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Most Important Ingredients for Successful Implementation of Six Sigma, Guideline for Pakistan’s Industrial Sector

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Abstract

Six Sigma is a comprehensive and flexible system for achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by close understanding and customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business process. (Pande et al. 2000). Six Sigma a powerful business improvement strategy, initiated by Motorola in the 1980’s, enables companies to use different statistical tools, leadership tools and team tools to achieve operational excellence. Six Sigma has been implemented by a number of well known world class organizations such as ABB, Honeywell, Texas Instruments, ford and GE and in Pakistan is being implemented by
CrescentBahuamm and Allied Engineering etc. In these all organizations Six Sigma is being implemented with a concept of reducing quality costs, improving process capability, reducing variability in process, and enhancing customer satisfaction. Six Sigma can be a great success or an expensive failure, depending upon how it is implemented. For effective implementation of Six Sigma in Pakistani organizations, key ingredients are mentioned in this paper.

**Introduction**

The concept of Six Sigma Was pioneered by Motorola in 1980’s with main emphasis of reducing quality related costs in manufacturing industry. After Motorola, many other multinational companies such as Kodak, GE, Sony, etc have claimed great savings as a result of Six Sigma implementation projects.

In statistical terms, Six Sigma is a term that refers to 3.4 defects per million opportunities (DPMO), where sigma is a term used to represents the variation about the process average. According to Thomas Pyzdek (2003) companies traditionally have accepted that their process perform at a level of three to four sigma, which translates to 6200 to 67000 DPMO.

According to Six Sigma a manufacturing process with a normally distributed output and a standard deviation $6\sigma$ has to display a distance of six standard deviations between process target an the closet tolerance limit and corresponds to a process capability ratio of 2.0 .As shown in Fig. 1.
Fig. 1 Distance between the target and tolerance limits if the process output is normally distributed and performing Six Sigma level.

Benefits achieved through Six Sigma Implementation

Six Sigma implementation was successful in many organizations and results were significantly improved performance and financial benefits. Key benefits obtained by some multinational companies are discussed here for guidance of Pakistan’s industrial sector.

Motorola (1987-1994)

- Reduced manufacturing costs by $1.4 billion.
- Reduced in process defects level by a factor of 200.


- Company wide saving of more than $1 billion.

- Reduced manufacturing cost by more than $1 billion.
- Reduced new product introduction time by 16 percent.

Ingredients for implementation of Six Sigma: an overview

The most important or key ingredients of Six Sigma play an identical role of input variables to any process. The first and far most important step is to carry out explanatory study on the topic as similar studies were performed by authors such as Henderson and Evans (2000), Pande et al (2000) and Eckes (2000). Moreover it is also important to learn the importance of these factors in a ranking or prioritized order particularly Pakistan’s industrial sector. For people understandings the relative weightings of critical success factors (CSFs) will assist them in understanding which ingredients are most important and which ingredients are less important. This paper will tell people of Pakistani industry about how Six Sigma will be implemented properly.

1. Top-level management commitment

Launching Six Sigma in a company is strategic management decision that needs to be initiated by top level management. All the elements of framework, as well as the formalized improvement strategy, need top level management for successful execution. Especially, without a strong commitment on the art of top level management, the training
program and project team activities are seldom successful. Although not directly active in the day to day improvement projects, the role of top level management as leaders, project sponsors and advocates is crucial. Pragmatic management is required, not just lip service, as top level; management commits itself and the company to drive the initiative for several years and into every corner of the company.

There are numerous pragmatic ways for the CEO (chief executive officer) to manifest his commitment. First, in setting the vision and long-term or short-term goal for Six Sigma, the CEO should play a direct role. Second, the CEO should allocate appropriate resources in order to implement such Six Sigma programs as training schemes, project team activities and measurement system. Third, the CEO should regularly check the progress of the Six Sigma program to determine whether there are any problems which might hinder its success. He should listen to Six Sigma reports and make comments on the progress of Six Sigma. Fourth, he should hold a Six Sigma presentation seminar regularly, say twice a year, in which the results of the project team are presented and good results rewarded financially. Finally, he should hold a Champion Day regularly, say once in every other month, in which Champions (upper managers) are educated by specially invited speakers and he should discuss the progress of Six Sigma with the Champions.

2. Cultural Change

The successful implementation of Six Sigma Requires change and adjustment in the culture of the organization and also change in the minds and attitudes of its employees. Employees have to be motivated and accept responsibility for the quality of their own work through various reward and recognition schemes. There is possibility that
employees feel that they have to do extra work. To remove this problem an effective communication to all employees on the benefits of Six Sigma. The same kind of problem arose when GE was starting Six Sigma implementation in their organization. They understood the problem and communicated thoroughly about Six Sigma to all their employees. Now employees within GE work their every day jobs with the ultimate goal of “Doing things right first time”. The people within the organization must be known and be aware of the need for change. Companies that have been successful in managing change are through increased and sustained communication, motivation and education. It would be ideal to create communication plan that would address why Six Sigma is important and how the methodology of Six Sigma works in organization.

