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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

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SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

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APPENDIX/ANNEXURE

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- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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# SIX SIGMA FOR IMPROVING PRODUCTIVITY AND ATTAINING SUSTAINABLE PERFORMANCE BREAKTHROUGH: THE BANGLADESH PERSPECTIVE

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**ABSTRACT**

*The twenty first century is marked substantially by technological revolution. In this era, no country can go ahead without technological innovation. Additionally, technological innovation is becoming absolute very rapidly. So, the guiding philosophy of world has become, "what is enough for today may not be enough for tomorrow". As a result, organizations should be technologically updated which will give competitive advantage in a highly volatile, turbulent, fast changing world environment. The study shows how different firms have gained remarkable success pertaining to using new technology like Six Sigma. By incorporation of Six Sigma in the production process, myriad firms achieved significant improvement in terms of quality, productivity and profitability. Bangladesh, as an underdeveloped country, has not been an advantageous position concerning productivity growth. This paper will show how quality and productivity are interrelated and how Six Sigma can contribute to the productivity growth. In addition, this article will show how different companies in Bangladesh can compete nationally and internationally by improving quality of the goods and services using Six Sigma. This paper will expose how a firm can attain sustainable performance breakthrough by incorporating Six Sigma. The bottom line of this article is that if firms can incorporate Six Sigma and manage it properly, it will assist to improve productivity and attain sustainable performance breakthrough in the twenty first century.*

**KEYWORDS**

productivity, quality, Six Sigma, sustainable performance breakthrough (SPB).

## INTRODUCTION

Today, businesses accept the fact that, to prosper, they must view customers, suppliers, facility locations, and competitors in global terms. Most products today are global composites of materials and services from throughout the world. Due to globalization strong global competition affects industries everywhere. The world businesses have witnessed several trends. One trend has been an increasing emphasis on competing on the basis of quality, time, and technological advantage (Ritzman et al., 2002, p. 18). Part of the success of foreign competitors has been their ability to provide products and services of high quality at reasonable prices. Without quality products and services, a firm loses its ability to compete in the market place, and its cost structure can also become uncompetitive (because of scrap, rework, and warranty costs).

Another important trend is that more firms are competing on the basis of time: filling order earlier than the competitors, introducing new products and services quickly, and reaching the market first while enjoying first mover advantage. Another trend is technological change. It affects the design of new products and services and a firm's process themselves. Introducing any new technology involves risk, and employee attitudes toward it depend on how the change is managed. The right choices and effective management of technology can give a firm a competitive advantage.

In order to combat the challenges unleashed by globalization, firms need to come out from the traditional technique, tools, and methods of improving quality. Six Sigma is a new technology that can improve the quality of products and services by reducing the defects to an unprecedented level.[1] Most of the industrialist countries have been successful in applying Six Sigma in the business processes and enjoying high profitability over other countries by distributing high quality products to the customers. Additionally, there is a close interrelation between quality and productivity. Park (2003) has shown how productivity and quality is related. Juran et al. (1995) has also supported this view. If company can increase quality of its products services, this will increase productivity as well. On the other hand, by sing Six Sigma firms can reduce the cycle time of the products and services which in turn help to deliver products firstly in the market.

Technology can be a competitive weapon for the industries in Bangladesh. Without technology, a country can not compete in the world market. Some experts argued in favor of policy reform. Their argument is that liberal trade policy will enhance Total Productivity Growth (TFP) through improved allocation of resources and better productive capacity realization. (Handoussa *et al*., 1986; Tybout *et al*., 1991; Alam & Morrison, 2000). It is found that after than a decade of economic policy reform, Bangladesh has not produced the expected improvement in growth rates. Thus, the linkage between policy reforms and productivity gains is still not properly understood. Rodrik (1992, p. 170) notes that "There is as yet no convincing empirical evidence for developing countries that shows liberalization to be conducive to industry rationalization".

Similarly, Pack (1988, p. 353) observes that "… to date there is no clear confirmation of the hypothesis that countries with an external orientation benefit from greater growth in technical efficiency in the component sectors of manufacturing"

More importantly, in a study on food manufacturing firms of Bangladesh, it is found that technological progress is the major force in TFP growth in industries (Ruhul, 2003, p. 95). Six Sigma can be a new technological weapon for Bangladeshi firms to compete in the era of globalization that increase productivity and helps to attain sustainable performance breakthrough.

The basic objective of this article is to get a general idea regarding the concepts of Sig Sigma, its methodologies, benefits, its superiority over other quality improvement program, its criticism against Six Sigma. Moreover, this article will explore different quality management tools that can be used in order to improve quality which in turn will lead to productivity improvement in Bangladesh. Additionally, this paper will unveil the answers some of the questions like how Sig Sigma is contributing towards the productivity improvement throughout the world's different firms, how Sig Sigma can create sustainable performance breakthrough, how Sig Sigma team can be managed in order to get competitive advantage. This paper will expose some guidelines for Bangladeshi firms concerning how to implement Six Sigma to improve quality, productivity, profitability and above all, how to generate sustainable performance breakthrough.

The data have been collected only from secondary sources like journals, articles, books, research papers, project papers, conference papers, websites etc.

# SIX SIGMA

## SIX SIGMA: MEANING, GENESIS & METHODOLOGIES

### MEANING

Before going to define what Six Sigma connotes lets have a brief idea about sigma. Sigma is the eighteenth letter of Greek alphabet. The name of sigma, according to one theory (Jeffery et al., 1961), may continue that of Phoenician Samekh. According to another theory (Woodard et al., 2006), its original name may have been "*San*" (the name today associated with another, obsolete letter), while Sigma was a Greek innovation that simply meant hissing. In terms of lower case it is symbolized as σ and in upper case it is symbolized as ∑carrying 'S' sound(Oxford dictionary of Biochemeistry,1997). The former frequently denotes a standard deviation; the latter is used in mathematics for the sum of the values of the term nominated (Saunders Veterinary Dictionary, 2007).

