

“Modern Practices in Project Management of Turnkey Engineering and Construction Projects”

Authors:

1. Vignesh Kumar S (Student – MBA
Operations Mgt.)
Alliance School of Business, Alliance
University

2. Chandan S (Student – MBA
Operations Mgt.)
Alliance School of Business, Alliance
University

Abstract

This paper discusses about the modern practices being followed in management of Turnkey engineering and construction projects such as, oil and gas units, refineries, power plants, petro chemical plant and other capital projects. The term “Turnkey” describes a project in which the service provider or the contractor takes the single point responsibility to complete the project in all aspects and hands over to owner/client in a ready to use state. Any project execution has to take care of schedule (timeline), cost and quality. The modern practices followed globally from concept to commissioning in terms of Engineering, Procurement Construction, QHSE (Quality, Health, Safety and Environmental) have also been discussed. Through all phases of the Turnkey project, certain software tools are used to optimize the engineering solutions, monitor the progress of project execution on a day to day basis, supply and track the items ordered, reconcile the items/materials that are bought and used for the project, control the pre commissioning and commissioning activities etc. The various Gate reviews to be carried out at appropriate phase of the project execution have also been addressed. The project management is a collaborated effort of the contractor and owner. The modern practices followed by the contractor are discussed and accordingly the project management techniques of the contractor are presented. The turnkey solutions in IT and robotics industry are also discussed.

Keywords: Turnkey project, Project Management, Modern Practices, Contractor, QHSE (Quality, Health, Safety and Environmental), single point responsibility, turnkey solutions

Introduction

Nowadays, the owner or promotor of any major infrastructure project takes the route of turnkey contract. The advantage of turnkey contract is that the complete responsibilities and the risk of project completion lies with the turnkey contractor or service provider.

There are various phases in realising a project, from feasibility study to commissioning. owner/promoter will first carry out a detailed feasibility study to assess the techno economic viability of setting up the project. Once, the viability is established, then a Front End engineering design will be carried out to define the overall concept and design philosophy for the project. The next phase will be to prepare the turnkey tender documents and issue the

tender to the pre-qualified contractors to bid for the project. The bids from all the bidders will be evaluated technically and commercially and based on the techno commercial merits, the successful bidder is chosen. The successful bidder becomes the turnkey contractor to execute the project. The turnkey contract in engineering and construction projects is commonly known as EPC or EPCC (engineering, procurement, construction and commissioning).

In this paper, we will discuss about the Modern practices followed by Turnkey contractor for project execution of a typical Oil and gas project.

The turnkey contract will be a lump sum fixed schedule contract. Hence the main elements of a successful project management are schedule, cost and QHSE (Quality, Health, Safety and Environment)

Project Management

On successful award of contractor, the starting point of the project execution is a kick off meeting between owner and contractor. During this kick off meeting, generally the following are discussed and agreed.

- Level 2 Project schedule
- Milestone activities and dates
- Various gate reviews and dates

Subsequent to the kick off meeting, the contractor will mobilise his team as per the typical Project management organisation (Refer Annexure -1)

Engineering

The turnkey contract being a lump sum contract, the main objective of the contractor will be not to exceed the project cost. In order to ensure the same, various alternate solutions will be worked out by simulating various operating conditions. Contractors use “Simulation software tools” to optimise the engineering solutions. Based on the optimised engineering solution, the contractor will carry out the detailed engineering activities taking into consideration of operation flexibility, maximum plant availability, standardisation of equipment, ease of construction etc.

The plant layout is developed using “3D model” where the complete project is developed in 3 dimension with walk through facility. Review of 3D model will be jointly carried out by

contractor and owner to ensure that the project layout is developed without any clashes among various services and to assess the ease access of various equipment from the point of view of operation and maintenance.

Today there are many engineering software tools available with which “intelligent engineering documents” can be developed. A common “data warehouse” can be developed thereby any changes in data will be automatically populated all the engineering tools that are connected to the data warehouse. Engineering reviews will be carried out at regular intervals to ensure that all project requirements and the statutory requirements are taken care of.

