

# Reengineering Project Management Processes for EPC Contractors: A Saudi Arabia Case Study

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## Abstract

Engineering Procurement Construction (EPC) contracts provide an effective framework for projects where integrated interdisciplinary engineering expertise is required for large-scale industrial projects such as power generation, processing plants, oil and gas sector, and mining development projects. However, project management processes in EPCs contracts are complex due to overlapping project phases, interface management among the project stakeholders, and specific requirements of various industrial sectors. Hence a complex and well-integrated project management process is required to deal with the structural, technical, directional, and temporal complexities of EPC projects. This paper presents research findings of a study that investigated the project management performance of an EPC contractor on a large power transmission revamps project in Saudi Arabia. The research findings are based on a single case study research methodology that investigated EPC contractor's project management processes using a detailed project audit including site visits, document review, team interviews and focus group sessions with various project stakeholders. This paper presents the overall case study, identified gaps in capacity and competencies of the EPC contractor in various project management areas, i.e., initial planning and proposal development, engineering management, procurement management, etc., and presented recommendations to enhance the project performance of the EPC organization.

## Keywords

EPC; Case study; Project management; Process reengineering; Performance improvement; Saudi Arabia

## 1. Introduction

Successful projects are usually the result of efficient and robust project management processes (PMI, 2013). There are five distinct project management processes i.e., project initiation, project planning, project execution, project monitoring and control, and project closing (Mantel & Meredith, 2009). These project management processes further require a specific configuration that comprises of project management method, project plans, project documentation, information exchange protocols, and the resources required for the project planning and execution.

Engineering, Procurement, Construction (EPC) is one of the well-known contracting methods used for large and complex projects and is widely used in complex industrial projects (Guo et al., 2010). A key intention of an EPC contract is to employ a single contractor to deliver the complete facility to the employer by coordinating all design, procurement, and construction work using a front-end engineering design (FEED) approach. The FEED process is typically completed before the EPC contract which encapsulates the project specifications, technical details, cost estimates, and performance requirements, yet the detailed engineering design is completed within the EPC contract. Inherently, the EPC contracts involve much higher risk than traditional Design-Bid-Build (DBB) or Design-Build (DB) methods (Galloway, 2008). Efficient project management is the utmost requirement in EPC contracts as these projects are ultra-large and large sums of money are at stake (Ballesteros, 2019). EPC contractors devise their project management processes as per the type of project and their respective industries. Their project management processes are also highly influenced by the requirements of their client or respective funding agency (Yeo & Ning, 2002). However, when an EPC contractor intends to take projects in a different industry with similar approaches and

techniques, they might face hurdles in the successful delivery of the said projects. This arises the need for re-engineered project management processes and related techniques according to the type of the industry and as per the requirements from the owner/client/funding agency which require a serious effort, commitment, and a major overhaul of their existing processes across all project management areas (Al-Hajji & Khan, 2016). Several EPC contractors working in different industries at once experience difficulties and one such example is selected for this research study.

This paper presents a case study where an EPC contractor with a well-established track record of executing power up-gradation projects with the Saudi Electric Company (SEC) moved to expand its client base by exploring similar work opportunities within the Oil and Gas sector. The EPC contractor faced several difficulties and challenges in executing the project and opted for a detailed project management audit to reengineer its project management processes for better performance in the understudy and future projects within the Oil and Gas sector. This paper presents partial findings of the project management audit by discussing gaps in the current project organization and processes to propose recommendations for improved project performance in this project and the overall EPC organization for future projects.

## 2. Research Methodology

This single case study research strategy was adopted within which several data collection tools, such as documents review, field visits, and in-depth interviews were used (Yin, 2009). The first step in this study was to collect all the relevant information about the status of the project, understand the current project origination, manpower, and resources, identify key challenges of the project, and review the cost, time, and quality variance in the project delivery. This preamble step enabled the research team to develop an understanding of the project and design an efficient strategy for a more in-depth analysis of the project in the next steps.