However, different definitions and descriptions of Six Sigma have been presented over the years. Let us therefore briefly look at some definitions found in recent literature of Six Sigma. Tomkins (1997) defines Six Sigma to be "a program aimed at the near-elimination of defects from every product, process and transaction." Harry (1998) defines Six Sigma to be "a strategic initiative to boost profitability, increase market share and improve customer satisfaction through statistical tools that can lead to breakthrough quantum gains in quality." Breyfogle et al., (2001) defines Six Sigma to be "an initiative that is designed to change the culture in an organization by way of breakthrough improvement in all aspects of the business." Pearson (2001) defines "Six Sigma is a programme that combines the most effective statistical and non-statistical methods to make overall business." Snee (2004) defines, "Six Sigma is a business improvement approach that seeks to find and eliminate causes of mistakes or defects in business processes by focusing on process outputs that are of critical importance to customers."[2] From the above definitions we can say that Six Sigma is a philosophy, vision, initiative, goal, method, tool, a means to stretch thinking with respect to quality (Six Sigma Academy, 2006). The basic premise of Six Sigma is that variations can be identified, quantified, eliminated or controlled. It is focused on strategic or core processes, right things and data driven. This methodology provides the techniques and tools to improve the capability and reduce the defects in any process. It is a highly disciplined approach used to reduce the process variations to the extent that the level of defects are drastically reduced to less than 3.4 per million process, product or service opportunities (DPMO)[3] (Hemant, 2000; Tennant et al., 2001;Motorola university Six Sigma dictionary,2006).

In a nutshell, Six Sigma is a company-wide management strategy for the improvement of process performance with the objective of improving quality and productivity to satisfy customer demands and reduce costs. Six Sigma is not like other quality improvement programs e.g., TQM which will be discussed in another section.[4] It is regarded as a new paradigm of management innovation for company survival in the 21st century.

### GENESIS OF SIX SIGMA

Six Sigma originated with a view to improving manufacturing process and eliminating defects. Six Sigma started as a defect reduction effort in manufacturing and was then applied to other business processes for the same purpose (Motorola University, 2009). Six Sigma has its roots in the early industrial era of Europe during the 18th century and was introduced with just one conceptual normal curve metric by Carl Frederick Gauss. In the 1920s Walter Shewhart showed how 3 sigma deviations from the mean required process correction. Later, the core of Six Sigma was taken birth at Motorola in the 1970s out of a criticism of an executive (Art Sundry) regarding Motorola's bad quality (Schroeder et al., 2006). Motorola discovered a connection between increases in quality and decreases in costs of production as a result of this criticism. At that time, the prevailing view was that quality costs extra money. In fact, it reduced total costs by driving down the costs for repair or control (Harry, 2000).Several research papers indicate regarding the inception of Six Sigma in Motorola. George Eckes (2003) has written in *Six Sigma for everyone*-"Motorola is where Six Sigma began. A highly skilled, confident, and trained engineer who knew statistics, Mikel Harry who is regarded as godfather of Six Sigma, began to study the variations in the various processes within Motorola." Pande, Neuman, and Cavanaugh have identified Motorola as the inventor of Six Sigma.

In the book *The Six Sigma Way: How GE, Motorola, and Other Top Companies are Honing their Performance (2000),* they quoted "Like many companies at the time, Motorola didn't have one "quality" program, it had several. But in 1987, a new approach came out of Motorola's Communications Sector – at the time headed by George Fisher, later top exec at Kodak. This innovative improvement concept was called "Six Sigma". So we can deduce that Six Sigma was developed in Motorola first by different individuals like Mikel Harry, George fisher etc. Another contributor was Bill Smith. Gygi, Craig, Neil DeCarlo, and Bruce Williams (2005) quoted in the book *Six Sigma for Dummies* –"Six Sigma per se didn't exist twenty years ago. Miraculously, a single individual working for a large corporation in a cubicle at a nondescript office building saw something…the late Bill Smith, a reliability engineer at Motorola in Arizona".

For his contribution, Bill Smith is called father of Six Sigma (Harry, 1984). However, we cannot ignore the contributions made by Unisys Crop in 1988. Asea Brown Boveri developed Six Sigma into its current form, which places importance on bottom lines and customer satisfaction in 1993. When Six Sigma developed in Motorola, the prevailing view was that quality costs extra money. In fact, it reduced total costs by driving down the costs for repair or control (Schroeder et al., 2000). Six Sigma was heavily encouraged by the quality improvement methodologies of the six preceding decades, such as quality control, Total Quality Management (TQM), and Zero Defects, based on the work of pioneers such as Shewhart, Deming, Juran, Ishikawa, Taguchi and others (Stamatis, 2004; Montgomery et al., 2009).

Now a day, Six Sigma core concepts concentrate around *defects* and *process variations*. Defects are offsets from the standard. Nothing is subjective, as all parameters are quantifiable. Basic measurable dimensions include time/delivery, cost/price, quality etc. In industry jargon these are called Critical to Delivery (CTD), Critical to Price (CTP) and Critical to Quality (CTQ), respectively. Each of these has a different significance to different industries, which needs to be identified before embarking on Six Sigma implementation. Process Variability is the second Six Sigma core concept. The more variability in a process, the larger the probability for a defect somewhere.[6] At the heart of this concept is elimination of variation of process for defect removal. So we can say that the concept of Six Sigma is to improve the existing methodology or create a new, defect- free methodology for production. This is achieved through two methodologies i.e., DMAIC and DMADV (De Feo et al., 2005).

