

CONTINUOUS PROCESS IMPROVEMENT IN READY MIX CONCRETE PLANTS

E.Poovaragavan¹, K.Chandra Sekar²

Student, M.E. Construction Engineering and Management, EBETi, Kangayam, TN, India

pvravn@gmail.com

Assistant Professor, Department of Civil Engineering, EBETi, Kangayam, TN, India

erchandrakar@gmail.com

ABSTRACT

In construction projects, quality, time and cost are the main factor for its success. Achieving good quality in scheduled time and budgeted cost is one of the tougher task. The use of ready mix concrete for the construction projects will reduce the time with a little variation in cost. In most areas the quality of RMC is proved as sub-standard. Hence the doubtfulness on the quality of RMC among the people and the construction personnel is the reason for the low preference of RMC than site mix concrete. To improve the quality of the concrete produced the system in the RMC plants should be standardized. The quality control should be ensured in the production process through the continuous process improvement. Such process improvement can be achieved using the statistical process control (SPC) tools. This project aims in standardization of the quality of the concrete produced in the RMC plants using the SPC tools.

I. INTRODUCTION

The construction projects are now a days being completed in a very short time with the advanced construction materials and techniques. Many new methods are being adopted in construction to reduce the duration of the projects. The use of ready mix concrete for the construction projects became trendy in recent days. Such preference will reduce the duration of the construction projects than the actual scheduled duration. But the doubt of quality on the RMC let the construction professionals not preferring for their projects. Such quality loss exists in the ready mix concrete due to various reasons. Such problems should be identified and rectified in order to increase the preference of the RMC among people. The reason for the defects in the products lies within the production plants and the process. Such defects should be eliminated from the process to obtain a quality product from the manufacturing plants. The SPC tools are very useful in identifying the defects in the process and developing the solutions for eliminating them to improve the quality of the products. The standardization of the system will definitely improve the quality of the products manufactured. The performance of the company can be evaluated and the improvement suggestions can be made with the use of SPC tools.

a. OBJECTIVES OF STUDY

- To study about the manufacturing process of the ready mix concrete in the RMC plants.
- To identify the defects and factors to be improved in the manufacturing processes.
- To prepare the solutions for making the continuous process improvement in process and standardizing the system.

b. SCOPE OF STUDY

- This research will derive the standardization procedure for the manufacturing process in firms.
- It improves the quality of the manufacturing product.
- It also will improve productivity, reduces wastage and improve customer service.

c. PROCESS IMPROVEMENT

Process improvement is a management philosophy and strategy to increase value of the product as defined by the customer. Process improvement can be characterized as strategic, team based, systematic, aggressive, continuous, cross functional, customer driven and low cost.

Process improvement involves analyzing and redesigning of the processes to eliminate problems, inefficiencies and defects in the organization. It entails small improvements over a time period, by improving one or two processes simultaneously. It is also defined as a systematic methodology for improving and stabilizing work tasks and systems that is based on customer requirements, and results in a means of establishing continuous monitoring of and control over those tasks to ensure predictability of quality and costs. Process improvement gives out a morale and inspires employees to look for innovative ways to deal with challenges.

d. STATISTICAL PROCESS CONTROL

Statistical process control is an analytical tool for decision making which allows us to see whether a process is working correctly or not. SPC is used in manufacturing sectors around the world. SPC is a tool to be used with experience and common sense as their guide. The strength of SPC is its simplicity.

e. SPC TOOLS

Seven quality tools are available to help organizations to better understand and improve their processes. They are

1. Check Sheets
2. Cause-and-Effect Diagram
3. Flow Charts
4. Pareto Charts
5. Scatter Diagram
6. Histogram
7. Control Charts

1. CHECK SHEETS

Check sheets are simply charts for gathering data. When check sheets are designed clearly and cleanly, they assist in gathering accurate and pertinent data, and allow the data to be easily read and used.

Check sheets should be understood by everyone in ease. The transferring of the required data from paper to electronic format should be clear and easy to implement.

2. CAUSE AND EFFECT DIAGRAM

One analysis tool is the Cause-and-Effect or Fishbone diagram. These are also called Ishikawa diagrams and fishbone diagrams. It organizes and displays the relationships between different causes for the effect that is being examined. This chart helps organize the

brainstorming process. A lot of good information can be discovered and displayed using this tool.

3. FLOW CHARTS

Flow charting also breaks the process down into its many sub-processes. Analyzing each of these separately minimizes the number of factors that contribute to the variation in the process. Quality Control is a continual process, in which factors and causes are constantly reviewed and changes made as required.

