

Barriers for implementation of Six Sigma by Small and Medium Enterprises*

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ABSTRACT

Six Sigma is a business improvement strategy adopted by companies all over the world which will reduce the process variation drastically and enhance effectiveness of the businesses. Since its inception Six Sigma has been largely confined to the domain of only the big companies with good resources. But, this breakthrough methodology is equally applicable to the small and medium size enterprises (SMEs) also for improving their bottom-line. SMEs should get educated about this methodology, overcome the barriers and start reaping the benefits. In this article some of the issues and factors that are acting as barriers for adoption of Six Sigma by SMEs have been discussed.

Keywords : Six Sigma, SME, auto components, automotive sector, manufacturing industry

1 INTRODUCTION

SIX Sigma process capability is equivalent to only 3.4 defects in every million possible defects in manufacturing or service processes. This has been accepted as a standard for world-class manufacturing. The average level in modern industrial applications is between three and four sigma, which means somewhere between 6200 and 67000 defects per million. Six Sigma uses facts and data obtained from production and service processes and determines how to improve them.

Companies should continuously strive for improving themselves. Organizations should focus on the performance characteristics of business processes or systems to identify and eliminate defects that are of critical importance to customers [20]. Six Sigma is a business strategy that enables organizations to increase their profits by optimizing their operations, improving quality and eliminating [7]. It is a work philosophy to achieve, maximize and maintain commercial success by understanding needs of the customer [18].

Embarking on a Six Sigma program means delivering top-quality products and service while virtually eliminating all internal deficiencies [21]. Six Sigma is relevant for any company that is delivering any product or service to the customers [9]. Six Sigma is an overall business improvement initiative rather than just a quality initiative.

Small and medium manufacturing sector must adopt proven business improvement program like Six Sigma to meet the global competition. SMEs have a perception that it is applicable only for large companies with better manpower and financial resources. There is also a view that Six Sigma implementation will only add to their cost without much return on the investments. The small companies may have many reservations regarding Six Sigma implementation. The issues faced by

SMEs in manufacturing sector for adoption of Six Sigma should be studied and addressed to bring awareness and interest in this breakthrough methodology by the SMEs. The issues and factors that are acting as barriers for adoption of Six Sigma by SMEs have to be ascertained and solutions to be found out for elimination of them.

2 SIX SIGMA APPROACH FOR SMALL AND MEDIUM ENTERPRISES

Six Sigma methodology came to existence at its earliest form in 1985 when Motorola aimed at making its production processes totally defects free. In 1988, Motorola won the Malcom Baldrige National Award, which set the standard for other companies to emulate. Larry Bossidy, past CEO of Honeywell says "There is more reality with Six Sigma than anything that has come down in a long time in business. The more you get involved with it, the more you are convinced". Industries are adopting different systems such as ISO 9000, TQM, etc. to assure quality. But, these systems do not encompass the financial element of the businesses. Three decades history of Six Sigma reveals that if it is implemented properly, organizations can secure a very high rate of return on their investment. The world-class companies such as General Electric, Johnson & Johnson, Honeywell, Motorola, and many others have adopted Six Sigma and the results accomplished by them are known to the world.

In the 1990s, Six Sigma became a business-centric system of management when General Electric Corp. ushered in the second generation of Six Sigma. The focus of Six Sigma shifted from product quality to business quality. It was possible to produce defect-free products using lowest cost of production and earn high profit. Six Sigma became a synonym for im-

proving quality, reducing cost, improving customer loyalty and achieving bottom-line results. Though the original goal of Six Sigma was to focus on manufacturing processes, later marketing, purchasing, billing, and invoicing functions were also involved.

Adopting Six Sigma project management approach will change the culture of the companies in many ways. Six Sigma is not just about statistics but rather based on the scientific method, utilizing statistical thinking [19]. Statistical Thinking is a philosophy of learning and action based on the fundamental principles: all work occurs in a system of interconnected processes; variation exists in all processes; and understanding and reducing variation are keys to success.

Implementing Six Sigma methodologies to improve their effectiveness in delivery of products and services will benefit the organisations, customers and all other stake holders to a great extent. Increase in competition has led to a pressure on profit margins, and the small industry players are trying to become more and more cost efficient. The domestic players are now focusing on export opportunities. The need of the hour is to make companies think about adopting the Six Sigma approach such that they can improve their effectiveness to a larger extent.