The specification and data sheets for all the bought out items will be prepared in the Engineering phase with which the procurement activities will be carried out. As QHSE one of the main objectives of the project Execution, various reviews will be carried out during the engineering phase.

“Quality Assurance audits” will be carried out at regular intervals to find out any non-conformance to the project requirements. Audit reports will be issued and the Open points in the audit report will be closed within the time frame by the responsible person. “Safety reviews” will be carried by the contractor with a “Third party Chairman” and the finding of the safety reviews will be addressed appropriately.

The design of the project will ensure that the “Local statutory requirements” are taken care.

Refer Annexure-2 for a typical Organisation chart for Engineering management.

Procurement (Supply Chain)

The equipment (Mechanical, Electrical, Instrumentation, Safety etc.) required for the permanent installation in the project will be procured as per the specifications and data sheets prepared during the engineering phase. The procurement activities can be termed as “Supply Chain management” which include the activities from issuance of bids to vendors up to material receipt at project site. Most of the contractors now use “SAP” (Systems, Application and packages for enterprise resource planning) for their supply chain activities and ERP. The contractors also use either a commercially available or an in-house “material management software” tool to track the material status. This material management software can be linked to engineering software tools also so that it becomes easy to track the materials right from engineering phase till the commissioning of the project.

Supply chain management includes the responsibilities of buying, expediting both home office expediting and vendor shop expediting, Quality control, Inspection Logistics etc.

Refer Annexure -3 for a typical organisation chart for Supply chain management

Project Control

During the initial phase of the project, a “Level 3” schedule will be developed by the contractor and agreed upon with the owner. Based on the Level 3 schedule, “Level 4”

schedule will be developed by breaking the projects into various sub projects. Breaking down into sub projects is known as “Work Break Structures” (WBS). There are quite a few Scheduling software tools Are available in the market. Contractors use one of these commercially available tool to establish the detailed schedule. As per WBS, the progress for each activity is assigned. Then based on the agreed project schedule, a progress plan will be developed and monitored on a continuous basis.

Owner will organise a weekly/fortnightly/monthly “progress review meetings” where the actual progress against the planned progress will be analysed. In case of any delay in the progress, “the root cause” analysis will be carried out and suitable course correction will be taken to bring the achieved progress in line with the planned progress to ensure the timely completion of the project. The scheduling software tools have the facility to extract “look ahead schedule” and thereby enabling the planner to forecast the requirements such as manpower, machinery, material etc. in advance.

Construction

Construction management is one of the critical activities of the project management. A day to day planning is carried out to ensure mobilisation of all the required resources. Contractors nowadays arrange the Labour camps with all facilities including hygienic sanitary facilities, local transportation from labour camp to site, “Personnel protection equipment” (PPE). Safety team will take care of the safe execution of the project by ensuring wearing of PPE of all project personnel, safety inspection prior to start of any activity either at the grade level or at the elevated levels, issuance of “Permit to Work” (PTW), verification of machinery validity certificates etc. A regular “Tool Box talk” will be made by the safety team to the entire working team. Contractor’s Quality control team will ensure use of the required quality of materials by reviewing the test certificates of all the materials being used for construction. A planning team will be working at site to monitor the day to day progress.

Refer Annexure-4 for a typical organisation chart of Construction Management

Interface

In some projects, the project may be split into various packages and awarded to different contractors. In such cases, it becomes important to have a smooth coordination among all the contractors. Interface manager will prepare an “Interface management Register” (IMR) and list down all the interface inputs required from other contractors. Regular interface meeting with all the contractors to discuss the required interface inputs and to agree upon the schedule of receipt of such inputs.

Project manager

The Project Manager is responsible the successful completion of the project. The project manager in addition to the management of Engineering, Procurement and Construction activities, is also responsible for Contract Administration, Cash Flow, Risk management etc.

Turnkey solutions in Information Technology

A turnkey solution is an end to end solution or a system that is built for a customer that can be directly implemented into the production environment of a business. Information technology solution providers who can offer a single or several product packages with minimalistic consultation are said to provide turnkey solutions. A consultant or a regular IT solution provider would offer more customizability where as a turnkey solution provider would provide a pre-configured solution with minimalistic or no customizability. For example, a client looking for recommendations on a database server would get a variety of

options from a regular solution provider whereas a turnkey solution provider would provide a pre-configured database server with pre-configured built in software.

