2011 International Conference on Management and Service Science
IPEDR vol.8 (2011) © (2011) IACSIT Press, Singapore

Quality Management Control Tool Development for Working with EPC Project

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Abstract. If the company wish to success in the Engineering Procurement and Construction (EPC) business, quality of work is a very important factor to deal with. This paper reveals the impact of quality deficiencies which can lead to costs overrun due to rework and can also cause a delay in the time schedule. The concept of the quality management control tool for EPC project is to analyze the company's quality historical data by using basic quality analyzing tools, define the priority of impact from deficiencies and analyze the root cause to determine improvement activities. The results of deficiency data analysis help management to make decisions with regard to work quality improvement programs and priorities. This quality control tool aims to solve the quality problems in future EPC projects by developing check sheets to control the quality of work.

Keywords: Quality control tools, 7QC tools, Quality improvement.

1. Introduction

The numbers of Engineering Procurement and Construction (EPC) projects are continuously increasing due to increased customer demand in an intens competitive environment. Large-scale plants are built in many counties all over the world. One of the significant factors that makes a company competitive in this market is the work quality. The thought of quality and continuous improvement of quality is a very important factor for a company to gain a competitive advantage in their business.

The EPC contract is made up of engineering design, procurement and construction. That is where the name EPC stands for. It is a common form of contracting arrangement within the industry and a well-known project management term used internationally. It refers to performing a complete project on a one-package, turnkey basis. The project objective is to ensure safe, timely, and successful completion of the EPC project within the allocated budget [2].

In general, there are three critical factors when working on an EPC project; these are duration of the project schedule, cost and quality of work. These are the challenges for a project to overcome to be successful. If the company can not control these challenges, these factors will turn into the risks to the project. The main advantage of EPC is an overlap in the design, procurement and construction stages and thereby a reduction of the total project duration.

In quality improvement processes, problem solvers need to know where they stand, what the problem really is, and what the cause of the problem is before any solutions can be proposed. Problem solving should follow a logical, systematic method. This method will place emphasis on locating and eliminating the root or real cause of the problem.

This paper uses the basic of quality control tools (7QC Tools) to develop a quality management control tool for working on an EPC project. These simple but effective "tools of improvement" are widely used as "graphical problem-solving methods" and as general management tools in every process between design and delivery [1]. Quality tools have an important place in data collecting, analyzing, visualizing and creating a sound base for data founded decision making. They have been used as problem solving and process improvement tools [3]. They form the fundamental foundation for all problem solving and quality control activities. The basic quality control activities are repeated analyses and improvements in order to reduce quality variations [4].

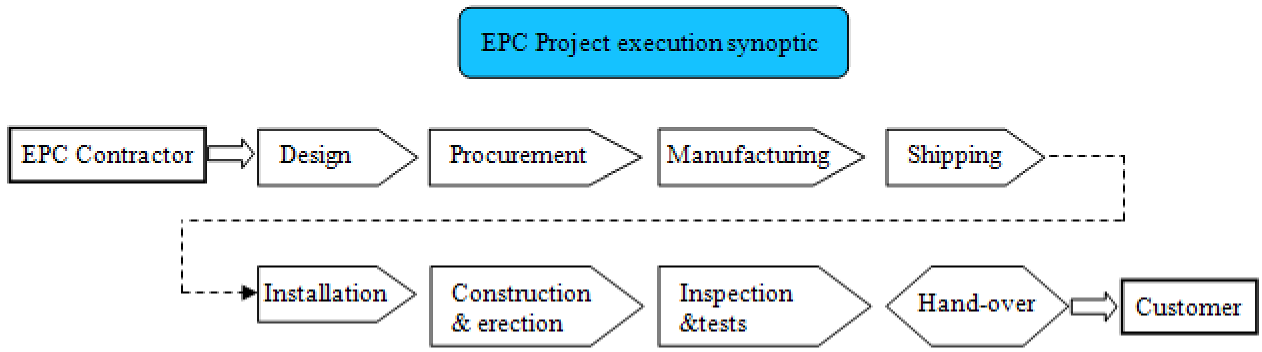


Fig. 1 EPC Project execution synoptic

Time and costs allocated to the EPC project are finite, there are restrictions. The key goal for the EPC project is to complete the project to the standard expected on time and within budget. Full consideration must also be given to safety and environmental issues. For a project to succeed, these matters must be monitored periodically during the project implementation and findings analyzed so that the cost, time, safety and environmental objectives are realized.