3 BARRIERS FOR IMPLEMENTATION OF SIX SIGMA BY SMEs:

Six Sigma approach since its inception has been usually associated with large companies. Gradually midsize companies have also started reaping financial benefits from the program. They are achieving enhanced savings from Six Sigma projects and better growth. Lack of knowledge and education and some of the misconceptions about Six Sigma has made the SMEs to be skeptical about the applicability of Six Sigma for them. Apart from these there are some genuine technological, organizational and financial limitations of SMEs that act as barriers for Six Sigma implementation by them. All these barriers are listed below and let us have a detailed look at all of them:

1. Lack of resources
2. Internal resistance
3. Lack of leadership from top executives
4. Lack of knowledge about Six Sigma
5. Insufficient organizational alignment
6. Cultural barriers
7. Poor training and coaching
8. False notion that Six Sigma is too complex to use
9. Wrong identification of the process parameters
10. Lacunae in data collection
11. Poor Six Sigma project selection

3.1 Lack of resources

A Six Sigma project would consume a lot of company resources like financial resources, human resources, time, etc. For implementation of Six Sigma, organizations essentially require competent and trained manpower for conceiving and running six sigma projects. Extensive training for some of the

selected competent people in the organisation is necessary to produce any noteworthy Six Sigma results. A Six Sigma project leader is called a Black Belt (BB) who works for full time on projects. The project team members are called Green Belts (GB) who normally work part of their time on projects. BBs and GBs should be necessarily provided specific trainings to tackle their roles properly. Master Black Belts (MBBs) are experienced BBs who have worked on many projects. MBBs guide the BBs and most of the training work would be their responsibility.

The cost involved in training the high level managers used to be a deterrent for the smaller companies for quite a long time. Research with leading Six Sigma companies show that the financial gains outweigh the investment [13]. So, large firms with capability to cope with Six Sigma endeavors reaped rich gains all through. Gen III Six Sigma has changed this scenario drastically. The training and infrastructure needed to get useful results from a Gen III project are much less. Gen III has introduced the concept of the White Belt Six Sigma practitioner who facilitates use of Six Sigma in work cells or similar settings. White Belts bring up benefits by applying Six Sigma to problems that would not justify the time and attention of a Six Sigma Black Belt. SMEs have started recognizing that Six Sigma can be adopted by firms of any size and substantial benefits could be attained.

It does not always make imperative for the companies to go for drastic changes in their manufacturing or service setup with huge investment for Six Sigma implementation. For most of the improvements the real need is to analyze the sources of errors and plan and control the activities to eliminate them. Some of the improvements may need minor changes in design of the products or manufacturing process, needing only intellectual input. SMEs have to recognize this point so that they can overcome their mental barrier regarding the cost of Six Sigma implementation. For some of the solutions where financial investment is needed the return on investment will vary from twice to around twenty times according to the experts and thus it is always worth considering this option for any organization.

3.2 Internal resistance

Any change in any organization will always meet with a certain amount of resistance and skepticism. Without the acceptance by employees, Six Sigma process improvement is bound to fail. In any organization, small or big, employees will get accustomed with the process they are using for a long time. Resistance to change this is natural and it should be anticipated by the Six Sigma teams. For employees the common way of showing resistance is by criticizing the new applications or tools and ignoring the new process. But, overcoming the resistance of people at all levels is very essential for successful implementation of Six Sigma.

Unless the benefits are clear, there will be resistance to change. Managements also may become sceptical about the benefits and hence may hesitate to support the Six Sigma initiatives. If there is concrete proof showing the success of the implementation - the acceptability of the process becomes simpler. Communication is the key to solve this type of problems. By communicating about the positive results of Six Sig-

ma, leaders can strengthen morale of people and enlist their support for the change process. For this the leaders should have enough examples of success stories in hand before rolling out the new process. Newsletters, emails or discussions will help for this cause.

Executing process change effectively requires skills that are not necessarily in any Six Sigma training manual. Implementation of Six Sigma requires more than just technical skill set. The first step to successful Six Sigma implementation is empathy. In short, everybody will ask themselves, "What's in it for me?" This question is a fundamental aspect of human nature. When each member of the team understands what's in it for him, he/she can involve wholeheartedly and contribute better.

