The Roots of Six Sigma are Found in Total Quality Management

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ABSTRACT

Total Quality Management (TQM) has embedded itself in today's corporations. Through the years a number of new quality movements have evolved from the roots of TQM, including the latest methodology known as six sigma. Six sigma is founded in the principles of TQM and has grown from the many precursor quality movements. Capitalizing on the successes and building on the failures of previous quality initiatives, six sigma expands TQM to include statistical analyses that develop process maps with the necessary level of measurable detail to promote change.

INTRODUCTION

Beginning with Edward W. Deming's total quality management program (TQM) and following through to today's Six Sigma, quality improvement strategies are rooted in the same basic fundamentals. In fact, the evolution of six sigma as it exists today can be likened to a growing tree whose roots are deeply embedded in TQM (see Figure 1). It can be argued that, although its proponents, consultants, and trainers often promote it as a radically new approach to quality improvement, Six Sigma is actually a modified, strengthened, and more focused version of TQM. One could say that the roots of Six Sigma began with W. Edwards Deming and the TQM movement.

TQM: The First Stage of Quality Growth and the Roots of Six Sigma

Total Quality Management (TQM) is an umbrella term for company-wide quality improvement efforts. TQM came from the work of W. Edwards Deming and his direction in the rebuilding of Japanese production beginning in 1950 and lasting for three decades. Deming brought his approach of quality to the United States in 1980. TQM became a successful quality movement in the US during the 1980's, providing a foundation upon which virtually all quality movements

emerge. Its philosophies were built around the view that businesses are composed of processes that start with customer needs and end with highly satisfied customers using a product or service.
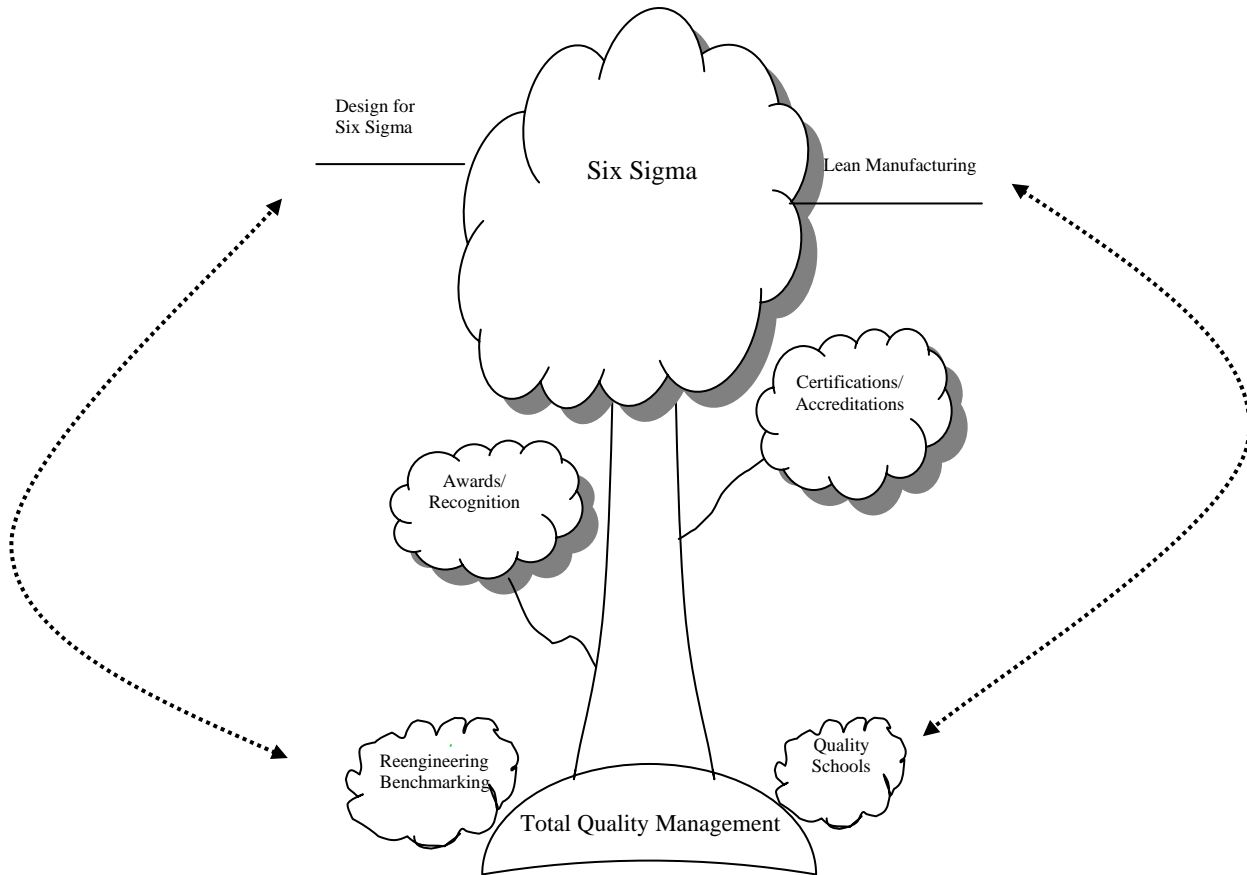