The concept of turnkey solutions came into existence as the country's economy became more service-oriented. Turnkey solutions are applicable to businesses that desire quick solutions to be implemented into production. However, since most turnkey solutions do not offer customizability, businesses do not prefer turnkey solutions unless they desire speed as it would be complex for them to make the business process adapt to the turnkey solution. A more feasible solution would be to approach regular service providers who can provide IT solutions that are custom made according to the client's business process.

Nowadays, the IT solution providers are moving towards client centric approaches to solution building. Practices such as design thinking, agile model, zero distance are already in practice by software giants, as they want to know their client's business and proactively provide better solutions that can increase the client's revenue. In such an industry, turnkey solutions sell less as knowing what the client needs before the client realises it would add a great deal of value to the client's business.

Intelligent test automation solutions are also available in turnkey format. Testing done in automated style reduces delivery time and hence results in cost savings. Turnkey test solutions also reduce the complexity of conventional test automation suits as it provides a well-established framework to run test cases. Turnkey test solutions are available for both functional and regression testing. Also turnkey test suits save testing time and costs while maximizing performance and availability of all applications. A business process might have a variety of execution paths. Turnkey test solutions are capable of dynamically generating test cases suitable for the application. These are made possible by data driven technologies with built-in logic and work flows to cover all execution paths.

Turnkey robotic solutions

The area of application of robotics is spreading like virus. It would be easier to list the areas where robotics is not applied, rather than listing all the areas acquired by robotics. Starting from manufacturing and healthcare services to agriculture and household, it is evident that robots are not only replacing humans, but also have an ability to work as efficiently as humans do and in some cases more efficient than human beings.

It has been the dream of the dwellers of late 20th century and current 21st century, inspired by Hollywood movies, that showcase robots doing all daily and official work and people just command the robot. This dream is now a reality and robots can be seen in the field becoming smarter and efficient day by day. As per PwC's Global Digital IQ Survey, the global robotic market is growing at a healthy rate. In 2016 the recorded sales were 6.69 million units and is expected to grow as much as 26.5% every year for the next four years.

The same can be recorded or observed in the turnkey revolution of providing solutions in robotics. Majority of the tenders which are called on in the current scenario are on AGV's and robotic solutions for their ease of work in industries. Some of the solutions provided in

manufacturing are automatic moulding, automotive parts manufacturing and assembly, equipment that perform finishing operations, loading and unloading, packaging, palletising, and many more.

The most demanded turnkey robotic solution is turnkey Cell. Turnkey cell is a robotic cell - a system that includes the robot, controller, and other accessories which are used to place and position the robot, safety controls and environment controls. These are completely integrated, pre-engineered solution. The cells also can be made to order and such calls are called custom cells. Applications of turnkey cells are, MIG welding, spot welding, gluing sealing, plasma Cutting, material handling, material assembly etc.,

The applications of turnkey cells in manufacturing, supply chains, health care and service industry are the major entries in the decade. Autonomous and adaptive robotics are developed and researched in a large scale. The trending area of research is bio-inspired techniques which can be used to provide solutions for engineering practices. They would be majorly used in engineering fields by implementing evolutionary algorithm and artificial neural networks. Strategies like self-replication and self-assembly are also likely to find application in the real world.

There are other radically innovative solutions emerging in the market such as “The Mail Cart”, which carries mails throughout the floor or plant to designated drop points and “The Garbage disposer”, which uses AGV’s to pick, collect and dispose the garbage.

These robotic solutions are programmed in three programming methods. “Teaching Pendant”, “Offline Programming” and “Teaching by Demonstration”. Teaching pendant is a widely accepted method. It is popular among technicians as it can be easily handled by them. To program this the operator moves the robot from one point other as per the requirement on the shop floor. While moving, the operator stores all the points essential in the movement. Once the complete area is covered the points are saved and loaded into the robot. From the next use onwards, the robot will move or work several times faster than the time taken by the operator to store the layout. This is generally operated on a joystick, key pad or a touchscreen table. Since it is a turnkey solution, re-programming the robot will be a tedious and time consuming process.