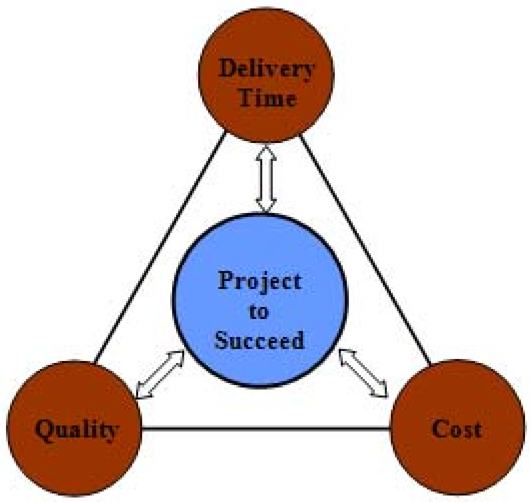


Fig. 2: Success of EPC Project

2. Materials and Methods

2.1 Engineering Quality Tools

These are the most fundamental quality control tools that were first emphasized by Kaoru Ishikawa, professor of engineering at Tokyo University and the father of “quality circles.” They are easy to learn and handle and are use to analyze the solution to an existing problem.

These seven quality tools which are basic for all other tools are:

1. **Flow chart:** A technique that separates data gathered from a variety of sources so that patterns can be seen.
2. **Pareto diagram** : Shows in a bar graph which factors are more significant.
3. **Check sheet:** A structured, prepared form for collecting and analyzing data; a generic tool that can be adapted for a wide variety of purposes.

4. **Control chart**: Graphs used to study how a process changes over time.
5. **Histogram**: The most commonly used graph for showing frequency distributions, or how often each different value in a set of data occurs.
6. **Scatter plot**: Graphs pairs of numerical data, one variable on each axis, to look for a relationship.
7. **Cause-and-effect diagram** (also called Ishikawa or Fishbone chart): Identifies many possible causes for an effect or problem and sorts ideas into useful categories.

One possible approach, proposed by J.G. Pimplott [4] is presented in Fig. 3 where Pareto and Cause and effect diagrams are common and essential in both processes (identification and analysis).

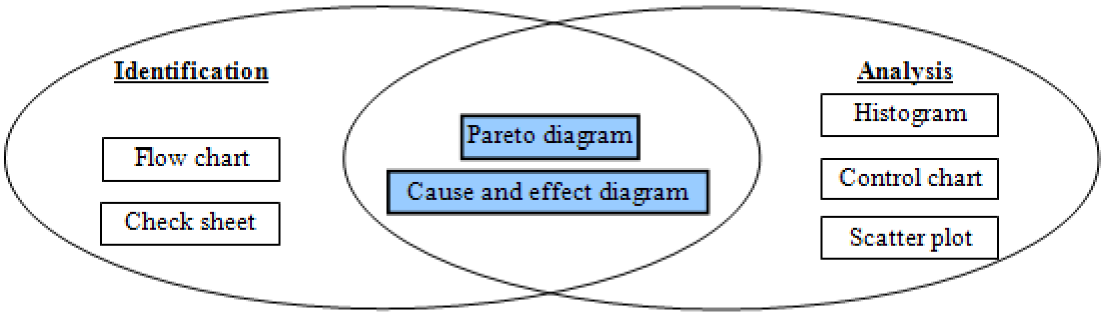


Fig. 3. Use of 7QC tools in process identification and analysis

3. Result

For this paper we used some of the seven basic quality control tools (7QC tools) approach to analyse data, define the priorities and identify the root cause of the quality deficiency historical data as case study. A check sheet for working with EPC projects was developed from the result of the analyzed data to better control the quality of the next EPC project.

