Organizational Context Approach in the Establishment of a PMO for Turnaround Projects: Experiences from the Oil & Gas Industry

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Abstract

Turnaround (general maintenance) projects are typically very costly, enclose high risk, require a large number of human resources to be involved and have a short duration (between 4 to 6 weeks); moreover, the cost of maintenance works is added to the losses for non-producing, thus rendering these projects of paramount importance in the life of the industry. Turnarounds take place periodically, every 3-5 years, depending on the type of units, the status of the equipment, the infrastructure or reforming works that need to be done, the economic condition of the company, the need to increase efficiency in certain units, etc. The increased complexity of such projects along with the need to achieve all critical targets (scope, time, cost, quality) without discounts and, at the same time, to respect health and safety rules and regulations, dictates the need to establish a project management office (PMO).

This work focuses on the development of such a PMO for turnaround maintenance projects, based on the standards recommended by the Project Management Institute (PMI®). The PM processes are selected and adapted to respond to the needs of turnaround projects, respect the nature of the projects (high cost, short duration, high risk, impeccable scope), and form a set of suggested tools to be adopted in such projects. The work is corroborated by a pragmatic case study which highlights the challenges that were encountered.

Keywords: project management, project management office, turnaround projects, maintenance, process industry

1. Introduction

The key characteristic of process industries, such as, refineries, is that their production is supported by complex capital equipment and machinery. Proper maintenance of these assets increases their reliability and effectiveness. Reliability is synonymous to uninterrupted operation and is ensured when maintenance activities are enforced. Such maintenance is primarily

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proactive and may or may not affect the operation of a unit. If the equipment is non-critical, its operation may be undertaken by a substitute item while the equipment is being maintained; otherwise, pause of the operation may be required. In order to increase operational reliability, refineries typically execute general plant maintenance projects, which involve a large number of operational units (Tsang, 1998). These projects are called turnaround or shutdown projects. Intermediate “pit-stops” involving lesser units and with a lesser maintenance scope may also take place.

Turnarounds take place periodically, every 3-5 years, depending on the type of units, the status of the equipment, the infrastructure or reforming works that need to be done, the economic condition of the company, the need to increase efficiency in certain units, etc. Such a project is very costly, encloses high risk, requires a large number of human resources to be involved and has a short duration (between 4 to 6 weeks); moreover, the cost of maintenance works is added to the losses for non-producing, thus rendering these projects of paramount importance in the life of the industry (Tsang, 2002).

The increased complexity of such projects along with the need to achieve all critical targets (scope, time, cost, quality) without discounts and, at the same time, to respect health and safety rules and regulations, dictates the need to establish a project management office (PMO). Such PMO should be responsible for developing and applying PM tools and techniques for project planning, execution and control, and contributes to the competitive advantage of the enterprise, as it forms the conditions for company profitability and creation of competitive advantage.

This paper focuses on the development of such a PMO for turnaround maintenance projects, based on the standards recommended by the Project Management Institute (PMI®). The PM processes are selected and adapted to respond to the needs of turnaround projects, respect the nature of the projects (high cost, short duration, high risk, impeccable scope), and form a set of suggested tools to be adopted in such projects. The work is corroborated by a pragmatic case study which highlights the challenges that were encountered.

2. Essence of Turnaround Projects and the Need for PMO

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 periodic and 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 (Benaya, 2007). Such a maintenance process is necessary to avoid unscheduled breakdowns which can have significant impact on the revenues.

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; procedures must be in place to make the process of conducting TAM at petrochemical plants more efficient and cost effective (Shaligram, 2008).
A Project Management Office (PMO), on the other hand, 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 a PMO 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 (Obiajunwa, 2007). 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, a PMO typically deals with the development and maintenance of PM standards, methods and project historical archives, the provision of project administrative support, PM consulting & mentoring, the assistance on human resources and staffing, as well as provision or arrangement of PM training (Duffua Salih, 2004). In a process industry environment, a PMO should cross these boundaries and deal in a holistic mode with the development of the project plans, the coordination of procurements, the cost control, the resources selection and assignment, the management of risks, the enforcement of health and safety regulations, the coordination of communication, and, last but not least, the real-time progress tracking. In the examined case, no formally established PMO existed but rather a team that provided basic PMO functions and services. Eventually, a PMO was formally established for managing the Turnaround maintenance projects and was named SPMO (for Shutdown PMO).

The SPMO first proceeded 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 thirty-six (36) out of forty-two (42) processes, that the model of PMI® includes, were used for the proper management of the project. In this phase, it was decided that the Develop Project Charter process, the processes from the knowledge area of quality management and two processes from the procurement management were handled by the respective functional departments and were not delegated to the SPMO (Emiris, 2012). The resulting processes have significantly fewer elements (inputs, outputs, tools and techniques) as they are focused and adapted to the particular field of application.