Figure 1: The Evolving Tree of Quality

Much of the Deming TQM philosophy and approach is captured in his fourteen points. Embedded in the fourteen points are the roots of several of the main tenets of Six Sigma. Both TQM and Six Sigma expect no less than total company involvement. In one of Deming's fourteen points, "adopt the new philosophy", Deming meant that if a company does not completely change its culture to total quality improvement, then the quality effort was doomed to failure. In another related point, "institute leadership", Deming reveals his belief that if top management is not totally committed to quality improvement in every way, it is a waste of time to adopt and practice TQM. He is famous for walking out of a high level meeting with Ford executives because the CEO did not attend, and Deming felt that by not attending, the CEO was demonstrating that he had not truly adopted the new philosophy nor had he instituted leadership. The Six Sigma movement, as demonstrated by its required heavy financial and time investment, expects no less from a company. That is, with Six Sigma, as with Deming, there is an expectation that the company will make whatever efforts are necessary to successfully

implement quality improvement. Such a total company effort permeates the company's culture from the CEO to the line worker.

With Six Sigma, there is a very significant requirement that Six Sigma training be taken by a high proportion of a company's employees as demonstrated by the "belt" system. Some workers spend weeks learning Six Sigma techniques/philosophies and become designated as "black belts".   Most other workers in a Six Sigma company attend at least minimal training and are designated as "yellow" or "green belts".   One of Deming's fourteen points was "Institute training" and another was "Institute a vigorous program of education and retraining". Deming believed that workers needed to know, understand, and be able to implement quality improvement ideas and tools. In addition, he felt that many "defects" were caused by workers who did not fully understand how to correctly "make" their product. Thus, a vigorous program of training and education would provide the worker with better skills and knowledge to produce their product and with a better understanding of how to implement and use total quality tools. Thus, Six Sigma's heavy reliance on training workers in continuous improvement techniques stems from its roots in TQM and Deming's fourteen points and in some ways is not a new concept.

Deming's last point of his fourteen points is "take action to accomplish the transformation". While the TQM movement seems to have drifted away from this original point, Deming was into defect investigation and root cause analysis. In a sense, Six Sigma's idea of applying the DMAIC (define, measure, analyze, improve, control) is just another way to operationalize Deming's root cause analysis. In Six Sigma, there is a strong structure to "dig down" and find out what are the causes of variation. There is a great emphasis on measurement in Six Sigma that is not foreign to the TQM movement. Remember, Deming's early work was in the area of control charts and measuring variability.

On the other hand, there are facets of Six Sigma that do not seemingly jive with TQM. Many of these came about as a result of the failure of TQM to meet the quality needs of companies as the quality movement grew and matured. What happened that rendered the early TQM efforts ineffective?