Flow charts use a set of standard symbols to represent different actions:

- Circle / Oval - Beginning or end
- Square - A process, something being done
- Diamond - Yes / No decision

4. PARETO CHARTS

The Pareto chart can be used to display categories of problems graphically so they can be properly prioritized. There are often many different aspects of a process or system that can be improved, such as the number of defective products, time allocation or cost savings. Each aspect usually contains many smaller problems, making it difficult to determine how to approach the issue. A Pareto chart or diagram indicates which problem to tackle first by showing the proportion of the total problem that each of the smaller problems comprise. This is based on the Pareto principle: 20% of the sources cause 80% of the problem.

5. SCATTER PLOTS

The Scatter plot is another problem analysis tool and is also called correlation charts. A Scatter plot is used to uncover possible cause-and-effect relationships. It is constructed by plotting two variables against one another on a pair of axes. A Scatter plot cannot prove that one variable causes another, but it does show how a pair of variables is related and the strength of that relationship. Statistical tests quantify the degree of correlation between the variables.

6. HISTOGRAMS

A histogram is a chart of the variation of a product or the results of a process. A histogram displays a frequency distribution of the occurrence of the various measurements. The variable being measured is along the horizontal x-axis, and is grouped into a range of measurements. The frequency of occurrence of each measurement is charted along the vertical y-axis. Histograms depict

the central tendency or mean of the data, and its variation or distribution. A histogram also shows the level of measurements, defining the process capability. A histogram can show characteristics of the process being measured.

7. CONTROL CHARTS

Process control charts are fairly simple-looking connected-point charts. The points are plotted on an x/y axis with the x-axis usually representing time. Control charts are an essential tool of continuous quality control. Control charts monitor processes to show how the process is performing and how the process and capabilities are affected by changes to the process. This information is then used to make quality improvements.

Control charts are also used to determine the capability of the process. They can help identify special or assignable causes for factors that impede peak performance.

f. STEPS INVOLVED IN USING SPC TOOLS

Proper statistical process control starts with planning and data collection. Statistical analysis must be appropriate for the data collected. The key to any process improvement program is the PDCA cycle.

1. PLAN

Identify the problem and the possible causes. The QC tools described above can help the organizations in identifying problems and possible causes and to develop corrective actions.

2. DO

Implementing the changes designed to correct or improve the system.

3. CHECK

Study the changes which is effected in the system. This is where control charts are used – they show the effects of changes on a process over time. Evaluate the results and repeat the process or abandon it and try with a different idea.

4. ACT

If the result is successful, standardize the changes and then work on further improvements or the next prioritized problem. If the outcome is not yet successful, look for other ways to change the process or identify different causes for the problem. Quality is a cycle of continuous improvement.

II.METHODOLOGY

The methodology for the study describes the complete path of the project and it also shows the individual steps involved in the project sequentially.