In the second step, the study investigated project management practices in the key areas identified which were not efficiently contributing to the planned execution of the EPC project. For each of the identified areas, the study analyzed the current organization and role in supporting the project line organization or functional services to the project. The investigations for each area were conducted using in-depth open-ended interviews with key project personnel in each area, details of interviewees are given in Table 1.

**Table 43.** Method of data collection and participant's detail

Sr. No.	Method	Project role
1		Project Director
2		Project Manager
3		Construction Manager (s)
4		HSE Manager (s)
5	One to one Interviews	Project Controls Manager
6		QA/QC Manager (s)
7		Procurement Manager
8		Engineering Manager
9		Commercial and Contracts
10		HR Manager

In the Analysis step, the study analyzed the collected data from the in-depth interviews by tabulating the information and arguments received in each area to identify information that reflects gaps in the project line organization and the supporting functional organization. The study proposed recommendations for the identified gaps in each area of the project management process.

## 3. Results and Discussion

The adopted research methodology was carefully executed to understand the difficulties being faced by the EPC contractor and provide useful recommendations to improve the project management processes for successful

management and delivery of the case study project. The first step of the research methodology helped researchers understand the management process and organizational policies being followed. The second step, in-depth one-to-one interviews with key project roles, identified key project management areas which were causing hindrances in the smooth delivery of the EPC project and remained the focus of this research study. This preliminary investigation identified 11 key project management areas i.e., Overall project management, Initial planning and proposal development, HSE Management, Engineering management, procurement management, subcontractor management, construction management, project controls, QA/QC management, interface management, and HR management. The following sections discussed the gaps identified within each project management area and presented improvement strategies to address the identified gaps.

### **3.1 Overall project management**

The overall project organization suffered from a lack of clarity regarding roles and responsibilities, missing key roles, and inadequate delegation of authority for effective project delivery. This study identified that there was a general lack of accountability across the project organization and a general perception prevailed that key decision-making rests outside the line of project organization. Furthermore, key service organization functions were not integrated, for example, the Engineering design team was not co-located with the line project organization along with some key management roles missing. As a result, design changes were not effectively managed on the project which resulted in information bottlenecks in shop drawings production at the site and caused significant delays. The key contributor to this situation was the absence of a formal change management process that resulted in a long and time-consuming process to formalize the proper approval within the organization before it can be incorporated. Moreover, there was no formal risk management process in the project and thus the project had no risk management charter, or a risk register to effectively manage the risks involved in such a complex project.

This study proposed suggestions to improve the overall effectiveness of the project organization which is critical in determining a project's success or failure. It proposed the creation of a common vision and mission for the project and advised its communication across the project team and overall organization along with the identification of all key roles and positions and assigning qualified and competent members of the project team. It also emphasized defining the Key Performance Indicators (KPIs) and empowering the project team with an adequate delegation of authority to control all aspects of the project. Furthermore, it also suggested the definition and creation of change and risk management processes and the assignment of clear responsible roles to manage change and risk on the project.

### **3.2 Initial planning and proposal development**

The study identified that the project bid did not adequately evaluate the scope and risk associated with this kind of project and client. As the contractor's strategy revolved around securing and sustaining the business with the proponent, so the project evaluation and bid preparation development process in the initial phases of the project did not benefit from the long and successful experiences of the contractor. Furthermore, the contractor did not have in-house engineering capabilities which contributed to the reason for underperformance from the early stages of the project. As the Engineering subcontractor was not involved in the bid evaluation and proposal development stage, therefore Engineering related contingencies in the bid were greatly reduced without strong evaluation and knowledge of the subject matter.

