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Process and Quality Improvement Using Six Sigma in Construction Industry

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ABSTRACT: Construction industry presents an extremely complex combined process, production flow, various structures, high quality requirements and long construction cycle. Large quantities of concrete and time are wasted during building construction due to management procedures, construction processes and reworks. Besides, the final construction quality cannot fully meet customer requirements. This paper explores practical solutions for construction process and quality improvement by using prefabricated composite structure (PCS) based on Six Sigma method. The D-M-A-I-C model of Six Sigma has been applied to conduct the analysis of the construction process, to discover essential factors to improve and thus to achieve higher customer Satisfaction. This research finds out what influence's construction process, construction quality and then adopts design and technique correction measures. It improves the construction process, quality resistance to various performances and proposes the best mix proportion. These improvement measures help to overcome and reduce considerably concrete cracking and slippage in building construction. Based on Design for Six Sigma model (Define, Characterize, Optimize and Validate: DCOV) and using the finite element analysis model (ANSYS), this study develops for scientific and economical use in construction industry a composite steel-concrete model. The proposed approach falls into three phases. Based on measurement and construction process analysis from Six Sigma black belt consultant, construction managers, Engineers, clients, architects, the model helps to find and eliminate critical defects and failure before they occur.

KEYWORDS: Six Sigma, construction quality, DFSS, construction industry, process improvement

I. INTRODUCTION

The Indian housing industry is an integral part of the economy, paving the way for a significant portion of its development investment, and the growing expectations for industrialization, urbanization, economic development and improving the quality of life of people., Prepare for growth. Construction constitutes 40-50% of India's cost of projects in various sectors such as highways, roads, railways, energy, airports and irrigation, making it the second largest industry in India after agriculture. It makes up about 11% of India's GDP. Improving construction performance and quality has become an important focus in the construction industry in every country. However, many researchers have observed a considerable decline in construction quality during the last two decades. Construction projects face a variety of issues and complex factors such as cost, timeframe, quality, safety and human resources. The construction industry plays an important role in the development of every country. The development of housing industry depends on the standard of construction projects. Quality is one of the key factors in the success of a construction project. Improving the quality of a construction project is associated with managing the quality of the project life cycle. While quality control at all stages of the project life cycle is essential, standard control at the execution (construction) stage contributes significantly to the final quality result of a construction project. This project mainly focuses the importance and factors that affects the standard management within the execution (construction) phase. The project includes visits to several construction companies, conducts a questionnaire survey, analyzes difficulties (main factors) due to poor quality control in quality control, and changes in costs, and conducts construction projects.

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II. LITERATURE REVIEW

Sumy Michael (2016) Defects Reduction in High Rise Residential Building using Six Sigma: A Case Study: This paper is to determine defects which lead to low quality in the construction projects. In this paper, DMAIC phase of six sigma is used for improving the quality of building using questionnaire survey & then calculation of six-sigma level by DPMO computation. Factors affecting is determined and then six-sigma is used for data analysis. Thereafter sigma level quality of the building is calculated which helps to reduce the costs for variations, improve quality of the product, greater utilization of labor and facilities.

Radhika (2017) A study of implementing lean six sigma in construction industry: This paper describes how to reduce waste in construction, to identify and analyze the defects. Then ranking is done by SPSS software based on the influence in project. The main aim is to eliminate defects by less Labour, machinery, space and time by reducing the number of activities.

Sarathkumar (2016) I Evaluation of Six Sigma Concepts in Construction Industry: In this paper the Painting work, Tile work and Brick work of a building by using DMAIC methodology. Six-sigma is new to construction sector and this philosophy is to reduce the defects in the construction. The aim of this study is to evaluate Six Sigma as a process improvement method within construction sector. In order to improve the process in construction it is important to understand the factors affecting the construction process and analyze the factors for the construction improvement.