Offline programming or simulation is a method used widely in research of robotics, which makes sure that advanced control algorithms are operated as expected before delivery or operating on the actual floor. This allows the instrument to be programmed in a virtual environment or a simulation of the actual environment and then tested. Depending on the functional complexity of the software which simulates the test environment, the performance of the robot can be tested more accurately. This method reduces time but the accuracy on the actual shop floor is lesser compared to the accuracy obtained on the simulation software.

Teaching by demonstration is the classical method to Teaching Pendant. This removes multiple use of the pendant technique before repetitive recording, where it is only needed to

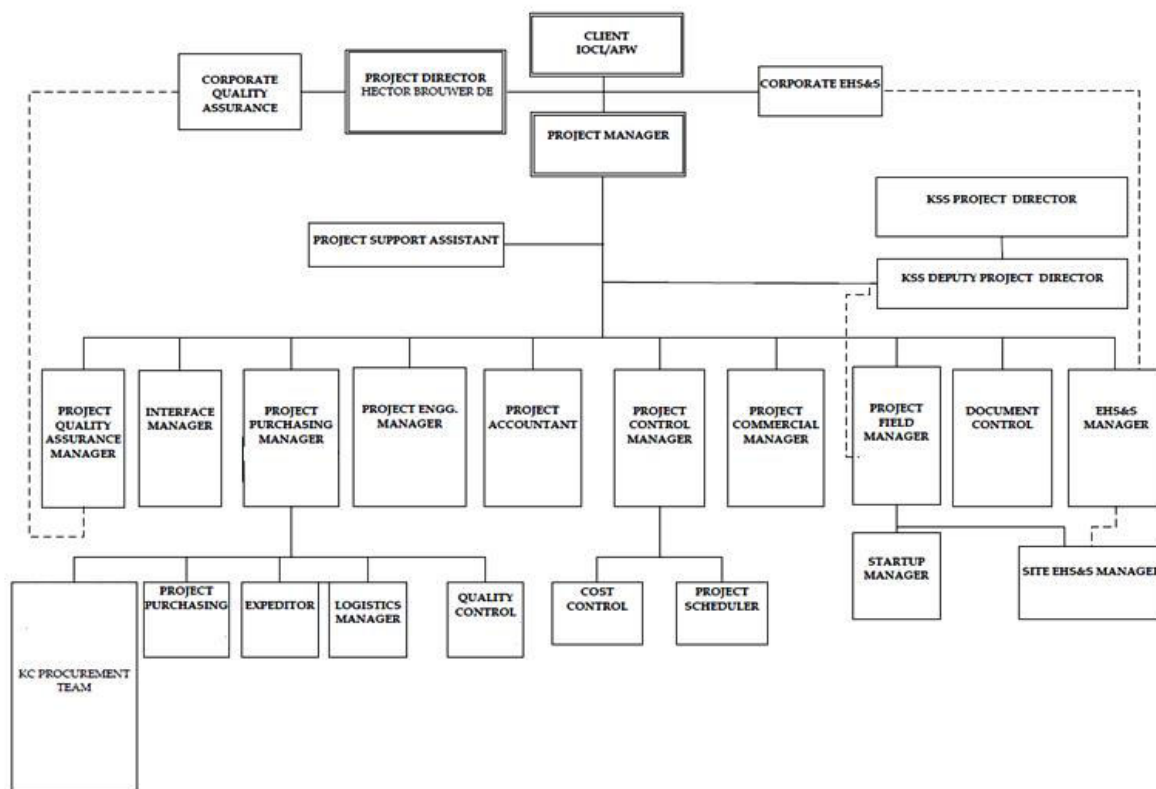
be moved once by the operator in the required direction. It is more intuitive, but it needs a physical robot to do the primary installation which is a major drawback.