One of the major sources of resistance is the belief that Six Sigma will lead to reduction in workforce. Goal of Six Sigma is not just increase in efficiency but also increase in effectiveness. Six Sigma efforts for improvement of effectiveness will lead to growth of business and not contraction. Hence, it is the responsibility of the leaders to educate the people of the company in this regard so that instead of resisting the implementation of Six Sigma they start extending their full cooperation.

If employees are not trained properly on the new process, they may resist it thinking that it is very difficult to implement. Training about the need and the procedures of the Six Sigma implementation may help people to absorb changes better. Training should transform them into the supposed 'change agents'.

A suggestion/feedback mechanism from all the concerned people for process enhancement and continuous improvement needs to be established. This helps in giving a sense of ownership to the employees and any resulting improvement due to their contribution will encourage them to get involved in the process voluntarily.

Resistance could also be used as a tool to improve the programme and guard against inappropriate application of Six Sigma. The change agent must ask themselves why the resistance exists, and what can be learnt from it to make the program acceptable to all. In fact, in some cases Six Sigma turns out to be solution for the problems of people, if the employees are restive, seemingly uninvolved, indifferent or hostile in the prevalent atmosphere, by providing them far greater opportunity to exhibit their creativity which they were lacking earlier. In a Six Sigma project the root causes of the problems should be determined, measured and analysed by the project team members using their experience and creativity. During the improvement phase team members should brainstorm ideas to generate improvement in performance such that the sigma level of the process rises to 6 sigma level. Teams with great ideas only can improve sigma performance. The environment in SMEs is more conducive for these happenings because of the compact nature of the organisation and better coordination between the management and the employees.

3.3 Lack of leadership from top executives

Due to poor leadership and lack of commitment from senior management, Six Sigma is viewed by some organisations as just a passing management fad and hence may not show interest in it. Organizations require innovative leadership at all levels of the organization for growth and development. It is

action, not words that create the successes. For proper implementation of Six Sigma an organization should have visionary top management that has knowledge of the processes and also knows how to create an organization that works together. The top management should support, encourage and provide resources such that Six Sigma becomes an enabler to achieving the business objectives of the organization.

Six Sigma has been successful worldwide because the results obtained by its implementation have attracted the management. Some of the statements from experts regarding implementation of Six Sigma by SMEs are listed below:

All companies large and small, share many common features and problems. Large companies, because of scale, may reap higher financial gains as a result of a given breakthrough, but this should not be taken to suggest that small companies would not benefit tremendously from its use – Joseph De Feo, CEO of Juran Institute, USA.

"Six Sigma is very appropriate for smaller companies too. The Six Sigma strategy works well in billion dollar corporations as well as \$50 million privately held companies. In fact, it has been our experience that the results are usually quicker and more visible in smaller companies" – Dr Matthew Hu, Vice President of Technology and Innovation, ASI, USA.

So, leadership of small organizations cannot give excuses like Six Sigma deployment in their organizations would not be practicable or not advantageous. Previous efforts at improvement might have probably failed in an organization because of the lack of management support, no strategy related to its implementation and lack of management of the acceptance of change [5]. When a management actively gets involved and supports something it will definitely work. That is the major difference between Six Sigma and the other quality initiatives. A Six Sigma organization will be proactive rather than reactive.

3.4 Lack of knowledge about Six Sigma

Dr. Joseph M. Juran, a quality guru, believed and stated that the three essential functions of a business – planning, controlling and improving – termed as "Juran Trilogy" must be understood and utilized to achieve sustainable high quality results. This is the basis for Six Sigma strategy also. It helps companies to identify and eliminate defects in business processes drastically by focusing on performance characteristics. The managements should understand that Six Sigma is not a mere quality improvement initiative, but a business improvement initiative. Unlike other quality management systems, Six Sigma brings financial element into the picture and if implemented properly it helps the companies to improve their return on investments considerably.

Six-Sigma calls for a lot of expertise on the part of practitioners to run projects effectively. Many critics have termed Six Sigma as a management fad [14], [21]. But, it has been around for more than 25 years and still growing stronger. Many of the well known large companies all over the world doing business in different sectors have benefited enormously by adopting Six Sigma business approach. Proper knowledge of Six Sigma tactics is very essential for people at different levels of an organization.

The tactics of Six Sigma include five phases- Define, Meas-

ure, Analyze, Improve and Control, popularly known as DMAIC methodology.

