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A COMPARATIVE STUDY OF IMPLEMENTATION OF SIX SIGMA IN SELECT INDIAN ORGANISATIONS

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ABSTRACT

Six-Sigma is a business technique and an orderly methodology, use of which provides burst through in profitability through quantum gain in product/service quality, consumer fulfilment and productivity. The idea of executing Six Sigma was implemented at Motorola in the 1980s and the goal was to reduce the quantity of defects to as low as 3.4 sections for each million openings. For the six sigma to be effectively implemented in the organization, one must understand the critical success factors that will make the function successful. This paper displays the key components, which are essential for Six-Sigma execution. Select Indian industries are chosen and data is collected using a structured questionnaire. Data thus obtained are analyzed to carry out a comparative study of various organizations. Various benefits of six sigma program are examined and responses from organizations are ranked according to effective utilization of six sigma in decision making. Benefits of adopting six sigma are 'improved product services', 'customer satisfaction' and 'increased profitability'. The result of this study can support substantial improvements in the business performance and competitiveness of the organisations'.

KEYWORDS: *Six Sigma, critical success factors, business strategy, Quality Improvement, Increased Profitability.*

1. INTRODUCTION

Six-Sigma is a business strategy that enables organization to increase their profits by optimizing their operations, improving quality and eliminating defects [1]. It is a work philosophy to achieve, maximize and maintain commercial success by understanding wants of the customer [2]. Many of the well-known huge companies all over the world doing big business in different sectors have benefited extremely by adopting Six Sigma business approach.

Six-Sigma uses facts and data obtained from measurement of processes within an organization, not by comparing with some external standard. In other words, it precisely measures what is actually happening with in the production and service processes and determines how to improve them.

Embarking on a Six Sigma program means delivering top quality products and service while practically eliminating all internal inefficiencies [3]. Apart from decrease of defects in manufacturing, Six Sigma also focuses on 'maintain processes' to get rid of errors and deficiency thus helping all the stakeholders of a business like management, consumers and workers to a great extent.

There is an observation that Six Sigma is applicable only for large companies possessing better resources. But, Six Sigma is equally applicable for companies of any size if deployment is done with proper thinking and the appropriate considerations. A detailed analysis is essential regarding what are the critical success factors for adopting Six Sigma in small and medium scale industries.

Most of the Indian organizations are not working on six sigma effectively and the companies from the outside of the country. Many companies in India do not use Six Sigma and the companies coming from outside are using Six Sigma, so for Indian companies to stay in the market, it is necessary that they adopt Six Sigma effectively because the Six Sigma increases profit and provide quality product to the customers.

2. LITERATURE REVIEW

Six-Sigma is an idea that was started by Motorola in the USA in 1980s [4]. It was a path for Motorola to express its quality objective where a deformity opportunity is a procedure disappointment that is basic to the client. This gave a vital spotlight on the change rate and, specifically, that basically "better" may not be adequate, but rather that the basic thought is that of ending up adequately better speedily. Six-Sigma plainly engaged assets at Motorola, including human exertion, on decreasing variety in all procedures including fabricating and regulatory procedures. To build up an unmistakable measure on the change exercises, this program was propelled in 1987. The purpose behind the name was that "sigma" is a factual measure identified with the capacity of the procedure or its capacity to deliver non-blemished items/units/parts. In factual word, sigma is a measure of process changeability alluded to as the standard deviation and "Six Sigma" by and large infers event of deformities at a rate of 3.4 imperfections for every million openings (DPMO) for deformities to emerge [5]. Table 1: enlist all factors for successful six sigma implementation.

Table 1: Factors for successful Six-Sigma implementation

S. N.	Success factors	Description	Source
1	Management involvement and commitment	Providing adequate financial support; Involving in project progress review meeting, Communicating what customer needs, requirements, and expectation throughout the Organization.	[7 -8]