Major turnkey robotic solutions used in India are, automation in steel industries, material handling robots, pick and place systems, pick and place with delta box, turnkey automation, machine tending cells, finishing cells, welding cells, robotic tagging system, robotic patching and plugging, robotic spray booth, robotic wrapping and packaging, robotic marking etc.,

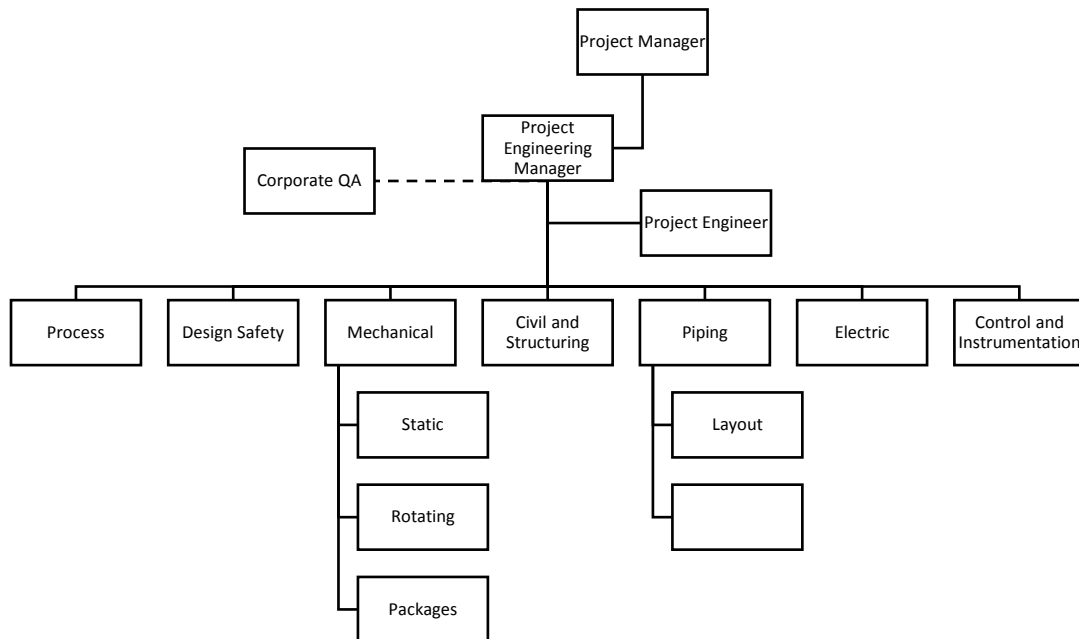
Summary

The Modern Practices followed in a turnkey management of all the phases of project execution is brought in the above paragraphs. As mentioned above, the project execution is carried out using various software tools available in the market, however the names of specific tools being used in the industry are not mentioned in this paper. Execution of a turnkey project being a single point responsibility, the contractors ensure that modern practices are followed in successful completion of the project with the main objectives of schedule, cost and QHSE. Turnkey solutions used in IT industry, the scenarios where turnkey solutions are used and scenarios where regular solutions are used have been discussed. The merits and demerits of turnkey IT solutions have also been discussed. A briefing about turnkey robotic solutions has been given and the methods used to train these robots have also been discussed in brief.