- Define phase includes identifying the needs and requirements of the customers, selection of projects, process mapping, and SIPOC.
- Measure phase includes identifying critical to quality (CTQ) and critical to cost (CTC) parameters, generation of data collection plan, measurement system analysis and statistical process control (SPC).
- Analysis phase includes analysis of data for quantifying critical few root causes using graphical tools, confidence intervals, hypothesis testing, ANOVA, correlation and regression.
- Improve phase includes generation and selection of tools using design of experiments (DOE), FMEA, mistake proofing, Design for Six Sigma (DFSS), etc.
- Control phase includes developing and implementing control plans, monitoring the processes using SPC and creating a response/feedback plan.

Tactics of Six Sigma are like elementary scientific methods which need to be understood and applied properly at the entire organization level to achieve the expected positive results. If it is used as a short term cost cutting measure locally applied in a business, it will lead to deceptively appealing but dangerous suboptimization of the business. In the long term it will result in overall higher cost and considerable customer dissatisfaction which is an example for bad application of a good method for which the method itself cannot be blamed. Many of the Six Sigma implementation failures come under this category. So, the management should try to bring complete awareness and clear understanding of Six Sigma methodology by presentations, discussions, training and on-job counseling.

3.5 Insufficient organizational alignment

Six Sigma project implementation adopts top-down approach. Improvement efforts are initiated by an executive management team which provides a champion for each Six Sigma project. The champion is responsible for success of the project and provides the necessary resources by breaking down the organizational barriers.

Alignment of the entire organization with Six Sigma implementation is a vital factor for its success. Selecting the team members of a Six Sigma project who understand each other and know when to take guidance and when to give their own views and opinions, etc. is essential for success. Six Sigma also teaches leaders a new way to lead. Their involvement in defining the organization's core processes, identifying process owners, finding opportunities for improvement, defining the drivers of these opportunities, selecting relevant metrics for the drivers, and linking the metrics to activities throughout the organization, etc. gives them a new way of getting things done.

The entire organization should be aligned with the Six Sigma projects by communicating the Six Sigma message using latest multimedia and other communication technologies at its disposal. Communication should be a two way affair. Numerous opportunities should be provided for upward, downward and also lateral communications. Promoting Six Sigma aware-

ness internally should be done with the same earnestness as external marketing campaign of the company products. Meetings, newsletters, email, one-to-one communications, web sites can be used for this purpose. Some of the messages should be repeated periodically so that the messages are received and understood properly. Six Sigma should be institutionalized as a way of doing business. In order to avoid failure of Six Sigma it is very essential that its activities are not kept separate from the mainstream activities.

3.6 Poor training and coaching

The greatest barrier to implementation of Six Sigma in SMEs to date has been the way the major Six Sigma training providers have structured their offerings [19].

The main realization the companies need to have is that Six Sigma is not about statistics, but about statistical thinking. When companies hire the external Six Sigma consultant they should hire the best, not someone touting gimmicks. But, Six Sigma training alone does not guarantee success; it is just a way to reduce the chances of failures in an organization. Sticking to the Six Sigma implementation process with sincerity and commitment by the entire organization is very essential for success.

George Eckes says, as a Six Sigma consultant, I feel confident in my skills. Data we accumulated over the years indicate there is an 80 percent likelihood of either a dramatic shift in culture or at least generating a significant ROI. Having said this, our data still indicates 20 percent of our clients have failed to generate ROI. A consultant should not be responsible for lackluster effort, not paying attention to consultant advice, or populating project teams with the equivalent of the roster of a bad baseball team.

The organizations may have to understand that the good consultants will not waiver their fees and take percentage in the resulting cost savings. It would be a marketing ploy and may lead to some short term gains and long term disaster. Companies should go for the best consultants with proven track record and abilities.

3.7 Cultural barriers

Organizations require change in organizational culture. In the longer term, it will be necessary to integrate Six-Sigma as one component of an overall quality management or improvement system [18].

Conflict should not arise within a company, but it almost always arises. So a good manager should know how to put those problems aside or handle the issues causing the trouble tactfully. Six Sigma projects can run smoothly if the teams are comprised of professional, knowledgeable, educated, and experienced people who work as team and know what is required of them.

The combination of rational thinking, a culture that embraces and expects change, knowledge of the customers' requirements and a motivating way to lead makes it possible for the leadership to bring together disparate parts of their organization focused on Six Sigma implementation. In fact, the scope of Six Sigma can be expanded from an operational improvement tool to a purposeful search for innovative improvement opportunities. Application of the core principles of

Six Sigma results in creation of a resilient organization that not only responds quickly to changing customer needs and competitive pressures by creating new products and services, but also improves the human condition within the organization.

