Challenges in the Development of a Project Management Office (PMO) for Turnaround Projects in the Process Industry

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Abstract
Turnaround projects are common and of paramount importance in the process industry, due to the complexity of operating production systems and the investment in capital equipment. Their frequency of occurrence lies between three and five years and their execution necessitates partial or complete pause of the production activity. These projects are, typically, characterized by intense execution of a broad scope in a short time, high cost, involvement of numerous and various resources, and strict safety regulations. Efficient project management tools and techniques, structured management and maintenance processes and close planning and monitoring activities are thus essential to achieve the project objectives.
This article presents a pragmatic case of implementation of a Project Management Office (PMO) for the purposes of managing turnaround projects in the refinery industry. This work attempts to highlight the challenges that were faced and the tactics to achieve the optimum result in a highly multi-disciplinary environment subject to the constraints and objectives of the project. This effort was based on the fundamentals of the PMI® processes and led to a lean subset that proved to enhance the management efficiency, to increase control and to minimize risks. These customized processes are presented herein; findings and suggestions for improving the applied practices can be extended to other process industries as well.

Introduction

Process industries, such as, mining, steel, and refineries, are industries where production is largely supported by the capital equipment, and consequently factors such as effectiveness, efficiency, reliability and maintenance of equipment are of vital importance for the uninterrupted, continuous and efficient operation. In a refinery environment, in particular, turnaround maintenance projects occur every 3-5 years depending on the type of units, while intermediate "pit-stops" may also appear. This work is expensive, encloses high risk, requires a large number of human resources and lasts

approximately one month. Moreover, the cost of maintenance is added to the losses for non-producing, thus rendering these projects of paramount importance in the life of the industry. As a result, the proper management of such projects is vital to the profitability of the company and to its competitive advantage, as it decreases the expenses and adds quality. The need to establish a project management office that is responsible for developing and applying project management tools and techniques for project planning, execution and control, emerges as the obvious need, and contributes to the competitive advantage of the enterprise.

The purpose of this article is to analyze the development of such a PMO -oriented to the management of turnaround maintenance projects- along the lines recommended by the Project Management Institute (PMI®) and to present the challenges that were encountered. The case study presented herein is pragmatic. The project management processes utilized at the specific project are specified and suggestions based on the findings are made. The nature of the work itself (high cost and short duration) makes it imperative to adopt the suggested methods for the execution of such projects and to overcome identified problems in the future.

Project Management Office

A Project Management Office (PMO) is an organizational entity established to assist project managers, teams and various management levels on strategic matters and functional entities throughout the organization in implementing PM principles, practices, methodologies, tools and techniques (PMBOK® Guide, 2008). The establishment of such an office improves PM effectiveness, particularly by enabling the acquisition of knowledge from earlier failures and successes and by providing a range of support and facilitative services not only for projects but also for various management levels and support units. An ad hoc approach to PM leads to inefficiencies and can even be dangerous, while establishment of a PMO can foster consistency and nurture PM professionalism.

Although a standard set of PMO presence features has yet to be agreed upon in theory or practice, the literature review led to the identification of the categories enumerated below (PMBOK® Guide, 2008):

- Development and maintenance of PM standards and methods
- Development and maintenance of project historical archives
- Provision of project administrative support
- Provision of human resource/staffing assistance
- Provision of PM consulting and mentoring
- Provision or arrangement of PM training

In the examined case, no formally established PMO existed; however, the office pursuing PMO activities did have resources providing PMO functions and services to project managers and teams. Eventually, the formal establishment of a PMO became a necessity for managing the Turnaround maintenance projects.

Essence of a Turnaround Project

In the process industry, project management refers to the management of new projects such as building a new plant or expanding an existing production plant, revamping projects to increase the operating capacity of equipment for higher output, and plant shutdowns for maintenance and repair. Maintenance projects in the processing industry (often referred to as turnaround maintenance (TAM) projects) are of highest priority as they look beyond reactive and preventive maintenance to totality of a business operation policy, and more emphasis is given in monitoring the product quality and the condition of equipment. TAM is a periodic maintenance in which plants are shutdown to allow for inspections, repairs, replacements and overhauls that can be carried out only when the assets (plant facilities) are taken out of service. Such a maintenance process is necessary to avoid unscheduled breakdowns which can have significant impact on the revenues. A proper maintenance can lead to increased reliability and technical integrity that leads to a more predictable workload in the industry and effective maintenance work planning.

