera for project planning and management, use this software to connect project risks to the time plan. This results in a chart over the activities with the respective risk for the activity to become overdue and indicates that the activities on critical path in a time plan Gantt chart is not necessarily the same as the critical activities when risk is included.

Timeline & Department Involvement

Below (fig 16) is a schematic over the departments’ involvement in the different phases of a turnaround. The schematic is generic and involvement might differ due to acute work or if a department is a part of a larger project. The planning starts approximately two years in advance, while education and software engagement is more long-term and no exact starting point related to each turnaround can be specified.

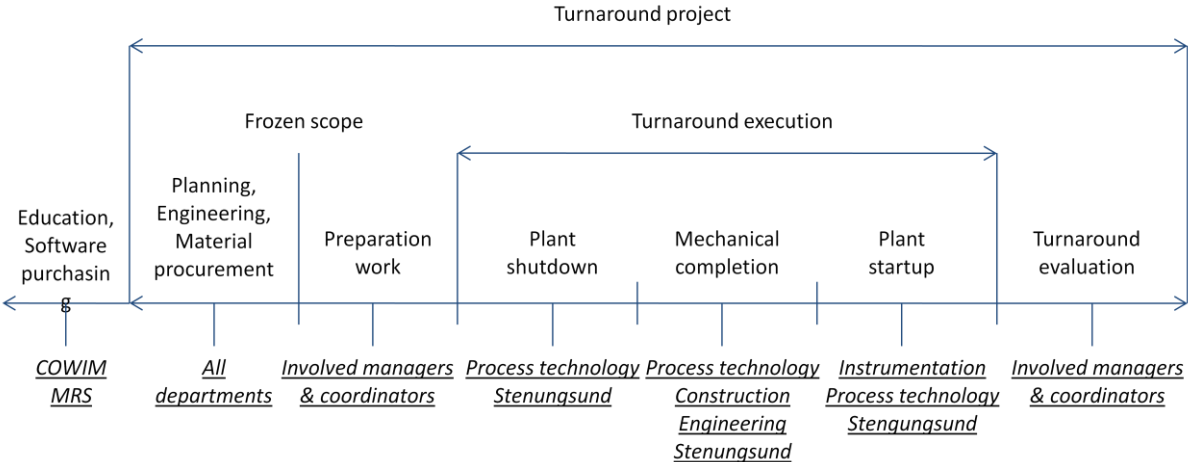


Figure 16: The turnaround timeline

4.4 Competitor Analysis

The layout of the competition analysis, within the turnaround industry, is based on the competitive theory presented in the theory section. The starting point is the company (COWI) goals and its corresponding means to achieve the stated goals. The key factors as well as the “Five Forces” and “National Diamond” models will be used to map the current competition scenario on the Swedish turnaround market.

Presented in the Company analysis section is the goal of expanding the company’s involvement within the oil & gas and energy sector. Narrowing this down, a mean for doing this is by a small step approach to push for further engagement within the turnaround business. Necessary means for this have also been stated; a better and faster training of junior consultants, the need for developing and offering of a complete turnaround concept from COWI’s side and the reinforcement of COWI’s position as a preferred partner by being involved as early as possible with the different engineering disciplines.

4.4.1 Key Factors

To further develop the competitive framework, the key factors need to be investigated. Compared to the majority of competitors (both domestic and foreign) on the Swedish market COWI has a significant advantage due to extensive plant knowledge and broad engineering competence. Presented weaknesses are the inability to harvest projects while already being occupied, i.e. resource shortage and the current sales organization. The first weakness is perceived as a very difficult aspect of consultancy business.

The economical and technical potential within the oil- and petrochemical industry in Sweden is believed to be great. Recently Borealis invested almost €400M in a high pressure plant expansion. Additionally environmental investments in steam turbines are being made. Furthermore, COWI is already signed with a now frozen expansion project at Perstorp Oxo and a new control room construction at Preem. In a longer perspective, carbon capture projects can be topical. In terms of turnarounds, all refineries/industries are moving towards longer shutdown intervals. This might render smaller organizations and give rise to greater consultancy engagement. However the Swedish industry is in general conservative with only a few exceptions.

The values and motivation of key personnel within the company should be strengthened by a better integration and training of junior consultants. The norm development seems to differ between the oil refineries and the petrochemical industry. Many of the industries in Stenungsund have already outsourced their entire maintenance departments, a step the oil refineries are not willing to take. However, the industries that have adopted the outsourcing policy are not particularly pleased with the outcome. Therefore, the rest of the industries will probably not follow the same path for a foreseeable future. The market is experiencing a vast competitive expansion, both from already established firms growing organically but also from firms looking to gain advantages by expanding in the vertical direction from being an entrepreneur to obtaining engineering capabilities.

4.4.2 Competitors

Listed below are a brief presentation of the notable competitors according to the interviews made both with COWI managers and customers.

BIS

BIS Industrial Services Sweden AB is holding company for all the Bilfinger subsidiaries, providing services within automation, piping, instrumentation, insulation, mechanics and scaffolding, specializing in industrial maintenance contracts. Within these areas they deliver maintenance services, installations and machines. The subsidiaries have around 650 employees spread over 24 offices in Sweden. The company is now experiencing steady growth and is aiming to get engineering competences (process technology) in order to move upwards in the value chain. Customers are among others the refinery, petrochemical, paper and pulp and nuclear industry, hence they will with engineering competences be competing with COWI on several of COWI's main markets.

Dens

Dens is primarily engaged in the right part of the timeline (fig 13) in a turnaround, performing a variety of entrepreneurial/contractor work. They are engaged in approximately 30 turnarounds annually, both in Sweden and abroad. However, Dens is not a direct competitor in the business field where COWI are placed, they perform no engineering and process design work. Though their existence is good to be aware of since they directly market themselves towards turnarounds in the reviewed industries. Dens can either be considered as potential future competition or as future business partners depending on COWI's service development.

Jacobs

For the refining industry Jacobs executes projects in the range from basic design to large-scale EPCM projects with references from Exxon, Shell, Chevron and BP among others. In Sweden they have an engineering and process design agreement with Borealis and operates from their Stenungsund office. Furthermore they have a large organization for other Oil & Gas activities further up-stream in the value chain where they provide full-service engineering, design, modular fabrication, maintenance and construction management services. Jacobs also provide clients with services such as; economical studies and models for projects, procurement, contractor prequalification, field and construction services within turnarounds, scheduling, project management, project finance etc.

Jacobs has a framework/general agreement with Borealis in Stenungsund, both the cracker plant and the polyethylene plant. The agreement guarantees Jacobs all engineering work at these plants, TA related excluded, under a € 7 million budget. A similar agreement is also about to be made between Jacobs and Borealis Finnish plants.

I Stenungsund Jacobs have approximately 30 employees, but has potential to grow and become an increasing competition threat. This is true not only regarding refineries, crackers and other petrochemical industry, but also concerning basically all other engineering work today performed by COWI; within the energy, building, infrastructure and environmental sectors. Even though Jacobs is not considered as a high end performer in every aspect and by all personnel at Borealis, the long time framework agreement gives them a stand-alone position for future engineering work, even if the current agreement is not extended. With this type of references from the petrochemical market in Sweden Jacobs can very well establish themselves at the other industries and increasing the competition in each quotation on engineering, project management and planning etc.

