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Six Sigma Qualities in Business

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Abstract:-Organizations adopt numerous business improvement methodologies to improve the business performance. Researchers and manufacturers advocate the manufacturing strategies such as Quality Circles, Just-in-Time, Concurrent Engineering, Business Process Reengineering (BPR), Total Quality Management and Supply Chain Management (SCM), according to the need of industry or the trend prevailing at the time for business performance improvement. These strategies surface and lose the shine in no time, but Six Sigma stands tall against all the odds and has become an integral part of corporate strategies. It is felt that to manage the supply chain effectively the entire structure of supply chain must be understood properly. This paper attempts to provide the reader with a complete picture of Six Sigma through a systematic literature review. It presents a state of the art on Six Sigma by systematically arranging main activities in Six Sigma. In addition, a step-by-step approach for understanding the breadth and depth of supply chain is proposed which consequently explores the domain of Six Sigma. The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of Six Sigma improvement projects. This is accomplished through the use of two Six Sigma sub-methodologies: DMAIC and DMADV. The Six Sigma DMAIC process (define, measure, analyze, improve, control) is an improvement system for existing processes falling below specification and looking for incremental improvement. The Six Sigma DMADV process (define, measure, analyze, design, verify) is an improvement system used to develop new processes or products at Six Sigma quality levels. It can also be employed if a current process requires more than just incremental improvement. Both Six Sigma processes are executed by Six Sigma Green Belts and Six Sigma Black Belts, and are overseen by Six Sigma Master Black Belts. This paper attempts to provide the reader with a complete picture of Six Sigma through a systematic literature review. It presents a state of the art on Six Sigma by systematically arranging main activities in Six Sigma. In addition, a step-by-step approach for understanding the breadth and depth of supply chain is proposed which consequently explores the domain of Six Sigma.

Keywords: **Six Sigma,DMAIC,,Six Sigma Improvement Projects, Green Belt, Black Belt, Master Black Belt.**

I. INTRODUCTION

Six Sigma is a phenomenon that is gaining wide acceptance in industry, but lacks a theoretical underpinning and a basis for research other than "best practice" studies. Rigorous academic research of Six Sigma requires the formulation and identification The Six Sigma of useful theories related to the phenomenon statistical representation of Six Sigma describes quantitatively how a process is performing. To achieve Six Sigma, a process must not produce more than 3.4 defects per million opportunities. A Six Sigma defect is defined as anything outside of customer specifications. A Six Sigma opportunity is then the total quantity of chances for a defect. Process sigma can easily be calculated using a Six Sigma calculator. The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of Six Sigma improvement projects. This is accomplished through the use of two Six Sigma sub-methodologies: DMAIC and DMADV. The Six Sigma DMAIC process (defines, measure, analyze, improve, control) is an improvement system for existing processes falling below specification and looking for incremental improvement. The Six Sigma DMADV process (define, measure, analyze, design, verify) is an improvement system used to develop new processes or products at Six Sigma quality levels. It can also be employed if a current process requires more than just incremental improvement. Both Six Sigma processes are executed by Six Sigma Green Belts and Six Sigma Black Belts, and are overseen by Six Sigma Master Black Belts.

According to the Six Sigma Academy, Black Belts save companies approximately $230,000 per project and can complete four to 6 projects per year. General Electric, one of the most successful companies implementing Six Sigma, has estimated benefits on the order of $10 billion during the first five years of implementation. GE first began Six Sigma in 1995 after Motorola and Allied Signal blazed the Six Sigma trail. Since then, thousands of companies around the world have discovered the far reaching benefits of Six Sigma. Many frameworks exist for implementing the Six Sigma methodology. Six Sigma Consultants all over the world have developed proprietary methodologies for implementing Six Sigma quality, based on the similar change management philosophies and applications of tools.

II. DEFINITION OF SIX SIGMA

Six sigma is a disciplined methodology that uses data and statistical analysis to measure and improve a company's operational performance. It focuses on identifying and eliminating "defects" in business process and has produce hundreds of millions of dollars in new profitability in a wide variety of industries.