2	Organization Infrastructure	Effective organizational infrastructure to support Six Sigma implementation and development plans. It would be ideal to create a communication plan that would address why Six Sigma is important, and how the methodology of Six Sigma works in Organization.	[9]
3	Integrate Six Sigma to business strategy	Establishing clearly business/functional strategies; Determining the linkage among business/functional strategies; Communicating business/functional strategies to all level of the organization.	[10]
4	Integrate Six Sigma to customers	Six Sigma should begin and end with the customer. Projects should begin with the determination of customer requirements.	[9 -11 -12]
5	Integrate Six Sigma to Suppliers	The traditional approach is to have different suppliers in order to maintain reduced costs, howev er under six sigma, new way to reduce variability is to have few suppliers with six sigma projects.	[9]
6	Project selection, prioritization and project management	Determining project timeframe; Determining of authority and responsibility for each stage of project management; Follow -up the progress in periodically.	[14]
7	Understanding the Six Sigma methodology, tools and techniques	Learning the principles behind th e Six Sigma methodology, i.e. DMAIC methodology.	[15]
8	Project management skills	Project management skills to meet the various deadlines or milestones during the course of the project. Most of the projects on Six Sigma fail due to poor project management skills, setting and keeping ground rules, determining the meeting's roles and responsibilities.	[16]
9	Integrate Six Sigma to human resources	Across all GE businesses no one will be promoted without the full Six Sigma training and a completed project. This in itself is an impressive behavior driver.	[18]
10	Training	Providing training budgets; the Six - Establishing the formal training programs; Evaluating the understanding of all training Courses.	[14]
11	Cultural change	Establishment should build a culture congenial towards embarking upon on sustainable Six Sigma development projects within the company by providing necessary education and awareness to all the employees.	[19]

Six Sigma is a quality program that, when all is said and done, improves your customer's experience, lowers your costs, and builds better leaders"-Jack Welch. The focus of six-sigma is to cut down the variability in key product quality characteristics to the extent at which failure or defects are extremely unlikely [21]. Design for Six Sigma (DFSS) is a systematic methodology utilizing tools, training and measurements to enable the organization to design products and processes that meet

customer expectations and can be produced at Six Sigma quality levels [22].

DMAIC and SMART Approach

Adoption of Six Sigma project management approach will lead to the cultural breakthrough in the companies in many areas. Definitely there will be positive effect on culture of the organization. Change in approach is due to introduction of methodical project controlling and creation of a knowledge management concept. It will change the culture in an organized manner by adopting systematic and practical D-M-A-I-C approach towards solving the problems in the system. Basically it will make your organizational goals "MART".

S= Simple
M= Measurable
A= Achievable
R= Realistic
T= Time bound.

According to Professor Douglas Montgomery, QREI Editorial, 2005, "Six Sigma has perhaps been the most successful business improvement strategy of the last 50 years". The future of Six Sigma depends on keeping it relevant to today's business needs and to continue to enhance and expand the traditional Six Sigma toolkit. As the use of Six Sigma matures, more and more companies begin to use Six Sigma as a culture change vehicle and leadership development tool. Management of cultural breakthrough that occurs in an organization, as a result of Six Sigma projects, on a continuous basis and imbibing it as permanent feature across the entire spectrum of the organization is the most vital responsibility of the organization.

3 METHODOLOGY

Methodology to analyse the gathered data is presented in this section SPSS 16 software is utilized for this purpose. A quantitative approach is utilized to examine the exploration issue. 37 filled questionnaires are taken from three different organisations that are utilizing six sigma programs. We utilized thirty two inquiries based poll to review and gather the helpful information. The poll contains 32 questions covering 11 factors. These factors (Fi) are listed below:

- F_1: Project prioritization and selection
- F_2: Integrate six sigma to business strategy
- F_3: Organizational Infrastructure
- F_4: Integrate six sigma to employees
- F_5: Integrate six sigma to suppliers
- F6: Integrate six sigma to customer
- F7: Cultural change
- F8: Management Involvement and commitment
- F9: Project management skills
- F10: Understanding Six Sigma Methodology
- F11: Training

Responses are gathered to each inquiry on a 5-point Likert scale (1= Strongly Disagree, 2= Disagree, 3= Somewhat Agree, 4= Agree and 5= Strongly Agree) [18]. Factual examination was finished utilizing SPSS 16.0 programming. Weightage of components were figured by paired comparison method. Subsequent to finding the weightage, the score of every respondent is computed by utilizing the accompanying formula:

SCORE $\sum_{i=1}^{5} Wi.Fi$ .....eq. (1)

Where, i = 1, 2, 3, 4..... 11

Finally, on the basis of the score, the rank of each industry was calculated with the help of SPSS 16 software. Thereby we identified which industry has most effectively adopted six sigma programs.