Midroc

Midroc Europe is a part of the international Midroc Group. Its business is focused on Sweden and northern Europe. Midroc Europe is constituted by three business segments; Contracting & Consulting, Property Investments and New Technology were the first is the most prominent competitor to COWI. Their business is in turn divided into a broad span of company segments; painting & coating, mechanical, electrical, remediation and cleaning, construction management and project management. This testifies broad competence but according to our interviews, a substantial proportion of the customers are not entirely satisfied with their services (competence, prices etc.).

They should however be taken seriously and currently they are expanding their businesses. Midroc was, for instance responsible for heat exchanger services during the latest TA at Borealis and have tight relations with Preem, partly to their mutual owner. Midroc operates through several companies; *Midroc Project Mangement, Midroc Engineering, Midroc Project CM, Midroc Electro* and *the branch Midroc Automation, Midroc Environment, Metalock Engineering, Alucrom, BAC Corrosion Control, GP Ställningar, Rodoverken.*

This list of subsidiary companies makes it obvious that Midroc competes with COWI in several industry segments. The business focus is on a later stage, compared to COWI, regarding the turnaround process but they offer services over the whole project span and claims considerable experience in project management towards the oil and gas industry. Through Midroc Engineering Midroc offers basically all services offered by COWI.

Mourik

Mourik is a Dutch entrepreneur company, specialized in maintenance work on oil- and petrochemical plants. They are mentioned here, not because of a great involvement in the Swedish turnaround market, but as an example of a foreign contractor that could be a threat if the market situation changes. Though currently the Swedish market is believed to be too sparse for a continental company to move its resources from its core market to Sweden for singular jobs. Mourik has close relations with Shell and ExxonMobile and offers several maintenance related services. As an example Mourik has a maintenance agreement with one of the largest integrated chemical-refinery plants in the world and has participated as a major contractor in several plant maintenance shutdowns.

Pöyry

Pöyry is in many ways similar to COWI. Their global service sector corresponds in many ways with COWI's. Pöyry's Swedish branch is specialized in the same areas as COWI's industry division; plant-, process- and instrumentation technology as well as mechanical engineering and project management. In addition, with about 8000 employees in over 49 countries, the similarities build up. Though the Swedish branch is a bit smaller than COWI's, 330 employees at 13 offices. However, in Sweden, Pöyry are not represented in the west coast area, which might be a disadvantage towards the refining industry cluster.

Reinertsen

Reinertsen Sverige AB is a part of the corporate group Reinertsen AB with 180 employees in Sweden and 1800 in total. Reinertsen Sverige is organized in the business areas; *Infrastructure, Energy and Industry* and *Oil and Gas*. Within the process industry Reinertsen is offering services within; *Project management, Process, Pipe construction, Electrical, Instrumentation and Automation, Building and Steel constructions* and is offering services throughout the value chain; Pre-studies, Planning and Design as well as implementation. Reinertsen has a well-developed organization for the offshore industry with larger multidisciplinary projects stretching over all the divisions.

Furthermore Reinertsen Sverige are expanding and are hiring several new engineers within the oil & gas industry. The Stenungsund office has approximately 30 employees. Reinertsen has among other projects participated in an expansion project at AkzoNobel, a hexane separation unit for Borealis Porsgrund and construction work for Borealis Stenungsund.

Scandpower

Scandpower is originally a Norwegian company specialized in risk management towards the oil & gas, process, nuclear, transport and maritime industry. Recently Scandpower joined the Lloyd's Register Group and has combined offices in 80 countries and approximately 7500 employees.

SIS

Like Dens, SIS is not a direct competitor. Their business is focused on performing maintenance and new project installation works, i.e. an entrepreneur role. However, they are recognized as being very competent and as a preferred partner during turnarounds, especially for work on heat exchangers.

Sweco

Sweco is a global technical consultancy company. In Sweden, they are engaged in several different market segments, such as infrastructure, manufacturing industry and the process industry. Their involvement is should be taken seriously, since they just recently acquired the LD5 project from Borealis in Stenungsund. On top of their well established department on process design, they also have the possibility of providing project managers and risk consultancy. In other words, a player worth noticing.

Swepro

Swepro's businesses are divided into three areas; energy, community construction and project technology. The base for business is Sweden although the company does work internationally along with their customers. They specialize in providing project managers, advisors and specialists within the three business areas. Hence Swepro is a competitor within the consultancy planning but also project and risk management market. This yields not only the refining industry but basically all the energy industries, from nuclear power plants to distant heating plants. However in Sweden they encompass only about 160 employees.

Tecnet

Tecnet is a relatively small company specialized in process technology, pipe and mechanical construction as well as automation and instrumentation. They have recently signed a general agreement with Fortum and Vattenfall (regarding wind- and waterpower as well as consultancy services towards Ringhals and Forsmark).

References from Ringhals among others indicate their possibility of delivering both pipe- & mechanical construction engineers, planning- and instrumentation services regarding turnarounds. However their size constrains Tecnets capability of delivering full scale packages.

4.4.3 Competition Mapping Using Porter's Models

With the primary customers and competitors surveyed the National diamond and the Five forces models provide a structured way of mapping the current competitive situation on the market. The starting point is the National diamond, gathering broad data, followed up by the Five forces model taking more details into account.

National Diamond

Demand conditions in terms of volume are not substantial on the Swedish market. Despite this, the demand and requirements for environmentally conscious production and products are high. This forces the refineries to diversify their products and improve their production. Excess volumes are stored or sold on foreign markets, but the relatively small volumes demanded in Sweden keeps the producers at a limited number.

One of the most important reasons for the refining and petrochemical industry to be located in the west of Sweden lies in the fact that it is on the "right" side towards the former Soviet Union. Furthermore, because of the petrochemical industry's great importance in case of emergency or war, rock shelters have been built (formerly owned by ÖCB) in the proximity of Stenungsund. These are the basic factor conditions for the industry in western Sweden.

Due to the relative sparseness of oil- and petrochemical refineries and plants in Sweden, related and supporting industries does not correspond to the clusters encountered on the continent, in the US or in Asia.

The structure of the Swedish turnaround industry is dichotomized due to customer preferences. The structure differs depending on which group the customer belongs to;

- Outsourced maintenance
- In-house maintenance staff

The difference between the two alternatives is that the latter keeps maintenance competence (but still needs to hire external entrepreneurs during turnarounds) and full responsibility for the plant. The motive for the first group to outsource maintenance is to focus on production as core competence.

However, both groups organize their maintenance work by employing one or two primary contractors for the bulk work and several specialist contractors for smaller tasks as described in the service description chapter. The difference is that the plants with outsourced maintenance have an already signed contractor to handle maintenance work, giving this contractor an advantage before the procurement process. Consequences regarding turnaround management are more evident. The customers with outsourced maintenance tend to be more willing to hire project managers or other roles with budget responsibility to external consultants as well as to let contractor management handle more of the work preparation. The planning and procurement organizations as well as the outsourcing of process and mechanical engineering work prior to the turnaround are similar for both groups.

Five Forces

Related to the fact that there are only a few refineries in Sweden, the supporting industry is kept fairly small. This gives suppliers both an advantage but at the same time a disadvantage. The upside (for the suppliers) is that contractors and engineering firms are not exposed to complete competition. At the same time customers are not plentiful, making it a zero-sum game. Furthermore supplier power is foremost defined by plant knowledge and available resources.

In terms of substitutes, customers cannot negotiate the technical requirements for maintenance work. What can be substituted is an in-house maintenance staff. The levels of substitution are either an entire outsourcing or a partial.

What weakens buyer power the most is availability of resources. The absence of contractor firms from the continent (it is not profitable to move personnel and equipment from Europe for a singular job in Sweden) makes resource scarcity a problem. However, for the engineering disciplines involved, foreign firms are now trying to take market shares, making business less profitable.