3.1 Data collection

The data collection work involved the selection of the information from past EPC projects which would be used as case study. The deficiency lists are the lists given to a contractor after inspections have been performed by project owner or owners engineer during construction and commissioning phases.

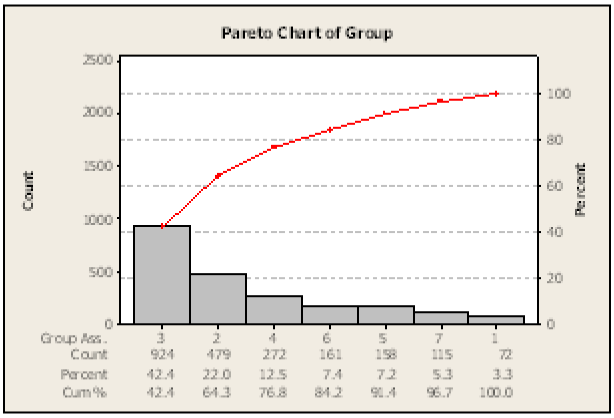
Table 1. Background of the project selection

Description	Project #1	Project #2
1. Type of EPC project	Small Power Project, Combine Cycle Power Plant (110 MW)	Small Power Project, Combine Cycle Power Plant (60 MW)
2. Number of engineering deficiency items	2181	1958
3. Number of date delay	10	46

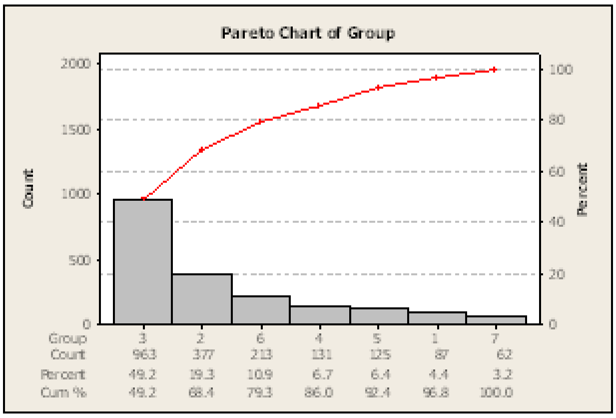
3.2 Deficiency group classification

There are two reasons to classify the engineering deficiency items in to groups. Firstly, by observing the deficiency items that have been found patterns can be determined on quality problems; for instance, touch up work, missing installation equipment, using wrong materials or equipment, the installed equipment was not in the project vendor list and so on. Secondly, to breakdown the large numbers of deficiencies into small groups, which makes it easier to analyze the cause of deficiency of quality.

Pareto analysis is the process of ranking opportunities to determine which of many potential opportunities should be pursued first. It is also known as “separating the vital few from the trivial many.” It is common in manufacturing to perform Pareto Analyses [6] to determine the major, few causes contributing to the majority of the defects. Similar studies can be performed in construction using industry-wide samples.



(a)



(b)

Fig. 4: (a) Group of deficiency from EPC project#1 (b) Group of deficiency from EPC project#2

3.3 Analysis of deficiency impact

According to the result of pareto diagram each deficiency item has a different weight that can effect the project execution with regard to cost and time schedule.

The impact from quality deficiency can be classified to three categories.

Table 2. Category of impact deficiency

Category	Time schedule perspective	Financial perspective
High impact	Deficiency need to be rectify before moving to the next phase/step/test	The high cost to rectify deficiencies
Medium impact	Deficiency need to be rectify before energizing/testing/commissioning	The medium cost to rectify deficiencies
Low impact	Deficiency need to be rectify after/before commercial operation dated	The low cost to rectify deficiencies

According to the group classification in section 3.2, in the same classified group each deficiency item has a different weight of impact to the project. This step analyzes the potential impact from a deficiency in each group in order to set priorities for improvement.