Side bushes: Quality Schools of Deming, Juran and Crosby and Company-Made Programs

While the quality movement began with Deming's TQM, as quality programs became popular, various companies and individuals began developing their own individualized quality programs. Two of Deming's contemporarties/followers, Joseph Juran and Philip Crosby, developed their own unique approach to TQM. Joseph Juran founded the Juran Institute in 1979 to "provide professional training and consulting services to continually improve the performance of our clients' processes, products, people and profits." (Juran Institute, 2004). In 1979, Philip Crosby initiated his version of TQM when he wrote the book *Quality Is Free.* Crosby established The Quality College where he trains executives on his philosophy known as the 'four absolutes of quality management' (Philip Crosby and Associates, 2004).   Deming even created his own institute, The W. Edwards Deming Institute, in 1993. The Institute, a nonprofit corporation, provides educational services such as conferences and seminars related to Deming's teachings. These 'schools' of quality were founded in the original tenets TQM to provide organizations

with both training and structure for deploying TQM, but they did not directly add to the growth of a "next generation" quality movement. In addition, to the institutes and movements associated with Juran, Crosby, and Deming, in the mid to late 1980s, companies began to develop their own in-house programs often being guided by consultants. There became a proliferation of quality programs most of which grew out of the Deming movement but many of which drifted away from some of his basic tenets. With TQM as the nutrients, these quality movements grew to become self-sustaining, but never developed into trees of their own. Figure 1 depicts these as bushes with their life support system tied into TQM.

Reengineering: Another Side Bush

While TQM was very successful at improving the quality of many processes, there were some processes that were so plagued by defects that continuous incremental quality improvement alone would not be enough to produce a quality product. That is, despite the best efforts of process improvement teams, some processes were so inefficient and defect-prone that they needed to be completely reworked or rethought. This opened the way for a movement called "reengineering". The reengineering quality methodology requires organizations to start with a "blank sheet of paper" and focus on where the company would like to be in the future without regard to where the company is now. It is, "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed" (Hammer and Champy, 1993). Reengineering's cross-functional improvement methodology is rooted in TQM. TQM encouraged cross-functional teams to work together to improve the process by breaking down departmental barriers. TQM focused outside of the company with the customer and required top-level leadership; just as reengineering does. In essence, reengineering evolved from TQM and serves the purpose of providing a process improvement methodology that requires (re)designing processes to meet customer expectations. Reengineering was most successful in companies that were in crises and/or on the verge of going out of business. However, while reengineering was the quality improvement program "of the day" for a few years, most companies did not relate to its radical approach of completely redefining their business and business processes. Thus, reengineering becomes another "bush" that grows out of the TQM roots but does not flourish into a full-grown movement (see Figure 1).

Side Branches: Recognition, Certification, and Accreditation Programs

With quality as the new buzz, organizations sought recognition for their efforts by striving to receive quality awards such as the Malcolm Baldrige award or by attempting to obtain quality certification or accreditation. Organizations sought such recognition because it was perceived to bring status and, presumably, customers. There was the potential of increased market share because its produced "quality" products or services, and through certification could be identified as a "quality" supplier.

Despite the predominance of quality awards, it was difficult for quality to be equated across industries. Thus, standards were developed to create homogeneous measurements and accreditation programs (which typically use predetermined standards) were formed to assure minimum levels of quality. Perhaps the best known certification program is The International

Organization for Standardization (ISO). ISO had been a leader in providing homogeneous measurements for industry-specific organizations. In 1987, ISO created ISO 9000 to provide generic management system standards that could be applied to any organization regardless of size or product. Although ISO 9000 standards focus on satisfying the customer's quality requirements, they do not make demands about the quality of a product. Thus, ISO 9000 spurred the growth of quality by making organizations pay attention to their measurement and documentation of quality; however, by itself, ISO 9000 did not provide a new quality methodology.