The greatest barrier to entry in the business of turnarounds is, linked to the supplier power, plant knowledge and learning curve advantages, both for contractors and engineering firms. Furthermore, there are few firms on the Swedish market specialized in solely providing turnaround services due to lack of customers. Another barrier to entry is economy. An engineering firm needs to host enough personnel (up to 25 persons for pre-turnaround work) to be able take projects corresponding to the scale of the turnaround.

Due to the same arguments dividing the structure of the industry, the industry rivalry is also dichotomized. As can be seen in the list above containing competitors there are several engineering firms providing consultancy services towards (but not solely) turnarounds. The same yields contractors, however these typically does not compete with the engineering firms. The distinction might however change since some of the entrepreneurs are aiming to get engineering competence as well. Rivalry among both engineering firms and contractors are foremost expressed through price setting and at second hand quality. Some firms, including COWI, benefits greatly by having framework agreements with one or several customers. A long-term strategy towards gaining competitive advantage is to be involved in between, during and after turnarounds in order to secure and develop plant knowledge and to nurture customer relationships.

To summarize the competition is currently increasing on the market as several consultancy firms are employing. A trend towards vertical integration is also seen, mainly from contractors moving towards engineering services as complement. Large scale maintenance and engineering framework agreements results in plant knowledge and threatens services provided by COWI outside these agreements.

5. Results

5.1 Market situation

The regional Swedish turnaround market on the west coast regarding oil refineries and petrochemical plants is, in terms of customers, constituted by Preem Gothenburg and Lysekil, Shell as well as Borealis, Perstorp Oxo, AGA Gas, Ineos and AkzoNobel in Stenungsund. The petrochemical industries along with its supporting industries have according to Stenungsunds county layout plan great potentiality (Kommun, 2006). This along with the recent investments in plant upgrades in the industry, by Preem, Perstorp Oxo and Borealis, further strengthens the picture of a prosperous market situation for the years to come. However, due to high barriers to entry as well as high exit costs, the quantity of customers will most likely remain constant.

In terms of turnarounds, the industry is currently moving towards longer time intervals and risk based maintenance policies. This puts new demands on the continuous maintenance and on contractor performance as well as on experience feedback, both on the customer side but also for hired consultancy firms. The longer time intervals have in some cases not yet been granted for the plants and in other not been applied long enough to review its consequences. Furthermore there exists no data on future turnaround organizations. Hence no conclusions can be made on how this will affect the turnaround market. Neither regarding changes in the average yearly extent of turnaround activities, nor whether or not the average yearly demand for current consultancy services will increase or decrease. The outcome depends on to which extent the customers chose to slim their organizations in favour of consultancy services and whether or not the scope of the turnarounds increases to an extent where the amount of plant employees is insufficient.

The experienced outsourcing trend in Stenungsund will probably not spread further to yield the oil refineries or the related industries in the region, if the current performances from contractors and consultants don't improve. This assumption is based upon conducted interviews where plants that haven't adopted an outsourcing policy are pleased while the ones that have are displeased. However, plants with outsourced maintenance have global policies comprising the entire company group, decided by a foreign board of directors. Experienced dissatisfaction in one country may be compensated for in several others as well as experiences might differ within the organization.

From interviews some distinct customer needs stands out. From what will be described below follows that the customers asks for higher quality and lower prices on the service provided by contractors. The root cause for this is lack of competition and inexperienced personnel. Furthermore it is not only higher competence, better routines and experience from turnarounds the customer asks for; it is also the quantity of contractors. Since the shipbuilding industry left Sweden the competence and quantity of maintenance personnel have gradually decreased.

More specifically customers recognize a need for skilled planning personnel for the turnarounds since it is expensive to keep this service in-house between the turnarounds. They identify a need for activity coordinators and possibly project managers. With Perstorp there is also a mentioned need for risk & safety experts for analyses and plans during the turnarounds.

The customers respond positively to package offerings from consultancy firms, listing all services and competences available as resource reinforcement during and prior to turnarounds. However, due to high profit losses at stake, only experienced consultants are requested.

Competition Between Contractors

On the contractor side, there is currently a lack of competition. Direct effects on customers are high prices, inadequate quality on performed services and a need for keeping planning & preparation activities “in-house” in order to protect against excessive prices. Furthermore, there exists an inter-mutual dependence between contractors. Competing actors are forced, due to lack of own resources and/or equipment, to hire these from a third party. This creates information flow and inflates prices. Continental contractors possess a substantial higher degree of experience from turnarounds, but due to a strong domestic- and sparse Swedish market their will of moving assets and personnel for singular jobs in Sweden should be questioned. With the longer time intervals, the Swedish contractor market will get even less training in their field of business.

Competition Between Consultancy Firms

The competitive climate between consultancy firms is currently getting harsher. Jacobs Sverige AB has since 2006 until 2008 increased their workforce with 50% and turnaround by 60% while Reinertsen Sverige has doubled its workforce and increased their turnaround by 150% during the same time (Allabolag.se, n.d.). Additionally both firms (which are believed to be the strongest competitors) are currently expanding their workforce. A further threat is constituted by the ambition of BIS to gain engineering competences. These factors clearly indicate a substantial potential within the industry and the need for employing an offensive strategy for securing projects and customer relations as well as gain market shares. Engagement in plant turnarounds is, due to its exceptional importance for the customers, an excellent opportunity to strengthen customer relations, gain experience and plant knowledge, secure continuous projects and gain market shares relative to competitors. Furthermore, turnarounds may act as a “way in” when customers are already signed with other firms through framework agreements, since services and projects implemented towards and/or during turnarounds are procured on the open market.

COWI currently has good relations to all of the investigated customers and has several years of experience with the customers, good plant knowledge as well as a geographical proximity. Their service capabilities towards the process industry span from detailed engineering design to project management, planning, procurement, permit, management, environment, risk and safety issues as well as workforce coordination. This vast service portfolio is a great competition advantage. The services are provided both on framework agreements and through quoting on larger projects.

Though the focus lies on providing larger projects and hence the offering of individual consultants is not the optimal approach toward turnarounds according to COWI's business strategy.

The critical factors determining which firm who wins a contract in this type of business are according to our investigation the following;

1. Pricing

Pricing strategies in order to win contracts has been noticed both on the contractor as well as on the engineering side of turnarounds at the various customers. If a company doesn't possess a good relationship or has been involved in previous assignments the pricing strategy is a frequently used method for entering the market. This is especially the case during a weak economic climate because its better to engage personnel in zero margin or loss projects than to not employ them at all. Pricing is a frequently used method for technical consultancy firms, both in the investigated industry and related industries such as nuclear power.

2. Relationships & previous work

It has been seen that many projects are sold based on long relationships. Customer managers and engineering managers have often worked together for several years or decades, creating a barrier to entry for new competitors. Previous relations is also convenient since no new analysis of the service supplier and/or negotiations is needed. It often both saves time and money for the customer.

3. Competence & availability

Competence is of course needed in order to win projects, however all competing firms on the market are expected to possess the desired level of engineering competence. Competence mainly comes into play as in terms of plant knowledge, design of existing systems, knowledge of methods and systems etc. Availability on the other hand is not an obvious factor in this field of business. During flourishing economic times many of the consultancy firms are fully covered and will therefore have problems to staff larger projects. Availability is also interconnected with the relations factor, often customers ask for a specific engineer, who might be tied up in another project.

4. Global partner agreements

Frameworks for entire global corporations, customers strive to standardize both work and partners. Top managements global decision can affect on a local level.