Because of the complexity and size of a TAM project, the successful accomplishment of this event in terms of quality and cost is vital to the profitability of the company and to its competitive advantage. TAM projects are characterized by intense labor conditions, broad scope, high costs, strict safety regulations, variety of resources, contract scrutiny and conformation to quality standards. For these reasons, it is important for such companies to have a sound process for planning and managing the events. Sound procedures must be in place to make the process of conducting TAM at petrochemical plants more efficient and cost effective. The processes outlined herein are thus expected to assist planners and engineers obtain a comprehensive view of the turnaround management process.

Adaptation of PMO processes at the specific project

The project management team, in an attempt to implement a Shutdown PMO (SPMO), proceeded first with the identification and adaptation of specific processes along the standards of the PMI®, for the effective and efficient management of the project. The choice was made carefully and on the basis of covering the specific characteristics of the turnaround maintenance project, as well as the stakeholders' requirements. In the particular case a total of twenty-seven (27) out of forty-two (42) processes, that the model of PMI® includes, were used for the proper management of the project. In this first implementation phase, it was decided that Project Risk Management processes should be included at a later stage, whereas processes from the knowledge areas of cost management, quality management and some from the procurement management were handled by the respective functional departments and were not delegated to the SPMO.

The processes that were developed for the specific project are presented below (Table 1) into the five project management process groups and the nine knowledge areas (PMBOK®). The processes in grey font were not used for the specific project. These processes interact with each other and cross the project phases. Planning processes, for instance, are triggered by Initiating processes and provide input to Execution processes. Moreover, Monitoring and Control processes

provide input to Planning and Execution processes so that the project is properly fulfilled. Closing processes signify the project completion and the development of lessons learned.

Table 1: Project Management Process Groups and Knowledge Areas Mapping

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Execution	1.Monitor and Control Project Work 2.Perform Integrated Change Control	Close Project
Project Scope Management		1.Collect Requirements 2.Define Scope 3.Create WBS		1.Verify Scope 2.Control Scope	
Project Time Management		1.Define Activities 2.Sequence Activities 3.Estimate Activity Resources 4.Estimate Activity Durations 5.Develop Schedule		Control Schedule	
Project Cost Management		1.Estimate Costs 2.Determine Budget		Control Costs	
Project Quality Management		Plan Quality	Perform Quality Assurance	Perform Quality Control	
Project Human Resource Management		Develop Human Resource Plan	1.Acquire Project Team 2.Develop Project Team 3.Manage Project Team		
Project Communications Management	Identify Stakeholders	Plan Communications	1.Distribute Information 2.Manage Stakeholder Expectations	Report Performance	
Project Risk Management		1. Plan Risk Management 2.Identify Risks 3. Perform Qualitative Risk Analysis 4. Perform Quantitative Risk Analysis 5. Plan Risk Responses		Monitor and Control Risks	

Project Procurement Management		Plan Procurements	Conduct Procurements	Administer Procurements	Close Procurements

A short reference to each process adapted at the specific project is quoted below. Each process is presented with the inputs, tools and techniques and the outputs used in managing the specific project. For most processes in the planning group, a schematic flow presentation is provided.
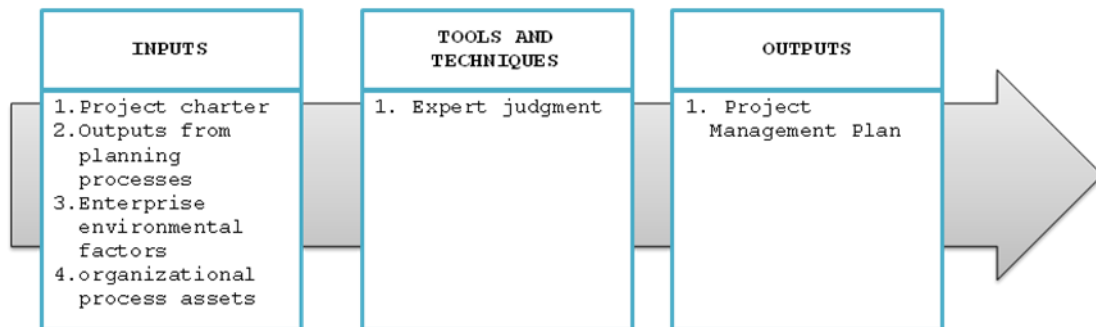
Initiating Processes