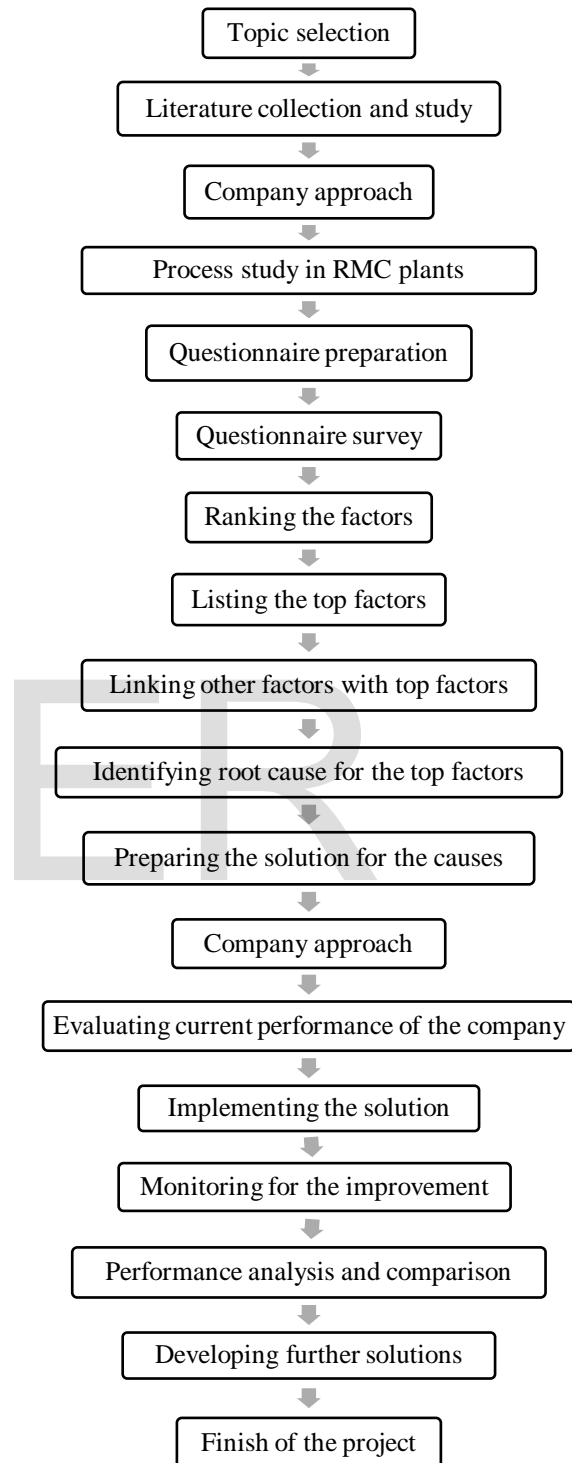


Figure 1. Methodology

III.DATA COLLECTION

Initially, the manufacturing process of the ready mix concrete is studied in RMC plants. The study about the manufacturing process is very

helpful in learning the methods adopted in the plants. The use of equipments in the plants for manufacturing is also being studied. With the process study the framing of the questionnaires became easier and give a way to identify the defects in the process easily. The improvements in the process can only be made by studying and monitoring the process completely and identifying the defects to eliminate them.

The questionnaires are prepared for making a survey among the personnel in ready mix plants. The questionnaire are set by referring the research papers collected for the literature study. Also for identifying the possible improvements which can be made in the production units are being made with some questions as separate part.

The companies for questionnaire survey are being identified and approached. The questionnaire survey has been done.

The responses are being collected and compiled in the database with the factors influencing the quality of RMC. The mean is found for all the factors from the collective responses and then ranked. The top factors are being identified with the obtained results.

IV. DATA ANALYSIS

The data analysis is done and ranking is made with the Relative Importance Indices (RII) method for the RMC.

a. RANKING OF FACTORS

The ranking for the RMC is made with the collective responses from the survey. The top 10 factors are being mentioned in the table below.

S. No	Factors	RII value	Rank
1	Mix design	1.25	1
2	Proper calibration of plant & machineries	1.28	2
3	Material quality	1.33	3
4	Condition of transit mixer	1.58	4
5	Skill & knowledge of operator	1.66	5
6	Raw materials	1.75	6
7	Tolerance limits	1.83	7
8	Superplasticizers	1.92	8
9	Mineral admixtures	2.25	9
10	Travelling time	2.33	10

Table 1. Top 10 factors influencing quality of RMC

The other factors are linked with the top factors where it is possible. With resolving these top factors the other relevant factors will get rectified.

b. SYSTEMATIC FLOW CHART

The systematic flow chart for RMC plants are being prepared. These flow charts will be very useful in carrying out the manufacturing process in a systematic manner. Through the implementation and practicing of these charts in manufacturing plants the system can be standardized and can expect an improved quality output from the system.

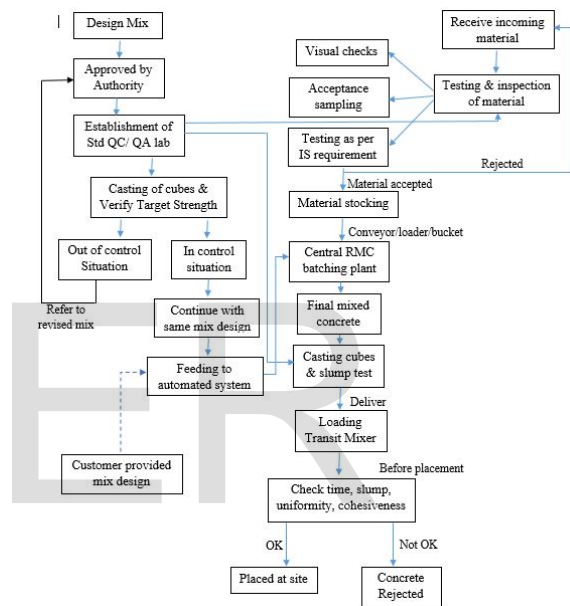


Figure 2. Systematic flow chart for RMC plants

c. CAUSE AND EFFECT DIAGRAM

The cause and effect diagrams are being drawn with the factors in the questionnaire survey. The quality loss in the products is considered as the effect and the top and other factors are the causes and sub-causes for the problem. The diagram represents that each causes and sub-causes influence the quality of the products.