3. The SPMO Implementation

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. A short reference to each process adapted at the specific project is quoted below accompanied by a description of its function and, in some cases, with the challenges faced. For delegated key processes, a schematic flow presentation is provided along with the inputs, tools and techniques and the outputs used in managing the specific project.
3.1 Initiating Processes

3.1.1 Identify Stakeholders

The primary use of the process is to identify 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.

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Table 1: Project Management Process Groups and Knowledge Areas Mapping (adapted from PMBOK® Guide, 2008)

3.2 Planning Processes

3.2.1 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. The PM plan for a TAM project should include all subsidiary plans, with special emphasis on scope, time, cost, procurements, risk and health & safety. The PM plan originates from the Project Charter
(typically provided by the highest management level) and utilizes previous experiences and best practices. The development of the PM plan follows a recursive pattern, as several updates may be fed during planning.

### 3.2.2 Collect Requirements

The collect requirements process is generally time consuming and spans for a period of four to six months. It is based on the project charter, yet it necessitates the provision to include all potential stakeholders, primarily maintenance departments, operational units, inspection findings, etc. The work to collect requirements is typically carried out through team work, standardized questionnaires and interviews, especially with external contractors and consultants, as shown in Fig. 1.

![Fig. 1: Collect Requirements (adapted from PMBOK® Guide, 2008)](image)

### 3.2.3 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 (EBS), were developed and updated. The evaluation of the need to perform maintenance works followed a multi-criteria assessment pattern that calibrated the cost, the impact, the urgency and the complexity of the work, in order to eliminate non-critical activities and alleviate implications from delayed execution. Despite efforts to freeze the scope by the early planning stages, this was not achieved resulting to noticeable scope creep and planning dysfunctions. Fig. 2 illustrates the process.

![Fig. 2: Define Scope (adapted from PMBOK® Guide, 2008)](image)
3.2.4 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. Templates from past projects greatly facilitated the process. The development of a WBS dictionary proved to be of high value as it permitted grouping of findings, eliminated ambiguities and assisted resource leveling. The main input elements, outputs and decomposition technique used in this process are presented in Fig. 3.

![Fig. 3: Create WBS (adapted from PMBOK® Guide, 2008)](image)

3.2.5 Define Activities and Sequence Activities

During the process of defining activities, 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. The sequence activities process (Fig. 4) on the other hand, was developed primarily according to the turnaround phase, and the development was extended establishing links between different phases; 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, ensuring network coherence and connectivity.

![Fig. 4: Sequence Activities (adapted from PMBOK® Guide, 2008)](image)

3.2.6 Estimate Activity Resources and Estimate Activity Durations

Estimate Activity Resources 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. The Estimate Activity Durations process (Fig. 5), on the other hand, proved to be an extensive process, because of frequent changes in the scope that occurred during project planning. When the process was finalized, activity duration estimates were produced and the relevant project documents were updated.

Fig. 5: Estimate Activity Durations (adapted from PMBOK® Guide, 2008)

3.2.7 Develop Schedule

Develop schedule is the process of analyzing activity sequences, durations, resource requirements and schedule constraints to create the project schedule (Fig. 6). The particular project utilized as a planning platform, the MS Project 2007 server. The overall result included plans for twenty-five industrial units, more than 800 pieces of equipment, over 15,000 discrete activities, and was scheduled to be executed in 32 days and amounting more than 25,000 person-days. Below the basic inputs, outputs and techniques for this process are presented.

Fig. 6: Develop Schedule (adapted from PMBOK® Guide, 2008)
3.2.8 Estimate Costs and Determine Budget

The cost estimation moved along three axes: (i) Determination of cost from contractors optimized through concrete scope definition and intense negotiations, (ii) Determination of cost of materials based on historical data, market data, market research and RFQs, and (iii) Personnel cost either through subcontractors or for internal staff. The cost was broken down into cost centers and monitored through the company ERP. An initial cost estimate with accuracy in the order of -10% to +20% was first extracted and then reviewed to end up with a final cost estimate with accuracy between -5% and +10% (to account for uncertain and unpredictable events). The cost estimates were associated with scheduled tasks to generate the project budget which was then baselined and used during control to monitor and align actual costs with remedial actions or additional work approvals.

3.2.9 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. Make or buy analyses were performed to evaluate the need to hire or subcontract people of special skills (e.g., welders). Typical RAM matrices were developed to clarify responsibilities.