Identify Stakeholders
The primary use of the process is to identify all people or organizations impacted by the project, and to document relevant information regarding their impact on project success. Using expert judgment and stakeholder analysis, the stakeholder register was developed.

Planning Processes

Develop Project Management Plan
Project management plan belongs to the Project Integration Management knowledge area and is developed through a series of integrated processes until project closure. Figure 1 shows the flow of activities used for this process.

INPUTS
1. Project charter
2. Outputs from planning processes
3. Enterprise environmental factors
4. organizational process assets

TOOLS AND TECHNIQUES
1. Expert judgment

OUTPUTS
1. Project Management Plan

Figure 1: Develop Project Management Plan

Collect Requirements
The collect requirements process started on October 2010 and was firstly formalized on February 2011. The project charter was primarily used to provide the high-level project requirements. It was accompanied by the primary maintenance project schedule containing the units to be maintained. The requirements collection was performed progressively, using tools and techniques listed in Figure 2 and resulting in the following outputs.
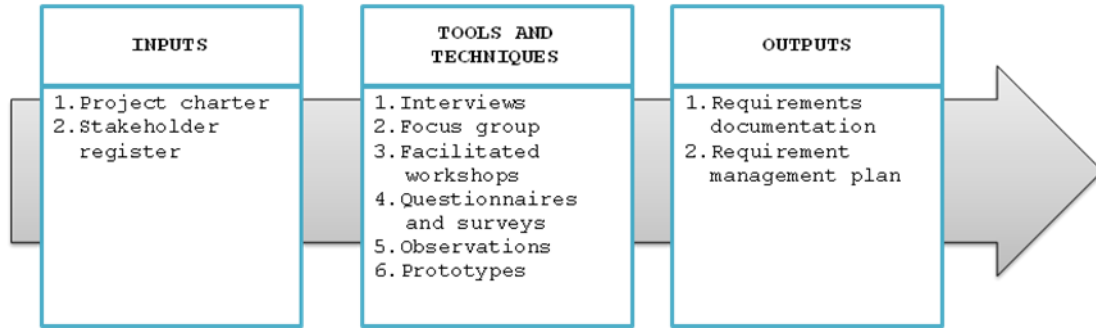
Figure 2: Collect Requirements

Define Scope

During this process, through facilitated workshops, the expert judgment was used to analyze the input information and alternative approaches were identified to execute the project. The output of the scope definition procedure was a project scope statement, which described in detail the project's deliverables and the work required to create those deliverables, enabling the project team to estimate and perform planning and scheduling of the project. Project documents, such as the Equipment Breakdown Structure, were developed and updated.
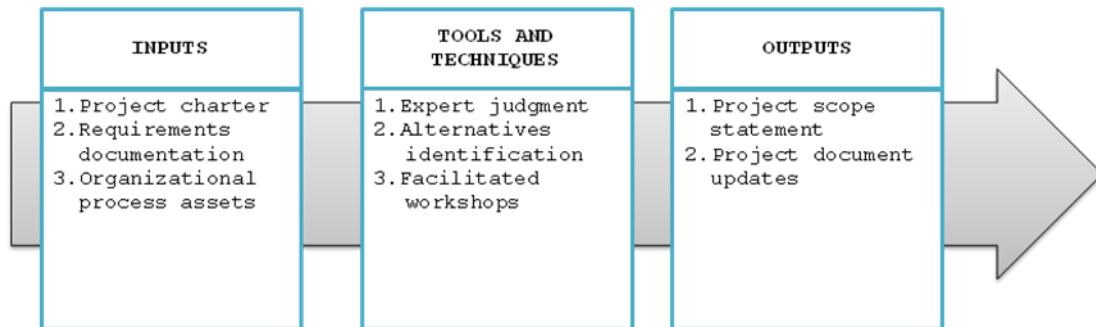

