ABSTRACT
In present age of competition and economic turbulence, all types of organizations are striving hard to control costs, maintain high levels of productivity, meet changing expectations of the customers and attain quality benchmark marks to sustain in the market. In this context, Six Sigma is a powerful world class improvement business strategy that enables companies to use simple but powerful statistical methods to define, measure, analyze, improve and control (DMAIC) processes for achieving operational excellence. From the literature survey, it is found that most of the Six Sigma work has been carried out in big manufacturing industries only and there is a definite scope of improvement in process industries, small and medium manufacturing industries and in service sector through Six Sigma application. The literature review on Six Sigma also suggests that the application of Six Sigma in the areas other than the big manufacturing industries has been rare and inconsistent, so there is a definite scope of opportunity to apply Six Sigma to diversify organizations in small sector and analyze the results. Literature also provides not much documented evidence of Six Sigma implementation in small industries which has a significant role in the Indian economy. On seeing the tremendous financial gains reaped through Six Sigma programs in big manufacturing sector, it is urgently required to replicate this strategy in small scale sector too. The contribution of small scale industries to the Indian economy cannot be ignored as this sector is strategically placed in the industrial population of the country and in the global economy as a whole. The increasing demand for high-quality products and highly capable business processes by large organizations has left no choice on the SMEs to consider the introduction of Six Sigma business strategy.

KEYWORDS: Critical-to-Quality (CTQ); Six Sigma; DMAIC Methodology; SME( Small and Medium Enterprise)

SIX SIGMA: CONCEPT
Six Sigma has been defined in different ways by researchers all over the world and according to Walters (2005), there is no perfect way to describe Six Sigma. From various definitions available in the literature, it can be concluded that Six Sigma implies three things: statistical measurement, management strategy and quality culture. It is a measure of how well a process is performing through statistical measurement of quality level. It is a new management strategy under leadership of the top management that creates quality, innovation and total customer satisfaction. It is also a quality culture which includes both statistical and management strategy and provides the way to do things right at the first time and to work smarter by using data information. It also provides an atmosphere to solve many CTQ (critical-to-quality) problems through team efforts.

a). Statistical Definitions:
In ‘statistical’ definitions, the emphasis is more on the application of statistical techniques to reduce the process variation in reaching a performance level of 3.4 DPMO. These definitions approach Six Sigma from statistical, probabilistic and quantitative points of view. As per Antony (2008), Six Sigma is a highly disciplined, customer-oriented and bottom-line driven business improvement strategy that relies on statistical methods to make dramatic reductions in defect rates in processes; manufacturing, service or transactional. In view of Wang (2008), Six Sigma has been defined as the statistical unit of measurement, a sigma that measures the capability of the process to achieve a defect free performance. Six Sigma has the ability to produce products and services with only 3.4 defects per million, which is a world-class performance. Agarwal and Bajaj (2008) have described that sigma is basically a Greek term for variation. Six Sigma is an extremely well structured program whose prime objective to improve the business processes by minimizing the variations or defects during the production process. It is defined as 3.4 defects per million products. Kumi and Morrow (2006) have quoted the definition that was given by Pande and Holpp: Six Sigma is an approach to the improvement of the quality of products or services which strive for near perfection, i.e., not more than 3.4 DPMO. It is a disciplined, data-driven statistical approach and methodology for the elimination of defects in any process and, thus, the product of that process. Defect is anything outside customer specifications (O’Neill and Duvall, 2005).

b) Management-Oriented Definitions
These definitions view Six Sigma as a philosophy and quality management system to reduce variation, drive out wastes and meet and exceed the expectations of customers by changing the culture of the organization. Six Sigma as a powerful management strategy has evolved from being exclusively about the original goal of a target of less than 4 failures or defects or errors per million opportunities, to encompass a broad range of approaches for incorporating quality into products and services from the early design and development stages and throughout their lifetimes (Antony, 2009). As per Savolainen and Haikonen (2008), Six Sigma is a process improvement methodology that aims to increase business performance through a solid and accurate business focus. It is a systematic approach to achieving continuous process improvements. Antony (2008b) defined Six Sigma is
a well-established approach that seeks to identify and eliminate defects, mistakes or failures in business processes or systems by focusing on those process performance characteristics that are of critical importance to customers. Six Sigma allows organizations to make customer-focused, data-driven decisions that ultimately yield a reduction in product defects, increased profits and employee morale, and high quality products (Aazadnia and Fasanghari, 2008). As per Ditahardiyan et al. (2008), Six Sigma is a systematic methodology for continuous process of quality improvement and continuous process of achieving operational excellence. In view of McCarty and Fisher (2007), Six Sigma becomes ingrained in the cultural context of the organization and represents a management and cultural philosophy of process orientation and continuous improvement. Six Sigma is a business improvement strategy that is used to improve profitability, drive out waste, reduce quality costs and improve the effectiveness and efficiency of all operations that meet or even exceed customers’ needs and expectations (Bañuelas and Antony, 2003). A Six Sigma initiative is designed to change the culture in an organization by way of breakthrough improvement in all aspects of the business (Klesjo et al., 2001). Caulcutt (2001) has quoted the definition that was given by Motorola: “Six Sigma is a business philosophy of driving behavior by making an organization’s values explicit in its compensation system and a business strategy of cutting costs and boosting customer satisfaction.” He has also quoted the definition that was given by Minitab: “Six Sigma is information driven methodology for reducing waste, increasing customer satisfaction and improving processes, with a focus on financially measurable results.”