Signs that an organization is embracing Six Sigma include more management with fact and data, management of process versus function, participation on project teams and a change in the reward and recognition system [5].

Breakthrough in culture creates a set of behavior standards and social climate that supports organizational goals very well. It instills values and beliefs in people that guide organizational conduct and decision making.

3.8 False notion that Six Sigma is too complex to use

Very few Universities and colleges are currently engaged in teaching and research on Six Sigma related field. The worldwide general awareness of Six Sigma is not high as of now though it is expected to grow in the coming years. Though bigger and multinational companies are using this methodology the application of Six Sigma in small and medium enterprises is still in its infancy in most of the countries. Because of lack of knowledge there are some misconceptions about Six Sigma.

Many people feel dreaded about Six Sigma thinking that it involves too much of mathematics and statistics. But, the reality is that mathematics involved in Six Sigma is simple addition, subtraction, multiplication and division. The overall statistical calculations involved are quite simple to understand and the computer software packages like Mini-tab, etc. have further eased application of statistics in Six Sigma.

There is a long list of Six Sigma soft tools that can be applied for projects. But, like any other methodology, a handful of methods and tools will solve most of the problems. All manufacturing or service businesses are transaction-based, meaning they rely on orders, invoices, purchases, payments, and so on. To handle these kinds of problems soft tools like control charts, Pareto charts and fishbone diagrams, etc. are enough. Most of the other methods and tools are used rarely. Teaching all of these methods and tools is not required and from the lean perspective, it results in overproduction type of waste.

Even application of control charts can be made simple if people understand that they need not learn the formulas for every kind of chart. They just need to know how to read the chart. Training people in control chart formulas is not always required. Control charts can be easily created with modern PC-based SPC software which will handle the math internally and show the graphical output. It will highlight the out-of-control signals so that people can concentrate on their real job of taking proper decisions to control the processes.

Organisations should include information that defines and quantifies the exact needs and requirements of the customer and the improvement needed in the value currently being offered to its customers. A Project Charter that covers new areas such as customer needs and expectations and how these are related to the implementations, will make it easier for the implementation team to carry out the implementations in a way that ultimately leads to better products and improved services [13].

The charter should also contain detailed information about the specific methods or processes that should be employed for carrying out the implementations. Any additional value-added content is included and all the related aspects are clarified, it becomes easier for implementation team to understand the real goals and objectives of the project. This ensures the successful completion of the project within the specified time and cost.

Checklists of the various factors provide helpful guidance or quick reference and make the processes simpler to implement.

3.9 Wrong identification of the process parameters

When the tolerances are wider and the processes are fairly well established, the production of parts may not call for quality engineering. But, in some cases the tolerances are stringent and manufacturing process variations are higher. The cost of such products also would be substantially higher. In such cases the gain for the companies would be significant if the number of rejections comes down. If a company is at 3 sigma level and the rejections are around 67000 PPM, with the adoption of Six Sigma their rejections come down to only 3.4 PPM. The cost benefit ratio would be too attractive to be neglected. But, every organization and business process would have one or the other forms of lacunae. When a product or service or its characteristics are not sufficient to fulfil the requirements of customers, the projects of improvement should be implemented to correct the drawback or remove the constraints in the processes.

Critical to Process (CTP) are the key process input variables. These are the process parameters which influence other critical approaches - Critical to Quality (CTQ) and / or Critical to Cost (CTC).

The critical to process concept is an essential part of six sigma projects. Customer satisfaction is a primary factor in the study of CTP. The performance level of CTP factors should be such that they meet all requirements of the customers. They harmonize improvement or design efforts in tune with customer requirements. Six Sigma at highest level of an organization should improve both efficiency and effectiveness of an organization. But, most of the times companies are interested in improvement of efficiency at the cost of effectiveness. Primarily this happens because the management would be engrossed in quicker return on investment after implementation of Six Sigma. So, instead of finding out the cost associated with the current level of ineffectiveness, the companies try to get short term cost benefit by concentrating on current level inefficiencies. As a result of this organizations identify wrong process parameters for measurement like machine downtime rather than wrong tolerance on a critical dimension. Ultimately this leads to higher cost of production to reduce the number of defective parts which could have been solved relatively easily by redesign of the part with higher tolerance for that particular dimension. So, Six Sigma implementation should call for balance between improvement of efficiency and effectiveness of processes while aiming at reduction of cost and enhancement of customer satisfaction.