4 DATA COLLECTION AND ANALYSIS

In this section, the approach for data collection, method, steps of data analysis etc. is represented in detail. The first step is to identify the area where the six sigma program can be implemented. Factors were identified by considering the pros and cons of the six sigma program. A structured questionnaire was used to collect the required data from each respondent (employees). The questionnaire consists of the following eleven factors: (a) Project prioritization and selection, (b) Integrate six-sigma to business strategy. (c) Organizational Infrastructure, (d) Integrate six-sigma to employees, (e) Integrate six-sigma to suppliers, (f) Integrate six-sigma to customer, (g) Cultural change, (h) Management Involvement and commitment, (i) Project management skills, (j) Understanding Six Sigma Methodologies, (k) Training. Table 2 thus

Table 2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.820	.827	11

Cronbach alpha coefficient was calculated to be 0.820 as shown in Table 2, which shows an acceptable level of internal consistency for our scale with this sample.

Table 3: Item Total Statistics

	Mean	Std. Deviation	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
F1	3.952	.444	.529	.801
F2	4.054	.586	.615	.796
F3	3.920	.595	.525	.802
F4	4.027	.600	.453	.809
F5	4.148	.551	.434	.811
F6	4.013	.506	.653	.789
F7	4.018	.437	.579	.799
F8	3.959	.505	.477	.806
F9	4.000	.624	.303	.821
F10	4.160	.602	.368	.818
F11	4.054	.421	.518	.804

Mean and standard deviation of all factors (variables) were calculated using SPSS software as shown in Table 3. This table (column 5) shows the value of Cronbach's alpha when a particular item is deleted from the scale. Here result shows that removal of any factor, except factor 5,9,10, would result in a lower Cronbach's alpha. So, we would not want to remove this factor. There might be a small improvement in Cronbach's alpha by the elimination of factor 5,9,10.

Pearson's correlation coefficients among various factors were calculated using SPSS 16.0 as shown in Table 4.

Table 4: Pearson's correlation coefficients

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F1	1	0.602**	0.190	0.224	0.371*	0.445**	0.272	0.176	0.176	0.370*	0.423**
F2	0.602**	1	0.450**	0.510**	0.122	0.370*	0.338*	0.219	0.223	0.289	0.552**
F3	0.190	0.450**	1	0.371*	0.153	0.297	0.411*	0.395*	0.289	0.250	0.493**
F4	0.224	0.510**	0.371*	1	0.084	0.334*	0.290	0.372*	0.173	0.193	0.295
F5	0.371*	0.122	0.153	0.084	1	0.449**	0.475**	0.296	0.141	0.334*	0.241
F6	0.445**	0.370*	0.297	0.334*	0.449**	1	0.508**	0.54**	0.247	0.302	0.413*
F7	0.272	0.338*	0.411*	0.290	0.475**	0.508**	1	0.48**	0.297	0.200	0.196
F8	0.176	0.219	0.395*	0.372*	0.296	0.540**	0.480**	1	0.138	0.038	0.289
F9	0.176	0.223	0.289	0.173	0.141	0.247	0.297	0.138	1	0.114	0.108
F10	0.370*	0.289	0.250	0.193	0.334*	0.302	0.200	0.038	0.114	1	0.129
F11	0.423**	0.552**	0.493**	0.295	0.241	0.413*	0.196	0.289	0.108	0.129	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The weightage of factors (Fi) was calculated by paired comparison method. And the results were calculated by paired sample t-test in SPSS software.

Table 5: Paired comparison for weightage calculation

F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	
F1(1)	F1(1)	F1(2)	F1(2)	F6(1)	F1(1)	F8(2)	F1(1)	F10(1)	F1(2)	F1
	F2(1)	F2(2)	F2(2)	F2(1)	F2(2)	F8(1)	F2(2)	F10(1)	F2(3)	F2
		F3(2)	F3(1)	F6(1)	F3(1)	F8(2)	F3(1)	F10(2)	F3(2)	F3
			F5(1)	F6(2)	F7(1)	F8(3)	F9(1)	F10(3)	F4(1)	F4
				F6(2)	F7(1)	F8(3)	F9(1)	F10(2)	F5(1)	F5
					F6(1)	F8(1)	F6(2)	F10(1)	F6(2)	F6
						F8(2)	F7(1)	F10(2)	F7(2)	F7
							F8(2)	F8(1)	F8(3)	F8
								F10(2)	F9(1)	F9
									F10(3)	F10

Table 6: Calculation of weightage

Total differences:		**Weightage (W_i) = Fi /ΣF i**
F1	9+1=10	0.099
F2	14+1=15	0.1485
F3	7+1=8	0.0792
F4	1+1=2	0.0198
F5	2+1=3	0.0297
F6	12+1=13	0.1287
F7	5+1=6	0.0594
F8	20+1=21	0.2079
F9	3+1=4	0.0396
F10	17+1=18	0.1782
F11	0+1=1	0.0099
Total	**101**	**Σ W i = 1**

Factor F11 has zero difference it means there is no importance for this factor while we can't neglect any factor, so for mathematical correction one is added to each factor.