c) Both Statistics-Based and Management-Oriented Definitions

The definitions that describe Six Sigma as a quality management system and philosophy, emphasizing the use of statistical and other problem-solving approaches, are grouped into this category. Gutierrez et al. (2009) have stated that, ‘Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates’. Six Sigma integrates both statistical and non-statistical tools of quality improvement in a sequential manner within a powerful problem-solving framework (Define, Measure, Analyse, Improve, Control) (Antony, 2007). Andersson et al. (2006) have quoted the definition that was given by Magnusson et al.: “Six Sigma as a business process allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction. Further it is described as an improvement programme for reducing variation, which focuses on continuous and breakthrough improvements, in wide range of areas and at different level of complexity. The goal of Six Sigma is to achieve a level of 3.4 DPMO.” Kumi and Morrow (2006) quoted the definition that was given by Stamatis: “Sigma (σ) is the Greek letter associated with standard deviation. However, in Six Sigma it takes on various definitions and interpretations, such as, a metric of comparison, a benchmark comparison, a vision, a philosophy, a methodological approach, a symbol, a specific value, or a goal.” Mahanti and Antony (2005) define Six Sigma as: “a powerful multifaceted approach empowered by statistical tools for ensuring defect free products through continuous process improvement. It is customer-oriented, structured, systematic, proactive and quantitative approach for continuous process improvement in the business processes of an organization to ensure improved quality, low cost and fast delivery and drive out waste from business processes using statistical tools and techniques.” Maleyeff and Krayenvenger (2004) have quoted the definition that was given by Breyfogle et al.: “Six Sigma is a comprehensive program for managing a business that emphasizes an intelligent blending of the wisdom of the organization with proven statistical techniques to improve both the efficiency and effectiveness of the organization in meeting customer needs.” According to Bañuelas and Antony (2004), Six Sigma has been considered a philosophy that employs a well-structured continuous improvement methodology to reduce process variability and drive out waste within business processes using statistical tools and techniques. The numerical goal of Six Sigma is reducing defects less than 3.4 parts per million (PPM), also known as defects per million opportunities (DPMO), reducing cycle time and reducing costs dramatically which impact the bottom line (Haikon et al., 2004). Reducing variation and mean is the essence of Six Sigma and a Six Sigma defect is defined as anything outside the customer specification. The parts per million defective with respect to various sigmas are given in table 1.

<table>
<thead>
<tr>
<th>Sigma</th>
<th>Percent yield</th>
<th>PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>99.9997%</td>
<td>3.4</td>
</tr>
<tr>
<td>5</td>
<td>99.98%</td>
<td>233</td>
</tr>
<tr>
<td>4</td>
<td>99.4%</td>
<td>6,210</td>
</tr>
<tr>
<td>3</td>
<td>93.3%</td>
<td>66,807</td>
</tr>
<tr>
<td>2</td>
<td>69.1%</td>
<td>308,337</td>
</tr>
<tr>
<td>1</td>
<td>30.9%</td>
<td>691,462</td>
</tr>
</tbody>
</table>

DMAIC: A FIVE PHASE SIX SIGMA METHODOLOGY

If there is an existing process that is not meeting customer specifications, then using Six Sigma five phase methodology DMAIC (Define, Measure, Analyze, Improve, Control) as shown in figure 1.1 that process can be improved and made more effective, more efficient, or both. DMAIC can be explained as:

a) Define
First step is to define the problem and what the customer requires. The define phase sets the
expectation of the improvement of project and maintenance of focus of Six Sigma strategy on customers requirement. There are many tools used in Six Sigma methodology for defining the problem and these tools are: QFD (Quality Function Deployment), FMEA (Failure model effect analysis), Process mapping, Logic Tree, Pareto Analysis etc.