Figure 3: Define Scope

Create WBS

The Work Breakdown Structure (WBS) was developed in parallel with the scope definition process. The project deliverables were decomposed into smaller, more manageable components until the activity durations and the resources assignments could be reliably estimated and managed. The main input elements, outputs and decomposition technique used in this process are presented in Figure 4.
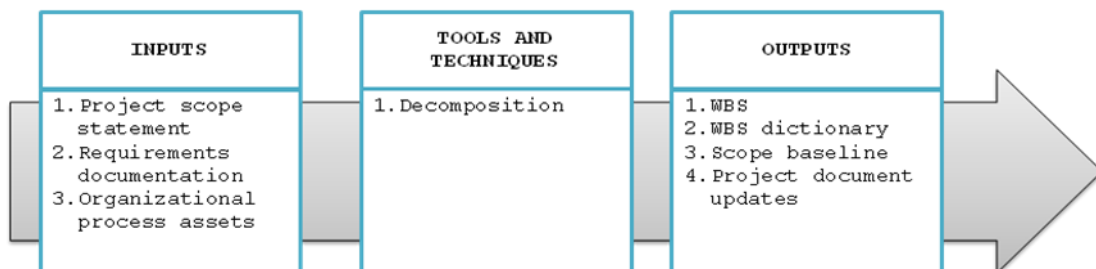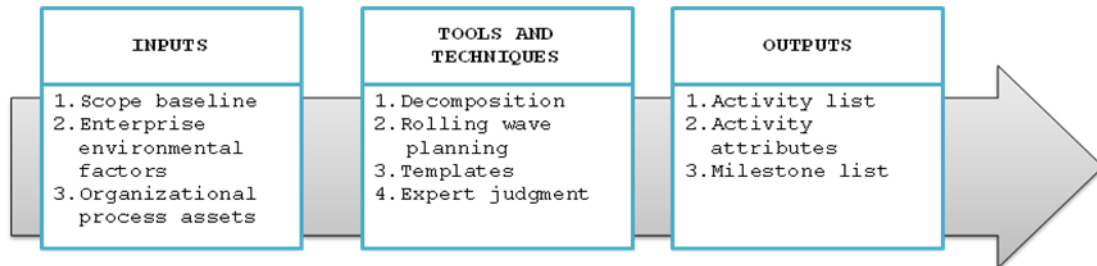

Figure 4: Create WBS
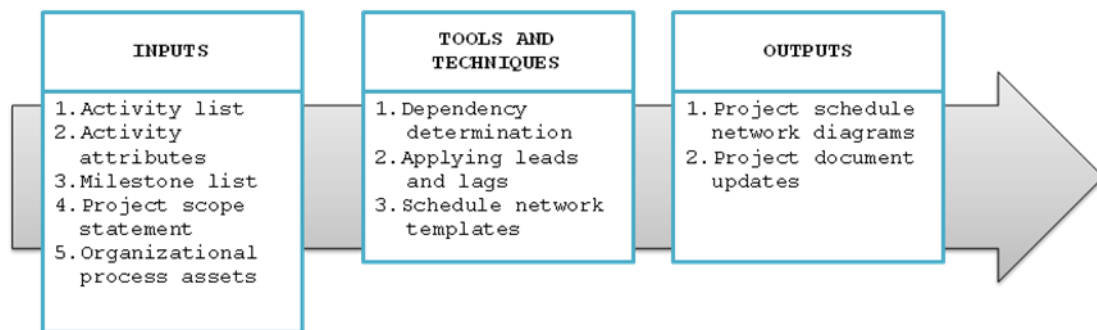
Define Activities

During the process of defining activities (Figure 5), the scope baseline, the equipment that was to be maintained and organizational process assets influenced both the output elements of the process and planning-related policies and scheduling methodology.

