Improvement of internal finishing work through Six sigma

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ABSTRACT

Six Sigma has implement in the manufacturing and other services industries, it was still a relatively new concept in the building industry. This paper described the Six Sigma concept as a quality initiative that may be applied in the building industry. The find suggest that initiative and support, relevant training, appropriate selection of pilot project, and commitment by team members are crucial for the successful implementation of Six Sigma in the organization. The application of Six Sigma for improving the quality of internal finishes during construction is explained. Improvement measures taken by a contractor helped to raise the sigma from 2.66s to 3.95s for quality of internal finishes.[3] six sigma improvements technique. By using six sigma concept to reduce the defects and improve quality of construction as well as customer satisfaction .The main objective of six sigma to complete the work within time of period by six sigma tools. This process can minimise the waste and efficient use of resources.

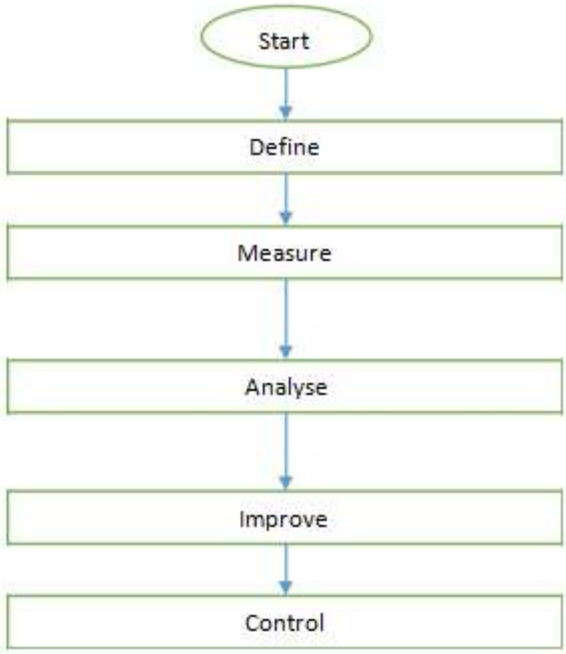
Keywords: Six Sigma, Construction, Defects, DMAIC, DPMO, Quality Improvement.

I INTRODUCTION

Constructional management and technology was the two key factors influencing the development of the construction industry. One approach for improving the process is using Six Sigma concepts in construction. Six Sigma was a quality improvement technique based on statistics used firstly by Motorola in 1980s by Bill Smith of Motorola to decrease cost, increase quality by improving process and reduce the production time[2]. This paper describes the Six Sigma principle and framework as a quality improvement strategy through the successful business. Six sigma was a quantitative approach to improve the major objective being elimination of defect from any process, specifically a numerical goal of 3.4 defects per million opportunities (DPMO)[1].

For implementation of six sigma method to improve the quality of products and processes base tool is DMAIC (Define, Measure, Analyse, Improve, and Control).

Flow diagram:



S.Sriram and A. Revathi was conducted in a residential building to which Six Sigma principles were applied for internal finishing work. DMAIC methodology has been applied to enhance the quality of the existing process by analysing the defects, their percentage of occurrence, the possible causes and effect of defects and recommendations to overcome them[1].

To enhance the quality of an ongoing process (internal finishing work) of a construction project by eliminating defects.

Six Sigma principles was applied for internal finishing work of a project and the sigma level for the same was calculated from the data obtained.

DMAIC Methodology:-

By studying the checklist we have selected some activities like walls and ceiling, floor, doors and windows and components. Out of the above mentioned activities, in this paper we have tried to improve the quality of Internal Finishes by using DMAIC methodology[4].

Define:- In this step it is necessary to define customer requirement and anything which do not meet those requirements known as defects, define project scope and goals, Identify CTQ (Critical To Quality) characteristics of the process[1].

Measure:- Identify and collect appropriate data which are relevant to the defects and the process that needs improvement[1].

Analyze:- We study and analyse the data collected in the previous step and we find out the root causes of the defects and unsatisfactory performance[1]. The Fishbone diagram is used to identify causes of problems or prevent the future problems.

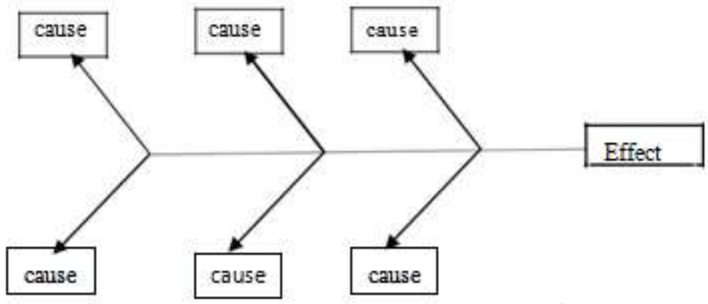


Fig.1 Cause and Effect Diagram

Improve:- Improve the process by eliminating the defects. Identify the ways to improve the existing problem. Develop potential solution[1].

Control:- Control plan will help us to check on the various preventive measures which will help to achieve the desired result[4].