5.2 Business opportunities

In this section different business alternatives for COWI's future services towards the industry are presented. Advantages and disadvantages are presented for each alternative regarding potential winnings and business risks. A list of services, in terms of role descriptions for work prior to and during turnarounds, that COWI has the competence to offer is presented below. In addition possible synergy effects will be mentioned along with the alternatives. For a detailed description of each role see appendix A.

Prior to Turnaround

- Education
 - Planning
 - Environment, safety and risk
 - Project management
- Engineering and process design
- Risk and environmental analysis
- Planning
- Project management
- Procurement

During turnaround

- Area managers
- Object managers
- Coordinators
 - Contract
 - Procurement
 - Planning
 - Work environment
 - Process safety
 - Service, equipment
 - External environment
 - Investment objects
 - Quality
 - Inspection
 - Process technology
 - Accounting
 - Construction
- Planner and Scheduler
- Cost controller (through COWI Global)
- Acute work (engineering, procurement, safety plans etc.)
- Project assistant

After turnaround

- Follow up work
- Future projects

5.2.1 Alternative 1

Description

Business as usual, i.e. each department continues selling individual consultants upon customer requests.

Advantages

Well known and proven method. Experienced consultants continue to perform services and further strengthen relations to the customers. All services are performed under framework agreements within the customer's organization. Possible mistakes and poorly conducted work by consultants are unlikely in this case due to their familiarity with their employer. If issues still occur insurances covers all expenses and possible claims and disagreement is regulated in the framework agreements, hence virtually no risks covered in the risk assessment procedure (fig 14) are considered to be of major relevance. No risks with unfamiliar service offerings will occur and there will be no need for investments or to develop new agreements and strategies, or conduct active sales and marketing work.

Disadvantages

No common strategy for work towards the turnarounds exists and services are sold only based upon chance and prior experience. This is not in any way profit maximizing and COWI's organization towards the industry is not utilized to its full potential. The experience feedback is currently poor and it is hard to school new consultants in the customer organization and for them to gain plant knowledge. This gets increasingly important considering the increasing time intervals between turnarounds. There is a risk of losing consultants to the customers organization as well as there always is the possibility for an individual consultant to leave the company for another consultancy firm, then bringing the customer relation and hence business opportunities with him. There is currently no forward planning towards the planned upcoming turnarounds to commit resources and if the customer specified consultant is not available at the time for the turnaround there is a great chance of missing out on debit able hours. Selling individual consultants do not lie within COWI's strategy to focus on selling EPCM projects. Considering the scale of the entire turnaround project and the small involvement by COWI there is a risk of losing market shares if the market changes towards further consultancy involvement in the future.

5.2.2 Alternative 2

Description

The essential feature of this alternative is for COWI to elaborate a solid strategy, including measurable goals, towards turnarounds. This is preferably done by the development group Oil & Gas, possibly along with other concerned departments. A subgroup regarding turnarounds with an appointed manager should be formed and given responsibility for future engagements. The group's commitment should include forward planning and scheduling of all upcoming turnarounds for potential customers and to commit preliminary resources to these. Furthermore, develop a detailed plan over the available resources and competences regarding turnaround activities for all concerned employees as well as a plan for experience feedback. The turnaround group and competence list should, in order to take advantage of all potential business opportunities regarding turnarounds, contain cross functional competences over the entire energy market. The competences should be compiled in terms of offerings as a service package (all available services that can be provided, see list above) and used as marketing material towards the customers. The appointed manager for turnaround services must have extensive experience from earlier turnarounds and good relations with plant and turnaround managers. Prior to a turnaround, approximately two - three years in advance, contact should be initiated and a dialogue started with the customer's turnaround manager. The pre-turnaround discussions should comprise the customer needs during and prior to the turnaround as well as inquiries and quotations on projects planned for implementation during the turnaround with emphasis on the advantages and synergy effects of using COWI as a multidisciplinary consultant for both entire turnkey projects and as turnaround support.

Advantages

This alternative business approach lies closer to COWI's vision to deliver EPCM projects and utilizes the resource in a more efficient manner. The need for experience feedback becomes more apparent when a group of consultants are assigned to the specific business segment. The experience feedback also becomes a part of the strategy and is included in the planning. The possibility to school inexperienced consultants increases with the aim to sell services instead of individuals as well as established routines for the experience feedback. With established measurable goals the possibility to evaluate and develop the strategy further arises. Contact surfaces and engagement in the customers business increases and hence improves the relations. A complete competence package provides the customer with available competences and services and hopefully opens their eyes for new opportunities in terms of consultancy services. The customer will have access to detailed service specifications and can easily match shortages in the own organization to the services offered by COWI. With an early engagement it is possible to market and sell services as well as get an understanding of the customer needs.

With a clear strategy and combined philosophy, all COWI departments can work in the same direction regarding turnaround and promote each other and create synergy effects such as increased sales of educational packages. In a broader perspective, a joint effort will increase the understanding of the industry and promote and benefit the existing expansion plans within the energy sector. If the level of responsibility remains equal to the current situation (see alt. 1) the risks are not affected, but at the same time profit margins will not increase.

Disadvantages

The most prominent disadvantages are the amount of effort required to form and manage a turnaround group and the possible loss of focus on other services provided. Further investments are in marketing material as well as in customer care activities. A compilation of competences and references is time consuming and dangerous if competitors gains access to it. The proposed alternative guarantees by no means that the conservative customer group will adopt further consultancy services. However interest has been stated and as the saying go; you can't do business sitting on your armchair.

5.2.3 Alternative 3

Description

The third alternative is based on rearranging the current customer-contractor situation. Currently the refineries procure the needed contractors for a turnaround. In a future scenario COWI can take the role as a turnkey contractor for the majority or entire turnaround, acting as an entrepreneur employing subcontractors performing the actual maintenance activities. Hence, the refinery delivers an inquiry to COWI, COWI delivers specific inquiries to each contractor or if it's handled through framework agreements and then delivers a complete package of turnaround services to the customer. In addition, COWI provides all the services mentioned in the former alternatives through its own organization. In contrast to the other alternatives, COWI would in this case be involved in the entire time span of the turnaround and most likely be forced to take the risks of delayed start-up. The turnaround would from COWI's perspective be a full-scale EPCM commitment. This service is currently not provided by any other firm on the Swedish market. However, the concept has been performed in the Netherlands. Current contractors on the Swedish market have already established relations with the customers, hence have no need to go through an entrepreneur to be a part of the quotation process. This means that COWI has to procure foreign contractors (more experienced) or attract Swedish contractors through beneficial agreements, e.g. guarantee a part of the turnaround if COWI wins the quotation.

Advantages

The alternative is aligned with COWI's EPCM policy and utilizes the full capacity of the company resources. Full responsibility for all turnaround activities also generates larger profit margins. If adopting this alternative COWI would be the first and only company providing turnkey solutions for turnarounds, creating a vast competitive advantage. If customers adopt this solution it will also work in favor of all engineering projects conducted prior to, and implemented during, the turnaround. It will create great possibilities to train inexperienced personnel and create a large data bank of experiences that can be utilized in other sectors and transferred to COWI globally. Agreements with contractors will also be possible to utilize in other industries subjected to turnarounds. It will also most likely be very beneficial in the quotation process for other engineering projects regarding plant/process development.