**Figure 5: Define Activities**

Sequence Activities

The sequence activities process (Figure 6) was developed primarily according to the turnaround phase, then the development was extended establishing linkages between different phases and finally project schedule network diagrams were developed by linking different equipment of one unit into a master plan. Checks were performed in order to minimize the number of dependencies between activities without losing the logical sequence of the network. That means that every activity should have at least one predecessor and one successor activity. Moreover, milestones were used indicating either the end of a project phase or predicting the start of an activity.

Figure 6: Sequence Activities

Estimate Activity Resources

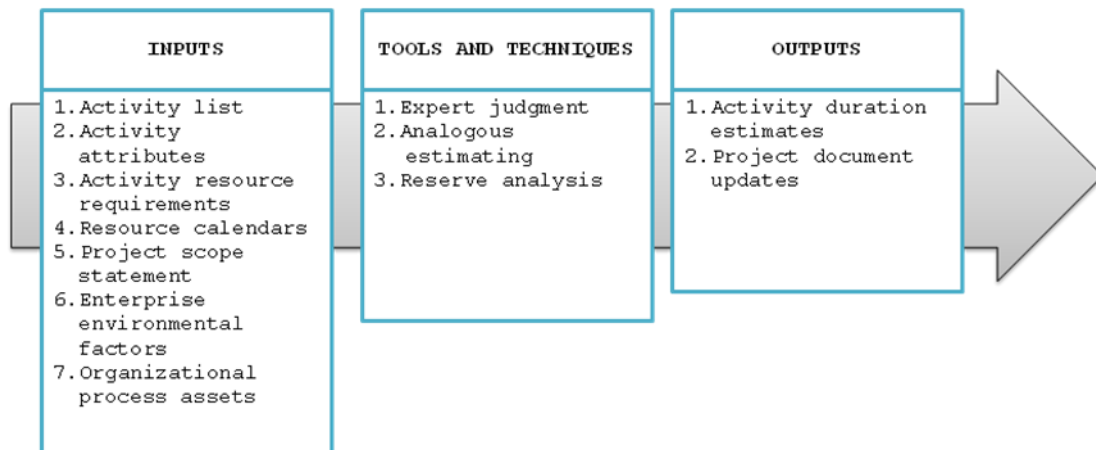Estimate Activity Resources (Figure 7) is the process of estimating the type and quantity of resources required to perform each activity. For the specific case study the resources that were used during the planning procedure were human resources (sorted according to the specialty or the contractor) and equipment. As far as material type resources are concerned, these were recorded by the responsible planning department.
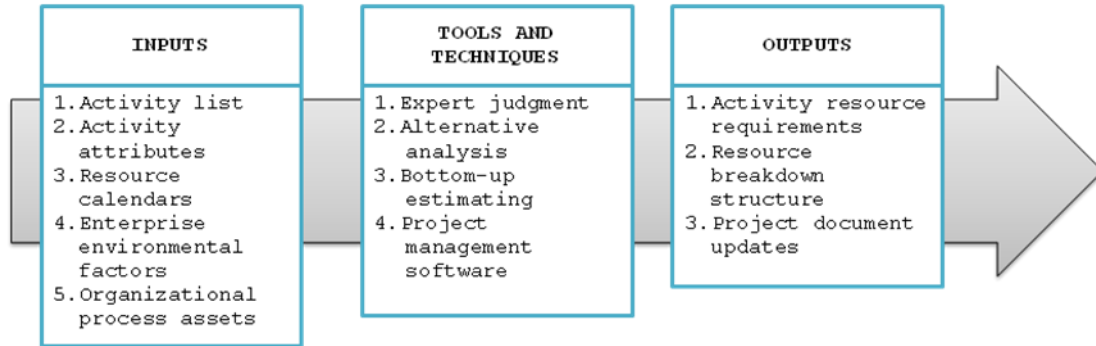
Figure 7: Estimate Activity Resources