3.10 Lacunae in data collection

Identifying what data is required and collection of full data for a Six Sigma project are very important activities. Solutions to services and products that fail to meet the needs of the internal and/or external customers depend on the quality and quantity of data collected for study. Collecting data is tricky. It is important to spend enough time collecting the necessary data and collecting it well. Collecting too much or too little data can be detrimental to the improvement of the process.

The MEASURE phase of DMAIC involves obtaining information about the processes that is found ineffective or to be improved. There are several tools that are useful in measuring the extent or impact of the problem. The smart leaders would try to enlist the involvement and support of the hard core process people who have first-hand knowledge of the problems for collection of data.

The next step is to ANALYZE the gathered data. In other words, statistical tests are performed on the data collected in the previous step in order to confirm that a problem actually exists or to quantify the problem.

Training on data collection is important for a Six Sigma organization, as the success of the entire DMAIC process relies on it. Generally, there is a 5 step data collection process.

- a) Set goals for data collection.
- b) Develop operational definitions and procedures.
- c) Validate the measurement system.
- d) Initiate data collection.
- e) Ensure that people abide by the data collection guide lines and continue improving the measurement system.

The skills and training of data collection leaders should be supplemented by the necessary software and hardware. Without the state-of-the-art tools collection and analysis of data for a Six Sigma project would be a Herculean task. It makes little sense in saving the cost here and making the entire project to lose effectiveness.

3.11 Poor Six Sigma project selection

It does not matter what type or size of business Six Sigma methodology is applied to – no matter whether it is a 300 employee company or a 10 employee family business, Six Sigma will work as long as you follow the process effectively [4].

Six Sigma projects begin with identification of problems and flaws within the processes of an organization. The goal is to identify quality issues and resolve them. Six Sigma projects are carried through by Six Sigma professionals from beginning to the end watching for obstacles or delays and finding solutions.

In a Six Sigma organization each leader working as change agent will complete three to seven projects in a year. Projects are the core activity driving change in the Six Sigma organization. One of the very important factors for success of Six Sigma implementation is selection of proper projects. Careful planning and management of the projects would not matter if the projects being pursued have very little or no effect on the bottom-line. Selecting projects which have impact on the net profit of the organization is of critical importance.

Six Sigma projects must be selected keeping the impact on all major stake holders like: customers, shareholders and em-

ployees. Each project consumes money and time and disrupts the standard operations and routines. Selection of projects should be done keeping both the short term and long term benefits to the organization justifying the investment and the effort.

Feasibility of a project should be determined by the scope and cost of a project and the support it receives from the owners of the process. An elaborate cost benefit analysis is essential for considering a project for selection. Reasonable cause and effect linkages can be established to form the basis for cost – benefit analysis.

Quality Function Deployment (QFD) is used for linking Six Sigma projects to strategies. Planning and execution of the projects should be integrated across the entire organization because many projects involve the efforts of several different functional areas. The Pareto principle is normally used to narrow down the selection of projects from a long list. Theory of Constraints (TOC) is another tool used to determine which projects to pursue.

Every organization should determine its capacity for successful completion of the projects. Organization may have resource constraint to meet the market demand. In such cases there is a tendency of adopting multi-tasking of the resources i.e. assignment of the resources to several priorities at the same period of time. For effective handling of the projects, at the organization level multi-tasking of the projects must be discouraged.

It is vital that information regarding results be accumulated and reported for tracking Six Sigma projects. Evaluation of the effectiveness, determination of the overall return on investment, identification of the areas where emphasis is needed, etc. are to be done during the entire duration of a Six Sigma project.

4 CONCLUSION

Rapid changes are taking place in the industry globally. A look at the ongoing industrial changes indicates that more and more people are turning to Six Sigma approach for improving bottom-line of their business. The future of Six Sigma depends on keeping it relevant to current 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.

It is very vital for SMEs to employ Six Sigma methodologies for improving efficiency and effectiveness and be globally competitive and cost effective. Six Sigma concepts, methods and the tools are equally applicable for small and medium enterprises as compared to large OEMs.