### SIX SIGMA METHODOLOGIES

The traditional PDCA (Plan, Do, Check, and Act) cycle was developed to identify sources of variations that cause products to deviate from customer requirements from any business process (Deming, 1950).[7] However, it has given the direction towards the evolution of two Six Sigma methodologies named DMAIC and DMADV where former is used for projects aimed at improving an existing business process and the latter is used for projects aimed at creating a new product or a new process design (Joseph, 2005). The following paragraph will explore pros and cons of DMAIC and DMADV methodologies.[8]

### DMAIC

The Six Sigma DMAIC process methodology is a system that brings measurable and significant improvement to existing processes that are falling below specifications. The DMAIC methodology can be used when a product or process is in existence at company but is not meeting customer specification or is otherwise not performing adequately. DMAIC is an acronym for five interconnected, interrelated and interdependent phases where D stands for Define; M stands for Measure; 'A' stands for 'Analyze'; 'I' stands for 'Improve' and 'C' stands for 'Control'.

### DMADV

Another important methodology is DMADV. DMADV is used for projects aimed at creating new product or process designs (Joseph, 2005). DMADV stands for Define, Measure, Analyze, Design and Verify. The DMADV project methodology is also known as DFSS (Design For Six Sigma). In DMADV methodology, the first step is to define design goals that are consistent with customer demands and the enterprise strategy. Second step is to measure and identify CTQs (characteristics that are **C**ritical **T**o **Q**uality), product capabilities, production process capability, and risks. The third step is to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.

The next step is to design details, optimize the design, and plan for design verification. This phase may require simulations. And the last step but not the least one is to verify the design, set up pilot runs, implement the production process and hand it over to the process owner(s).On the other hand, according to Six Sigma Academy, DFSS (IDOV) process consists of eight phases which align to the four main steps. The first step is to ***identify***. Here Six Sigma team identifies customer needs and strategic intent. In second step ***design***, the team delivers the detailed design by evaluating various alternatives. The next step is to ***optimize***. Here basic function is to optimize the design from a productivity (business requirements) and quality point of view (customer requirements), and realize it. The next step is to ***validate***. It involves piloting the design, updating as needed and preparing to launch the new design. Basically, DFSS design teams apply advanced

design methods and tools throughout the phases of a rigorous product, service, or process design roadmap to ensure proper design discipline and superior results (Six Sigma Academy, 2001-2005).

**BENEFITS OF SIX SIGMA**

A company can use Six Sigma as a quality management tool to improve proficiency in its strategy implementation (Mannan, 2010, p. 210). Six Sigma aims at producing not more than 3.4 defects per million of parts produced in a manufacturing process. The benefits of Six Sigma can be summarized as follow:

- Six Sigma statistically ensures that 99.9997% of all products produced in a process are of acceptable quality.
- If a given process fails to meet the criterion (3.4 defects per million opportunities), it is reanalyzed, altered and tested to find out if there are any improvements by applying Six Sigma methodologies. If no improvement is found, the process is reanalyzed, altered, and tested again. This cycle is repeated until an improvement becomes visible. Once an improvement is found, it is documented and the knowledge is spread across other units of the company so they can implement his new process and reduce their defects per million opportunities (Hitts et al., 2004).
- Six Sigma improves profitability through improving quality and efficiency. Evidence shows that many companies that implemented Six Sigma have seen profit margins grow 20% year after for each sigma shift (up to 4.8 to 5 sigma).
- Six Sigma is a fresh quality management strategy which can replace TQC, TQM and others. That is why, many companies which were not successful in implementing previous quality strategies as TQC, TQM, are eager to introduce Six Sigma.
- Six Sigma provides efficient manpower cultivation and utilization. It employs a belt system in which levels of mastery are classified as green belt, black belt, master black belt and champion. They work together in order to attain significant result.
- Last but not the least, Six Sigma provides flexibility in the millennium of 3Cs which are change, customer and competition (changing society, power is shifted to customer and customer demand is high, competition in quality and productivity) (Park, 2003, p. 04).

Everything is changing very swiftly in this world. In order to survive, organizations should adapt with the changes very quickly. Most notably, power has shifted from producer to customer. The producer-oriented industrial society is over, and the customer-oriented information society has arrived. Competition in quality and productivity has been ever-increasing. Second-rate quality goods cannot survive anymore in the market. So the importance of Six Sigma can be summarized as follows, "Six Sigma with its 4S (systematic, scientific, statistical and smarter) approaches provides flexibility in managing a business unit" (Park, 2003, p. 04).

**SIX SIGMA VS. OTHER QUALITY IMPROVEMENT PROGRAMS INCLUDING TQM**

| SL | Six Sigma | Other quality improvement programs including TQM |
|---|---|---|
| 1 | Six Sigma focuses on making improvements in all operations within a process. | TQM programs focus on improvement in individual operations with unrelated processes |
| 2 | Six Sigma has a well-defined project charter that outlines the scope of a project, financial targets, anticipated benefits, milestones, etc. It's based on hard financial data and savings | In TQM, organizations go into a project without fully knowing what the financial gains might be |
| 3 | Six Sigma focuses on improving quality by reducing the number of defects. | TQM views quality as conformance to internal requirements. |
| 4 | Six Sigma is like running,(Gupta, 2006). | TQM is like walking(Gupta, 2006). |
| 5 | Six Sigma represents rapid, radical and dramatic change through innovation | . TQM is for incremental and continual change |

To sum up, we can say in tune with the words of Ronald Snee (1999) that Six Sigma is gaining popularity & superiority over other quality improvement programs e.g., QC, SQC, TQC, TQM because of the following eight factors:

- Bottom-line results expected and delivered
- Senior management leadership
- A disciplined approach (DMAIC)
- Rapid (3–6 months) project completion
- Clearly defined measures of success
- Infrastructure roles for Six Sigma practitioners and
- leadership
- Focus on customers and processes
- A sound statistical approach to improvement

Other quality initiatives including TQM have laid claim to a subset of these characteristics, but only Six Sigma attributes its success to the simultaneous application of all eight.