Estimate Activity Durations

Estimate activity durations process (Figure 8) lasted long because changes came up during the planning of the project. When the process was finalized, activity duration estimates were produced and the relevant project documents were updated.
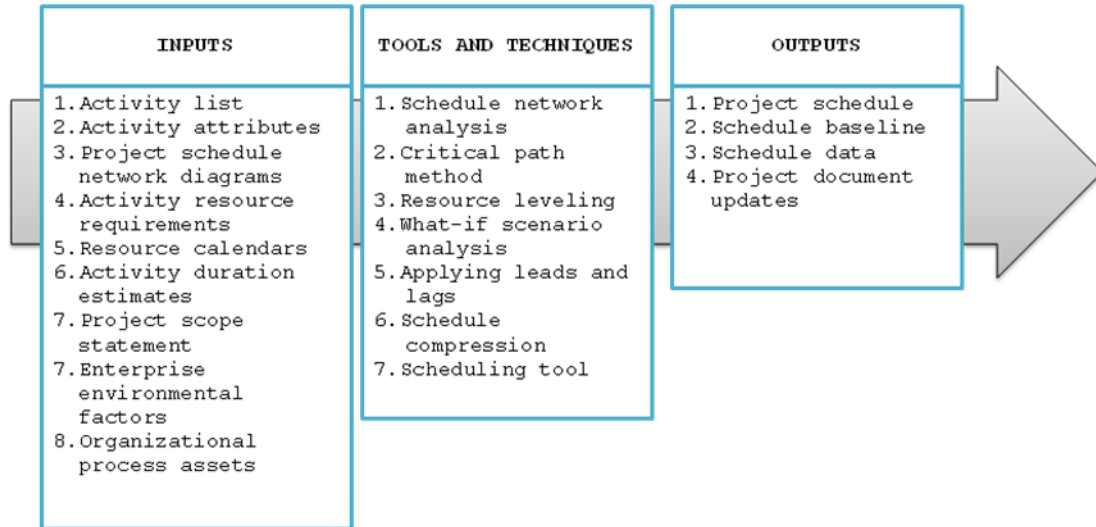

Figure 8: Estimate Activity Durations

Develop Schedule

Develop schedule is the process of analyzing activity sequences, durations, resource requirements and schedule constraints to create the project schedule (Figure 9). Below the basic inputs, outputs and techniques, that were used, are presented.

INPUTS	TOOLS AND TECHNIQUES	OUTPUTS
1. Activity list	1. Schedule network analysis	1. Project schedule
2. Activity attributes	2. Critical path method	2. Schedule baseline
3. Project schedule network diagrams	3. Resource leveling	3. Schedule data
4. Activity resource requirements	4. What-if scenario analysis	4. Project document updates
5. Resource calendars	5. Applying leads and lags	
6. Activity duration estimates	6. Schedule compression	
7. Project scope statement	7. Scheduling tool	
7. Enterprise environmental factors		
8. Organizational process assets		

Figure 9: Develop Schedule

Develop Human Resource Plan

The department of turnaround management contributed to the human resource plan development. In particular, organization charts and position descriptions were utilized and enriched and finally produced the human resource plan.

Plan Communications

Communications planning aimed to defining the communications requirements and determining the appropriate response approach. The input elements of this process were the stakeholder register, enterprise environmental factors, and organizational process assets. The project execution progress was communicated using the following tools and techniques: 1) Communication requirements analysis, 2) communication technology (E-mail) and 3) oral and written communication methods. As a result, the 1) communications management plan was conducted and 2) project documents were updated.

Plan Procurements

The plan procurements process utilized input elements such as the scope baseline, requirements documentation, risk register and risk-related contract decisions, activity resource requirements, project schedule, and activity cost estimates. The process was conducted using make-or-buy analysis and expert judgment and produced as outputs the procurement management plan, procurement statements of work, make-or-buy decisions, procurement documents, and source selection criteria.

Executing Processes

Direct and Manage Project Execution

Direct and manage project execution was based upon the project management plan and approved change requests. The tools and techniques used were expert judgment and project management information systems, providing real time and precise information. The outputs of this procedure were the project deliverables, work performance information, change requests, project management plan updates, and project document updates.