For many successful companies in Six Sigma (GE, Motorola, ABB, Sony, Honeywell), a key factor in communicating over the commitment and enthusiasm of Six Sigma has been the direct involvement of their top leaders.

Eckes (2000) identifies four different factors of resistance, which are:

- **Technical** – frequently people find difficulties in understanding statistics within Six Sigma program. Education and involvement is needed.
- **Political** – it is based on seeking the solution to be implemented as a loss, real or imagined. The strategy to avoid this is creating the need for change and then showing how change can be beneficial for them
- **Individual** – it consists of employees who are highly stressed as a result of personal problems. The strategy could be to try to reduce stress with a less workload.
• **Organizational** – this occurs when an entire organization is committed to certain beliefs, which are usually instituted and communicated by the management. Reluctance to change can be diminished by communicating to the managers the benefits of the initiative. Many authors and theories have been developed to reduce this behavior (Rao, 1996; Bounds, 1994).

3. **Organization Infrastructure**

After Top level management commitment and cultural change there is also need to be an effective organizational infrastructure to support Six Sigma implementation and development plans in any organization. A great deal of work has been done by teams in Six Sigma implementation in many world class organizations. The people within the organization must be made known and be aware of the need for change. Companies that have been successful in managing change have identified that the best way to tackle initial resistance to change is through increased and sustained communication, motivation and education. 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.

4. **Training and Development**

Training and development is also most important factor in the implementation of Six Sigma. It is important to communicate myths of Six Sigma to all employees, and provide an opportunity to people to improve their comfort level through training classes.
There is usually a hierarchy of expertise, which is identified by the Belt System. The curriculum in the belt system varies from organization top organization and consultant to consultant. For Example black belt training in Motorola is minimum one year and in GE the length of training is 4-5 month. For promotion in organization black belt qualification is considered most important.

In GE belt system is fundamentally divided into (Henderson and Evans, 2000):

- **Champions** – fully trained business leaders promoting and leading the Six Sigma deployment in significant or critical areas of the business

- **Master Black Belts (MBBs)** – fully trained quality leaders responsible for Six Sigma strategy, training, mentoring, deployment and results.

- **Black Belts (BBs)** – fully trained experts leading improvement teams across the business

- **Green Belts (GBs)** – individuals trained in Six Sigma supporting Six Sigma projects

- **White Belts (WBs)** – individuals supporting specific projects in their areas
5. Understanding the Six Sigma Methodology, Tools and Techniques.

Six Sigma training involves learning of the theory and the principles behind the methodology; i-e- DMAIC methodology. The elements of the DMAIC cycle (which stands for Define, Measure, Analysis, Improve and Control) are explained below, with their tools and techniques.

➢ Define & Measure Phase

This phase involves following tools:

- Six Sigma Metrics
• Project Management
• Team Building
• Quality Function Deployment
• Process Mapping
• Probability
• Basic Statistics
• Process Capability
• Measurement System Analysis
• FMEA

➢ Analyze Phase

Six Sigma improvement methodology and tools for analyze are:

• Project Review
• Collecting and Summarizing Data.
• Statistical Tools and Techniques.
• Benchmarking
• Central Limit Theorem
• Power and Sample Size
• Multi Vari Analysis
• Confidence Interval
• Hypothesis Testing
• Correlation and Regression

• Analysis of Variance

➤ **Improve Phase**

Six Sigma improvement methodology and tools for improve are:

• Design of Experiments

• Full and fractional Factorial Experiments

• Taguchi Methods

• Response Surface Methods/ Setting Operating Tolerances

• Evolutionary Operations

• Facilitating Teams

➤ **Control Phase**

Six Sigma improvement methodology and tools for control are:

• Control Charts

• Mistake Proofing

• Control Plans

• Reliability

• Quality Management System
In addition to Six Sigma tools and techniques, we also need to have a clear understanding of the common metrics used within Six Sigma business strategy. Examples of these metrics include: costs of poor quality, number of customer complaints, defect rate, throughput yield to mention a few.

6. Linking Six Sigma to Customers

A key element of the success of Six Sigma program is its ability to link to the customers. Projects should begin with the determination of customer requirements (Harry and Schroeder, 2000). However Pande et al. (2000) argue that before customer needs can be met successfully, there has to be a good understanding of the organization and its linkage to various business activities. The process of linking Six Sigma to the customer can therefore be divided into two main steps:

1. Identifying the core processes, defining the key outputs of these processes and defining the key customers that they serve.

2. Defining and identifying the customer requirements and needs.

An important issue here is the selection of critical to quality characteristics (CTQs). These CTQs must be identified quantitatively in the starting phase of the Six Sigma methodology. Quality function deployment is a powerful technique to understand the needs and
expectations of customers and translate them into design or engineering requirements. In service industry, the customer requirements are often ambiguous, subjective and poorly defined.