b) Measure
The second phase ie., measure phase identifies the defects in the product, gathers valid baseline information about the process and establishes improvement goals.

c) Analysis
The analysis phase examines the data collected in order to generate a prioritized list of source of variation. It is the key component of any defect reducing program. This is the stage at which new goals are set and route maps created for closing the gap between current and target performance level. Statistical tools as well as conventional quality techniques like Brainstorming, Root-cause analysis, Normality analysis, Process capability, Fish bone Diagram, Pareto Analysis etc may be used for carrying out the analysis.

d) Improvement
The optimal solution for reducing variation or mean is determined and confirmed in the improve phase. The objectives of this phase are to confirm the key process variables, to quantify their effects on the critical to quality (CTQ) and use of ‘Brainstorming and Action’ workouts. This phase helps to identify and quantity the key process variables and their influence on CTQs and determine acceptable limits to reduce the number of defects in the process. This step may involve the use of a variety of statistical methods and tools to determine high priority attrition variables and need to develop and/or redesign functions that impart product performance and success.

e) Control
The final stage of Six Sigma implementation is to hold the gains that have been obtained from the improve stage. Hence in this stage the new process considerations are documented and frozen into systems so that the gains are permanent. This phase emphasizes in determining process capability and implementing various process controls to make sure the modified process stay within acceptable limits.

SIX SIGMA: RELEVANCE FOR SMALL INDUSTRIES
The contribution of small scale industries (SSI) to the Indian economy cannot be ignored. SSI sector is strategically placed in the industrial population of the country and in the global economy as whole. The increasing demand for high quality products and highly capable business processes by large organizations has left no choice for the SMEs except to consider the introduction of Six Sigma business strategy. To meet this new set of business needs, organizations need to deploy tools, which can enable them to remain competitive and grow in the increasing digital age (Burton 2004). Over the relatively short interval of time since Six Sigma was first conceived at Motorola, its application has been principally within large manufacturing companies and the question therefore remains how best to apply Six Sigma elsewhere, especially in small and medium scale enterprises. Six Sigma has been implemented with success in many large corporations and there are very few documented evidences of its implementation in smaller organizations. Each organization will have its own strengths and difficulties, some of which may only become apparent during the implementation of the Six Sigma improvement drive. One of the major advantages of Six Sigma as an improvement drive is the ability to introduce a common metric of customer-perceived quality, which should be applicable to any size and type of organization. As small companies are more agile, it is much easier to buy-in management support and commitment as opposed to large organizations. Moreover, small companies do not have the slack to free up top talented people to engage in training followed by execution of Six Sigma projects as they are crucial to the day-to-day operations and problem solving within the company. Linking compensation to Six Sigma implementation is much easier in small companies compared to a large company (Rowlands, 2004). The contribution of small scale industries (SSI) to the Indian economy cannot be ignored. SSI sector is strategically placed in the industrial population of the country and in the global economy as a whole. Owing to growing importance of supply-chain management issues in the global market environment, large firms are heavily dependent on small to medium sized enterprises (SMEs) for the provision of high-quality products and services at low costs. The increasing demand for high-quality products and highly capable business processes by large organizations has left no choice for the SMEs except to consider the introduction of Six Sigma business strategy. To meet this new set of business needs, organizations need to deploy tools, which can enable them to remain competitive and grow in the increasing digital age (Burton, 2004). For understanding the gravity of the problem a “Chain of Causation” showing the cycle of problems in the manufacturing industries can be used. Figure 1.2 shows the various factors that directly or indirectly
affect the quality level of the manufacturing industry processes. All this can be innovatively used by the entrepreneurs of SME’s effectively and profitably to solve their production problems in a systematic manner.

CONCLUSION

To sustain in the present competitive age, operational excellence is the basic success mantra for SME sector. For global competitiveness, many techniques, such as Quality Circles, TQM and ISO Certifications etc. are being tried but the SME sector needs a breakthrough strategy, which can lead to multiple benefits in shorter duration. Six Sigma is emerging as one of the most effective business strategies in the large organisations over the world. The multiple gains achieved by Six Sigma efforts over different productivity problems in a company amply prove the usefulness of this strategy for small industries as well. Project by project application of Six Sigma in SSI sector can strengthen the understanding about this strategy along with consolidating gains from it. Six Sigma among the small industries is a much-awaited movement, which can strengthen their bottom lines besides contributing to uplifting global economy. The real requirement is to believe in Six Sigma and prepare a road map for its implementation and proceed earnestly to derive benefits out of it in real sense.

REFERENCES