QUALITY AND RELIABILITY CORNER

Six Sigma: myths and realities

Nihar Ranjan Senapati
Avici Systems, Inc., North Billerica, Massachusetts, USA

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Abstract *The Six Sigma approach has set a new paradigm of excellence in any manufacturing ambience. But do the ground realities speak in favor of spending millions of $ budget, when any exotic process centric concept even like Shainin's can also map out process improvement in the similar objective manner? The Define, Measure Analyze Improvement and Control (DMAICR) approach is discussed* vis-á-vis *Deming's cycle, total quality management assessment methodologies including Malcolm Baldrige National Quality Award Assessment (MBNQA) or European Foundation for Quality (EFQM) framework and of late, much popularized Dorian Shainin's Statistical Engineering (SE). The 3.4 PPM, so-called quantitative aspect of Six Sigma, is challenged statistically over process variability. The conclusion leads to acknowledge Six Sigma as any other process improvement and enrichment systematic methodology like any other aforementioned improvement initiatives.*

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Introduction

Six-Sigma process improvement methodology has been accepted as the pioneering process improvement framework. Industry leaders like Raytheon, Motorola, GE and Honeywell (formerly, Allied Signal) have laid out specific blue prints for process improvement using this framework. In the last one decade Six Sigma has become a buzzword across corporations and has been effectively capitalized to push up the stocks on the Wall Street. Since Bill Smith's concept had its birth at Motorola and was passed down to Bob Galvin, a lot of water has flown under the bridges. The original Define, Measure Analyze Improvement and Control (DMAIC) scheme has undergone a critical review by the practitioners and implementers including addition of R (Reporting) to the tail end of the framework. Corporations have relied, invested and reportedly ploughed back a lot of dividends from the implementation of this approach.

In the current times of economic recession and slow down in demand, every corporation looks at any possible issue of cost cutting and wise deployment of scarcely available funds. So it is worthwhile to deliberate on Six Sigma with intent, rather than an impulse? Everybody might agree with the author about a possible concurrence to introduce or not to introduce Six Sigma by looking at the other traditional and contemporary process improvement models. Some of those referred later are more or less known as Deming's (1982) cycle, total quality management (TQM) assessment methodologies including Malcom Baldrige National Quality Award Assessment (MBNQA) or the European Foundation for Quality (EFQM) framework and of late, the much popularized Dorian Shainin's Statistical Engineering (SE).

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Overview of various process improvement methodologies

Six Sigma and process steps (DMAICR)

Various steps of Six Sigma framework are outlined below:

(1) *Define (D)*. Selection of appropriate projects, development of project plans and identification of the relevant process. The Supplier-Input-Process-Output-Customer (SIPOC) mapping exercise can be used effectively to describe the process.

(2) *Measure (M)*. Measurement of process variables through data quality checks, repeatability and reproducibility (R&R) studies, and addressing process stability.

(3) *Analyze (A)*. Usage of graphical techniques to analyze the process behavior.

(4) *Improve (I)*. Improvement of the existing process through experimentation and simulation techniques.

(5) *Control (C)*. Development of the control plan for process improvement.

(6) *Reporting (R)*. Reporting of the benefits of the re-engineered process.

Deming cycle and process steps

Different steps of the Deming cycle are outlined as below:

(1) *Plan*. Plan the process (equivalent to D of Six Sigma).

(2) *Do*. Act on the process (equivalent to M-A-I of Six Sigma).

(3) *Check*. Measure the results by finding out the deficiencies (equivalent to C of Six Sigma).

(4) *Act*. Act on the gap between the intended goals and achieved results (equivalent to R of Six Sigma).

TQM and its implementation steps

According to Juran and Grayna (1993), emphasis on customer satisfaction, broad application of quality concepts, and participation of all employees has given rise to a new title – TQM. TQM is an approach to improving the competitiveness, effectiveness and flexibility of a whole organization. It is essentially a way of planning, organizing and understanding each activity. The philosophy of TQM, in the words of Bates (1993), recognizes that customer satisfaction; business objective, safety and environmental considerations are mutually dependent and applicable in any organization. According to Barclay (1993), the impact of TQM on any organization is, first, to ensure that the management adopts a strategic view of quality.