What does the term "Six Sigma" mean?

- "Sigma" is a statistical term for the measures of variability.
- "One" sigma is a very high degree of variability (7 "mistakes" out of 10 opportunities)
- "Six" sigma is a very low degree of variability (3.4 "mistakes" out of 1000000 opportunities) . If you

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have a close ratio of 30% your sales process can be said to be operating at one sigma. The following figure 1 shows how variation is occurring in the process.

Table 1.Six Sigma Levels

Sigma level	Defect per million	Defect as percent
One sigma level	690000.0	69.0000%
Two sigma level	308000.0	30.8000%
Three sigma level	66800.0	6.6800%
Four sigma level	6210.0	0.6210%
Five sigma level	230.0	0.0230%
Six sigma level	3.4	0.0003%

The objective of Six sigma is only 3.4 defects or (errors) out of every million defect opportunities. This translates into 99.99966%perfection. Since most private manufacturing companies in Vietnam are currently around Three Sigma or even lower in some cases , a process improvement project using Six Sigma principles may initially aim at Four Sigma or Five Sigma , which would nonetheless result in significant defect reduction .An important clarification is that Six Sigma measures defect opportunities and not defective products . The more complex a product, the more defect opportunities it has. For example, there are more defect opportunities in an automobile compared to paper clips .Below is an example of counting the no. of defect opportunities in the production of wooden chairs: Company A is producing 5 orders for customer; is order has one wooden chair item (5 units). Opportunity for wooden chair item is clarified as follows:

- The chair was made by correct material? (1 opportunity)
- Moisture content of wood is within the standard ?(1 opportunity)
- The chair was made in correct size? (1 opportunity)
- The chair has no damage ? (1 opportunity)
- Correct finishing is applied? (1 opportunity)
- Correct packaging method is applied? (1 opportunity)

Total no. of defect opportunities =units x opportunities =5x6

=30 opportunities

III. DMAIC ROADMAP

The DMAIC methodology is central to Six Sigma process improvement projects. The following phases provide a problem solving process in which specific tools are employed to turn a practical problem into a statistical problem, generate a statistical solution and then convert that back into a practical solution.

Define (D)

Fig.1. DMAIC Cycle

The purpose of the define phase is to clearly identify the problem, the requirements of the project and the objectives of the project. The objectives of the project should focus on critical issues which are aligned with the company's business strategy and the customer's requirements. The Six Sigma DMAIC method is about "solving a problem with an unknown solution." The problem (the "Y") needs to be defined in concrete measurable terms with an operational definition. In the Define phase, the Six Sigma project team identifies a project based on business objectives and the customers of the process and their needs and requirements. The team identifies CTQs (critical to quality characteristics) that have the most impact on quality - separating the "vital few" from the "trivial many"- and creates a map of the process to be improved. ."Six Sigma has the power to vastly improve processes. Don't waste these valuable resources. Identify and understand how you deliver on the promises of your brand and deploy your Black Belts intelligently where they are needed. The use of Y=f(x) analysis is one proven way to gain insight into an organization. If you don't understand how to deliver to your customers, eventually they will find someone who does!"