A well-known, healthcare specific accreditation program is the Joint Commission Accreditation of Healthcare Organizations (JCAHO). JCAHO is an independent, not-for-profit organization, that seeks to improve the safety and quality of care provides by healthcare organizations through accreditation. Healthcare organizations are evaluated based on how they perform on the JCAHO predetermined standards. Like ISO 9000 certification, JCAHO accreditation signifies a healthcare organization's commitment to follow a set of pre-determined standards.

The National Committee for Quality Assurance (NCQA) is another healthcare-specific certification program. Like ISO 9000 and JCAHO, the NCQA uses standardized, objective information to evaluate the quality of healthcare organizations including accreditation, specific performance measures (Health Plan Employer Data and Information Set, HEDIS), and customer satisfaction surveys (NCQA, 2004).

The quality award, certification, and accreditation programs have heightened the publics' awareness of quality and forced organizations to seek comparative, equitable measures. They are a direct offshoot of the TQM methodology; and thus, they are represented by branches on the evolving quality tree (Figure 1). Without TQM there would be little need for recognition or standard setting programs. Organizations that do not embrace the principles of TQM have no foundation for participation in recognition, certification, or accreditation programs. Organizations seeking these achievements have a fundamental TQM approach to quality. Some may embrace the teachings of Deming, others may look to Juran or Crosby, or their own self-adaptation of quality principles. Whatever the motivation and evolution, organizations seeking recognition, certification and/or accreditation have similar quality foundations. However, awards and certification efforts did not grow into new approaches to quality nor did they produce any new quality programs.

Six Sigma Springs Out of TQM Roots

The first significant new approach to quality improvement since TQM is Six Sigma. The roots of Six Sigma are set in TQM, and there are several common tenets between Six Sigma and TQM. However, Six Sigma, in part, developed in response to TQM inadequacies; and at the same time, Six Sigma introduced substantial new concepts and approaches. While TQM created "constancy of purpose" and promoted "improving constantly and forever" the product or service, Six Sigma establishes deliverable quality improvement in a specific time frame. One of the "failures" of TQM was that CEOs, whose compensation was being driven by the bottom line,

often could not identify measurable quality improvement in product or process over a given period of time other than the company was doing better with quality. Such company leaders wanted a return for their dollar and time investment in quality programs and often could not find it. It seemed that with TQM, quality improvement was open-ended and open-financed and was a never-ending effort with few identifiable results. In Six Sigma, doable quality improvement projects are identified and tackled. A timetable for deliverable improvement is set-up. Six Sigma projects run for only four to six months and are usually overseen by a full-time dedicated employee trained as a "black belt" along with a team of cross-functional employees. Quite often, the resulting quality improvement impact on the company is assigned a dollar figure with many Six Sigma projects claiming to save the company a half million dollars or more annually.

In order to add further structure to the quality improvement process, Six Sigma follows a procedure known by the acronym, DMAIC. This procedure guides the Six Sigma investigators through the specific steps of Define, Measure, Analyze, Improve, and Control. While TQM originally only specified such advice as "Adopt the new philosophy" and "Take action to accomplish the transformation", Six Sigma adherents carefully define a problem/opportunity and place particular emphasis on measurement. In order to find measurements that are meaningful in discovering variability, Six Sigma team members apply root-cause techniques – purposefully digging deeper than other quality improvement efforts that have gone on before. The Six Sigma team uses such measurements to analyze problems and thereby improve the process of product. These activities and actions are more focused and more specific than most TQM efforts.

In addition to these, the Six Sigma movement introduced a metric that can be used to generally locate where a process, product, or company is in its quality improvement effort as compared to others. The metric is the sigma level at which a company or its processes are currently operating under. Many companies have been operating at a sigma level of between 2.5 and 3.0 and want to improve. Companies operating at sigma levels of 4.0 and higher have greatly reduced the number of defects produced to quite low levels. Operating at a Six Sigma level for any company or process means that the company or process produces no more than 3.4 defects/million opportunities. The TQM movement had no way to quantify the level of quality that a company had attained. With Six Sigma, the sigma level can be used as a benchmark against which a company can compare its improvement.

