Choosing Which Process Improvement Methodology to Implement

Mark Gershon
Temple University

A variety of methodologies are available for process improvement. These include Six Sigma, Lean Management, Lean Six Sigma, Agile Management, Re-engineering, Total Quality Management, Just-In-Time, Kaizen, Hoshin Planning, Poka-Yoka, Design of Experiments, and Process Excellence. Consulting firms all seem to have one of these that they claim is the best. The large number of competing approaches, all claiming to be the best way to achieve a similar goal, can leave any organization at a loss as to how to decide which is best for them. In this paper, these methodologies are briefly described and lists of common characteristics are developed. Implementation requirements for each are examined next. The same is done for organizations, comparing characteristics and implementation needs and limitations. The methodologies are then compared in terms of how each can be implemented. A scoring system is developed, where a company can list its implementation criteria and measure how well each methodology satisfies these criteria. The goal is to make recommendations as to which type of methodology should best be implemented in which type of organization under what circumstances.

INTRODUCTION

Improving the quality of processes and maintaining acceptable levels of performance quality are critical factors in the success of any organization. Over the past thirty or so years there have been waves of interest and application of several seemingly different approaches beginning with the Total Quality Management (TQM) "revolution of the 1970's and 80's and including Six Sigma, BPR, Lean, etc. Often, there has been a focus on the "wave of the moment" and this has led to attempts to implement magic bullet or overly restricted methods.

A variety of methodologies are available for process improvement. These include Six Sigma, Lean Management, Lean Six Sigma, Agile Management, Re-engineering, Total Quality Management, Just-In-Time, Kaizen, Hoshin Planning, Poka-Yoka, Design of Experiments, and Process Excellence. Consulting firms all seem to have one of these that they claim is the best. The large number of competing approaches, all claiming to be the best way to achieve a similar goal, can leave any organization at a loss as to how to decide which is best for them.

In this paper, these methodologies are briefly described and lists of common characteristics are developed. Implementation requirements for each are examined next. The same is done for

organizations, comparing characteristics and implementation needs and limitations. The methodologies are then compared in terms of how each can be implemented.

A scoring system is developed, where a company can list its implementation criteria and measure how well each methodology satisfies these criteria. The goal is to make recommendations as to which type of methodology should best be implemented in which type of organization under what circumstances.

In general, it is most practical to first understand the underlying principles and goals of an approach and its prescribed means for accomplishing them. Once these are understood, application in a particular situation requires creative adaptation. This adaptation may involve merging techniques and tools from other defined modalities and integrating all improvement initiatives under a single, well managed program.

This paper identifies and describes several of the most well thought of and applied modalities, compares and contrasts them and offers a proposed framework for Process Improvement.

Six Sigma is now considered to be THE APPROACH to quality improvement. All 500 of the Fortune 500 companies have Six Sigma programs built into their management structure. The successes are well publicized and all of the major consulting groups offer Six Sigma training and services. The ASQ recently awarded the new Crosby Prize for a book on the subject.

For the past quarter century, another approach was recognized as the standard for quality improvement. It was very different from previous approaches, leading to a quality revolution in the field of management. That approach, of course, is Total Quality Management, TQM. TQM is a name coined by Juran, but the approach is most closely identified with the philosophy of Deming. The catalyst for that quality revolution brought about by TQM was Crosby, who published his best selling book on the subject (Quality is Free) in 1979.

The successes of TQM have also been well publicized. In fact, virtually all would agree that Six Sigma developed from the TQM movement and that it would probably not exist without TQM having come first. Not surprisingly then, some disagreement has developed between the proponents of each, bringing up a number of issues in question. This paper looks at both approaches and attempts to provide answers to these questions.

These questions are as follows:

1. Is there really a difference or is Six Sigma really just TQM under a new name?
2. If Six Sigma is something different than TQM, what is the nature of the relationship between them? Is it an improved version, where TQM has evolved into Six Sigma, or is Six Sigma something new?
3. Differences do not necessarily lead to advantages. Does Six Sigma show any advantages over TQM?
4. Many other related programs have been developed and are in use. Each claims to improve on TQM. Where do these fit in and why has Six Sigma become so widely accepted over them?

BACKGROUND

What is TQM?

TQM should be considered the "mother of all" of the more recent process improvement methodologies. With TQM, the quality movement began, and the notion of continuous improvement entered the conscious of management.

TQM was based on Deming's 14 points, and embraced a philosophy that involves 4 major areas:

1. Managerial responsibility for continuous improvement
2. Focus on the work processes to achieve improvements
3. Use of statistics to measure process performance
4. Employee involvement and empowerment

TQM led to a revolution in managerial thinking and was embraced on a world-wide basis. But after twenty years or so, business wanted something new. And TQM had evolved into Six Sigma.