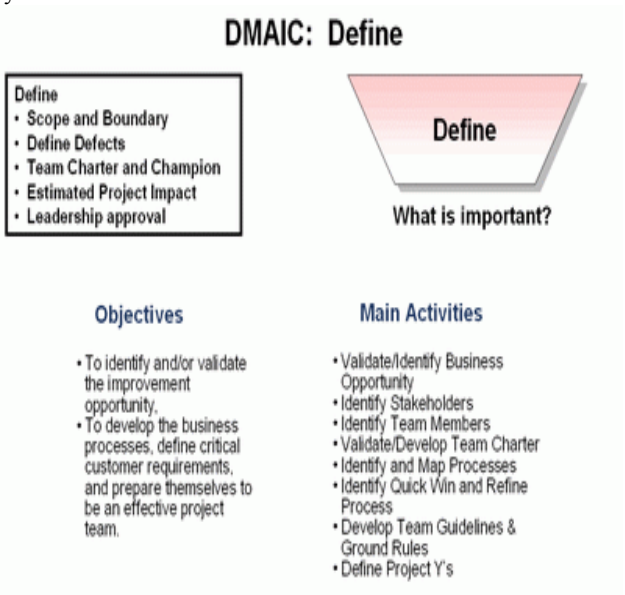

Fig .2. DMAIC Define Chart

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Measure

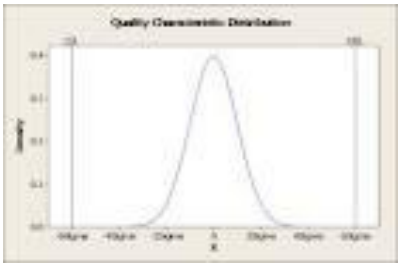

Fig 3: Distribution Chart

The Belt leading the project determines both the initial capability and stability of the project Y, and determines the ability to measure the Y. Once the project has a clear definition with a clear measurable Y, the process is studied to determine the Key Process Steps and the Key Inputs for each process. After the Key Input list is established, the Belt will consider the potential impact on CTQs that each input has with respect to the defects currently generated in the process. key Inputs are prioritized to establish a short list to study in more detail. With a prioritized list of inputs in hand, the Belt will determine the potential ways the process could go wrong or how the input could go wrong. The best method to do this is an FMEA. Once the reasons for input failure are determined, preventative action plans are put into place. Another big part of the Measure phase is beginning with proper metrics. Valid and reliable metrics to monitor the progress of the project are established during the Measure phase. Business Process Charting is the best way to track project metrics.

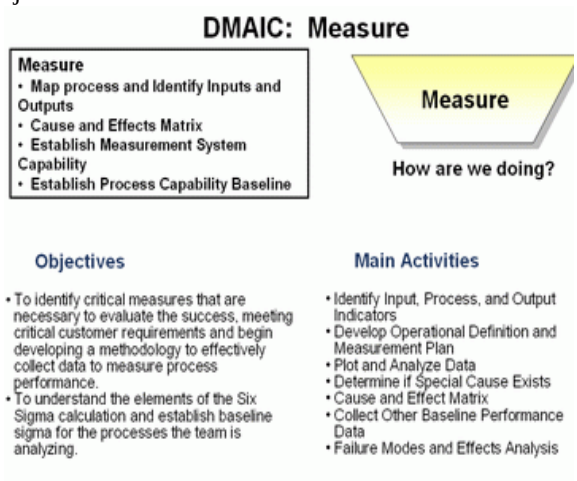

Fig 4: DMAIC Measure Chart

Analyze

Through analysis, the team can determine the causes of the problem that needs improvement and how to eliminate the gap between existing performance and the desired level of performance. This involves discovering why defects are generated by identifying the key variables that are most likely to create process variation. A common error people make when they discuss the Six Sigma process is they think the DMAIC process takes too long to accomplish improvements. This is far from the truth; often "quick hits" are established early in the project and frequently already implemented by the time the team reaches the Analyze phase. If the team has not already identified major improvements, then the breakthrough often results from careful process analysis with data. Six Sigma analysis techniques are the proper tools to uncover more difficult solutions.