Disadvantages

With full responsibility for the activities from shut-down to start-up follows great business risks. Deviations from planned start-up date within this type of industry can cost several millions SEK per day. As an example, the latest turnaround at Borealis Cracker lasted for two months and the annual turnaround for Borealis is 13.5 BSEK. Claims from an unsuccessful turnaround are likely to be substantial and. Even if COWI conducts several large-scale EPCM projects, the experience from this type of unique projects is poor. COWI has no policy to act as an entrepreneur for a cluster of contractors, and there is a risk of losing focus from the core activities, multidisciplinary engineering projects. Large and time-consuming efforts must be put in finding, evaluating, negotiating with and finally procure contractors. Further experienced problems in the industry with foreign contractors are issues with collective labor agreements and language barriers. If this shall be worth the effort the support and interest from the industry must be vast, which it is not. Swedish plants are, by tradition, reluctant to hand the plant over to strangers and employees a large work force to be utilized during the turnaround. Furthermore a turnaround requires not only great plant knowledge but also familiarity with the operational functions, knowledge doubted to be extensive enough at COWI. If agreements with larger technical firms are made the principal-agent problem, or agency dilemma, occur. I.e. there is a risk that a hired contractor sees to its own interests and acts disloyal from COWI's point of view. Another disadvantage with this alternative is that it lacks support at COWI, both by several managers and experienced employees.

5.2.4 Associated Risk Categories to Each Alternative

The listed results in the table below (table 3) have been produced according to COWI's risk analysis methods presented in the risk analysis section. Information required for the data entry is based on the entire analysis section including interviews, study visits and literature reviews. A more detailed risk mapping should be made listing specified hazards with probabilities based upon COWI's statistic data base and experiences along with monetary consequences for similar engagements. The table and risk matrix below, (table 3) (fig. 17), presents an overview of the risk picture for the presented alternatives according to the COWI categories for project risk assessment. The risk matrix acts a part, combined with the specified advantages and disadvantages, as the foundation for the conclusions and recommendations. COWI's MRS department is also urged to conduct a relative ranking study of the alternatives if further analyzes are seen as necessary.

Table 3: Risk classification for the alternatives

Category	Alt. 1			Alt. 2			Alt. 3		
	P	C	R	P	C	R	P	C	R
1. Economy	L	L	L	M	L-M	L-M	M	H	H
2. Project Organization	L	L	L	M	L-M	L-M	H	H	H
3. Work Environment & Safety	L	L	L	M	L-M	L-M	H	H	H
4. Changes	L	L	L	M	L	L	M	M	M
5. Technical	L	L	L	L	L	L	M	M	M
6. Partner & Supplier	L	L	L	M	L-M	L-M	H	H	H
7. Environmental	L	L	L	L	L-M	L	L	M	L
8. Time	L	M	L	L	M	L	H	H	H
9. Permits	L	L	L	H	L	M	H	M	H
10. External	L	L	L	L	L	L	M	M	M
11. Contractor & Scope	L	L	L	M	L-M	L-M	H	H	H

Each alternative (1,2 and 3) is in the risk matrix (fig- 17) represented with an integer number while each category is represented as decimals. I.e. 2.6 in the matrix represents alternative 2, category 6 (partner & suppliers).

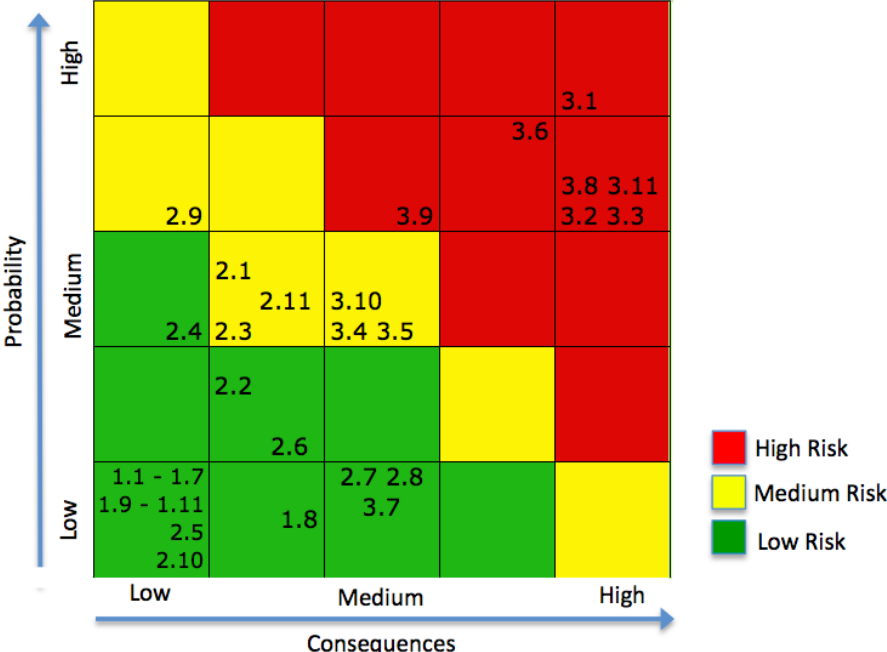


Figure 17: Risk ranking matrix

6. Conclusions & Recommendations

Generally there exists opportunities for consultancy services towards the industry. All interviewed customers have expressed a need for resource reinforcement during or prior to upcoming turnarounds. The contractors are, from the customers' point of view, not enough exposed to competition and skilled workers are hard to find. Especially in the quantities needed for a turnaround. Regarding consultancy services the competition is getting tougher, with actors formerly only performing contractor work now acquiring engineering skills and other consultancy firms acquiring new personnel and employing an offensive strategy. The competition on the analyzed market is not fully recognized throughout COWI's organization but should be taken seriously. With a business mainly based upon good relations between specific consultants and customers it is of major importance to protect, strengthen, and if possible extend these relations. A shift towards customers to rely on COWI's services instead of the specific consultants performing them would be a beneficial change. COWI's vision for EPCM projects, where the competition is small due to complexity and high risks, is in no way fulfilled through the current approach towards turnarounds. Performing turnarounds as EPCM projects are theoretically possible but it demands great efforts to compile service packages and the reluctance from several actors on the market are substantial.

In order to improve their performance towards the customers COWI should consider:

- Appoint a responsible manager for turnaround services and service development
- Decide upon a strategy, common for all involved departments
- Create marketing material, describing all available services and competences
- Stress the importance of marketing all departments and functions
- Be involved in the customers work and planning in an early stage
- Use in situ consultants to market all COWI services
- Employ a sustainable and consistent strategy for educating junior consultants
- Continue the dialogue with the customers regarding further engagements
- Create a plan for the upcoming turnarounds and match the corresponding competences
- Strive towards early on engagements in the turnarounds
- Surveil the competition

Below a commented summary of the three elaborated alternatives for COWI's future approach to the industry is presented. Based upon the prerequisites as well as the advantages and disadvantages, the most favorable option is chosen as a suggestion for COWI's further work.

Alternative 1

Continue with business as usual, is not an optimal strategy due to the risk of losing market shares to competitors if no aggressive move is made to strengthen the business. This is especially relevant when new players establish themselves on the market as well as when old ones are strengthen their positions. Furthermore the market shows unutilized potential and COWI should make an effort to gain market shares and develop and strengthen customer relations. COWI should aggressively market themselves and make efforts to profit on the industry potential. If not, there is a risk of other consultancy establishment with the customers. Such an establishment can easily result in less business these consultants creates, the so important, relations with the customers and starts bidding on the same inquiries as COWI.

