Application of Six Sigma Tool for Construction Project - A Review

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Abstract— Six-Sigma is a Quality improvement technique that has been implemented in manufacturing and other industries. It is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services. Till now, Six-Sigma is mainly implemented in manufacturing industries. But if it is implemented in the construction industry, probably we would get good and improved quality of the construction. This paper presents a literature review regarding the implementation of Six-Sigma in construction industry.

Key words: Six Sigma, Quality Control, Construction Industry

I. INTRODUCTION

Six-Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services. The word *Sigma* is a statistical term that measures how far a given process deviates from perfection. The conceptual diagram of six-sigma quality control is presented in Figure 1. If normal value for a process is located at the midpoint between upper and lower limit, each one is 6σ away from the normal value. In short, the range of no defect is ±6σ from the normal.

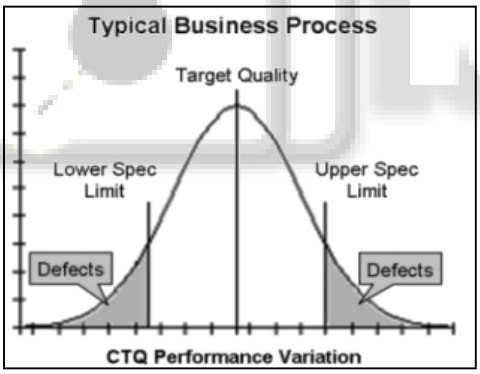

Fig. 1: The concept of six-sigma

The purpose of this study is to analyze Six Sigma within construction context and evaluate its features through Literature Review.

II. LITERATURE REVIEW

According to Frank T. Anbari and Young Hoon Kwak [1] provides a brief overview of the Six-Sigma management method and its use in project management. They have presented the methodologies used in managing Six-Sigma projects for both- process improvement and new development projects. They have discussed the challenges and obstacles in the application of the Six-Sigma method. They have also identified the success factors for Six-Sigma. According to their findings, the main factors influencing the success of Six-Sigma projects include management commitment, organizational involvement, project governance, project selection, planning, implementation methodology, project management and control, cultural change and continuous training.

Ganesh U. Borse and Prof. P. M. Attarde [2] have carried out the literature survey and have presented the review of eight literatures in which Six-Sigma is applied in the construction industry.

Low Sui Pheng and Mok Sze Hui [3] carried out the case study at the Housing and Development Board (HDB), Singapore. Six-Sigma was applied to improve the quality of internal finishes where improvement measures taken by Contractor A helped to raise the Sigma from 2.66σ to 3.95σ.

Prof.Sunil Desale, Dr.S.V.Devdhar and Hemant Patil [4] present an investigation of various barriers for implementing Six-Sigma in developing countries like India. In their study, they classified the barriers in four catergories viz. Technological barriers, Financial barriers, External barriers and Internal barriers such as human factor, culture factor, learning factor and absence of customer voice and compotation.

According to R. Radhakrishnan and P. Vasanthamani [5] determined the size of the lot of a Six-Sigma based single sampling plan with Poisson Distribution as a base line distribution. They made tables for the easy selection of the plan for various values of sample size and Average Outgoing Quality (AOQ) with probability of acceptance 1 – $3.4x10^{(-6)}$.

Sarathkumar K and Loganathan R [6] aimed on developing a project questionnaire model based on the theory of Six-Sigma. They tried to improve the painting work, tile work and brick work of a building by using DMAIC methodology.

Seung Heon Han, Ho Dong Ryu, Myung Jin Chae, Han Him Kim, Do Yon Kim, Sun Hee Kim [7] explored the feasible solutions for the construction performance improvement by use of the Six-Sigma principle. They carried out a case study of the standard unit activity groups. In-depth comparative analysis was done on the existing methods for performance improvement and the advantages of the Six-Sigma principle over the traditional techniques were identified. It was concluded by them that the Six-Sigma principle had brought more benefits in generating the optimized solution sets from initial performance indices as the target processes became complicated and extended. The authors suggested that an advanced methodology should be developed for the financial feasibility analysis to achieve the aforementioned objectives, before implementing Six-Sigma principle to a real project.