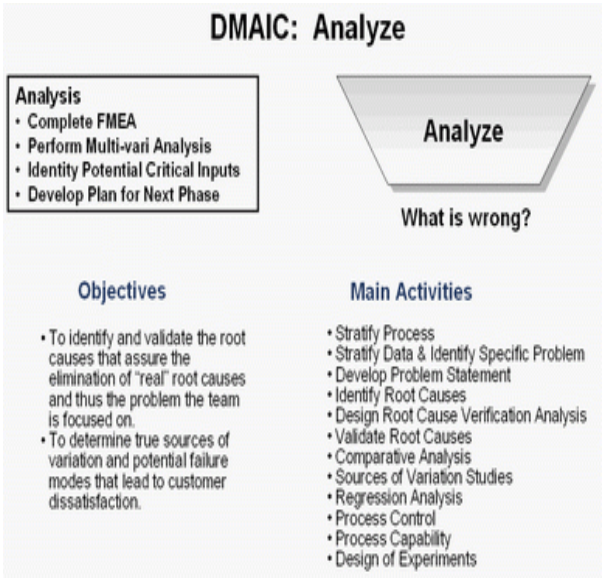

Fig 5: DMAIC Analyze Chart

Improve

This phase is often the most fun and at the same times the most difficult. Once problem causes are determined in the Analyze phase, the team finds creative new improvement solutions. More often than not simple process experimentation and simulation bring the team big gains in this step. The team also identifies what will happen if needed improvements are not made and what will happen if the improvements take too long.

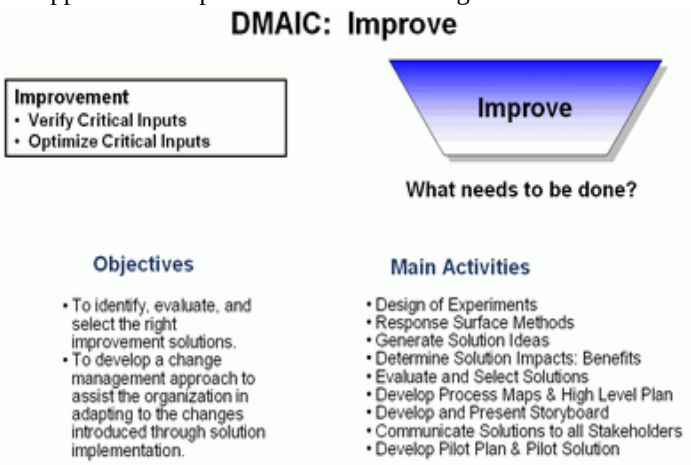

Fig 6: DMAIC Improve Chart

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Control

Success in this phase depends upon how well we did in the previous four phases. If we used proper change management methods starting with identifying key stakeholders we should be on the way to success. In the Control phase, tools are put in place to ensure that the key variables remain within the acceptable ranges over time so that process improvement gains are maintained. The team develops a project hand off process, reaction plans, and training materials to guarantee performance and long-term project savings. Finally, the team identifies what the next steps are for future Six Sigma process improvement opportunities

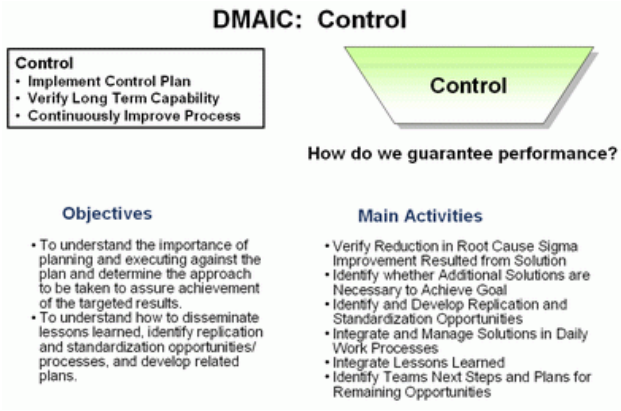

Fig 7: DMAIC Control Chart

IV. SEVEN QUALITY TOOLS OF SIX SIGMA

What is a Check sheet?

- A simple and effective method of gathering information.
- Ensures consistency of data collected.
- Can be completed whilst doing the normal job.
- Simplifies data collection and analysis.
- Highlights trends.
- Spots problems.

How to use Check sheets

- Decide on the format required e.g table, tally chart etc.
- Decide on the factors that need to be measured.
- Create a format that makes it simple to collect data on all the factors.
- Allow space for comments – often gives a valuable insight
- Prepare instructions for use and train the data collectors.
- Test the check sheet before full usage – allows problems to be eradicated.
- Audit the process and validate the results.

What is a Pareto Chart?