Core processes are supported by a number of enabling processes that provide vital inputs to value generating activities. Therefore Pakistani companies first need to identify, define and prioritize core processes. The next stage is then identifying key output of the organization form the core processes of the organization and the key customers that these output serve. The organization therefore needs to prioritize projects that enhance the ability to meet customer’ needs. Six Sigma requires “Voice of the Customer (VOC)” system to gather customer data.

7. Project prioritization and selection

If Projects are poorly selected and defined then these will lead to delayed result and a lot of frustration for teams. The following generic criteria may be used for the selection of projects (Pande et al.).

➤ Business Benefits Criteria

1) Impact on meeting external customer requirement
2) Impact on core competencies
3) Financial impact
4) Urgency
Feasibility criteria

1) Resources required
2) Complexity issues
3) Expertise available and required
4) Likelihood of success within a reasonable timeframe

Organizational impact criteria

1) Learning benefits – new knowledge gained about the business, customers, processes, etc.
2) Cross-functional benefits

For many organizations, financial returns to the bottom-line are the main criterion. Therefore the projects should be selected in such a way that they are closely tied to the business objectives of the organization (Ingle and Roe, 2001). The scope and the lead time of projects is crucial during the early stages of the Six Sigma effort. Many complex projects require long term efforts and huge investment leading to long lead times for payoffs. This can be sometimes frustrating and discouraging to many people in organizations. Hence it is imperative to keep projects small and focused so that they are meaningful and manageable.
8. Linking Six Sigma to Suppliers

Many organizations that implement Six Sigma find it beneficial to extend the application of Six Sigma principles to management of their supply chain. The concept that “everybody plays” created special challenges for AT & T, Bose and General Electric Appliances (GEA). You cannot be a Six Sigma company without your suppliers participating in the culture change (Hendricks and Kelbaugh, 1998). The key element of successful integration of suppliers into Six Sigma is obtaining support up front from the highest levels of management in the supplier firm. Under Six Sigma philosophies, one way to reduce variability is to have few suppliers with high Sigma performance capability levels (Pande et al., 2000).

9. Information Technology Infrastructure

Purposeful and useful action cannot occur without a system to monitor and control it. Hence effective Six Sigma implementation requires an IT system to receive, organize and help translate this information into effective decisions for the organization. For such a system to be active and functional, it requires an underlying IT infrastructure. The following are some of the main roles an effective IT system would be required to play (Kendall and Fulenwider, 2000).

- Provide an easily accessible database holding information regarding all ongoing and completed Six Sigma projects
• Provide an interactive training tool for employees to learn the Six Sigma methodology and the tools within the methodology for problem solving activities.

• Provide on-line coaching for Six Sigma tools and techniques

• Support the collection of data from the process

• Provide a means for effective communication and sharing of data/information across the organization

• Provide software packages to assist with the selection and prioritization of projects.

Research Methodology and Data Collection

The research question for this pilot study was “how organizations in the Pakistan priorities these key ingredients?” The questionnaire developed in this study consisted of two main sections (1) the background of the company and (2) the most important ingredients. The first section was intended to determine fundamental issues such as the type of product or service made, the size of the company, whether a certified quality management system standard was held, the level of sigma capability of the company, the common metrics used by the company for measuring performance, problem solving and quality improvement tools and techniques utilized by the company, etc.

The target respondents for the survey were the quality directors, CEOs, MDs, Project Managers, Quality Managers or Black Belts, since they are directly involved in the process and have first-hand knowledge and experience of Six Sigma projects in their businesses. An online survey was
used for gathering data due to the advantage that the designed questionnaire could be sent to a large number of organizations in a limited time. A total of 35 questionnaires were sent to large organizations with more than 1000 employees and higher turnover and mostly multinationals. The response rate from the companies was about 10 per cent i.e. 6 companies. However, just 2 companies were applying the principles of Six Sigma. Rest of four companies was employing TQM tools. Two companies were planning for Six Sigma in next one year.

The most commonly used tools include cause and effect analysis, Pareto analysis, control charts and run charts. It was found that many companies are not using more powerful techniques such as design of experiments, Taguchi methods, quality function deployment, failure mode effect and criticality analysis, 5-S practice, Poka Yoke and statistical process control. In other words, the more powerful techniques are less commonly used in these organizations as shown in Figure 3.
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. This paper presents the key ingredients for the effective introduction and implementation of Six Sigma program in organizations. Management commitment and involvement has been considered as the most important ingredient as most of the authors of Six Sigma (Eckes, 2000; Harry and Schroeder, 2000; Pande et al., 2000) agree with this.
From the results of Six Sigma implementation in world class organizations and little bit from Pakistani organizations, we come to know that following are most important ingredients of Six Sigma in descending order.

1) Top-level management commitment
2) Understanding the Six Sigma Methodology, Tools and Techniques.
3) Information Technology Infrastructure
4) Linking Six Sigma to Customers.
5) Project prioritization and selection
6) Organization Infrastructure
7) Cultural Change.
8) Linking Six Sigma to Suppliers
9) Training and Development

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