DPMO:- Higher sigma values indicate better products or processes with fewer numbers of defects per unit of product or service. The Products produced at a Six Sigma level of quality operate virtually defect-free by definition, with only 3.4 defects per million opportunities (DPMO) as shown in Table-1.[2]

Table-1 Basic Six Sigma Conversion[2]

Yield=Percentage of items without defects (%)	Defects per million opportunities (DPMO)	Sigma Level
30.9	6,90,000	1
69.2	3,80,000	2
93.3	66,800	3
99.4	6, 210	4
99.98	320	5
99.9997	3.4	6

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Table 2.Six Sigma Data collection sheet For Internal Finish (stage A) [3]

Locations		Floors					Walls					Ceilings					Doors					Windows					Components				
		Finishing	Alignment & Evenness	Cracks & Damages	Hollowness	Jointing	Finishing	Alignment & Evenness	Cracks & Damages	Hollowness	Jointing	Finishing	Alignment & Evenness	Cracks & Damages	Roughness	Jointing	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects
Bedrooms	Wall 1	√	X	√	√	√	√	√	√	X	√	X	√	√	√	X	X	X	√	√	X	√	√	√	√	√	X	√	√	√	√
	Wall 2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	X	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 3						X	√	X	√	√																				
	Wall 4						√	√	√	√	√																				
Hall	Wall 1	√	√	√	√	X	√	√	√	X	X	√	√	X	√	√	√	√	√	√	√	√	√	√	√	√					
	Wall 2						√	√	√	√	√																				
	Wall 3						√	√	√	√	√																				
	Wall 4						√	√	√	√	√																				
Kitchen	Wall 1	X	√	√	√	√	X	X	X	√	√	√	√	√	√	√											√	√	√	√	√
	Wall 2	X	√	X	√	X																									
	Wall 3																														
	Wall 4																														
Toilets	Wall 1	√	√	√	√	X	√	√	√	X	√	√	√	√	√	X	√	√	√	√	√	√	√	√	√	X	X	√	√	√	√
	Wall 2	√	√	√	√	X	√	√	√	√	X	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 3						√	√	√	X	X																√	√	√	√	√
	Wall 4						√	√	√	X	√																√	√	√	√	√
No. of Defects		8					13					4					4					1					2				
No. of Checks		35					65					30					25					25					35				
Total Number of Defects																											32				
Total Number of Checks/Opportunities for Defects																											215				

As explained earlier, assessed items in Construction Quality Assessment System (CONQUAS) are given a check (√) for meeting the specified standard in data collection sheet and cross (X) for not complying with the standards. The yield is then calculated as follows:

(%) = (· "√")

The discrete method of data collection is used in CONQUAS. To calculate sigma for the processes, the DPMO (or defects per million opportunities) formula is used:

$\text{DPMO} = \frac{32}{215} \times 1,000,000 = 1,48,837.21$

Based on the sigma conversion table in Table 1, the equivalent sigma for 1,48,837.21 DPMO was approximately 2.66σ.

special attention was paid by Contractor to ensure that its on-going building projects were closely supervised to meet the quality standards specified in CONQUAS for internal finishes. Contractor also reviewed the quality track records of its trade subcontractors to ensure that only those with good past performance were employed. The same review was also made for the suppliers where products (such as doors, windows, and components) were used in the projects.

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Table 3.Six Sigma Data collection sheet For Internal Finish (stage B) [3]

Locations		Floors					Walls					Ceilings					Doors					Windows					Components				
		Finishing	Alignment & Evenness	Cracks & Damages	Hollowness	Jointing	Finishing	Alignment & Evenness	Cracks & Damages	Hollowness	Jointing	Finishing	Alignment & Evenness	Cracks & Damages	Roughness	Jointing	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects	Joints & Gaps	Alignment & Evenness	Material & Damages	Functionality	Accessories Defects
Bedrooms	Wall 1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 3						√	√	√	√	√																				
	Wall 4						√	√	√	√	√																				
Hall	Wall 1	√	√	√	√	√	√	√	√	√	X	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√					
	Wall 2						√	√	√	√	√																				
	Wall 3						√	√	√	√	√																				
	Wall 4						√	√	√	√	√																				
Kitchen	Wall 1	X	√	√	√	√	√	√	√	√	√	√	√	√	√	√											√	√	√	√	√
	Wall 2	√	√	√	√	√																									
	Wall 3																														
	Wall 4																														
Toilets	Wall 1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Wall 3						√	√	√	√	√																√	√	√	√	√
	Wall 4						√	√	√	√	√																√	√	√	√	√
No. of Defects		1					1					0					0					0					0				
No. of Checks		35					65					30					25					25					35				
Total Number of Defects																											2				
Total Number of Checks/Opportunities for Defects																											215				

The ‘‘Six Sigma Data Collection Sheet for Internal Finishes (Stage B) for one flat unit in the completed buildings is shown in Table 3. Based on the checks in Table 3

$$\text{DPMO} = \frac{2}{215} 1,000,000 = 9,302.33$$

Based on the Sigma Conversion Table in Table 1, the equivalent sigma for 9,302.33 DPMO is approximately 3.95σ.

The entire exercise shows that the initial sigma (2.66σ) which was able to provide a warning sign that the quality standards of internal finishes achieved initially by Contractor A were found lacking. If Contractor A continues to implement these improvement measures, it can be expected to get the quality standards for internal finishes right more than 99% of the time. Based on this finding, Contractor A was encouraged to work towards getting the quality standards for internal finishes right all the time, i.e., moving towards achieving 6sigma.

CONCLUSION

1. The various factors are affected to quality of the building construction. These factors must be identified as early as possible so that the quality of construction can be improved.
2. We compare the regular method of working for internal finishing work of building with DMAIC technique of Six Sigma methodology on stage A, increase of 1.29σ is found in stage B.
3. The DMAIC methodology of six sigma principles gives systematic approach to identify and improve the construction process.
4. Six sigma is the quality management program in the construction to need future development.

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