The leadership issue is crucial for the success or failure of Six Sigma implementation. The top management should create an environment where they support and endorse Six Sigma as the management philosophy. The top management should actively get involved in Six Sigma implementation through project champions who sponsor and guide the projects till completion. There are some technological, organizational and financial limitations of SMEs that act as barriers for Six Sigma implementation. Some of the barriers are due to lack of

knowledge, insufficient exposure and wrong understanding of the Six Sigma philosophy. Leadership of small organizations should not exclude themselves from Six Sigma deployment because of some of the imaginary and easily avoidable barriers.

In this article an attempt has been made to provide a general overview of barriers for implementation of Six Sigma by the small and medium enterprises. The main idea is to change the common misperception of the SMEs about Six Sigma and helping them to overcome the barriers for its implementation.

REFERENCES

- [1] Antony, J, "What is the role of academic institutions for the future development of Six Sigma?", *International Journal of Productivity and Performance Management*, 57, (1), pp. 107-110, 2008.
- [2] Bisgaard, S.; Hoerl, R.; Snee, R, "Improving business processes with Six Sigma", In: *Annual Quality Congress, Milwaukee*, pp. 701-704, 2002.
- [3] Breyfogle, III, F.W., Cupello, J.M, and Meadows, B, "Managing Six Sigma: A practical guide to understanding, assessing, and implementing the strategy that yields bottom-line success", Danvers, MA: John Wiley & Sons, Inc, 2001
- [4] Brue, G, "Six Sigma for Small Business", CWL Publishing Enterprises, Inc., Madison, Wisconsin, 2006
- [5] George Eckes, "Six Sigma For Everyone", John Wiley & Sons, Inc.
- [6] Harry et al., "Six Sigma: A breakthrough strategy for profitability", *Quality Progress*, 31, (5), pp. 60-64, 1998.
- [7] Harry, M.; Crawford, D, "Six sigma - The next generation", *Machine Design Cleveland, Estados Unidos*, 77, (4), pp. 126 -130, 2005.
- [8] Jeffrey D. Ford and Laurie W. Ford. *Decoding Resistance to Change*. Harvard Business Review, April 2009.
- [9] Jiju Antony, "Six Sigma in the UK service organisations: results from a pilot survey", *Managerial Auditing Journal*, 19, (8), pp. 1006-1013, 2004.
- [10] Jiju Antony, University of Strathclyde, Scotland, UK, *Some Common Myths of Six Sigma Demystified, CQI*, West of Scotland 4th March 2008
- [11] John P. Kotter, Leonard A. Schlesinger. *Choosing Strategies for Change*. Harvard Business Publishing. (1979)
- [12] Joseph A De Feo; William W. Barnard, "JURAN INSTITUTUE'S SIX SIGMA Breakthrough and Beyond", Tata McGraw-Hill Publishing Company Limited, 2005
- [13] Kim M. Henderson, James R. Evans, "Successful implementation of Six Sigma: benchmarking General Electric Company", *Benchmarking: An International Journal*, 7, (4), pp. 260 - 28, 2000.
- [14] Lynne B. Hare, "Linking statistical thinking to Six Sigma", *International Journal of Six Sigma and Competitive Advantage* - 1, (4), pp. 389 - 402, 2005
- [15] Pande P.S, "The Six Sigma Way", McGraw Hill New York, NY, 2000
- [16] Peter de Jager. *Resistance to change: a new view of an old problem*. *The Futurist*, 24-27, (2001, May/June).
- [17] Roger Hoerl, "One perspective on the future of Six-Sigma", *Int. J. Six Sigma and Competitive Advantage*, 1, (1), 2004
- [18] Rotondaro, R, "Six Sigma management strategy for improving processes, products and services", New York: Atlas, 2002
- [19] Snee, R. D. and R. W. Hoerl, "Leading Six Sigma - A Step by Step Guide Based on Experience With General Electric and Other Six Sigma Companies", FT Prentice Hall, New York, NY, 2003
- [20] Snee R.D, "Impact of Six sigma on quality engineering", *Quality Engineering*, 12, (3), pp. 9-14, 2004
- [21] Thawani, S, "Six Sigma – strategy for organizational excellence", *Total Quality Management*, 15, (5-6), pp.655-664, 2004.
- [22] Y.H. Kwak & F.T. Anbari, "Benefits, obstacles and future of six sigma approach", *Technovation*, 26, pp. 708-715, 2006.