Since the main aim was to sustain the business with the proponent in this industry, this study recommended the establishment of a dedicated team for effective proposal development for projects with this specific client. It also emphasized ensuring that the initial bid evaluation and development process must benefit from the experience of key project stakeholders with relevant technical and commercial experience. A clear and precise subcontracting strategy and the prequalification of suppliers and subcontractors must be developed. Lastly, a risk assessment must be performed in the initial bid development stage to incorporate contingencies based on the results of the risk assessment process.

### **3.3 HSE management**

The study identified that the overall performance of the HSE management was satisfactory and met the requirements of the project. However, the HSE practices were generally disconnected from the overall project management and require integration and collaboration with other disciplines to improve overall project performance. Overall safety culture in the organization was weak and lacked companywide cohesion. The safety program was not very well communicated and adhered to by the construction and subcontractors. Inadequate safety training was offered to overcome fragmented site locations and the high turnover of subcontractors. Not enough focus was put on leading

indicators to measure safety performance on the overall project. An in-depth assessment of HSE practices and management indicated that although recorded incidences were generally low, there were however indications that data collection and preventive actions were lacking.

This study recommended that the EPC contractor must define and communicate clear corporate safety objectives and strongly communicate its vision for HSE management on the project. Also, direct serious efforts towards defining companywide safety KPIs and performance measures. Furthermore, the subcontractor selection and hiring process should be updated to include safety performance prerequisites to enhance HSE performance on the project. Lastly, this study advised actively addressing any training deficiencies in the HSE performance and management of the project on all levels.

### **3.4 Engineering management**

Engineering management was a critical area of this revamp EPC project, as the EPC contractor did not have any in-house Engineering capabilities and the project design package was completely subcontracted. This study identified several issues hindering the project performance where a trickle-down effect of inadequate engineering management caused several other issues. The engineering organization on the project suffered from a lack of integration, inadequate staffing, and a late engagement in the project. The project suffered heavily from the deficient design due to inappropriate engineering practices in detail design development, revamping work processes, team capability, and management ability to resolve issues. The engineering management process was not tailored to suit the specific needs of the proponent's revamp project and lacked clarity regarding issues resolution. Engineering deficiencies had major negative impacts on procurement, construction, and overall project planning and integration.

This study recommended an urgent restructuring of the engineering organization. The engineering organization must be realigned with the construction organization, attending to urgent construction priorities. It is further advised to strengthen and align field engineering roles with the overall engineering to effectively respond to immediate construction needs and missing roles in the engineering organization shall be filled with qualified and experienced staff. Furthermore, to proactively resolve engineering issues and quality deficiencies, this study recommended the agile response from engineering to improve the quality of engineering, develop and follow up a corrective action plan and incorporate lessons learned throughout the lifecycle of the project.

### **3.5 Procurement management**

This study observed that Procurement performance did not meet the project requirements and was hampered by incomplete information from Engineering and caused regular delays. It was observed that the procurement on this project underperformed due to its rigid process and suffered from poor quality of engineering information. An in-depth investigation revealed that the critical material deliveries were delayed 60% of the time throughout the project. The procurement organization lacked the integration and flexibility needed to deal with the specific requirements of this project. The procurement process was utilizing a paper delivery system, which must go through the head office for approval. However, the actual procurement process was ambiguous and was not fully understood by the project management. The procurement process on the project was not efficient, did not consider execution requirements for contracts, and was not integrated with the project team as the procurement process was developed earlier in the project but was not followed later.

This study recommended that the project procurement needs to improve its response to meet the requirements of the proponent and it must be streamlined with all stakeholders to reduce the overall process duration. It also emphasized the need for digitizing and automating the procurement process to reduce the limitations and restrictions posed by the paper-based system and improve the workflow and tracking of procurement-related inquiries. Furthermore, this project organization was in dire need of a strategic long-term relationship with key suppliers to establish reliable and timely delivery of materials. Finally, the procurement department needs to be consistently engaging with project control to further streamline the procurement process with planned and ongoing project activities.