The authors, Seung Heon Han, Myung Jin Chae, Keon Soon Im, Ho Dong Ryu [8], focused on the development of the general methodology to apply the Six-Sigma principles on construction operations rather than construction materials in terms of the barometers to measure, evaluate and improve construction performance. The authors carried out the comparative analysis of the Six-Sigma principle and the

traditional techniques. They verified the results by carrying out two case studies. They made Process Simulation Models that shows the construction performance improved as the sigma level advanced by enhancing the condition of CTQ (Critical to Quality).

Sneha P. Sawant and Smita V. Pataskar [9], describes the basic theory of Six Sigma, principles, methodology and various tools used. The authors carried out a case study of a residential building in which they applied the Six-Sigma principles to the internal finishing work so that the quality can be improved and checked against the sigma level. Their findings suggest that proper training and management support can help in improving the quality.

Swethaa. B and Chris Anto. L [10] applied the Six-Sigma principles to the concreting activity. For this, they collected 140 different samples of concrete blocks from RMC and checked their strength. They found the number of defects in them and then by applying Six-Sigma principles, they reduced the defects and verified the results.

The authors, Virender Narula and Sandeep Grover[11] updated the database available for Six-Sigma. They arranged the publications in an orderly manner to enable easy and quick search. They classified the literature on the basis of Research methodology, content, journal, year and further sub classification. They have also identified the research gaps and have provided hints for future research.

III. METHODOLOGY

The main purpose of this study is to present the benefits and to discover the various trends of Six-Sigma. The research strategy was made by selecting the research papers in which successful implementation of Six-Sigma in Construction Industry was presented and documented. Research papers from various international journals were studied. It involved searches from the well-known research databases like Google scholar, ASCE Journals, Inderscience and Science direct. The search was carried out in the journals of these websites with key word as "Six-Sigma in construction industry". In addition, www.delnet.ac.in was searched for Six Sigma books.

IV. CONCEPT OF SIX-SIGMA

Six-Sigma is a quality management philosophy which aims at process improvement by applying statistical process control to reduce variations in product and minimize the defects. The word *Sigma* is a statistical term that measures how far a given process deviates from perfection. At early 1980s, Motorola Corp was the initiator of the Six Sigma concept and led the organization successfully through the implementation of the Six Sigma principles. Most people consider Six Sigma as a purely statistical methodology. In methodology's practice the term Six Sigma level, means 3.4 defects per million opportunities or success rate of 99.999660 percentages. Six Sigma's purpose is to reduce the variance-variability in processes, so to provide to the clients-consumers of the organization, products or services which are more reliable and with fewer errors. Six-Sigma is a statistics based methodology and relies on the scientific method to make significant reductions in customer defined defect rates in an effort to eliminate defects from every product, process and transaction. The Six-Sigma principle can be represented on a normally distributed product quality distribution curve. When the mean is located at the center of the normal distribution curve, the lower and upper limits are six times the standard deviation (sigma) from the center line. In other words the range of lower and upper limit defect is +/- 6 sigma from the mean. Six Sigma can be applied in two ways viz. DMAIC (Define, Measure, Analyse, Improve and Control) and DMADV (Define, Measure, Analyse, Design and Verify). DMAIC is used for projects aimed at improving an existing business process whereas DMADV is used for projects aimed at creating new product or process designs.V.

V. CONCLUSION

This work recognizes that vast literature was obtained on six sigma philosophy, which gives a wide idea of present practices and researches carried. Six sigma philosophies are widely accepted by manufacturing/production industries and it is also possible to implement in construction industry with little modification. More research work is still required in this field, so great scope of research is accessible for new researchers in this field.

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