Ten points that guide implementation of TQM are:

(1) The organization needs long-term commitment to constant improvement (Dean and Evans, 1994).

(2) Adopt the philosophy of "zero defects/errors" to change the culture to the "right first time".

(3) Train to people to understand the customer-supplier relationships.

(4) Do not buy products or services on price alone-look at total cost.

(5) Recognize that improvement of the systems needs to be managed.
(6) Adopt modern methods of supervision and training – eliminate fear.
(7) Eliminate barriers between departments by managing the process-improve communications and teamwork.
(8) Eliminate the following:
    - arbitrary goals without methods;
    - all standards based only on numbers;
    - barriers to pride of workmanship; and
    - fiction – get facts by using the correct tools.
(9) Constantly educate and retrain-develop the experts in the business.
(10) Develop a systematic approach to manage the implementation of TQM.

Baldrige framework and TQM assessment

The Baldrige framework (Figure 1) administered by NIST and instituted by Federal government has four basic elements, namely: Driver, System, Measures of progress and Goal. Senior executive leadership is the Driver element that creates the values, goals and systems and guides the sustained pursuit of quality and performance objectives.

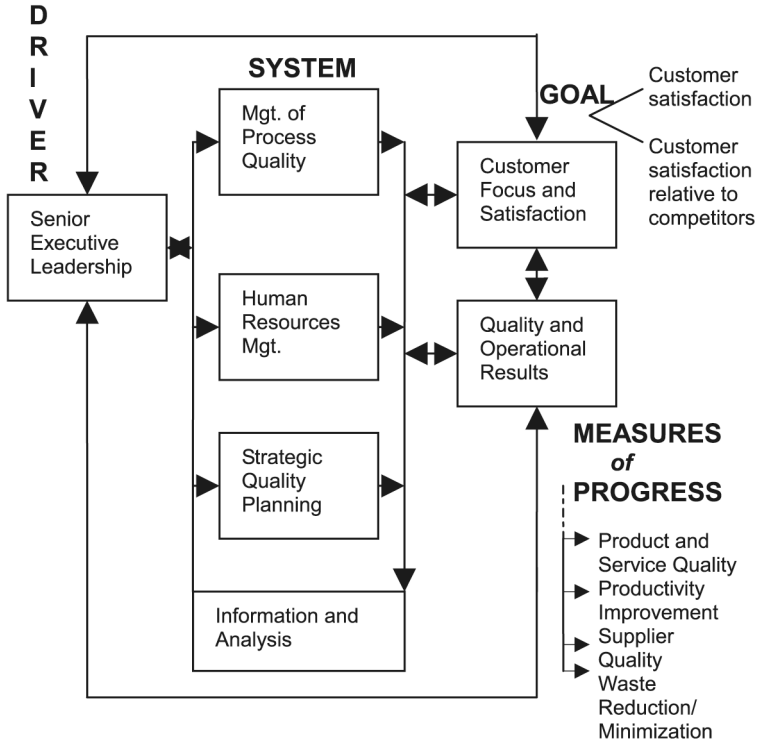

Figure 1.
Baldrige TQM assessment framework

EFQM framework and TQM assessment

The EFQM (Figure 2) recognizes that processes are the means by which a company organization harnesses and releases the talent of the people to produce the results. Also according to Greising (1994), customer satisfaction, employee satisfaction and impact on society are achieved through leadership driving policy and strategy, people management, resources and processes which lead ultimately to excellence in business results.

SE and Six Sigma

Dorian Shainin, a consultant who worked earlier with Rath and Strong, pioneers Statistical Engineering. He has outlined the framework and corresponding tools, which have been changing since their inception. Since the framework has not been discussed or exposed to the professionals at large because of the proprietal reasons, it has been mired in controversies. However, corporations, including semiconductor businesses like Motorola, have benefited from the implementation. The winning of the first MBNQA by Motorola has been attributed to the practice of the SE (Bhote and Bhote, 1991).

