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A STUDY OF SIX SIGMA IMPLEMENTATION
AND CRITICAL SUCCESS FACTORS

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A Study of Six Sigma Implementation and Critical Success Factors

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INTRODUCTION
Six Sigma is a new addition to the menu of powerful concepts which has gained significant attention through its dramatic results. Motorola, which pioneered Six Sigma, claimed a fivefold growth in sales with cumulative savings of US$ 14 billion as a result of ten years of Six Sigma implementation while General Electric (GE) and AlliedSignal reported savings of US$ 1 billion and US$ 2 billion, respectively, within two to five years of Six Sigma implementation. Whilst it promises a lot, the results so far, do however, indicate that not all the organizations implementing the concept have achieved dramatic results. Rather many of them abandoned their Six Sigma initiative since it was not significantly contributing to the bottom line in any meaningful period of time. These contrasting results of Six Sigma implementation pose some very serious questions: what are the factors which contribute to the successful implementation of Six Sigma? what are the problems faced in implementing a Six Sigma program? what are the tangible and intangible benefits of Six Sigma implementation?
OBJECTIVE OF RESEARCH

The purpose of the research was to study the implementation of Six Sigma in the UK organizations. Based on the results of the study, it then aimed to identify the critical factors which contribute to the successful implementation of Six Sigma implementation. In addition, it also attempted to investigate the different problems faced in the Six Sigma implementation, and the benefits attained through implementing Six Sigma.

LITERATURE REVIEW

What is Six Sigma?

According to Paul (1999),

Six Sigma is a statistical term that refers to 3.4 defects per million opportunities (or 99.99966 percent accuracy), which is as close as anyone is likely to get to perfect. A defect can be anything from a faulty part to an incorrect customer bill (Paul, 1999).

Pande et al (2000) defines Six Sigma as:

“a comprehensive and flexible system for achieving, sustaining, and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes.”

According to Antony and Banuelas (2001), Six Sigma is:

“. . . a business improvement strategy used to improve business profitability, to drive out waste, to reduce costs of poor quality and to improve the effectiveness and efficiency of all operations so as to meet or even exceed customers’ needs and expectations”

Why Six Sigma?

A “big dollar impact” is one of key reasons cited by Hoerl (1998) for the success of Six Sigma. Some of the other reasons for implementing Six Sigma (Henderson and Evans, 2000) are:

- to be responsive to and focused on the customer base
- to improve product and service performance
- to improve financial performance and profitability of business
- to be able to quantify quality programs
- to be considered as a supplier for a business

Critical Success Factors for Six Sigma

Critical Success Factors (CSFs) are those factors which are critical to the success of any organization, in the sense that, if objectives associated with the factors are not achieved, the organization will fail (Rockart, 1979).

Hendersons and Evans (2000), based on the study of GE’ Six Sigma implementation, suggest upper management support/involvement, organizational infrastructure, training, tools, linkage to human-resource based actions (promotion, bonuses), early communication to employees, measurement systems, and an information technology infrastructure as the key elements for successfully
implementing Six Sigma.

Antony and Benuelas (2001), based on the review of existing literature, identify that the key ingredients for the effective implementation of Six Sigma are: top management involvement and commitment; cultural change; organizational infrastructure; training; project management skills; project prioritization and selection, reviews and tracking; understanding the six sigma methodology, tools and techniques; linking Six Sigma to business strategy; linking Six Sigma to the customer; linking Six Sigma to the human resources; and linking Six Sigma to the suppliers.

From the abovementioned literature review, following CSFs of Six Sigma are identified:

- Continued top management support and commitment
- Suitable organizational infrastructure
- Organizational culture change
- Education and Training
- Effective use of Six Sigma methodology and tools
- Project Management Skills
- Rewards and recognition
- Effective Communication
- Employee involvement and empowerment
- Linking Six Sigma to Customer

RESEARCH DESIGN

To collect data for the research project in quantitative terms, a research questionnaire was designed and then distributed to the companies. Multiple-choice and scale-type questions were used to collect response in an objective manner. In addition, open questions were used to collect subjective information. Lickert scale of 1 to 7 was used to rate the critical success factors and the benefits of Six Sigma implementation.

The population of the research consisted of UK organizations, manufacturing and services, which are implementing or have implemented Six Sigma. Due to limited control over the choice of the companies, non-probability sampling techniques, i.e., convenience sampling and snow-ball sampling methods, were used for selecting the companies. A total of 75 UK companies from a diverse range of sectors were selected based on the data available through Six Sigma web portals, conferences, events, news releases, articles, and print media. Out of 75 questionnaires, 19 valid responses were received and 6 questionnaires were returned undelivered. It represents a response rate of 25% which is satisfactory in this type of research and corresponds well with the similar surveys done in other academic researches. The respondents were mainly Six Sigma Project Leaders, Master Black Belts, or Quality Managers.