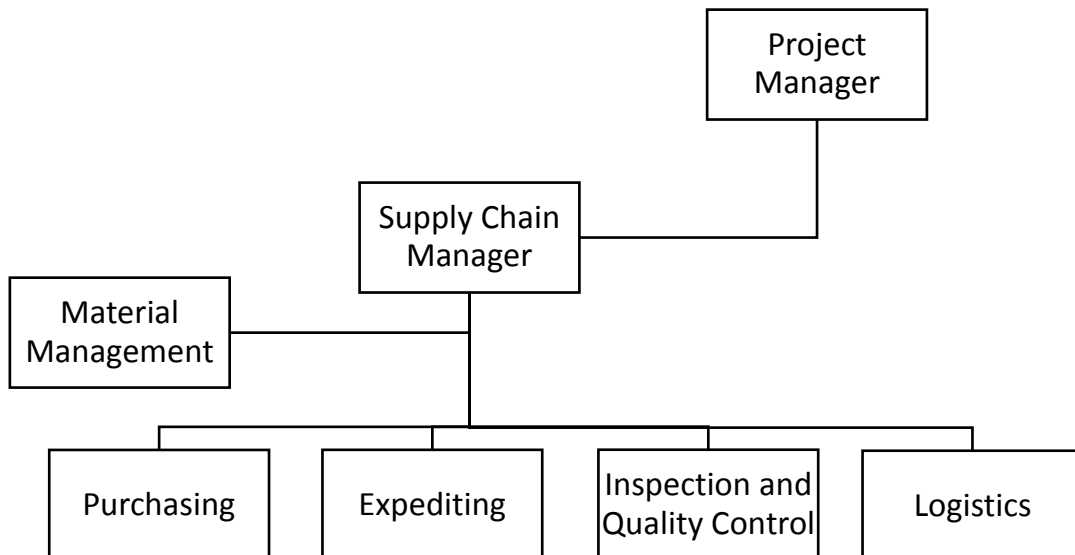
Annexure – 1 Overall Project management Organisation Chart



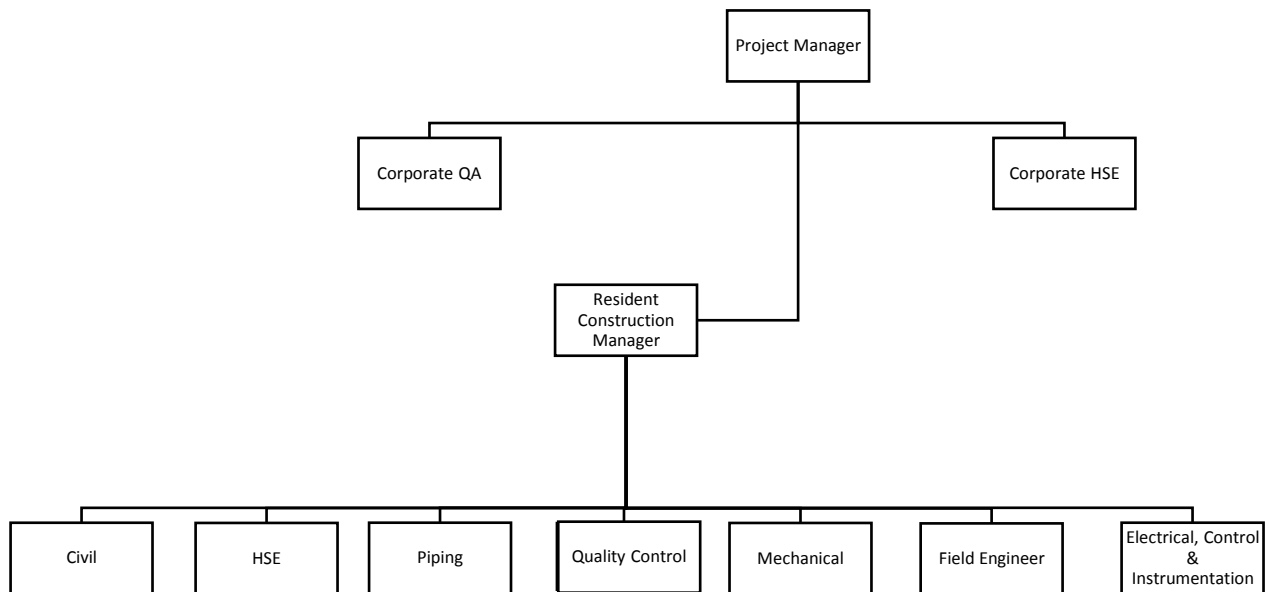
Annexure – 2 Project Engineering management organisation chart



Annexure – 3 Project Supply chain management organisation chart



Annexure – 4 Project Construction Management Chart



References

1. Primary references from experts working on turnkey projects in engineering and constructions industry
2. Surprise versus unsurprised: Implications of emergence in robotics by Edmund M.A. Ronald, Moshe Sipper
3. <http://usblogs.pwc.com/>
4. https://www.investopedia.com/terms/t/turnkey_solution.asp
5. <http://turnkeysolutions.com/>