The weightage was calculated in Table 6 by the following formula as shown in Equation 2:

Weightage (W_i) = $\frac{Fi}{\Sigma Fi}$ ..... eq. (2)

Where, i = 1, 2, 3, 4……., 11

The score was calculated by the given formula in Equation (1) as shown in Table 7.

$SCORE_j$ = ($0.099*F_1+0.1485*F_2+0.0792*F_3+0.0198*F_4+0.0297*F_5+0.1287*F_6+0.0594*F_7+0.2079*F_8+0.0396*F_9+0.1782*F_{10}+0.0099*F_{11}$).

Where, j = 1, 2, 3….37.

Table 7: Score and Rank of organizations

ORGANIZATION	PLACE	SCORE
Grasim1	Nagda	3.739
Grasim2	Nagda	3.559
Grasim3	Nagda	4.232
Grasim4	Nagda	3.512
Grasim5	Nagda	4.593
Grasim6	Nagda	3.564
Grasim7	Nagda	3.544
MEAN		3.820
Eicher1	Pune	4.041
Eicher2	Pune	3.863
Eicher3	Pune	4.333
Eicher4	Pune	3.858
Eicher5	Pune	3.670
Eicher6	Pune	4.286
Eicher7	Pune	3.457
Eicher8	Pune	4.185
Eicher9	Pune	3.858
Eicher10	Pune	4.046
MEAN		3.960
Honeyw1	Bangalore	4.148
Honeyw2	Bangalore	4.063
Honeyw3	Bangalore	4.056
Honeyw4	Bangalore	3.853
Honeyw5	Bangalore	4.054
Honeyw6	Bangalore	3.776
Honeyw7	Bangalore	3.722
Honeyw8	Bangalore	3.935
Honeyw9	Bangalore	4.091
Honeyw10	Bangalore	4.021
Honeyw11	Bangalore	4.714
Honeyw12	Bangalore	4.054
Honeyw13	Bangalore	4.343
Honeyw14	Bangalore	4.464
honeyw15	Bangalore	4.313
honeyw16	Bangalore	3.809
honeyw17	Bangalore	4.383
honeyw18	Bangalore	4.719
honeyw19	Bangalore	4.437
MEAN		4.156

5 RESULTS

The result obtained from the 37 employees of three different organization viz. Grasim, Eicher and Honeywell. The mean score calculated from the data provided by all employees of the same organization gives score 3.820 (Grasim industries private limited, Nagda), 3.960 (Eicher, Pune) and 4.156 (Honeywell, Bangalore). Grasim scores the lowest and it has been ranked 3 and Honeywell being highest scorer ranked first. We categorized the score as WEAK, MODERATE and BETTER. If the score is below 2.5 then it would be considered as Weak, while score is obtained between 3 and 4 it is considered as moderate and between 4 and 5 the score is considered as better result. It is

observed that all three organizations have scores in the range of moderate to better level of implementation of the six sigma technique. While Grasim industries and Eicher have potential to improve upon further by integrating six sigma philosophies in all spheres of their potential and business strategies harness its benefits, the Honeywell has shown better Implementation of six sigma. It is shown that the thrust areas like project prioritization and selection, organizational infrastructure, Integrate six sigma to employees, integrate six sigma to suppliers, management involvement and commitment, project management skills and understanding six sigma methodology as key success factors.

6. CONCLUSION

Six Sigma has been considered as a strategic approach to improve business profitability and achieve operational excellence through the effective application of both statistical and non-statistical tools/techniques. Six-Sigma provides a comprehensive and flexible system for maximizing business success. It has been considered as a revolutionary approach to product and process improvement through the effective use of statistical methods. This paper illustrates the key ingredients one should consider before a Six Sigma program is initiated in their organizations. The success factors identified can be important guidelines to other organizations which use in the process of six sigma implementation. The work can be further extended to study different organizations for different domains like textile, pharmaceutical, apparel, footwear, automotive industries to validate the result in other domains.

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