### **3.6 Subcontractor management**

In general, the contracting strategy adopted for the project was not a good fit for the requirements of the project. The key strategy of the EPC contractor was to subcontract the key work packages including "Engineering" and "Construction". However, selected subcontractors underperformed which prompted the contractor to deploy its resources pulled from other projects. The contracts for the subcontracts were all "Unit Rate" which is in contrast to the actual Lump sum contract between the EPC contractor and the proponent. Pre-qualification process was not

sufficient to confirm the qualification of subcontractors. As observed, the subcontractor selection was done based on the recommendations instead of a proper selection process by following standard prequalification procedures which resulted in the selection of subcontractors without adequate experience and required capabilities to execute this project. The ineffective subcontractor management process failed to influence performance, frequent turnovers, and commercial disputes throughout the lifecycle of the project.

This study recommended that the strategy for contracting the under-defined work needs to be revised and subcontractor performance metrics need to be developed along with clear work requirements to manage subcontractor's quality. It is also directed toward the establishment of clear requirements for subcontractors and measuring their performance against clearly defined and communicated performance metrics. Furthermore, the subcontractor prequalification process needs to be revamped to include past performance, quality performance, safety performance, and quality of key personnel along with the resolution of issues hampering the retention of subcontractors such as assurance of timely remunerations, addressing mobilization delays, and ensuring all project condition requirements laid out in contracts.

### **3.7 Construction management**

The project site construction organization was fragmented, inexperienced in revamping projects of this nature, unfamiliar with the proponent's requirements, and lacked adequate authority and drive. This study identified that the increased turnover in key executive positions was hurting the overall performance of the construction organization. Important roles including Project Director and Construction Managers had remained vacant for a longer period. Moreover, the overall scope of the project was challenging as this project spanned the country with 36 site locations which posed a significant challenge for construction management organizations. Site work execution management did not adopt appropriate management processes, particularly for this type of project and client. Incomplete engineering had hindered construction works and the construction work planning was also disconnected from the overall project plan and schedules thus creating delays.

For strengthening the construction organization roles and processes this study recommended the addition of a Project Engineer role to strengthen the integration and delivery focus. Moreover, it emphasized the improvement and integration of engineering support for the construction process and adequate availability of resources, and a dedicated process of distribution of resources across all construction sites. Furthermore, it also suggested rethinking the requirements of key roles for construction organization as team capabilities not only require technical skills but also management knowledge and experience to develop and implement effective processes. Lastly, this study emphasized the development of KPIs to monitor and control progress and efficiency.

### **3.8 Project controls**

The investigation of project controls revealed the key hindrances occurring due to inadequate staffing and lack of clarity of role, responsibility, and reporting. The project team had communication and integration gaps with the project leadership. Moreover, the team that developed the baseline schedule for this project was different from the team that was managing the schedule during the construction phase. Project control plans were unrealistic and not integrated well with the proponent and other project disciplines and lacked corrective actions plans. This study identified that the baseline project schedule was developed focusing on fulfilling the requirements of the contract and forecasts were largely dictated by the proponent without considering realistic planning making the baseline schedule highly unrealistic. The current planning process was deficient in focusing the project team on critical activities/issues of the project. Even though the project schedule was approved by the proponent, there was no great value in the critical path process in the project and the critical path was never reviewed.

This study emphasized addressing deficiencies in the project control organization by employing adequate staff under experienced leadership to manage the project controls department. This study also highlighted the fact that there was a general need for the whole organization to educate on the importance of project control and provide essential support to keep the project on track. The current project team needed to improve their technical competencies, especially in planning, scheduling, and cost management. Moreover, the planning process should be clear with assigned roles and responsibilities. It should be aligned with all key stakeholders in all disciplines to support the planning process. Project control needs to include assessment of variances, reporting, and advising on action plans along with key stakeholders.