Alternative 2

This alternative is suggested to COWI as the best alternative to develop the business segment. Mainly due to that it is a small but important step towards larger project scope as well as the risks are basically the same due to no increased responsibilities per service provided. As for today there is a presented need for further resources within the industry. Services to the industry regarding turnarounds are hardly marketed and with a clear strategy and with efforts on further sales an increased amount of roles can be filled and, most importantly, money earned.

Alternative 3

Alternative 3 is not considered as the best option as for today. This is mainly due to a market that is not ready for major changes as well as reluctance within the own organization, from customers. The alternative also presents great complexity and high risks involved for this type of business. Hence both COWI and customers are believed to benefit more from smaller changes, though in the direction of larger consultancy proportions. It is an interesting option for future revising when COWI has established themselves even further on the turnaround market and customers to a greater extent has relied upon consultants. When COWI and the market is ready this is an opportunity to get an exceptional position within the market that can be quite lucrative as long as hazards are taken seriously and measures are taken against them. Great effort must also be put in the formulation of contracts and agreements if the nature of the responsibility will change to the forms presented in this alternative. This is also a factor where the experience might not be sufficient within COWI considering the partly new line of business.

To summarize; this paper suggests COWI to adopt *alternative 2* after handing the issue to the *MRS department* for thorough analyze and evaluation together with concerned managers.

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Appendix A

Listed in the appendix are the different roles involved in a turnaround. The roles are ordered according to responsibility.

	Objective	Main tasks	Regular Members
Steering Group	The Plant Manager gives the Maintenance Manager the task to, with the help of the steering group and the TA Manager, organize the project to be led and coordinated according to decided guidelines to achieve goals and perform the scope of the TA within budget	Assure that resources and roles are filled according to resource and organization plans Develop key figures within Work and External Environment, Plant Safety, Quality and Profitability Attend in the establishment of work scope and sign off on the scope Sign off on the budget Review and authorize/refuse additional work that effects the total budget and/or the master time plan	Maintenance Manager Production Manager Environment and Safety Manager Technical Manager Production Planning Manager Reliability Manager

	Objective	Main tasks	Responsibility & authority
General Member of steering group	On behalf of the Steering Group support the group members within own field of responsibility regarding work priority	Attend in relevant safety rounds Attend in quality work Support in decisions on work scope Support the TA Manager with professional knowledge Attend and lead relevant meetings	Authority and responsibility according to governing documents to decide and prioritize TA work activities

	Objective	Main tasks	Responsibility & authority
General Member of the Area Management Group	On behalf of the Area Management Group support the group members within own field of responsibility regarding work priority	Attend in relevant safety rounds Attend in quality work Support in decisions on work scope Support the TA Manager with professional knowledge Attend and lead relevant meetings	Authority and responsibility according to governing documents to decide and prioritize TA work activities

	Objective	Main tasks	Responsibility & authority
Maintenance Manager in Area Management Group	On behalf of the Maintenance Manager together with the TA Manager and the members of the Area Management Group lead and prioritize all TA related tasks in all phases of the TA	Attend safety rounds Conduct observation rounds Attend quality work Plan, find room for and prioritize work tasks Be the key figure for planning of additional work Keep the TA Manager updated on the TA Lead meetings Return the plant to Production after maintenance and inspection work	Responsible to plan and prioritize additional work Authority according to budget, governing documents and attestation rules

	Objective	Main tasks	Responsibility & authority
Maintenance Manager in Steering Management Group	Along with the TA Manager and the Steering Group lead and prioritize work throughout the TA	Attend safety rounds Conduct observation rounds Attend quality work Plan, find room for and prioritize work tasks Be the key figure for planning of additional work Keep the TA Manager updated on the TA Lead meetings Return the plant to Production after maintenance and inspection work	Responsible to plan and prioritize additional work Authority according to budget, governing documents and attestation rules

	Objective	Main tasks	Responsibility & authority
Production Manager in Area Management Group	On behalf of the Maintenance Manager and together with the TA Manager and the Area Management Group lead and prioritize TA activities through out the TA	<p>Responsible for coordination between activities</p> <p>Attend safety rounds</p> <p>Conduct observation rounds</p> <p>Attend in quality work</p> <p>Prioritize TA activities</p> <p>Responsible for fitting in additional work</p> <p>Update the TA Manager on the TA progress and issues jeopardizing it</p> <p>Support the Production Coordinator with shut down and start up</p> <p>Hand over the plant shut down, isolated and emptied to Maintenance/Ta Management</p>	<p>Authority and responsibility according to governing documents to decide and prioritize TA work activities</p> <p>Responsible for, according to budget, fitting in TA work</p>

	Objective	Main tasks	Responsibility & authority
Production Manager in Steering Group	Together with the TA Manager and the Steering Group lead and prioritize TA work through out the TA	<p>Lead and prioritize work</p> <p>Hand over the plant shut down, isolated and emptied to Maintenance/Ta Management</p> <p>Support the production coordinator I shut down and start up work</p> <p>Attend in quality work</p> <p>Update the TA Manager on the TA progress and issues jeopardizing it</p>	<p>Authority and responsibility according to governing documents to decide and prioritize TA work activities</p>

	Objective	Main tasks	Responsibility & authority
TA Manager	On behalf of the Maintenance Manager assure that the TA is organized, led and coordinated. Within the TA Management ultimately responsible for all activities regarding the TA	<p>Assure development and follow up on goals</p> <p>Development of a TA organization and recruiting of competent personnel</p> <p>Create prerequisites for effective control of the TA on all levels, in all business areas throughout the TA</p> <p>Assure compiling of and follow up on basic data for budget work and planning</p> <p>Assure compiling of material for updates on the development of the TA activities</p> <p>Assure circulation of TA information and inform externally on the TA scope and dates</p> <p>Summon and lead meetings</p> <p>Assure establishment of strategy plans for procurement, attend in the procurement activities</p> <p>Assure realization of decided educations</p> <p>Plan presentations of activities that demands decision from steering group</p>	<p>Responsible for work environment</p> <p>Responsible for the development of a TA organization</p> <p>Responsibility for and authority to run issues on personnel resources to man up the organization</p> <p>Responsible for coordination of all business areas in the TA</p> <p>Responsible for the communication on the TA</p> <p>Responsible for establishment of work methods and routines</p> <p>Responsible for the TA budget</p>

	Objective	Main tasks	Responsibility & authority
Object Manager Production	Coordinate all activities related to production	<p>Assure that production activities are prepared and planned according to established routines</p> <p>Assure existence of risk analyses and checklists</p> <p>Attend budget work for production activities</p> <p>Attend negotiations with suppliers and entrepreneurs for production activities</p> <p>Develop shut-down and start-up plans</p> <p>Coordinate production activities with other activities</p> <p>Summon and lead production related meetings</p> <p>Assure the representation of the production dept. at all meetings</p>	<p>Authority according to established budget and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Object Manager Infra. / Service	Lead activities within an area / object / category	<p>Assure preparation and project plans for turnaround objects</p> <p>Attend budget work for objects</p> <p>Attend procurement meetings</p> <p>Specify prerequisites for operations within objects and that work follows them, routines and is kept within budget</p> <p>Along with responsible planner develop time plans for prep. work and realization of decided maintenance/modification work</p> <p>Coordinate own activities with other objects</p> <p>Summon and lead meetings</p> <p>Represent objects in turnaround meetings</p>	<p>Authority according to established budget and attestation rules</p> <p>Responsible for risk analyses in own area</p> <p>Responsible for operations in own area</p>