What is Six Sigma?

In researching the historical perspective of Six Sigma, it became clear that the evolution of Six Sigma is written quite similarly by various authors, but each author gives a varied depth and breadth of the History of Six Sigma depending on the subject matter of the text in which the authors are writing; however, Six Sigma is generally defined in very similar manner across the board thus providing a pervasive definition that can be relied on for the use of this thesis.

Rowland Hayler and Michael D. Nichols (2007) explain the history of Six Sigma as having "originated at the Motorola Corporation in the United States in the mid-to-late 1980s and were subsequently expanded at GE and other leading firms during the 1990s." The authors go on to explain that "over the last 15 years or so, Six Sigma has been increasingly recognized as a powerful approach to achieve business process improvements in both manufacturing and, more recently, service and transactional industries, (Hayler and Nicholas 2007, p. 5)[i]."

While Hayler and Nichols provide somewhat of a more recent perspective of Six Sigma's evolution, they fail to speak of the earlier years, the roots of Six Sigma. In filling the gaps from left open by Hayler and Nichols, Pyzdek (2003) adds the depth and breadth that is essential in understanding the reality surrounding a more accurate and complete historical perspective of the evolution of Six Sigma. Pyzdek (2003) writes that Six Sigma originated "when a Japanese firm took over a Motorola factory that manufactured Quasar television sets in the United States in the 1970s, they promptly set about making drastic changes in the way the factory operated. Under Japanese management, the factory was soon producing TV sets with $1/20^{th}$ as many defects as they had produced under Motorola's management. They did this using the same workforce, technology, and designs, and did it while lowering costs, making it clear that the problem was Motorola's management. It took a while but, even Motorola's own executives finally admitted our quality stinks' (Pyzdek 2003, p.4.).

In addition to the better historical perspective, Pyzdek provides a more informative background about the executives and their claim to fame in utilizing Six Sigma in those earlier years to achieve success for the Motorola organization. Pyzdek explains that "it took until nearly the mid-1980s before Motorola figured out what to do...Bob Galvin, Motorola's CEO at the time, started the company on the quality path known as Six Sigma and became a business icon largely as a result of what he accomplished in quality at Motorola. Using Six Sigma Motorola became know as a quality leader and a profit leader. After Motorola won the Malcolm Baldrige National Quality Award in 1988 the secret of their success became public knowledge and the Six Sigma revolution was on, (Pyzdek 2003, p. 4)."

Today, stemming from the hard work and dedication of the for father's of Six Sigma in the early 1980s, the utilization of Six Sigma and the realization of the benefits that is can derived for organizations is still being discovered and implemented as an effective tool throughout most industries throughout the world.

Six Sigma definition and philosophy

Pyzdek (2003) defines Six Sigma as "a rigorous, focused and highly effective implementation of proven quality principles and techniques. Incorporating elements from the work of many quality pioneers, Six Sigma aims for virtually error free business performance. Sigma, σ, is a letter in the Greek alphabet used by statisticians to measure the variability in any process. A company's performance is measured by the sigma level of their processes. Traditionally, companies accepted three or four sigma performance levels as the norm, despite the fact that these processes created between 6,200 and 67,00 problems per million opportunities. The Six Sigma standard of 3.4 problems per million opportunities is response to the increasing expectations of customers and the increased complexity of modern products and processes, (Pyzdek 2004, p. 3)."

To support Pyzdek's claim that Six Sigma is relevant and effective tool for organizations, the reader can be directed to many quality experts who have written numerous books, publications, and technical papers that give additional support to Pyzdek's definition and philosophy of Six Sigma. Another very reputable and reliable source is Pande (2000) where the author gives credence to Pyzdek (2003), "Six Sigma is a comprehensive and flexible system for achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by close understanding and customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business process", (Pande, 2000 p. xi).

Hayler and Nichols (2007), both reputable and highly recognized quality management experts and consultants in Financial Services industry, support Pyzdek (2003) and Pande (2000) in a more recent interpretation of the definition of Six Sigma. Hayler and Nichols define Six Sigma as an "application of scientific management methods, but it actually integrates many different creative, technical, and change management methods, tools, and techniques to improve business processes", (Hayler and Nichols, 2007 p. 5).