III. METHODOLOGY

Six Sigma is a new and emerging approach to quality assurance and quality control with an emphasis on continuous quality improvement. The main goal of this approach is to meet the demands and expectations of today's demanding customers and to reach and exceed the level of quality and reliability. The term Sigma quality level is used as an indicator of process goodness. The lower the sigma quality level, the higher the likelihood of defective products, and the higher the sigma quality level, the lower the likelihood of defective products in the process. The concept of Six Sigma derives from what is known as the "standard normal distribution," which is represented by a symmetrical bell-shaped curve. "Theoretically, this normal curve has been extensively studied and proved to be very useful. Many natural continuous phenomena appear to follow or are often close to it." Of the segment. Each segment is named "Sigma", symbolized by "σ" (Greek letter), and in statistical terms is the deviation from "mean" (μ: bell curve mean or peak). A significant portion of the curve covers the −3σ and +3σ ranges by covering 99.73% of the population, and Six Sigma considers the −6σ and +6σ ranges covering 99.9997% of the data. The curve shrinkage indicates that the major population is cumulatively near the mean, which is the specification limit for excellent performance.

Define: Organize goal clarity, state opportunity, form the project team, analyses SIPOC, recognize the current process.
Measure: Define the measure indicators, collect data, seek for the variation source and determine the current process Sigma level.
Analyses: Analyze process data, analyses the causes of potential problems, the nature and its impact.
Improve: Identify problem-solving and process improvement programs, define new standards and assessment process.
Control: Control method, review performance on a regular basis, expand the quality of follow-up, and improve process standardization and documentation
Characterize: Propose and screen concept for the technical requirements in accordance with the concept of steel-concrete beams and then establish preliminary design.
Optimize: Conduct optimal design and implement process documents and product life-cycle cost optimization. Monte Carlo simulation is used in this phase on a computer to simulate the production of steel-concrete beams according to the initial design and simulation of different design elements in the scope of their respective values. The risk analysis software opt Quest of Crystal Ball tool is used to optimize steel-concrete beams design. The finite element (ANSYS) model is then.

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IV. OBSERVATION & ANALYSIS

To perform an observation and analysis of Quality improvement in a construction Industry, you can follow these steps:

1. Quality Planning

Project management body of knowledge guide defines quality planning as the process of identifying quality requirements and/or standards for the projects and its deliverables and documenting how the project will demonstrate compliance with quality requirements. It is very important to plan all the quality activities during the project planning phase to avoid any discrepancies latter in the project. The PMBOK identifies the below tool & techniques for quality planning:

2. Quality Control

PMBOK describes quality control as the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes. The American society of quality (ASQ) termed quality control as process orientation that consist of product inspection and statistical quality control (2). PMBOK identifies the following tools & techniques for quality control:

3. Quality Assurance

PMBOK defines quality assurance as the process of auditing the quality requirements and the results from the quality control measurements to ensure that appropriate quality standards and operational definitions are used. The tools and techniques for quality assurance are:

1. Quality management & control tools
2. Quality audits
3. Process analysis.

V. CONCLUSION

. This paper considers that wide literature and knowledge about six sigma method was obtainable and gives a wide idea of foregoing practices and techniques used in construction industry and research carried across the world. Six sigma concept is new to construction industry but is being used widely by production/manufacturing industries and it is also possible to use it in construction industry. Several papers have been presented on six sigma it is to improve the process performance thus increasing customer satisfaction. This research is carried out to show various techniques and more research work is required in this field. In this paper, I have studied several journal papers about quality management using six sigma in residential construction. Thus, it is concluded that six sigma is used to reduce the quality defects in construction.

Prefabricated composite structure design based on actual engineering prototype and related test theories is combined to the notion of six sigma management to obtain better application results. Six Sigma centers on improving project by improving process, analyzing and selecting project as well as to compose the project team. It also requests strictly to implement DMAIC process model, to guarantee improved results, to demonstrate its validity through each project result. Six Sigma objectives depend on continuous improvement of the project through data to realize the management effects. Construction enterprises should realize the feasibility and importance of this theory and method. Generally, the application of Six Sigma principles to establish a quantitative and qualitative construction engineering quality system may increase the cost. But from the perspective of long-term benefit, applying Six Sigma management increases quality management.

Quality is a culture an attitude, without the commitment and support of the top management of the organization, no quality program is going to success.

No matter how qualified resources the organization has, without quality system the output will always be poor.

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