SE is a structured and systematic approach. It aims at finding and removing the cause of variation like any other quality improvement initiative. Process is characterized and measurement systems are emphasized during the implementation phase. The framework uses a progressive search technique using families of variation. Clues are generated using observational data. Process data and engineering process knowledge leverage on the available information.

SE steps are:

(1) Define the problem.

(2) Quantify and measure the problem.

(3) Determine problem history.

(4) Generate clues.

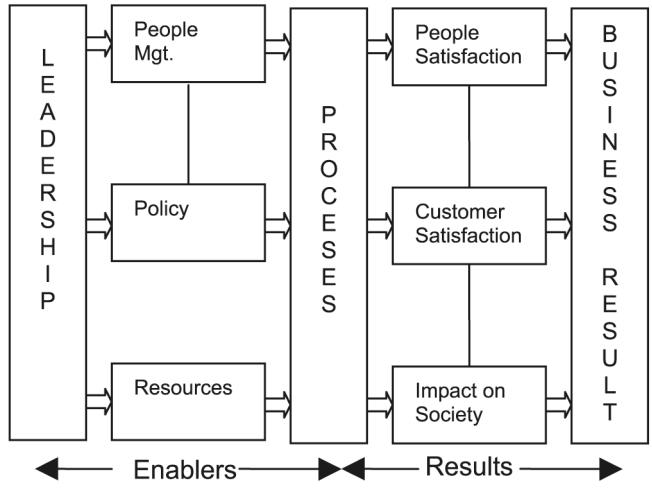

Figure 2.
EFQM TQM assessment framework

(5) Formal design of experiments (verify cause).
(6) Turn the problem on and off.
(7) Establish realistic specifications and tolerances.
(8) Freeze the process improvements (positrol).
(9) Certify the process (process certification).
(10) Hold the gains with statistical process control (SPC (precontrol)).

If we look at the above ten steps of SE, we can understand that step 1 obviously relate to D of Six Sigma framework. Steps 2, 3 and 4 correspond to the Measure phase of the DMAIC framework. Steps 5, 6 and 7 are analogous to the Analyze phase; 8, 9 relate to Improve; and 9 and 10 correspond to the Control and Reporting phases of Six Sigma.SE differs from Six Sigma in the following ways:

- smaller steps in methodology;
- smaller team size for problem solving;
- lesser application of DOE;
- proprietor usage (service marks); and
- both SE and Six Sigma advocate application of more or less same tools.

3.4PPM and Six Sigma: some myths

Process deviations are assumed to be within $\pm 1.5\sigma$ of the process mean (otherwise 2PPB would be the amount of non-conformities on a standard normal table). There is sufficient mystery around this process deviation, which was used to calculate 3.4PPM of non-conformities. Is this particular $\pm 1.5\sigma$ of the process mean is presumed for all business processes to arrive at 3.4 defects per million opportunities (DPMO)? And there has been sufficient debate around why normal distribution would be used. There have been attempts to assume different distributions of data and find out the non-conformities in case of Six Sigma situations (Ramberg, 1994, 2000). However, the outcome of that research is limited in terms of relevance and further application.

So what then makes the industry pioneers view Six Sigma as the framework of choice? A summary of the Six Sigma *vis-à-vis* TQM, SE and the simpler Deming cycle is articulated below to serve as a guide for industry leaders before launching an improvement program. Is it not that the contemporary industry has been plagued with an overdose of *sick* (six) sigma? The industries like GE, Raytheon and Motorola claim to have saved millions of dollars through Six Sigma implementation. Had they ever though of implementing even a low budget incremental developmental plan like *Kaizen* to the same set of situations? How many corporate giants have ever thought to adopt the Baldrige Award as an improvement path, which is itself an example of continuous improvement (Juran and Godfrey, 1998)? Since Six Sigma is more sensitive to variability in process (a positive element), is not this statistical process control in *new clothing*?