Commonly known as "ABC analysis" or "the 80:20 rule"

– For example: 80% of problems are attributed to 20% of the causes

- Data categories are arranged in order of frequency - starting with the most frequent
- It is one of the most effective yet simple tools available
- It identifies the most significant problem to be worked first
- It is an effective on-going improvement tool

What is a Scatter Diagram?

- A graphical tool allowing the identification of possible relationships between two different sets of variables
- A display of what happens to one variable when another changes
- A method of testing possible cause / effect relationships

What is a Histogram?

- It has much in common with the Pareto Diagram – can be vertical or horizontal
- Is a visual way of representing data – easier to display and interpret large amounts of data than using tables
- It is a picture of the process behaviour at a given process of time
- ***Why use a Histogram?***
- Allows us to make sense of data
- It allows us to see patterns that are difficult to see in tables of numbers
- It is a simple way of communicating data

What is a Control Chart?

It is a statistical tool used to distinguish between variation in a process resulting from **common causes**, and variation resulting from **special causes**

- It is a graphic display of the process **stability** or **instability** over time
- It displays data in the time sequence in which it occurred
- ***Why use a Control Chart?***
- Can be used to make judgements of the process performance over a certain period of time
- It provides a common language for discussing process performance
- To assess the effectiveness of changes to improve a process

What is a Cause and Effect Diagram?

It is a tool that is used alongside brainstorming and helps to identify, sort and display possible causes of a specific problem.

- Can otherwise be known as a Fishbone or Ishikawa Diagram.
- It illustrates the relationship between the outcome and the factors that influence it.

What are Flowcharts?

They show the steps in a process (eg flow of materials, sequence of operations)

- They can be used to compare intended changes with the actual situation

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- They can be used to initiate process improvement activities

Why use Flowcharts?

They provide a process overview at a glance

- They relate one step in the process to the others
- They provide insight for data collection and control points
- They assist in identifying the process customers

V. LIMITATIONS OF SIX SIGMA

Six Sigma gained prominence as an effective quality improvement technique after it was successfully implemented in Motorola. Since then, many large organizations have implemented Six Sigma programs and improved the quality of manufactured goods or services rendered. However, the full potential of Six Sigma has not been realized so far because many competent small to medium level enterprises have still not implemented Six Sigma programs. These enterprises have all the resources to implement such programs, but are often wary of the final certification, as they believe that it is meant only for large organizations. These companies often do not realize that Six Sigma delivers the same benefits to both large as well as small business enterprises. The only difference may be in the volume of goods manufactured or services rendered.

VI. FUTURE OF SIX SIGMA

Six Sigma may appear similar to other quality management tools such as TQM or Kaizen Events, but in reality, it is quite different. Other quality management programs often reach a stage after which no further quality improvements can be made. Six Sigma, on the other hand, is different as it focuses on taking quality improvement processes to the next level. This means that Six Sigma has the potential to outlast other quality management programs in the future. The scope of Six Sigma is also much broader than other quality management programs as it can be applied to every business process of an organization. The future is bright for Six Sigma programs with the growing awareness in small and medium enterprises about the potential benefits that can be derived from implementing such programs.

VII.CONCLUSION

Six Sigma looks at all work as a series of processes with inherent variations, which can cause waste or inefficiency. Focusing on those processes with greatest impact on business performance, as defined by leadership teams, the methodology involves statistical analysis to quantify repeated common cause variations - which can then be reduced by the Six Sigma team. Six Sigma becomes a continuous process for quality improvement and cost reduction flowing throughout the company.

Originally developed from a Japanese quality control process for manufacturing electronic semi-conductors, Six Sigma developed the capability of reducing problems or issues effecting customer expectations on key business processes. Six Sigma has provided the opportunity to drive forward important customer focused initiatives across the Cummins global organization. As an improvement and cost reduction process, Six Sigma is equally valid for marketing and product development as well as manufacturing and customer services. Six Sigma improvement projects and techniques are now the cornerstone of Cummins continued success in cost reduction and quality improvement.

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