	Objective	Main tasks	Responsibility & authority
Object Manager Equipment	Lead activities within equipment areas / objects / categories	<p>Assure preparation and project plans for turnaround objects</p> <p>Attend budget work for objects</p> <p>Attend risk analysis work for objects</p> <p>Attend procurement meetings</p> <p>Along with responsible planner develop time plans for prep. work and realization of decided maintenance/modification work</p> <p>Coordinate own activities with other objects</p> <p>Summon and lead meetings</p> <p>Represent objects in turnaround meetings</p> <p>Develop checklist</p>	<p>Authority according to established budget and attestation rules</p> <p>Responsible for risk analyses in own area</p> <p>Responsible for operations in own area</p>

	Objective	Main tasks	Responsibility & authority
IT Coordinator	Create prerequisites for a working IT structure and service IT systems	<p>Make sure all IT, software as well as hardware requirements for the turnaround are met</p> <p>Along with suppliers and entrepreneurs make sure that all IT related work flows efficiently</p> <p>Create a complementary IT organization and network for the turnaround</p> <p>Support suppliers and entrepreneurs</p>	<p>Responsible for all IT activities</p> <p>Authority according to affirmed budget and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Procurement Coordinator	<p>Assist turnaround objects/partial turnaround projects with procurement</p> <p>Develop and apply procurement routines and secure the most beneficial entrepreneurs, material etc. regarding price, quality and lead time</p>	<p>Provide updated supplier register</p> <p>Provide updated supplier evaluations</p> <p>Along with responsible managers decide upon strategy for procurement</p> <p>Compile quotes</p> <p>Lead supplier/entrepreneur negotiations and evaluations</p> <p>Lead quotation evaluations</p> <p>Place orders</p> <p>Delivery follow-up</p> <p>Attend supplier visits</p> <p>Develop and compile templates for supplier /entrepreneur evaluations</p> <p>Lead negotiations with suppliers/entrepreneurs after turnaround</p>	<p>Responsible for procurement according to company policy</p> <p>Responsible for procurement according to best possible price, quality and lead time</p>

	Objective	Main tasks	Responsibility & authority
Inspection Coordinator	Coordinate all inspection activities related to plant and equipments safety	Coordinate all inspections initiated by the inspection department Coordinate all resources related to inspection activities Preparation work for inspection activities Compile and update inspection activities Develop checklists for inspections Make sure an entrance guard are present for “interior” inspections	Authority according to established budget and attestation rules Responsible for checklist updates Responsible for archiving of inspection documents

	Objective	Main tasks	Responsibility & authority
Quality Coordinator	Coordinate all activities related to quality	Develop, compile and lead quality courses Engage in entrepreneur negotiations Compile and coordinate quality revision groups Develop material and routines for continuous quality work Investigate quality deviations Compile and follow up quality deviations Attend in development and update of checklist Coordinate all resources related to quality	Authority according to established budget and attestation rules Responsible for update of checklist Responsible for update of routines and instructions for quality work

	Objective	Main tasks	Responsibility & authority
Production Coordinator	Lead all production activities in assigned area during turnaround	Preparation and planning of production activities Produce and review riskanalysis Budget work Procurement work Specify and supervise prerequisites Produce shutdown and startup plans together with turnaround manager Coordinate production activities with other activities Summon and lead follow up meetings Represent production in other meetings Produce and update checklists	Risk analyses Production activities Checklists

	Objective	Main tasks	Responsibility & authority
Contract and Procurement Coordinator	On behalf of the TA Manager lead and coordinate all contracts for TA Objects and projects. Develop and assure application of procurement routines to assure the most favorable contractor, material and rental agreements regarding quality, cost and lead time	Provide an updated supplier register Provide updated supplier evaluations Together with the responsible at each TA object decide upon strategies on procurement Develop commercial parts of basic data inquiries. Compile letter of enquiry according to strategy Lead negotiations with suppliers Establish agreements/contracts Lead evaluations of inquiries Place orders according to attested purchase data from the budget responsible Surveil deliveries Attend supplier visits Develop and compile material for supplier evaluation and lead the evaluation work Lead negotiations with suppliers	Responsible for procurement according to the company's established policy Authority to take direct contact with personnel in the TA Authority and responsibility according to governing documents

	Objective	Main tasks	Responsibility & authority
Planning Coordinator	On behalf of the TA Manager develop plans and reports for control and follow up of activities	<p>Develop main time plans for all phases of the TA</p> <p>Assure planning and scheduling of activities</p> <p>Coordinate planning and scheduling resources</p> <p>Attend update work on instructions for planning and scheduling of work orders</p> <p>Schedule planned work orders transferred from maintenance system, analyze critical path and compile work and resource plans</p> <p>Update plans</p> <p>Retrieve and administer reports from planning system</p> <p>Together with Area/Object Managers develop the prerequisites for activities and control the conformance with these plans</p> <p>Summon and lead planning meetings</p>	<p>Responsible for planning routines and plans</p> <p>Authority according to budget, governing documents and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Work Environment Coordinator	On behalf of the Work and Safety Coordinator coordinate activities related to work environment	<p>Attend coordination of work environment activities</p> <p>Assure that laws, routines and specifications related to work environment are followed</p> <p>Lead/attend safety and observation rounds</p> <p>Develop all material for continuous work with work environment</p> <p>Attend development work for work environment routines</p> <p>Investigate by management chosen work environment deviations</p> <p>Attend compilation and analyze work of work environment deviations</p>	<p>Responsibility and authority according governing documents</p>

	Objective	Main tasks	Responsibility & authority
Coordinator for Company Health Service	On behalf of the Safety and Work Environment Manager coordinate activities related to the company health service	<p>Work with preventive and acute health care</p> <p>Coordinate procurement for the company health care services</p> <p>Plan resources</p> <p>Coordinate and assure execution of drug tests</p> <p>Develop routines for company health care services</p> <p>Investigate by management chosen deviations</p>	<p>Responsibility and authority according to governing documents</p> <p>Responsible for updating of checklists of own activities</p> <p>Responsible for updating of routines and instructions for company healthcare</p>

	Objective	Main tasks	Responsibility & authority
Mercantile Coordinator	On behalf of Object Management create prerequisites for planned activities to continue according to plan.	<p>Assist object managers with coordination and management of planned work</p> <p>Along with contractors and suppliers assure work is conducted with a minimum of disturbance</p> <p>Assure equipment such as; Temporary kitchen, dining room, kiosks, restaurant equipment, serving schedule and open hours, menus etc.</p>	Responsibility and authority according to governing documents

	Objective	Main tasks	Responsibility & authority
Process Safety Coordinator	On behalf of the Safety and Work environment coordinator coordinate all activities related to process safety	<p>Attend in resource coordination of process safety activities</p> <p>Assure that laws, specifications and routines related to process safety are followed</p> <p>Conduct risk analyzes on process safety</p> <p>Develop maps over the facilities with marked risk areas</p> <p>Lead safety and observation rounds</p> <p>Attend development work for process safety</p> <p>Attend in compile and follow up work on deviations in process safety</p> <p>Investigate by management chosen deviations</p>	<p>Responsibility and authority according to governing documents</p> <p>Responsible for updating checklists of own work</p> <p>Responsible for updating routines and instructions regarding process safety</p>

	Objective	Main tasks	Responsibility & authority
Service Coordinator	On behalf of Object Management create prerequisites for planned activities to follow plan.	<p>Assist Object Manager with coordination and management of planned activities</p> <p>Along with contractors and suppliers assure work is conducted with a minimum of disturbances</p> <p>Along with contractors and suppliers assure that security, safety and permit regulations can be applied with minimum disturbance of work</p> <p>Assure that time reporting routines are followed</p> <p>Report the development of work within the object</p> <p>Support contractors and suppliers on routines, instructions and systems</p>	<p>Responsibility and authority according to governing documents</p>