ANALYSIS OF RESEARCH DATA

Figure 5-1 and 5-2 presents the classification of respondents in terms nature and size of businesses, respectively:
The primary businesses of respondents in the survey included both manufacturing and services sectors. Rather services sectors make more than 50% of the respondents. Also, the majority of organizations implementing Six Sigma are large organizations having more than 2500 employees.

Figure 5-4 shows the major drivers of Six Sigma program:

Figure 5-6 shows the primary sponsors for Six Sigma program:
The figure indicates that in more than 50% cases the Director was the primary sponsor of the Six Sigma Program, followed by GM in 22% cases. CEO was the primary sponsor in only 11% cases.

Figure 5-7 and 5-8 show the no. of Six Sigma projects initiated and the average time for each Six Sigma project:

![Pie chart showing the number of Six Sigma projects](image)

It can be seen that more than 15 Six Sigma projects have been initiated and implemented in 66% cases, thus indicating that Six Sigma program was started and implemented on a wider scale in most organizations. Regarding the average project time, equal proportion of respondents reported the average project time of 4-6 months and 7-9 months. This suggests that the average Six Sigma project spans between 4 to 9 months, depending on the nature and scope of project and the experience of Six Sigma team.

Figure 5-9 and 5-10 show the percentage of employees involved and the percentage of time spent on Six Sigma program:

![Pie chart showing the percentage of employees involved](image)

The figure indicates that in 83% cases, 1-20 percent of employees were involved in the Six Sigma projects while in 17% cases, 41-60% employees were involved. Regarding the percentage of time devoted by Six Sigma team members to project activities, it varies from role to role. While MBBs and BBs spend almost 100% of their time in Six Sigma project activities, other roles (GBs, team members) devote from 1-20% to 21-40% of their time in project activities.

Figure 5-11 shows the contribution of management to the Six Sigma program:
As can be seen in the figure that the biggest contribution of the top management to Six Sigma has been in the form of commitment and support, followed by leadership and championship as well as resource provision.

Figure 0-10 shows the problems faced in Six Sigma implementation:

As can be seen from the figure, lack of resources and poor data collection and analysis were the biggest problems faced, in 20% of cases. Other significant problems were the lack of management commitment, the organizational resistance to change, and problems with measurement system, in 12% of cases.

Figure 0-11 indicates the critical success factors as ranked by the respondents in terms of their significance:
Figure indicates that an effective organizational culture of change and top management support were rated as the two most critical factors for successful implementation of Six Sigma. The next critical factor was effective communication of Six Sigma program, followed by teamwork, employee training and education on Six Sigma, effective use of Six Sigma methodology, and organizational infrastructure for Six Sigma. On the lower end, use of external consultants and role of IT were rated as less critical factors for successful implementation of Six Sigma.

Figure 5-17 presents the ranking of critical factors in terms of soft and hard factors:
Creating an effective culture change

Effective communication

Employee training & education

Effective use of Six Sigma methodology

Effective use of Six Sigma tools

Role of IT

<table>
<thead>
<tr>
<th>Factors</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating an effective culture change</td>
<td>6</td>
</tr>
<tr>
<td>Effective communication</td>
<td>5.8</td>
</tr>
<tr>
<td>Employee training &amp; education</td>
<td>5.6</td>
</tr>
<tr>
<td>Effective use of Six Sigma methodology</td>
<td>5.5</td>
</tr>
<tr>
<td>Effective use of Six Sigma tools</td>
<td>5</td>
</tr>
<tr>
<td>Role of IT</td>
<td>3.8</td>
</tr>
</tbody>
</table>

As can be seen, soft factors have been rated higher as compared to the hard factors, thus indicating that soft factors play a more significant role in successful implementation of Six Sigma than the hard factors.

Figure 5-19 describes the ranking of benefits achieved through Six Sigma implementation:

As shown in the figure, the most significant benefit achieved through Six Sigma implementation is cost reduction. This validates the argument that Six Sigma impacts the bottom line and creates a “Big dollar impact”. The next significant benefit attained is the defect/error reduction, which invariably is the core objective of Six Sigma Program. Other significant benefits achieved were reduced cycle time, and minimization of waste/non-value added activities.