**QUALITY MANAGEMENT TOOLS AND METHODS USED IN SIX SIGMA**

Different quality management tools are used in QC for continuous improvement. Susan Park has identified 7 QC tools. Since they are so widely utilized by almost every level of the company, they have been nicknamed the Magnificent Seven (Park, 2003, p. 74). They are applicable to improvements in all dimensions of the process performance triangle: variation of quality, cycle time and yield of productivity. Within the individual phases of a DMAIC or DMADV project, myriad tools along with the seven are extensively used in all phases of the improvement methodology.

***Cause-and-effect diagram***

Six Sigma teams typically use the C&E matrix in the Measure phase of the DMAIC methodology. When constructing a cause-and-effect diagram, it is often appropriate to consider six main causes that can contribute to an outcome response (effect): so-called 5M1E (man, machine, material, method, measurement, and environment).

***Check Sheet***

The check sheet is used for the specific data collection of any desired characteristics of a process or product that is to be improved.

***Control Charts***

Six Sigma teams use control charts to assess process stability. Control charts are simple but highly effective tool for monitoring and monitoring and improving process performance over time.[9]

***Histogram***

A histogram is used to graphically summarize the distribution of a data set. A histogram is constructed by dividing the range of data into equally sized segments. This data tool enables anyone to quickly and easily answer several important questions like what In the "analyze" phase, control charts are applied to judge if the process is predictable; in the "improve" phase, to identify evidence of special causes of variation so that they can be acted on; in the "control" phase, to verify that the performance of the process is under control.

***Pareto Charts***

A Pareto chart is used to graphically summarize the relative importance of the differences between groups of data.[10] A Pareto chart is constructed by dividing the range of data into groups.

***Scatter Diagram***

In the improve phase of the Six Sigma improvement methodology, one often searches the collected data for Xs that have a special influence on Y. Knowing the existence of such relationships, it is possible to identify input variables that cause special variation of the result variable. It can then be determined how to set the input variables, if they are controllable, so that the process is improved.

***Stratification***

Stratification is mainly used in the analyze phase to stratify data in the search for special cause variation in the Six Sigma improvement methodology.

***Quality Function Deployment (QFD)***

With QFD, Six Sigma teams can more effectively focus on the activities that mean the most to the customer, beat the competition, and align with the mission of the organization.

***Failure Mode and Effect Analysis (FMEA)***

Using FMEA allows organization to analyze any system or subsystem in manufacturing or service industries in the early stages of the process. FMEA improves the quality of products and services and processes by preventing problems from occurring. An effective FMEA identifies corrective actions required to prevent failures from reaching the customer and will improve performance, quality and reliability.

***Design of Experiment (DOE)***

DOE helps Six Sigma Black Belts make the most of valuable resources.[11] DOE is a statistical technique that encompasses the planning, design, data collection, and analysis and interpretation strategy used by Six Sigma professionals. Six Sigma teams use DOE to determine the relationship between factors (Xs) affecting a process and the output of that process(Y).

***T-Test***

Six Sigma teams might use it to determine if a plan for a comparative analysis of patient blood pressures, before and after they receive a drug, is likely to provide reliable results.

**USE OF SIX SIGMA**

Business in various industry segments such as services industry (example: Call Centers, Insurance, Financial/Investment services), e-commerce industry (example: B2B/B2C websites), and education can definitely use Six Sigma principles to achieve higher quality which in turn will increase productivity. Many big businesses such as General Electric, Sony, Ford Motors, Nokia, Texas Instruments, Hitachi, Toshiba, Canon, DuPont, American Express, Celanese, Caterpillar, GE, Honeywell, 3M, Polaroid and Motorola have successfully implemented Six Sigma. It is not surprising that some people may perceive Six Sigma as being only for large corporations. It is incorrect to think that Six Sigma process improvement results can only be achieved by large organizations. Small businesses can also succeed in implementing Six Sigma and reap the process improvement benefits that Six Sigma provides.

Certainly, there are factors that can be disadvantageous for implementing Six Sigma in a small business rather than a large business, such as lack of resources and expertise in change initiatives. However, there are also characteristics inherent in small businesses that can speed up the effective implementation of Six Sigma more than in large businesses, such as flexible process flows, a shorter decision-making chain, and higher visibility of senior management. Six Sigma can work in any size business because the nature of Six Sigma is dependent upon characteristics inherent to any business, not on the size of a business.

**CRITICISM OF SIX SIGMA**

Sig Sigma is a new concept to the industrialists. Hence lots of debates are going in order to explore the strengths and weaknesses of this new technology. Six Sigma has been described as “old wine in a new bottle” since most of the tools ‘packaged’ in it have been around for several decades (Thawani, 2004). Quality guru Juran also expressed similar view points in an interview. According to his words (Juran, August 2002), “from what I have seen of it, it’s a basic version of quality improvement.