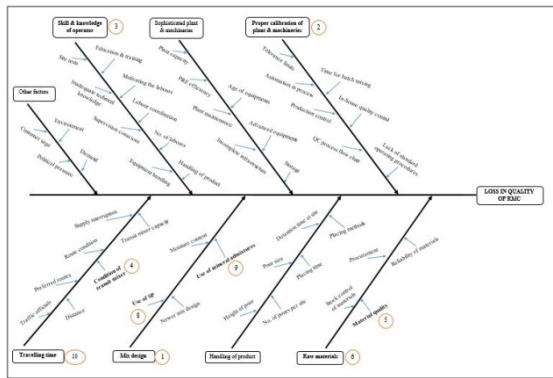


Figure 3. Cause and effect diagram for loss of quality in RMC

d. PARETO CHART

The pareto chart has been drawn with the factors ranked in the questionnaire survey. All the factors are taken in account and the factors are sorted in the ascending order and the pareto chart is drawn with factors influencing the quality of the product manufactured is marked in x-axis and level of influence in the quality of the product as y-axis. The pareto chart for RMC has been shown below.

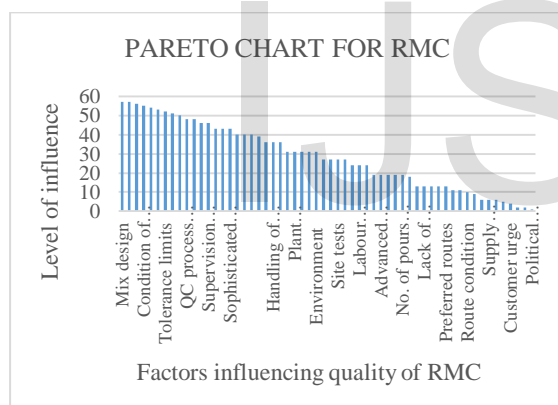


Figure 4. Pareto chart for RMC

e. EVALUATING THE PAST PERFORMANCE OF THE COMPANY

The past performance of the companies in the aspects of quality and productivity of ready mix concrete are being evaluated with the help of the control charts. The check lists are being prepared and provided to ensure the proper functioning of the plant. The relationship diagrams are being plotted using scatter diagrams. The variations and growth over time are being drawn with the histograms. The composition, level of influence and proportioning are being plotted with the bar charts.

V. CONCLUSION

Thus the performance of the companies are being evaluated and the quality of ready mix concrete also being analysed using SPC tools. The solutions for the identified defects will be provided accordingly and improvements will be monitored clearly in the manufacturing units. After the later performance analysis, further improvement suggestions will be made or the suitable alternative solutions will be provided. Thus statistical process control tools are very helpful in the process improvement with improving the quality and productivity and also in reducing the wastage of the materials used for the manufacturing process.

REFERENCES

1. A.D. Lade, A.S. Nair, P.G. Chaudhary, N.R. Gupta (2015), "Implementing Six Sigma Approach for Quality Evaluation of a RMC Plant at Mumbai, India", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume: 12, Issue: 2, Version: I, Page: 01-04
2. Abdulrahman M, Alhozaimy Abdulaziz I, Al-Negheimish (1999), "Introducing and Managing Quality Scheme for RMC Industry in Saudi Arabia", Article in Journal of Construction Engineering and Management, Page: 249 – 255.
3. Arjita Biswas and P.R Adavi (2008), "Analysis of Sludge Formed in RMC Plant", AKGEC International Journal of Technology, Volume: 2, Issue: 2, Page: 60 – 65
4. Hanumant P. Naiknavare, Sushma S. Kulkarni (2013), "Experimental Approach to Study Performance of RMC Plants in Western Maharashtra: Case Study", International Journal of Scientific & Engineering Research, Volume: 4, Issue: 8, Page: 1608 – 1616
5. Hanumant P. Naiknavare, Swati D. Deshpande, Rajesh D. Pande (2010), "Model Chart of Quality Control Process for Ready Mix Concrete Plants", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2278-1684, Page: 50-54
6. Michael Anson and Shou Qing Wang (1998), "Performance of Concrete Placing in Hong Kong Buildings", Article In Journal Of Construction Engineering And Management, Page: 116 – 124
7. Mohamed Aichouni (2012), "On the use of basic quality tools for the improvement of the construction industry: A case study of a ready mix concrete production

- process”, International journal of civil & environmental engineering IJCEE – IJENS, Volume: 12, Issue: 05, Page: 28-35
8. Pao-Long Chang, Kuen-Horng Lu (1995), “The construction of the stratification procedure for the quality improvement”, Journal on Quality Engineering, Volume: 8, Issue: 2, page: 237-247
 9. Varsha M. Magar, Vilas B. Shinde (2014), “Application of 7 Quality Control (QC) Tools for Continuous Improvement of Manufacturing Processes”, International Journal of Engineering Research and General Science, Volume: 2, Issue: 4, Page: 364 – 371.

IJSER