Acquire Project Team

The Acquire Project Team process utilized the project management plan, enterprise environmental factors and organizational process assets. Pre-assignments were performed in basic activities. In some cases, the performing organization lacked the in-house staff needed to complete some activities, so extra personnel were temporarily hired. Outputs of the above procedure were the project staff assignments, resource calendars and project management plan updates.

Develop Project Team

Project staff assignments, project management plan and resource calendars were used as input elements of this process. Crucial role for the project team development played the 1) interpersonal skills, 2) training, 3) co-location of the most active team members in order to enhance their ability to perform as a team, and 4) ground rules for acceptable behavior and operation. The process outputs contributed to 1) team performance assessment and 2) enterprise environmental factors updates.

Manage Project Team

Project team management process utilized 1) project staff assignments, 2) project management plan, 3) performance reports and 4) organizational process assets, such as meeting charts, inspection reports etc. Through project performance appraisals and conflict management techniques, 1) change requests, 2) project management plan updates, 3) organizational process assets updates and 4) enterprise environmental factors updates have arisen.

Distribute Information

The distribute information process is included in the communications management plan, which is part of the project management plan. The information to be distributed included performance reports and organizational process assets. The information distribution was performed using 1) hard-copy documents and 2) electronic communication. Information distribution resulted in organizational process assets updates.

Manage Stakeholder Expectations

Manage stakeholder expectations utilized 1) stakeholder register, 2) project management plan and 3) organizational process assets to meet stakeholder expectations, with the contribution of 1) communication methods and 2) management skills. Organizational process assets updates, project management plan updates, project document updates and change requests were outputs of this process.

Conduct Procurements

Conduct procurements process utilized the following elements: 1) Project management plan, 2) procurement documents, 3) source selection criteria, 4) qualified seller list, 5) seller proposals, 6) project documents, 7) make-or-buy decisions and 8) organizational process assets. The tools and techniques used for this process were: 1) Bidder conferences, 2) proposal evaluation techniques, 3) independent estimates, 4) expert judgment and 5) procurement negotiations. Finally, a 1) procurement contract was awarded to the 2) selected sellers, who provided information about 3) the resource calendar of their staff. Change requests, project management plan updates and project document updates also arose.

Monitoring and Controlling Processes

Monitor and Control Project Work
This process utilized 1) the project management plan, containing the goals and objectives of the project, 2) performance reports, 3) organizational process assets and 4) enterprise environmental factors, such as strikes, company work authorization system, etc. Based on expert judgment, this process resulted in 1) change requests, 2) project management plan updates and 3) project document updates.

Perform Integrated Change Control
This process is crucial for the completion of the project and is applied throughout the project planning and executing phases. The main input activities for this process were 1) the project management plan, 2) work performance information, 3) change requests, 4) organizational process assets and 5) enterprise environmental factors. The change approval or rejection decision was based on expert judgment and was taken during change control meetings. The output activities of this process were 1) change requests status updates, 2) project management plan updates and 3) project document updates.

Verify Scope
Verify scope process was based on the 1) project management plan, the 2) requirements documentation and the 3) validated deliverables. Through inspection technique, 1) accepted deliverables, 2) change requests and 3) project document update arose.

Control Scope
Controlling scope was one of the most crucial processes for the execution of the project. The 1) project scope management plan and the 2) requirements documentation were used as primary information for this process. Both 3) work performance information and 4) organizational process assets were collected every day and were used to determine the necessity of corrective actions and changes. Variance analysis was performed, based on earned value management technique. The results of this process were: 1) Work performance measurements, 2) project document updates, 3) organizational process assets updates, 4) change requests and 5) project management plan updates.

Control Schedule
Control schedule requires high performance speed and precision, that is related to the activity planning and the information being gathered. Control schedule process utilized 1) project management plan, 2) project schedule, 3) work performance information and 4) organizational process assets. The following techniques were used: 1) Performance reviews 2) variance analysis, 3) project management software, 4) resource leveling or 5) adjusting leads and lags, 6) schedule compression, 7) what-if analysis scenarios were developed in order to predefine the impact of various changes and finally, project management software was used as scheduling tool for the above techniques. Control schedule process resulted in 1) work performance measurements, 2) project document updates, 3) organizational process assets updates, 4) project management plan updates and 5) change requests.