There is nothing new there.” Some researchers have concluded that Six Sigma is a tool within TQM framework (Klefsjö et al. 2001; Micklewright, 2004. However, advocates of Six Sigma have argued that many of these claims are in error or ill-informed (Richardson et al., 2007; Ficalora et al., 2007). As a new technology, Six Sigma can bring sustainable performance breakthrough in organization and improve quality, productivity and above all profitability of the organization. There is accumulating evidence in favor of this argument.

## SIX SIGMA TEAM

**FORMATION AND STRUCTURE OF SIX SIGMA TEAM AND MANAGING SIX SIGMA**

**FORMATION AND STRUCTUERE OF SIX SIGMA TEAM**

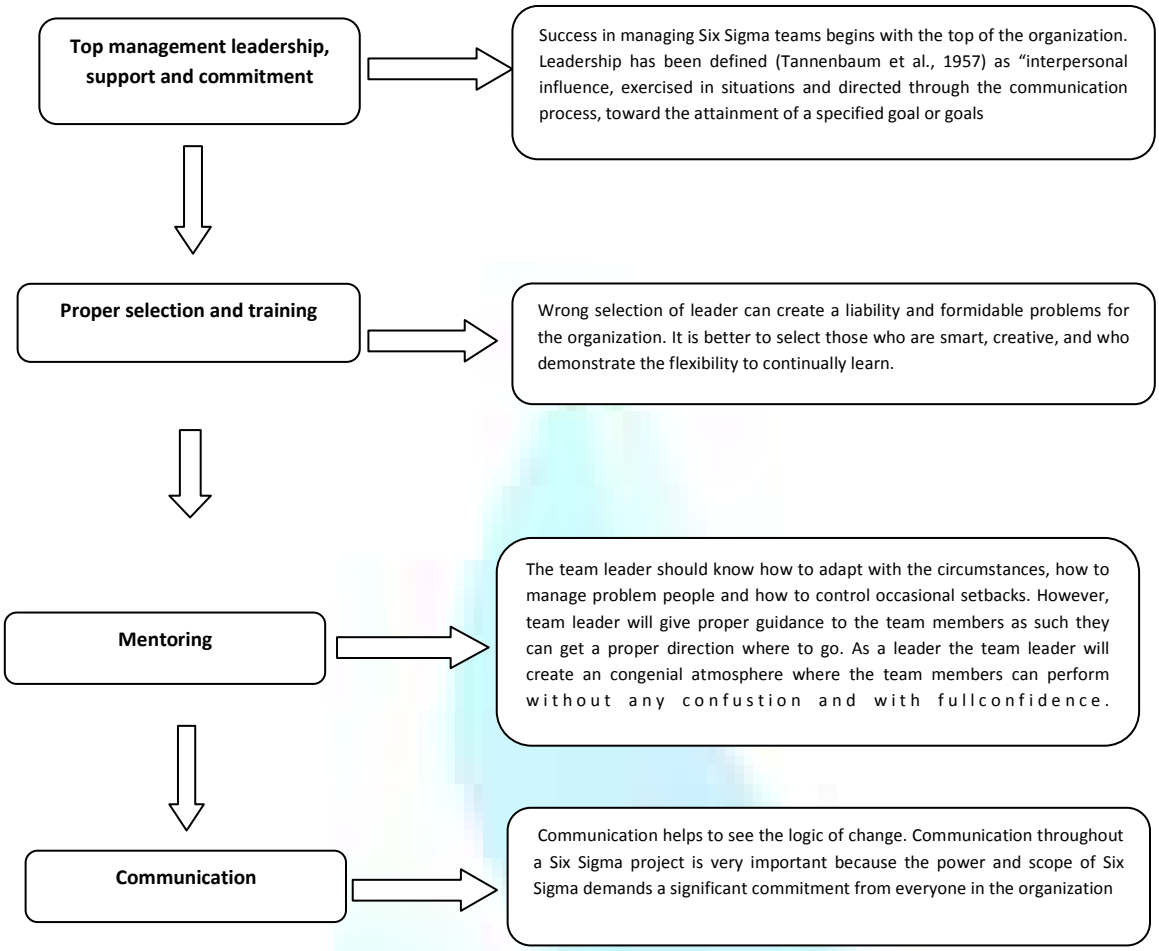
Six Sigma team formations is an important and significant issue in order to get the desired goal.[12] Six Sigma team accomplishes many of the tasks and goals set before them. There are several individual works in a sig sigma team.[13] This section will explore different types of people who work in a Six Sigma team performing myriad different roles and responsibilities. Borrowing a concept from eastern martial arts, practitioners of Six Sigma are ranked by “Belt”. Six Sigma uses a belt tire system in order to organize the trained and certified professionals that work within their methods. They are categorized as Six Sigma Master Black Belts, Black Belts, Green Belts, Yellow Belts and White Belts.[14]

| SL | Belt Tire System | Position in a hierarchy and Functions. |
|---|---|---|
| 1 | Six Sigma Master Black Belts | They are the full time experts in Six Sigma integration. They remain at the top of the hierarchy |
| 2 | Six Sigma Black Belts | Six Sigma Black Belts are the ones who directly responsible for the execution of Six Sigma projects within an organization. They perform the role of line managers as well as staff managers |
| 3 | Sigma Green Belts | Six Sigma Green Belts are the “worker bees” of the Six Sigma project. They gather data and execute experiments in support of the Black Belts |
| 4 | Sig Sigma Yellow Belts | Yellow Belt professionals work under the direction of the Green and Black Belt Professionals. They have a solid basic knowledge of the Six Sigma methodology. They remain at the centre of the analyzing, measuring, and collecting of data. |
| 5 | Sig Sigma White Belts | They work at the bottom level. help the members working in a project organize a local level |

**MANAGING SIX SIGMA TEAM**

Managing a Six Sigma team is a considerable responsibility. Six Sigma is a team process and requires cooperation and collaboration at each and every level of the organization. It is not an individual approach rather it is a comprehensive, multi-level, organization wide, integrated, coordinated & synchronized approach. Before going to the discussion regarding managing Six Sigma team it will not be unwise to have a brief idea about team and team process.