3.2.10 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. The communications plan also included report specifications (content, frequency, format, etc.) and proved efficient in implementation.

3.2.11 Plan Risk Management and Identify Risks

Risk management planning in a structured mode according to risk templates was applied for the first time in the specific plant. Unofficial templates from previous projects and recommended templates from a strategy consultant were used as the basis to create the Risk Breakdown Structure (RBS) and to develop the Probability and Impact Matrix (PIM). Only threats were included at this stage and were classified in three categories; opportunities were opted out. Potential risks according to the RBS were identified in uncertain activities. A maximalistic approach was employed to encompass all possibilities; this was achieved through experts’ meetings, data mining from previous projects and through review of contractors work description. In certain cases, identified risks were reflected as contract clauses.

3.2.12 Perform Qualitative and Quantitative Risk Analysis

Identified risks were analyzed, evaluated and recorded in a risk register, and subsequently assigned to risk owners. The evaluation of risks was based mostly on multi-criteria techniques with weighted average scoring. During scope selection and finalization, typical criteria included
impact on operation, cost of impact, temporal deviation with respect to MTBF, etc. When scope was frozen, a focused set of activities resulted, and subsequently analyzed further to account for proactive actions in an effort to minimize the probability of occurrence. The risk register proved to work appropriately, although the final set of monitored risks covered only partially the project risk spectrum.

3.2.13 Plan Risk Responses

The selected set of risks was assigned to risk owners who worked on proactive actions as well as reactive plans (responses) to apply for the case of risk occurrence. Risk responses included cost estimates, resource backups, safety plans, etc.

3.2.14 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.

3.3 Executing Processes

3.3.1 Direct and Manage Project Execution

The process was based upon the project management plan and approved change requests. The TAM project was coordinated by the Shutdown manager, who was assisted by qualified personnel; this was necessary especially for the first week, when works initiate, risk is higher and uncertainty is evident. 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.

3.3.2 Acquire Project Team and Develop Project Team

The Acquire Project Team process utilized the PM 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. The Develop Project Team process used 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 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.
3.3.3 Manage Project Team

Project team management required 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.

3.3.4 Distribute Information

The distribution 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 document distribution and 2) Information distribution tools, such as electronic communication. Information distribution resulted in organizational process assets updates.

3.3.5 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.

3.3.6 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 provide information about 3) the resource calendar of their staff. Change requests, project management plan updates and project document updates also arose.

3.4 Monitoring and Controlling Processes

3.4.1 Monitor and Control Project Work

This process utilized 1) The project management plan, containing the goals and objectives, 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. Project progress was collected on a daily basis. A work list was issued the previous day and was returned at the end of the shift. Progress data were input in the schedules and the plans were updated. During the initial stages of the project this proved to be extremely demanding in terms of effort and computational power, yet, as the project progressed, updating of projects and incorporation of changes was much smoother. An important outcome was the
progress update within-the-shift, when experts in turnaround projects welcome updates within two shifts.

3.4.2 Perform Integrated Change Control

This process was 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. Changes were tracked and evaluated at the end of the project. A percentage of changes of the order of 3.1% with respect to the initial plan was observed, and is considered a sign of proper and proactive planning.

3.4.3 Verify Scope and Control 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. Controlling scope, on the other hand, 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.

3.4.4 Control Schedule and Control Costs

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 redefine 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. The control of costs, on the other hand, was performed through the company ERP. Although real-time monitoring for the entirety of activities proved unfeasible, periodic cost control proved adequate. The final actual cost was compared to the baseline cost; for baselined activities, forecasted costs were highly accurate, while occasional discernable variances were monitored for extra activities.
3.4.5 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.

3.4.6 Monitor and Control Risks

Risks included in the risk register were closely monitored. The proactive actions greatly diminished the number of risks that actually occurred and all but two were properly handled. A potential improvement area is the increase of the number of risks monitored as well as the increase of monitoring frequency during execution.

3.5 Closing Processes

3.5.1 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 result in the final products and updated organizational process assets.

4. 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 PM 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 PM 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 if the necessity and high value of collect requirements process were 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 TAM projects because of the large number of information and stakeholders. Main consideration for communications planning improvement is 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.
5. Conclusions

In this paper, the development of a structured PMO for turnaround maintenance projects, based on the standards recommended by the Project Management Institute (PMI®), was presented. The PM processes were selected and customized so as to respond to the needs of turnaround projects, to respect the nature of the projects (high cost, short duration, high risk, impeccable scope), and to form a set of suggested tools to be adopted in such projects. The work was evaluated in a pragmatic industrial setting, thus giving the opportunity to highlight the challenges that were encountered.

References


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