Therefore what shall be analyzed is the relevance of the deficiency to:

(1) Time schedule perspective (schedule delay)

(2) Financial perspective (additional cost due to rework)

3.4 Quality improvement priority ranking

In the process of setting the magnitude of impact we convert the number of deficiencies (quantity) into the impact on time delay and cost for do re-work by given a weight to each category by multiplying the quantity times the weight for each group we can set the priorities for quality improvement activities.

3.5 Identify the root causes of the deficiencies

A root cause analysis is a methodology that attempts to get to the bottom of a problem. Root cause analyses aims to help to resolve the "owner" complaints about quality problems that occur in the construction and commissioning process by assuring these deficiencies are minimized. To assist in identifying the factors contributing to the cause of the quality problem and understanding the underlying factors causing the problems, the Ishikawa or fish bone diagram has been used as an analytical tool.

3.6 Quality mitigation/improvement plan

The conclusion of the analyzes was that the following 2 improvements had the highest priorities with regard to quality improvement activities:

1. Develop helpful checklists of each major discipline for each phase of the project execution.
2. Develop a sufficient detailed work procedure.

4. Conclusion

This paper describes the development of a quality control tool for a company executing an EPC project. This paper shows that by using the seven basic quality control tools important information can be obtained which helps the management to choose which quality improvement projects should be implemented to improve the quality of the EPC projects and reduce the risks of time delays and cost overruns. This tool is intended to be used within a continuous improvement process.

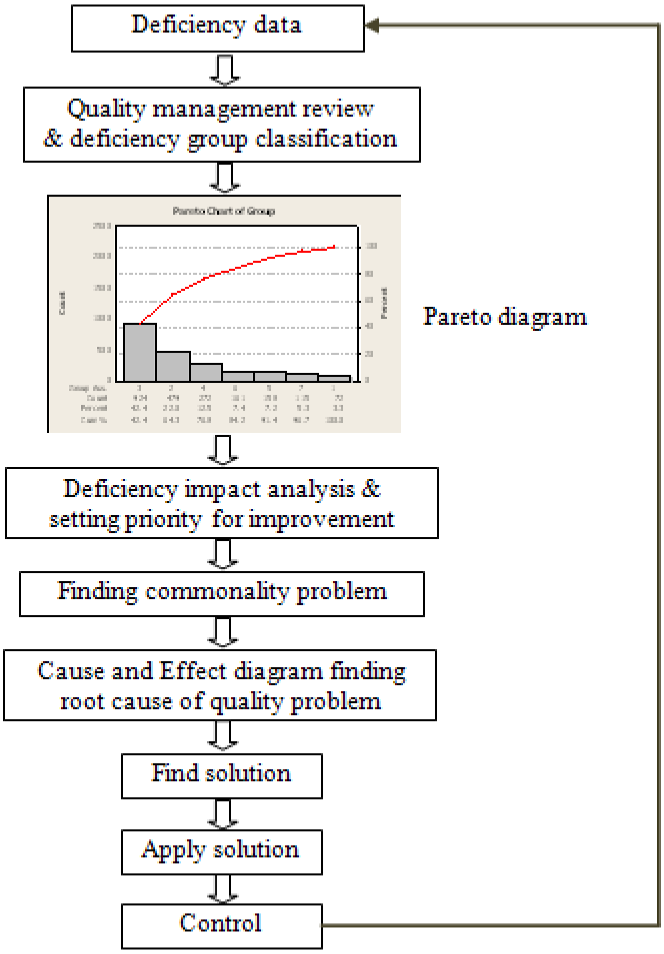


Fig. 5: The concept of the quality control tool for working with EPC project

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