In order to transform a Six Sigma project team into a high performance effective team organizations have to manage it properly because the difference in productivity between an average team and a turned-on, high-performance team is not 10 percent, 20 percent, or 30 percent, but 100 percent, 200 percent, even 500 percent( Peters, 1996). The following diagram will explore how to manage a Six Sigma team.




## SIX SIGMA, PRODUCTIVITY AND SURSTAINABLE PERFORMANCE BREAKTHROUGH

### CONTRIBUTION OF SIX SIGMA TO THE PRODUCTIVITY IMPROVEMENT IN THE 21ST CENTURY

In order face the challenges of 21st century companies need to increase the productivity to a great extent. In this case Six Sigma can be an important tool to improve productivity. Improving productivity has become a major goal in virtually every organization (Robbins et al., 2011, p.565). However, before unfolding the contribution of Six Sigma to improve productivity, it is imperative to know the meaning of productivity and the importance of productivity in Bangladesh. Because, most managers do not know what productivity really means, how much vital it is for them organization and for their organization, it can be improved significantly, how to measure and analyze it, what factors affect it and how to improve it (Bernolak, 2000).

Productivity is a multidimensional and dynamic concept (Monga, 2000, p.13). Fabricant defines productivity (as cited in Ali, 1978) in the following words, "always a ratio of output and input". Productivity for industrial activity has been defined in many ways, but the following definition proposed by the European Productivity Agency (EPA) in 1958 is perhaps the best. According to EPA, productivity is the degree of effective utilization of each element of production. EPA, however, added that productivity is, above all, an attitude of mind, it is based on the conviction that one can do things better today than yesterday, and better tomorrow than today, it requires never-ending efforts to adapt economic activities to changing conditions, and the application of new theories and methods, it is a firm belief in the progress of human beings. From the above –mentioned discussion, it is evident that there is a wide range of productivity definitions available in the academic literature.

Productivity and quality are interrelated. The more productive an industry, the better its competitive position because its unit costs are lower. Quality and low cost usually move in same direction (Akkas, 2000, p. 39). Quality of product and services has become the competitive edge in the world marketplace. Whereas price, brand loyalty, attractive design and technical innovation are still important to the consumers in developed countries, the quality of products has surged ahead in relative importance. Importantly, there is accumulating evidence that the delivery of quality products and services to consumers has a direct impact on the success of the organization (Akkas, 2000, p. 39).

Among the different number of options, Six Sigma methodologies can increase productivity which is sustainable. Six Sigma is a powerful business improvement strategy. It helps the organization to identify, reduce, and eliminate defects from any product, process, or transaction. More than a "quality" program, Six Sigma is a flexible and dynamic continuous improvement strategy and process initiative that helps the organization uncover solutions. Six Sigma can reduce cycle time significantly and thus increase yield which in turn will increase productivity.[15] So we can say that, by reducing defects rate at a significant level, Six Sigma can bring unprecedented quality improvement to products and services which in turn will contribute to improving productivity of an organization to a dramatic level.

***Now let's look at the fundamental question why productivity improvement is so important in Bangladesh.***

Productivity growth is a crucial source of growth in living standards, because more real income improves people's ability to purchase goods and services (whether they are necessities or luxuries), enjoy leisure, improve housing and education and contribute to social and environmental programs. Paul Krugman (1992, p.9) has said 'Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker. The total factor productivity (TFP) of Bangladesh is very trivial. TFP is generally low in many developing countries; it seems to be even lower in Bangladesh (Gazi et al., 2009, p. 2). TFP has been negative up to 1989 and made a positive contribution to growth only since 1990. Its contribution was about 1% during the decade of the 1990s and then decreased to 0.5% during the 8 years of 2000(Gazi et al., 2009, p. 10).

### SIX SIGMA AND SUSTAINABLE PERFORMANCE BREAKTHROUGH

Breakthrough means deliberate change. It is a planned change emphasized on second order rather than first order change. It connotes moving from one situation to another situation. It is a dynamic, decisive movement to new and unprecedented levels of performance (Joseph, 2004). And performance means result. Performance can be measured against shareholder value, profitability(ROI, ROS, ROA), sales, market share, cost, customer/client satisfaction,

customer/client loyalty, employee satisfaction, employee loyalty, cycle time, number of errors, defects, rework, redo, scrap, environmental citizenship, community citizenship etc. Sustainable performance breakthrough is not a single time activity. It is rather, aggregate result of many planned, coordinated and meticulously executed individual improvement efforts in multiple functions and levels of the organization. It's a continuous process that, once undertaken is not only capable of rescuing an organization from predicament but also of preventing the predicament from reasserting itself. One of the biggest challenges for the today's managers is to maintain breakthrough process which will create purposeful and unprecedented beneficial change (Juran, 1964) (to improve upon current operations and to adapt to change-to prolong organizational life). However, Six Sigma methodologies help organization to sustain performance breakthrough along with Juran Trilogy.[16] The guiding force behind the Juran Trilogy is Dr Joseph M Juran, who founded Juran Institute in 1979 and developed many of the tools and techniques on which Six Sigma's methodology is based. Dr Juran(2004, p. 21) said "When the planning process is complete then turn the responsibility over to the operating forces to maintain control, detection of any deficiencies traceable to the quality planning process, and quality improvement – the main road to quality leadership. Their job is to maintain the level of quality that management established – not to re-plan. The challenge then is to reduce deficiencies, rejects or errors to the level that has been planned and is acceptable." From the above statement it is clear that Six Sigma methodologies can have a very significant contribution to the reduction of deficiencies & errors. An important effective breakthrough improvement innovation is DMAIC. Systematic application and deployment through proven methodologies like Six Sigma DMAIC and Design for Six Sigma (DFSS) along with Juran Trilogy can prepare an organization to continuously improve at rates faster than competitors and make performance breakthrough sustainable.