	Objective	Main tasks	Responsibility & authority
Equipment Coordinator	On behalf of the Object Management create prerequisites for planned activities to follow plan.	<p>Assist Object Manager with coordination and management of planned activities</p> <p>Along with contractors and suppliers assure work is conducted with a minimum of disturbances</p> <p>Along with contractors and suppliers assure that security, safety and permit regulations can be applied with minimum disturbance of work</p> <p>Assure that reporting routines are followed</p> <p>Report development of work at the object to TA planners</p> <p>Support contractors and suppliers on routines, instructions and systems</p> <p>Compile and coordinate all management of work packages within own object management</p>	<p>Responsibility for the quality and logistics of work packages</p> <p>Authority according to budget, governing documents and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Accounting Coordinator	On behalf of the Cost Controllers develop routines on budgeting, cost follow up and reporting on the TA	<p>Along with the Cost Controller develop routines on budgeting and accounting</p> <p>Attend in the work to develop a work order structure</p> <p>Develop and administer basic data for budget follow up</p> <p>Attend in procurement work regarding agreements to assure invoice control and good accounting routines</p> <p>Assist TA Management with reports needed for reporting of TA budget</p> <p>Be a contact link between TA Organization and Accounting</p>	<p>Authority according to budget, governing documents and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Security and Surveillance Coordinator	On behalf of the Safety and Work Environment Coordinator coordinate all activities related to security and surveillance	Attend work with resource coordination for security and surveillance Coordinate material procurement related to security and surveillance Develop routines for security and surveillance Investigate by management chosen deviations Plan for testing of work areas for permit releases Coordinate management of entry cards	Responsible for updating routines on security and surveillance Authority according to budget, governing documents and attestation rules

	Objective	Main tasks	Responsibility & authority
Coordinator Investment Objects	On behalf of the object manager coordinate all activities related to investment projects	Coordinate all activities initiated as investment projects, through all phases of the TA Assure that activities related to investments are planned and scheduled according to instructions Assure that TA related investment projects are coordinated with other activities in the TA Create and update checklists for own activities Coordinated all resources related to investment projects	Responsible for checklists concerning own activities Responsible for debriefing on TA related investment projects

	Objective	Main tasks	Responsibility & authority
Coordinator Process technology	On behalf of the TA manager coordinate all activities concerning process technology	Coordinate all activities initiated by process technology Inventory need of material related to process technology Attend in planning of activities and creation/updating of checklists related to process technology Coordinate all resources related to process technology, through all phases of the TA Assure that entrance guard is present on interior process inspections	Authority according to governing documents and manuals Responsible for updating of checklists regarding own activities

	Objective	Main tasks	Responsibility & authority
Coordinator External Environment	On behalf of the TA manager coordinate all activities concerning external environment	<p>Compile material for and conduct education related to external environment</p> <p>Attend contractor procurement for waste management</p> <p>Coordinate logistics for waste management</p> <p>Compile material for continuous work with external environment</p> <p>Develop routines on external environment</p> <p>Investigate, by management appointed, deviations related to external environment</p> <p>Compile and follow up on deviations concerning external environment</p> <p>Update checklists concerning own activities</p> <p>Coordinate all resources related to external environment</p>	<p>Authority according to governing documents, manuals, budget and attestation rules</p> <p>Responsible for updating of checklists regarding own activities</p> <p>Responsible for production and registration of relevant documents to the authorities</p> <p>Responsible for all waste management and updating routines and instructions concerning EE</p>

	Objective	Main tasks	Responsibility & authority
Coordinator for Safety and Work Environment	On behalf of the TA Manager coordinate all activities within work environment and safety	<p>Coordinate all activities within work environment and safety</p> <p>Coordinate resources concerning security guards, surveillance, fire related, process security and personnel health</p> <p>Develop, and coordinate management of, risk analysis and rescue plans</p> <p>Coordinate management of safety and observation rounds</p> <p>Attend in entrepreneur procurement meetings</p> <p>Assure compilation of material and realization of educations in work environment and safety</p> <p>Develop routines and material for the continuous safety work</p> <p>Investigate, by management chosen, incidents</p>	<p>Authority according to governing documents, manuals, budget and attestation rules</p> <p>Responsible for update of routines and instructions concerning work environment and safety</p> <p>Responsible for development and registration of relevant documents with authorities</p>

	Objective	Main tasks	Responsibility & authority
Planner	On behalf of the planning coordinator develop and provide plans and reports necessary for follow up and management of activities in all phases of the TA	<p>Schedule planned activities according to established routines and instructions</p> <p>Along with Object/Area Managers plan prepared work orders from maintenance software system. Analyze critical line and compile work and resource plans</p> <p>Collect data for follow up on plans and update these</p> <p>Along with Object/Area Managers define prerequisites for the operations and assure fulfillment thereof</p> <p>Summon and lead planning meetings</p>	Authority according to budget, governing documents and attestation rules

	Objective	Main tasks	Responsibility & authority
Scheduler	On behalf of the TA Manager assure scheduling of planned activities according to given instructions	<p>Collect all data needed for the execution of activities specified in a work order; work activities, tools, material and services</p> <p>Compile inquiry requisition and conduct call offs on scheduled work orders</p> <p>Communicate with and retrieve information from other concerned disciplines</p> <p>Inform concern disciplines on the work scope</p> <p>Compile work packages for work areas</p> <p>Compile work packages for conducted work orders</p> <p>Schedule additional work</p>	Responsibility and authority according to governing documents

	Objective	Main tasks	Responsibility & authority
Cost Controller	On behalf of the TA Manager prepare a budget, assist in control and follow up on costs and time in all phases of the TA. Attend in development of and application of procurement routines and participate to assure the most favorable contractor, material and rental agreements.	<p>Together with responsible functions within the organization review activities and from these collect information on costs to support the budget, forecast and real cost work. Work out sufficient cost and time margins</p> <p>Coordinate activities related to entrance routines, time reporting and accounting</p> <p>Follow up, analyze, forecast and report costs</p> <p>Assure that the right cost allocations are made</p> <p>Establish suitable values for cost measurement</p> <p>Develop and maintain a standard for cost control</p>	<p>Responsible for the cost control within the TA organization</p> <p>Authority according to budget, governing documents and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Time Reporter	On behalf of TA Manager/Cost Controller control entrances vs. reported time on a daily basis	<p>Control entrance time vs. reported time</p> <p>Register and correct worked hours and use of equipment according to data on time cards provided by work management</p> <p>Print reports, organization plans for attestation and finish as well as distribute reports</p> <p>Attend in administrative assignments</p>	<p>Responsibility for direct contact with work management regarding reporting</p> <p>Authority according to budget, governing documents and attestation rules</p>

	Objective	Main tasks	Responsibility & authority
Project Assistant	Perform and coordinate activities needed for documentation and circulation of information	<p>Assure information reaches concerned persons and depts.</p> <p>Coordinate recruitments and educations</p> <p>Circulate turnaround information in-house</p> <p>Compile and circulate meeting invitations</p> <p>Develop and maintain documentation structure</p> <p>Write and compile documentation for the turnaround</p> <p>Develop material for turnaround information folders</p> <p>Responsibility for parts of infrastructure</p>	<p>Authority according to governing documents and attestation rules</p> <p>Authority to order office material</p> <p>Responsible for office material</p> <p>Responsible for compiling of and distribution of turnaround information</p> <p>Responsible for catalogue structure and read/write authorities</p>