### **3.9 QA/QC management**

This investigative study revealed that the presence and influence of QA/QC in engineering and procurement were not adequate. Overall QA/QC procedures on the project were adequate and met the minimum requirements of the proponent. However, this was observed that QA/QC procedures were not integrated with other project disciplines, as well as with subcontractors, for better performance and results. Further investigation revealed that QA/QC procedures were not properly applied in Engineering quality during the design development stage. Similarly, these procedures in procurement were not timely highlighted and resolved as well. Resultantly, the QA/QC plans and procedures were not followed adequately by the project team and subcontractors during the construction phase.

This study recommended empowering the QA/QC department to better integrate with other disciplines. Also, engage the executive management support for the QA manager role by emphasizing the importance of QA/QC procedures for engineering and procurement.

### **3.10 Interface management**

This study identified that the project did not have a formally structured interface management process to manage the complex interfacing involved in this project. Due to the complex nature of this project, it required substantial efforts to manage interface points with external stakeholders. For example, this project involved a requirement of a Shutdown to complete the works on live substations that required an extensive effort to manage the interfacing between various external stakeholders. Moreover, there was no documented process, the project team was managing interfacing on an ad-hoc basis and there was no ownership of the interface management process. Furthermore, the details of interface management were not identified early, and issues were not addressed in time. Similarly, engineering interface management was under the responsibility of the Engineering Manager, but it was not integrated with the construction and project management as well.

This study put forwarded several recommendations to address this critical area of project management and emphasized the need for dedicated support to identify and resolve issues to enhance project performance. It is also advised to develop a clear process for interface management by clarifying roles and responsibilities for all participants and stakeholders. Lastly, it advised the utilization of state-of-the-art tools available for interface management.

### **3.11 HR management**

In summary, the HR management processes were not timely resolving the issues and concerns of the project. This study identified that the HR management on the project was not systematic, but rather followed ad-hoc methods to handle any issues and challenges, which usually took a long time. Moreover, the HR processes on the project were generally disconnected from other project disciplines which also added to the prolongation or resolving HR issues. Overall, the project was understaffed and suffered from recruitment delays for new appointments. Due to the absence of formal HR procedures, the morale of project staff was low and disputes on overtime compensations, poor conditions of site facilities, lack of recognition and reward, and poor management of staff commute from accommodation to work site and back were frequent.

This study recommended the development of a clear corporate-level policy for HR resource development and implement it on each project. Also, provide additional expertise and resources in HR development and training. Furthermore, revisit the recruitment process and procedures to optimize the overall duration of new employee recruitment and remove bottlenecks in the process. Lastly, it advised investigating root causes for morale and turnover issues and implementing corrective action plans.

## **4. Conclusions**

This paper presents the findings of a study conducted to improve the project performance of an EPC contractor on a large revamp project in the power transmission sector. The study adopted a single case study approach with data collection tools ranging from document reviews, physical site visits, meetings, and one-to-interviews. Initially, a detailed review of existing processes was conducted to understand the prevailing processes and build an understanding of prevailing policies and practices. Later, in-depth interviews were conducted to investigate the phenomenon and identify gaps in current practices, policies, and processes. Based on the standard project management practices and theories, recommendations were provided, across all project management areas, to improve the overall project management process for the EPC contractor. The findings of this study will guide the EPC contractors to review their existing practices and processes and improve shortcomings to improve overall project management and increase project performance on complex EPC projects.

This study also contributed to the existing body of knowledge by investigating the overall project management process for an EPC contractor, which is a complex endeavor. Also, this study identified a wide variety of factors that hinders smooth and effective project performance across all aspects of an EPC project. This wide range of causes and factors will pave the way for future studies to further investigate and improve the project performance across all the phases of the EPC project and associate project management areas. Moreover, key recommendations provided for every project management area will also serve as a valuable resource for performance improvement research studies and will provide a guided direction to achieve their research ambitions.

Future research can explore the prioritization of recommendations made in this study and explore effective organizational structures which are aligned with the requirements of EPC contracts and will improve overall project management processes in EPC projects.

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