## CONCLUSION AND RECOMMENDATIONS

The twenty first century is characterized by revolution of technology which is changing very fast and rapidly. This changing nature of technology is posing threats and opportunities simultaneously for an underdeveloped country like Bangladesh. In order to survive, there is no alternative other than welcoming and adapting with the technological change. Most of the companies of our country are not aware of the technological changes that are taking place in the world market (e.g., America, Japan and china etc). If they know, they cannot imagine the huge impact of this technology on the productivity, profitability, and quality of the products of the companies. Most of the companies are prone to think and do business locally not internationally which can outlast them from the world competition. Doing business locally will not give any possibility to become leader in world market. More and more foreign products (e.g., China) are entering into the local market due to trade liberalization and deregulation. We cannot avoid it rather it's a reality. We have to face it. The main competitive weapon is to bring new technology and use the technology in order to innovate to face the challenges unleashed by globalization Six Sigma is a new technology which can bring unprecedented performance breakthrough for the organizations in Bangladesh increasing quality, productivity and profitability of the firms.

So, in order to attain sustainable performance breakthrough and improve productivity through Six Sigma in different companies of Bangladesh, the following recommendations can be made:

- Top management commitment and support is must for the introduction of Six Sigma in the organization. The top manager should incorporate this new technology into its corporate strategy. Then, the company will develop a Six Sigma vision for the company.
- Training and education can give a clear idea about the Six Sigma. Education can make Champions really smart individual which helps him/her to behave as an effective leader. Six Sigma education should be provided to each and every employee of the organization.
- Participation of each and every employee is a must. Participation of all employees is essential for the Six Sigma success. Top management should try not to create a so called elite or strange class within the organization. In Bangladesh, it is a common phenomenon not to allow employee to participate in decision making.
- While introducing Six Sigma, top management should bring this into mind that customer is the boss. So, identifying the core customers and the voice of the customers (VOCs) should be linked with the process.
- In order to sustain Six Sigma success, it is advisable to go for continuous learning rather than few months' intensive training. Top management should make organization a learning organization.
- Communication can play a vital role to the success of Six Sigma. All the improvements should be documented and communicated with the regular intervals.
- Identifying an area where Six Sigma will be introduced is an important decision. After identifying, organization should deploy CTQ from the standpoint of customer specifications to each and every process.
- Infrastructure development is another issue in order to introduce Six Sigma solidly which includes Knowledge management (KM), Data base management system (DBMS), statistical process control (SPC) etc.
- Each day of the month should be declared as "Six Sigma Day". In that day, the top manager will personally check all the Six Sigma progress. He/she will reward individuals for better performance.
- Lastly, all the business processes should be evaluated in order to measure real improvement against benchmark's company performance.

## NOTES

[1] Quality means the ability of a product or service to reliably do what it's supposed to do and to satisfy customer expectations (Robbins et al., p. 577). In manufacturing sectors quality dimensions are performance, features, flexibility, durability, conformance, serviceability, aesthetics, perceived quality and in service sectors the quality dimensions are timeliness, courtesy, consistency, convenience, completeness, accuracy (Dean et al., 1994; Roberts et al., 1993; Garvin, 1988; Hitt et al., 2001, p. 211).

[2] A **business process** or **business method** is a collection of related, structured activities or tasks that produce a specific service or product (serve a particular goal) for a particular customer or customers. Business process may be management process, operational process, supporting process, controlling process etc. Six Sigma is widely used in operational process (purchasing, manufacturing etc.)

[3] DPMO means defects per million opportunities. This calculation requires three pieces of data namely unit, defect and opportunity. DPMO is calculated number of defects multiplied by 1 million and divide with the result of multiplication between number of opportunities for error per unit & number of units.

[4] TQM is a management philosophy of continuous quality improvement along with cost reduction in an environment of participative management through self directed team development and employee empowerment, and quality supportive culture where trained human resources would focus on monitoring process variations by using necessary tools and techniques for gaining competitive advantage through customer satisfaction. It is a top-down process, and a means to an end, not an end in itself (Mannan et al., 2007, p. 09).

[5] ISO 9000 is a series of international quality management standards established by the International Organization for Standardization (www.iso.org), which set uniform guidelines for processes to ensure that products conform to customer requirements. These standards cover everything from contract review to product design to product delivery (Robbins et al., 2010, p. 579).

[6] For example, if a carriage takes 40 minutes to transport a 5-ton load a distance of 10 miles at 99.9997% defect free Six Sigma; a four sigma will take 45 minutes to cover the same distance per same load but at 99.94% defect free. It might appear that 99.94% is quite good – if this is your conclusion, you will need to think again. Taking Six Sigma concepts into account, this equals a 20% defect in the product, which passes on to the customer.