Report Performance
Report performance process required the 1) project management plan, 2) work performance information and 3) work performance measurements, and

4) organizational process assets. All these elements were used to stimulate the variance analysis technique. Furthermore, real-time forecasting methods were used, based on earned value management. Electronic communication methods and reporting systems were also used to report daily performance. The outputs of the process were: 1) Performance reports, 2) organizational process assets updates and 3) change requests.

Closing Processes

Close Project
Close project is the process of finalizing all activities across all the project management process groups to formally complete the project. The input elements of this process were the 1) project management plan, the 2) accepted deliverables and 3) organizational process assets, and using expert judgment, the process resulted in 1) the completion and transition of the final product, 2) an updated knowledge database and 3) updated project files and reports.

Findings – Suggestions for the future

The application of the project management processes to the turnaround project resulted in conclusions and recommendations presented below. These recommendations could be a basis for proper turnaround project management in process industries. The main findings are presented below:

- The use of project management tools and techniques is very useful for turnaround maintenance due to the complexity of the process, the high cost, high risk, the large amount of resources involved and the short duration. A formal organizational structure, a PMO, is very essential for the proper management of such projects.
- The development of a formal project management plan that would be available to the stakeholders at the initial phase of a turnaround project, involving guidelines, regulations, project schedules, lessons learned etc, would be essential for its success.
- It is of great importance that the necessity and high value of collect requirements process should be clarified to all stakeholders during the planning process. Many conflicts and bad cooperation can be avoided in case of a better understanding of the process. As far as the finalized scope is concerned, this should be defined early, before the project execution begins. This can lead to a better understanding of the activities that have to be performed, in-time project scheduling and coordination of the project related procedures.
- The work to be executed was decomposed in such a detail that each activity was clearly and uniquely defined. This remains a good practice to follow in turnaround projects.
- The processes of sequencing activities and estimate activity resources took long time to be completed. Best practice should be the planning of these processes to have finished before the project start date.
- Estimate activity duration is a time consuming process. It requires continuous communication between the responsible parts to assure that the correct information will be extracted and used to schedule the project. As best practice would be recommended the participation

of as many responsible persons as possible and the effective communication between them.

- Developing schedule is an extensive and complicated process because of the large number of activities in conjunction with the large number of stakeholders, the deadlines and the enterprise requirements. As a result, the more accurately a new project schedule is developed the better, as it would become a basis for future use and precious time could be saved. Furthermore, the activity definition should comply with the one that contractors provide for their work. The degree of decomposition should follow the 1%-10% rule. Finally, because of the complexity of the process, the planning procedure should be under the responsibility of the PMO, so that conformation to rules, common terminology and planning specifications and project monitoring could be followed.
- Communications management is one of the key elements of managing turnaround projects because of the large number of information and stakeholders. Main consideration for the communications planning improvement could be the proper use of communication methods from the early project planning phase, so that more accurate planning is performed. Moreover, staff training on using communication tools is of great importance.
- Procurement planning should be performed formally, using specific source selection criteria and procurement metrics to manage sellers.
- One of the major problems in turnaround projects is the changing project scope. In the case project, there was large number of change requests that resulted in scope doubling. The ground reason for this was the lack of understanding of the necessity of scope definition and the uncontrolled approval and rejection of change requests. What is suggested is re-planning of the integrated change control process. That means, establishing a controlled change request approval and rejection system and a change control board constitution responsible for reviewing, evaluating, approving or rejecting changes, with all decisions and recommendations being recorded.
- Report performance process should be conducted in an integrated way. Information about the progress of work should be gathered from all the related departments, and the progress reporting and communications should be properly managed.

Conclusions

In this paper a structured PMO approach for managing Turnaround projects has been outlined. The main activities in the five main process groups – initiating, planning, executing, monitoring and controlling, and closing - have been discussed. The current practices have been applied to a refinery and possible improvements to the turnaround management processes have been suggested. Lessons learned from a turnaround maintenance project should be documented and best practices should be shared so that overall efficiency can be increased across the industry.

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