Thus far, the definitions of Six Sigma provide more of a prima facie description of Six Sigma's ability to improve processes within organizations to achieve a form of organizational process excellence which yields a virtually error free production of customer defined products and services that are aimed at maximizing customer satisfaction, earning customer loyalty, improved profitability for shareholders, improved employee job satisfaction and retention, and improved market position of the organization; however, the definitions falls short in describing Six Sigma the rational behind the Six Sigma Methodology.

Six Sigma organizations work diligently to achieve an overall Six Sigma level of performance for each key process that equals to 3.4 defects per million opportunities for each core process. The reason Six Sigma organizations focus on achieving the Six Sigma level is to improve the quality of products and services for their customers. The largest problem that impedes the highest level of quality is due to process variation. To improve quality, the many variations must be identified, analyzed, measured, improved and controlled in a very systematic and holistic way to ensure that process inputs are converted to the highest quality level of output that meets customer requirements. To support this claim we cite Pyzdek (2003), "Six Sigma is, basically, a process quality goal, where sigma is a statistical measure of variability in a process", (Pyzdek 2003, p. 59).

Measuring process performance is called process capability measurement, and there are various tools and methods that are leveraged, that will be discussed later in this thesis, that will enable organizations to measure their initial starting point of process capability then set the

future process capability goal requirements over the long-term to achieve the 3.4 defects per million opportunity process excellence Six Sigma goal.

As a frame of reference, Pyzdek (2003) states, “the traditional quality paradigm defined a process as capable if the process’s natural spread, plus or minus three sigma, was less than the engineering tolerance. Under the assumption of normality, this three sigma quality level translates to a process yield of 99.73%. A later refinement considered the process location as well as its spread and tightened the minimum acceptance criterion so that the process mean was at least four sigma form the nearest engineering requirement. Six Sigma requires that processes operate such that the nearest engineering requirement is at least Six Sigma from the process mean”, (Pyzdek 2003, pp.59-60).

Changes in the acceptable engineering tolerance limits historically stemmed from the increased complexity in the way in which products are produced. “Motorola correctly pointed out that modern technology was so complex that old ideas about “acceptable quality levels” could not longer be tolerated. Modern business requires near perfect quality levels”, (Pyzdek 2003, p. 60).

In achieving this near perfect quality level of Six Sigma, a process’ performance is constantly measured and benchmarked against engineering standards that were developed through the use of techniques and tools that allows the organization to understand the level of quality that the customer demands in their products and services. These tools and techniques are named DMADV and Quality Functional Deployment and are discussed later in this Thesis.

A Six Sigma level is determined by random sampling then calculating a statistical reading from the sample to estimate the defects of the entire population of goods and services. From this random sampling and estimate of the population, the Six Sigma firm gains an understanding of the level of quality the organization is producing at. This level of quality is the sigma level which again is an indication of the number of defects per million opportunities.

Pyzdek (2003) clarifies a confusing point about the Six Sigma level where he state that “one puzzling aspect of the “official” Six Sigma literature is that it states that a process operating at Six Sigma will produce 3.4 parts-per-million (PPM) non-conformances. However, if a special normal distribution table is consulted (very few go out to Six Sigma) one finds that the expected non-conformances are 0.002 PPM (2 parts-per-billion, or PPB). The difference occurs because Motorola presumes that the process mean can drift 1.5 sigma in either direction. The area of a normal distribution beyond 4.5 sigma from the mean is indeed 3.4 PPM. Since control charts will easily detect any process shift of this magnitude in a single sample, the 3.4 PPM represents a very conservative upper bound on the non-conformance rate”, (Pyzdek 2003, p.60-61).

From a quantitative perspective, Six Sigma can be defined in terms of its ability to improve organization’s bottom lines by reducing the cost of poor quality. The cost of poor quality is sum of the cost associated with items like scrap, rework, the cost of carrying excess inventories, and idle capacity costs. Six Sigma firms link their financial performance to process performance. There is an inverse relationship between the cost of poor quality and profitability. The higher the cost of poor quality, the lower the profitability of the organization will be. This should be an incentive for all organizations to implement Six Sigma.

Pyzdek (2003) claims that there is a clear connection between which sigma levels a company is operating at and the cost of poor quality. Furthermore, Pyzdek (2001) states that a company operating at a level between three and four sigma spends about 25-40 per cent of their annual turnover taking care of problems. However, a company operating at a higher Six Sigma level only spends about five per cent of the turnover.

What are other Process Improvement programs?

Re-engineering

One of the earliest "next generation" approaches to go beyond TQM was re-engineering. This approach did not have to include all of the TQM tools because they were used to get many small or gradual improvements. Why not, the argument went, go for big, dramatic improvements? No specific tools were provided for accomplishing this, but the focus is on restructuring the organization around the current client base. Many examples of successes are provided, and the idea is a good one.