[7] The PDCA cycle was in fact originally developed by Walter A, Shewhart, a Bell Laboratories scientist who was Deming's friend and mentor, and the developer of Statistical Process Control (SPC) in the late 1920s. So sometimes this is referred to as the "Shewhart Cycle". See *The Man Who Discovered Quality* by A. Gabor, Penguin Books, 1990.

[8] The original Six Sigma process developed for problem-solving at Motorola is MAIC, which means measurement, analysis, improvement, and control. Later, DMAIC instead of MAIC was advocated at GE. IDOV was suggested by GE and has been used most frequently in practice. However, a new methodology, DIDES, was suggested by Qualtec Consulting Company which means Define, Initiate, Design, Execute and Sustain. See Park, S.H. (2003). Six Sigma for Quality and Productivity Promotion, Asian Productivity Organizations, Productivity series 32, Tokyo, Japan, p. 43.

[9] The original concept of the control chart was proposed by Walter A. Shewhart in 1924 and the tool has been used extensively in industry since the Second World War, especially in Japan and the USA after about 1980. Control charts offer the study of variation and its source. They can give process monitoring and control, and can also give direction for improvements. They can separate special from common cause issues of a process. They can give early identification of special causes so that there can be timely resolution before many poor quality products are produced (Shewhart, 1931).

[10] The Pareto chart was introduced in the 1940s by Joseph M. Juran, who named it after the Italian economist and statistician Vilfredo Pareto, 1848–1923. It is applied to distinguish the "vital few from the trivial many" as Juran formulated the purpose of the Pareto chart. It is closely related to the so called 80/20 rule – "80% of the problems stem from 20% of the causes," or in Six Sigma terms "80% of the poor values in Y stem from 20% of the Xs."

[11] The tool, DOE, was developed in the 1920s by the British scientist Sir Ronald A. Fisher (1890–1962) as a tool in agricultural research (Fisher, 1925). The first industrial application was performed in order to examine factors leading to improved barley growth for the Dublin Brewery. After its original introduction to the brewery industry, factorial design, a class of design in DOE, began to be applied in industries such as agriculture, cotton, wool and chemistry. George E. P. Box (1919–), an American scientist, and Genichi Taguchi (1924–), a Japanese scientist, have contributed significantly to the usage of DOE where variation and design are the central considerations.

[12] There are a number of excellent works on team building: for example, see Cleland, 1997; Dyer, 1987; Ford and McLaughlin, 1992; Katzenbach and Smith, 1993; Pinto and Pinto, 1991; Rossy and Archibald, 1992; and Todryk, 1990.

[13] Besides six sigma project team there are other teams like continuous improvement teams(CIT), self-directed teams(SMT), self-directed work teams(SDWT), self managed teams(SMT), high performance teams, cross functional teams(Tom peters, 1996; Smith, 1993; Meredith et al., 2006, p. 217). While these teams may have slightly different structures and may vary somewhat in the amount of decision making authority and autonomy exercised by the team, they are all aimed at improving worker performance as well as improving production methods and product quality. But these teams have some problems. In a multiplant study comparing three team structures, CIT, QC, and SDWT, Bailey (1998, p. 30) found that SDWTs " did not perform as well as more traditionally organized and supervised workgroups whose members participate in" QCs or CITs. This is due to poor design of team involvement, lack of information infrastructure, and a management structure that may not have fully supported the teams. Six Sigma project team is devoid of these problems.

[14] There are two additional individuals i.e., executive Leaders and champions in Six Sigma teams work at the top level. *Executive leadership* includes the CEO and other members of top management. They are responsible for setting up a vision for Six Sigma implementation. They also empower the other role holders with the freedom and resources to explore new ideas for breakthrough improvements. *Champions* take responsibility for Six Sigma implementation across the organization in an integrated manner. The Executive Leadership draws them from upper management. Champions also act as mentors to Black Belts (Harry et al., 2000). More over, Champions are responsible for keeping the Six Sigma program focused within their business area; they select Black Belts, approve projects, set improvement targets, and provide the resources needed to conduct the projects (Watson, 2003).

[15] Every process has a cycle time and yield. The cycle time of a process is the average time required for a single unit to complete the transformation of all input factors into an output. The yield of a process is the amount of output related to input time and pieces. A more efficient transformation of input factors into products will inevitably give a better yield. And better yield will result in improving productivity (Park, 2003, p. 09).

[16]Juran trilogy is a universal approach to managing for quality. Quality guru Juran has coined this term first. That is why, it is named as Juran trilogy. The underlying concept of the quality trilogy is that managing for quality consists of three basic quality-oriented processes e.g., quality planning, quality control and quality improvement. Each of these processes is universal; it is carried out by an unvarying sequence of activities. Furthermore, these universal processes are interrelated. The starting point is quality planning — creating a process that will be able to meet established goals and do so under operating conditions. The subject matter of the planning can be anything: an office process for producing documents; an engineering process for designing products; a factory process for producing goods; a service process for responding to customers' requests. Following the planning, the process is turned over to the operating forces. Their responsibility is to run the process at optimal effectiveness. Due to deficiencies in the original planning, the process runs at a high level of chronic waste. That waste has been planned into the process, in the sense that the planning process failed to plan it out. Because the waste is inherent in the process, the operating forces are unable to get rid of the chronic waste. What they do instead is to carry out "quality control" — keep the waste from getting worse. If it does get worse (sporadic spike), a fire fighting team is brought in to determine the cause or causes of this abnormal variation. Once the cause(s) has been determined, and corrective action is taken, the process again falls into the zone defined by the "quality control'' limits(Juran, "The Quality Trilogy: *A Universal Approach to Managing for Quality "presented* at the ASQC 40th Annual Quality Congress in Anaheim, California, May 20, 1986).

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