Based on the review of literature and best practices, and the analysis of the survey findings, a framework for effective Six Sigma implementation is being proposed, as shown in the Figure 0-14.
CONCLUSION

The research led to some interesting, yet important, findings. First, Six Sigma has been adopted in both manufacturing and services organizations in UK, thus dispelling the myth that Six Sigma is more applicable in the manufacturing environments. Second, though Six Sigma was pioneered in mid 80s, it was mainly adopted by UK organizations during or after 2000. Third, the major drivers for Six Sigma implementation are a need for change for continuous improvement, competitors’ pressure, and poor customer satisfaction. Fourth, most of the organizations had implemented ISO 9000 and, in some cases, TQM or BPR before embarking on implementing the Six Sigma program.

One significant finding was the average time of the Six Sigma project which ranged between four to nine months, thus implying that Six Sigma projects are short-term projects. Another important finding showed that around 1-20% of employees have been involved in Six Sigma projects, thus indicating that Six Sigma program so far has been focused on a selected group of people, which include the Champions, Sponsors, MBBs, GBBs, and team members. Also it was found that the percentage of time devoted by Six Sigma project team members vary from role to role, with Six Sigma leaders, MBBs and BBs devoting 100% of their time on Six Sigma projects while other team members spend around 1-20% of time. The major roles of top management in the Six Sigma program have been in the form of commitment and support, championship and leadership, and resource provision.

RECOMMENDATIONS

- **Top management commitment and support** for Six Sigma program is vital and crucial. Top executives must be part of Six Sigma and should contribute towards its implementation through visible commitment and support, leadership and championship, resource provision, and communication and consultation. They should support the Six Sigma initiative by personally spending time in every Six Sigma training, speaking and answering questions.
raising by employees, dropping in on Six Sigma reviews, making site visits to observe at first-hand the degree to which Six Sigma is ingrained in the culture; and monitoring Six Sigma project progress.

- **An effective Six Sigma organizational infrastructure** of Champions, Master Black Belts, Black Belts, and Green Belts should be established. Champions should come from the top executives ensuring that Six Sigma initiative has the top management support and appropriate resources are made available for projects. Master Black Belts will be the Six Sigma leaders acting as coaches and mentors for Black Belts and other team members and, hence, should be competent in terms of experience, training and skills related to project management, process improvement, and statistical analysis. Black Belts are the frontline project leaders, facilitating the planning and implementation of Six Sigma projects in collaboration with Green Belts and team members. Black Belts should be selected based on their knowledge of organizational processes and their command on application of statistical and project management tools and techniques.

- **A well-defined training and certification program** of Champions, Master Black Belts, Black Belts and Green Belts should be established. The body of knowledge for each level of training should be developed and the qualification criteria should be defined. This program should then be applied for selection and training of employees for the different Six Sigma roles.

- **Effective communication** is critical to overcome resistance to Six Sigma and maintain enthusiasm for quality initiatives within the organization. A communication plan addressing the importance of Six Sigma quality and how the method works should be developed and implemented to drive out two basic fears at individual levels: fear of change and fear of not measuring up to the new standards. The most commonly used communication media are kick-off meetings with managers, workshops, and individual meetings with employees.

- Six Sigma is an advanced quality initiative and should be preceded by other simpler quality initiatives such as ISO 9000 Quality System. This will help in developing a quality-oriented culture in the organization and prepare the employees to adopt more complex initiatives like Six Sigma.

- Six Sigma, being a breakthrough management strategy, requires **changes in organizational culture and in the attitudes of employees**. The organization should identify the factors (technical, political, individual, organizational) which cause employee’s resistance to Six Sigma and address these factors through education and involvement, creating the need for change, listening to employees, and better communication. GE’s CEO Welsh created change in organizational culture and overcame employee resistance by changing the organizational structure at the top, investing on training, adjusting the reward and recognition system, and early communication to employees (Henderson and Evans, 2000).

- The **effective use of DMAIC Methodology** is a key to successful implementation of Six Sigma. To affect this, the Six Sigma team should be fully conversant and trained on the application of certain tools and techniques, the most critical of which include project management, statistical analysis, and process management. A balanced combination and smart application of these tools is a recipe for successful Six Sigma results.

- While the **hard factors** like tools and techniques must be there to support the DMAIC methodology, it is the **soft factors** that play a more significant role in Six Sigma success and hence should be given higher attention. Top management commitment, cultural change, effective communication, teamwork, and employee training and education are critical soft factors which should be effectively constituted in the organizational culture in conjunction with the hard factors to maximize the probability of Six Sigma success.
REFERENCES