Because it has been around for almost a decade and is being widely used around the world, Six Sigma is not a mere "branch" on the tree of quality programs but rather is a significant continuous growth extending the trunk of the tree and growing into new branches. It has built on the basic roots of TQM and has added significantly new features that focus quality efforts and make them accountable and measurable.

Beyond Six Sigma: New Growth

Where will the quality movement go and grow from here? Already, quality experts are discovering that because of Six Sigma limitations, there are opportunities for new quality programs to emerge and grow. Two of these are Design for Six Sigma (DFSS) and Lean Manufacturing.

DESIGN FOR SIX SIGMA

Companies using Six Sigma discovered that because many process and products were designed before the Six Sigma era, they contained so many flaws and problems that even by implemented deep-root analysis and working very hard at applying Six Sigma concepts, the process or product could only be improved so far without being completely redesigned. This has opened the door for a new movement called Design for Six Sigma.

Design for Six Sigma (DFSS) is a relatively new quality scheme that seeks to take effective Six Sigma companies to an even higher sigma level. History has shown that most companies can only achieve five sigma status with process improvement. In order to truly achieve six sigma status, most companies need to design for six sigma. That is, you can only improve an engine, a process, an operation so much until you run into the constraints or limitations based on the design of it. By designing it right the first time, much time and energy is saved from having to improve an inferior and limiting design.

The DFSS quality scheme is an off-shoot from six sigma. It does not add depth to six sigma, nor does it alter six sigma's underlying principles. Instead, DFSS is to Six Sigma much like reengineering was to TQM. It is a value-added quality approach that can assist organizations that are already at their peak using Six Sigma. DFSS allows successful six sigma organizations to perform at an even higher quality level, much like reengineering allowed successful TQM organizations to achieve sustainable results. Figure 1 depicts DFSS as a growth out of six sigma, yet tied to reengineering. Like reengineering, DFSS would not exist without six sigma.

LEAN MANUFACTURING

Lean manufacturing is another value-added off-shoot from Six Sigma. Lean manufacturing comes from the Toyota Production System which requires a disciplined attitude to seek out and eliminate all waste in every area of production including customer relations, product design, supplier networks and factory management.

(citation,). The ultimate goal of lean manufacturing is to produce quality products by cost by instilling the discipline to reduce cost, to generate capital, to make the money, to bring in more sales, and to remain competitive in a growing global market.   Many proponents of lean manufacturing are attracted to its notion of increasing production/operation speed and thereby reducing cycle time. Some advocates of lean manufacturing claim that even if an operation or process is operating as a six sigma level, it does not necessarily follow that the operation or process has gotten more lean. At this point, lean manufacturing is viewed as a necessary co-product of Six Sigma, with Six Sigma providing an effective quality system and lean manufacturing providing an efficient production process. In fact, there is a new movement being touted as 'Lean Six Sigma'.

CONCLUSIONS

TQM has provided companies with a foothold in quality. Rooted in its principles, other quality schemes have expanded TQM creating an evolutionary quality tree. The introduction of standards, documentation of functional processes, data orientation and passion about quality are all parts of the original tenets of TQM that have been expanded upon by later quality initiatives.

Six Sigma is the most powerful expansion of TQM because it introduces another level of customer focus and a formal methodology (DMAIC) to execute change across functions. It also engages management and leverages dedicated resources against the projects with the biggest strategic and financial impact. Six sigma achieves its results by expanding the original tools of TQM to include statistical analyses that develop process maps with the necessary level of measurable detail to promote change. The culmination of TQM, and its successor movements, coupled with the standard intense accreditation and recognition programs, has shaped this latest quality methodology known as six sigma. As with its precursor TQM, six sigma is also seeing successor methods and movements come alive. This is promising for today's organizations who are focused on quality. The plethora of methodologies and measurement tools affords organizations a unique opportunity to create their own brand of quality; one that is synergistic with their management style, industry demands and process capabilities.

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