Of course, TQM never precluded large improvements. It just recognizes that most improvements will be smaller and more local in nature. Since TQM became synonymous with the idea of continuous improvement, re-engineering can be viewed as another "tool" under the TQM umbrella.

Just-in-Time

Just-in-time (JIT) evolves from many of the practices followed by the Japanese auto industry. In its most simplistic sense, it is an inventory policy, not a quality improvement policy. It builds on the Japanese Kanban system for tracking and ordering parts and is the philosophy behind the MRP systems now in use in most manufacturing plants. These systems have evolved into the ERP systems that are so popular today.

When viewed as an inventory policy, JIT says to order exactly what is needed at the exact time it is needed. It is a zero-based inventory policy. Nothing is stored because it is acquired as it is used.

To make this work in practice, two things have to occur. Quality has to eliminate defects so that the exact quantities delivered will all be good enough for use. Then the timing issue requires that schedules be maintained exactly as planned and all the support systems come through successfully. In other words, all business processes must be improved.

Viewing extra inventories, extra capacities, extra time and so forth as waste of resources, JIT becomes a continuous improvement system by focusing on reducing these and all other sources of waste in the system. The idea is that exposing these sources of waste will force us to eliminate them is used. No specific tools outside the MRP tracking tools are provided, but the tools of TQM are very helpful in this environment. JIT and TQM work together very well. Neither has claimed to be a successor to the other.

Lean Thinking

Lean thinking, or lean management, also is based on the idea of eliminating waste. So it is very much like JIT. Lean thinking includes two extra features. One comes from the organizational structure of the company. The lean organization eliminates many levels of management, bringing everyone closer to the processes. The second feature is a strong process analysis orientation. Every step in the work processes is evaluated. The processes are recreated around the steps that add value, trying to reduce or eliminate those that don't. This is more structured than JIT, but this process analysis is the same, to eliminate the waste in the process.

ISO 9000

ISO 9000 has been accepted as the international quality standard. It is formally accepted by the European Union and informally by virtue of its use in the rest of the world. However, it is

more of an administrative system than an improvement system. In fact, in terms of Deming's principle that specifications and quotas can actually become barriers to improvement, it will not foster improvement.

There are no tools associated with ISO 9000. It is heavily oriented towards reliance on documentation for all processes. This is the sense in which it is like TQM, being very process driven. But the emphasis is on following the documented processes and not on improving them. ISO provides certification, another barrier to improvement in that once certified, a company is good enough. The implication is that the company has "arrived", as opposed to the Crosby concept of a race with no finish line.

In response to the criticism that ISO companies lag behind their continuously improving competitors, the latest version of the ISO builds in the need for continuous improvement. Ten years ago, the TQM and ISO communities were competitors. Now it is clear that TQM had the right idea and ISO now adopts that idea. Certification programs will always be important and ISO is a very helpful one with regard to quality.

Theory of Constraints

The theory of constraints (TOC) rests on the idea of managing the bottlenecks in a process, the constraints. It is very much a process oriented management approach, just like TQM.

It is also very focused on continuous improvement. Where TQM emphasizes continuous improvement in any sense, TOC is more like JIT in exposing the problem in a process and trying to exploit it. The continuous nature of the improvement comes about because improving the process in the area of a bottleneck will just expose another bottleneck, which is the next candidate to improve.

TOC has no real tools associated with it, except the process flow analysis. The tools of TQM are very useful in the response to the bottleneck, so TOC can really perform best in a TQM environment.

COMPARISON OF THE PROGRAMS

TQM versus Six Sigma

Six Sigma includes all tools and philosophies of TQM. And almost everything one would do in a Six Sigma project could have and would have been done under TQM.

But history of when and why TQM failed led to some improvements. And Six Sigma incorporates these.

First, TQM failed where management did not participate and back it up. Six Sigma, with its structure of belts, champions and sponsors, requires management involvement.

Second, TQM did not require groups to work on projects. In fact, this was viewed as an end run by management to avoid creating a true culture of continuous improvement. Six Sigma requires both, the culture and the groups and project s to lead to accomplishment.

Third, TQM never defined a prescriptive methodology for its implementation, a sequence o steps to follow that would lead to success. Six Sigma definitely does this. It provides a well-defined improvement model known as DMAIC. The DMAIC methodology takes every project through five stages, ending with success and maintaining that success (See Figure 1).

Six Sigma also has more advanced statistical tools. While not a reason for TQM failure, incorporating these tools creates the opportunities for bigger and better improvements, and improvements that might not have been found with just the TQM tools.