Now let us take a look at the protagonists of Six Sigma. Lockheed Martin made an attempt at Six Sigma in the early 1990s, but this so foundered that it now calls its

trainees "program managers," instead of black belts to prevent in-house jokes of skepticism. John Akers promised to turn IBM around with Six Sigma, but the attempt was quickly abandoned when he was ousted as CEO in 1993. Motorola says Six Sigma saved $2.2 billion from 1987-1991. However, the company has stumbled badly at the customer's market front. "Our customers don't measure six standard deviations," says Gordon Bethune, CEO of Continental Airlines, in an industry with perhaps the most to gain with 99.9997 per cent perfection. "They just say 'I want my bag and I kind of liked the pasta.' That's the definition of success'". Then if Six Sigma does not really appeal to the customer through its metrics, then why not to adopt just another methodology, which applies another process control with a bigger map? And not mention the high cost of Six Sigma training that creates a barrier for spending and prevents the implementation of this improvement program. The four-year-old Six Sigma Academy in Scottsdale, Arizona, run by former Motorola quality experts Mikel Harry and Richard Schroeder, charges fees to the tune of $1 million per corporate client. Unfortunately enough, some companies have tried to imitate the so-called élite Six Sigma companies and the results have been disastrous. Deming (1982) was a strong critic of this "imitation trend" in the corporate world as far as quality practices are concerned.

If Six Sigma suggests the same tool pack as others do, then why not to embrace any other process improvement methodology, which can be a low cost phenomenon? It is the time to sit up and decide before embarking on any *blitzkrieg* in the worse times of tight buck situations across any industry segment. TQM became dead towards the beginning of 1990s and Six Sigma soared being launched on the mega budget platforms of Bossidy and Welch. Can corporations afford to act lavishly in these worse times of lay offs and continuing recession?

Sometimes the *aficionados* of Six Sigma go to the extent of arguing that that TQM lacks the customer orientation, unlike Six Sigma. However, we see from both the MBNQA/EFQM framework that the customer sits on the goal/results area respectively. So TQM is customer-driven. Some theorists view the Deming cycle as a part and parcel of a TQM implementation plan, which may be true at times. The Deming cycle may be considered as an approach plan within the sub-folder of bigger TQM movement. TQM is also data driven like Six Sigma and it encourages application of appropriate SPC tools on a case-to-case basis. A bigger merit of TQM lies in its approach in tackling the soft issues in a typical problem solving process. Behavioral Training is always a bigger module within the TQM tool kit. The application of TQM calls for investment primarily in people, time to implement new concepts, time to train, time for to recognize the benefits and move forward to new or different organizational cultures. Six Sigma and SE seemingly lack such a broader intent.

Table I suggests the corporate planners or Quality and Reliability champions in industries to take a look at the cross-comparison before planning an improvement initiative plan. Although that is precise and does not contain the quantitative aspects of gains/losses, but certainly it throws light what improvement plan to adopt and when. Basically approaching an improvement plan with an open mind and instead of being consummated by the hype, results in *real* million dollar savings. The Japanese perspective in the automobile industry is a lesson by itself.

Table I. Cross-comparison among quality improvement programs

Attribute	Six Sigma	Deming cycle	TQM	SE
Process-centric approach	High emphasis	Implicit	Implicit	High emphasis
Customer orientation	Implicit	Invisible	Explicit	Implicit
Statistical approach	Has a statistical base	Does not confine itself to statistical approach	Tools have statistical base	Usage of simpler statistical tools
Behavioral content	Exists	Does not emphasize the behavioral side of problem solving	Emphasizes the behavioral approach to problem solving	Talks less about behavioral attributes
Easiness	Tough to implement in terms of goals	Simplest guide to solve problems	Easier to implement	Moderately difficult
Cost	High to medium investment required; depends on projects	Usually low investment projects; depends on project sizes	Usually moderate budget allocations made in lieu of higher gains	No publicized estimates available
Duration	High	Project span depends on project sizes	Project sizes are moderate	No figures are made available
Executive role	Top down	Not emphasized	Top down	Bottom up

Conclusions

Various improvement methodologies have been briefly discussed. Six Sigma as a popular corporate belief has been debated *vis-à-vis* other traditional quality approaches. The message is conveyed to propagate and adopt an improvement plan that leads to an effective and productive process and not the label that sells the plan. So the corporate leaders should think over whether Six Sigma as an improvement initiative talks less and does more than any other existing improvement plans.

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