TQM/Six Sigma versus other programs

All the other programs fit within the TQM/Six Sigma umbrella. The exception to this is Lean, which comes from the Toyota system. Today, Lean and Six Sigma are being merged into Lean Six Sigma. IT seems that this is the method of the future.

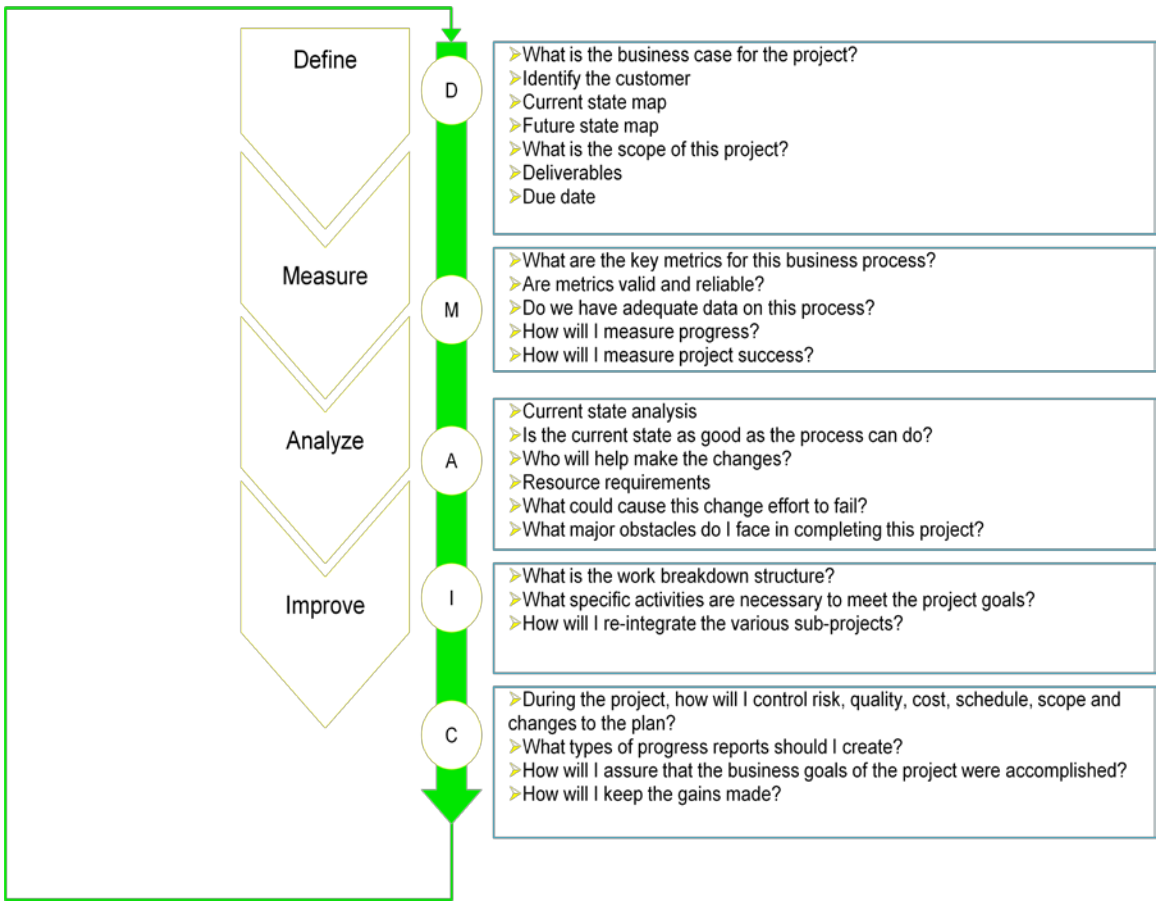
CONCLUSION

All the process improvement tools share many common features. They share the philosophy that processes can always be improved. They share the assumption of measurement and statistics being a key to improvement. And they share the faith in the power of the workers closest to a process to be able to improve it.

We have also seen that Six Sigma, while borrowing almost all its content from TQM, is truly an advancement over TQM. It strengthens all the areas of TQM where it was weak, while maintaining the strengths.

But the combination of Lean and Six Sigma is proving to be the best approach developed yet. It adds more tools, looks at more situations, and achieves results faster than Six Sigma alone.

FIGURE 1
DMAIC PROCESS



REFERENCES

Hayler, R. and Nichols, M.D. (2007) Six Sigma For Financial Services New York, NY: McGraw-Hill.

Pyzdek, T. (2003). The Six Sigma Handbook, McGraw-Hill.