

Continual Improvement Methods with TQM, Six Sigma, Lean

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Abstract— Purpose – During the last few decades, continual quality improvements methods, including total quality management (TQM), six sigma and lean, have been practised by many different organisations. Hence, the purpose of this paper is to describe the similarities and differences between the concepts, including an advantages and disadvantages of each concept and Continual Improvement Methods with TQM, Six Sigma, Lean.

Findings – While TQM, six sigma and lean have many similarities, especially in origin, methodologies, tools and effects, they vary in some areas, in particular regarding the main theory, approach and the main criticism. Six Sigma filled the vacuums created by these TQM failures in several ways. Beneath the Six Sigma methodology, quality improvement projects are attentively defined so that they can be successfully completed within a relatively short time frame. The lean concept is slightly different from TQM and six sigma. However, there is a lot to benefit if organizations are able to combine these three concepts, as they are interdependent.

Originality/value. The paper will also serve as a basis for further research in this area, concentrating on practical experience of these concepts.

Index Terms— Quality management, Six sigma, Total quality management, Lean production

I. INTRODUCTION

Continuously improving quality is a core goal of most of the organizations across the globe. Engaging in quality signifies that the organization is concerned about the value it brings to its customers, its employees, and its stakeholders. Over the years, most of the companies have adopted and implemented various quality methodologies and philosophies with some companies even developing their own quality-based initiatives. The Six Sigma improvement initiative has become extremely popular in the last several years. In addition to developing a great deal of discussion within statistical and quality circles, it has been one of the few technically determined Initiatives to generate significant interest from business leaders, the financial community, and the popular media.” (Hoerl, 2001). Six Sigma is a quality movement, a methodology, and a assessment .As a quality movement, Six Sigma is a major player in both manufacturing and service industries throughout the world. As a methodology, it is used to calculate the capability of a process to perform defect-free, where a defect is defined as everything that results in customer irritation. Six Sigma’s breakthrough strategy combines improved metrics and a new management philosophy to significantly reduce defects thereby

strengthening a firm’s market position and improving the profit line (Harry and Schroeder, 2000). It involves designing, improving, and controlling business activities to minimize or eliminate waste while optimizing customer satisfaction and increasing financial stability. Six Sigma is customer focused and has the potential to achieve exponential quality improvement through the reduction of variation in system processes.

The notion of Six Sigma is derived from previous quality schemes in which a process was considered to produce quality results if 99.74 percent of the product, service, or attributes were within specification ($\mu+3\sigma$). Six Sigma adherents seek exponentially higher quality results having as an ultimate goal of virtually all products, attributes, or services being with specification ($\mu+6\sigma$) thus producing less than 3.4 defects per million.

Lean manufacturing

Lean manufacturing comes from the Toyota Production System which requires a disciplined attitude to seek out and eliminate all waste in every area of a process including customer relations, supplier networks and organization management. The ultimate goal of lean manufacturing is to produce quality outcomes by instilling the discipline to reduce cost, to generate capital, to make the money, to bring in more customers, and to remain competitive in a growing global market. Proponents of lean manufacturing claim it evaluates the entire organization and restructures the processes to reduce wasteful activities. “It re-locates the processes in consecutive order and, in so doing, reduces variation..” Some advocates of lean manufacturing claim that even if a process or service is operating as a Six Sigma level, it does not necessarily follow that the process or service has gotten lean. At this point, lean manufacturing is viewed as a necessary co-product of Six Sigma, with Six Sigma investigating and resolving variation from lean manufacturing’s efficient processes. In fact, because some companies combine the two methodologies, there is a new movement being publicised as “Lean Six Sigma”.

Total quality management (TQM)

Quality has been an important issue for organisations for many years. The early focal point on quality evolved from inspection to quality control and later to quality assurance. Different definitions of TQM have been presented over the years.

Dahlgaard et al. (1998) view TQM as:

... a corporate culture characterised by increased customer satisfaction through continuous development, in which all employees in the firm actively participate.

Shiba et al. (1993), on the other hand, argue that:

TQM is an evolving system of practices, tools, and coaching methods for managing companies to provide customer satisfaction in a speedily changing world.

Klefsjo" (2000) support the view that TQM is an evolving system. Klefsjo" (2000) define TQM:

... as a continuously evolving management system consisting of values, methodologies and tools, the intention of which is to increase external and internal customer satisfaction with a reduced amount of resources.

Misunderstanding is concerned with the key success criteria of six sigma quality. It seems as if most training programs on six sigma quality, which typically are planned as a number of 3-5 days modules, focus only (or mainly) on training in various tools and techniques and almost ignore the human factor, i.e. how to build up a company culture characterized by commitment for continuous improvements and everybody's involvement. This paper has two purposes. The first purpose is to present the main concepts behind lean production and to relate the discussion to "six sigma quality" and "TQM". The second purpose is to target on some of the latest findings on how to explain human commitment. In the last sections of the paper, we will reflect on these findings and shortly discuss the implications of these findings in relation to building a company culture, which supports the implementation of TQM, and hence the implementation of lean production and six sigma quality.

II. VARIOUS QUALITY MANAGEMENT CONCEPTS

Six Sigma

Six-Sigma is a now widely applied programmed for companywide quality improvement. It was developed by Motorola, in the 1980s, but gained enormous energy, after its adoption by General Electric, in the mid 1990s. Several variants of the approach are current but all variants can be characterized by the programme's customer driven approach, by its attention on decision-making based on quantitative data, and by its priority on bottom line results. One of the Methodologies such as Six-Sigma's consist of four classes of elements which are listed and discussed below:

(1) *Business context.* At the background of the Six-Sigma programme is a philosophy that presents a business strategy. This philosophy provides the motivation for implementing the programme by specifying which benefits it is claimed to have, and – of more essential to us – the type of objectives that can be pursued with the methodology. Elements of the business situation of Six-Sigma are the latent factory model and cost of poor quality models.

(2) *Stepwise strategy.* The Breakthrough Cookbook gives a stepwise procedure for tackling projects. Harry (1997), for example, proposes 12 steps that are grouped in four phases. Steps define end terms (the deliverable of the step) and mostly prescribe in which format they should be documented. For example, the end term of Harry's step 4 is that the

process's performance is estimated; this result should be reported in the form of a capability index Z.

(3) *Tools and techniques.* The Six-Sigma programme offers a wide range of procedures that are intended to assist the project leader in attaining intermediate results. Some of these tools and techniques are linked to particular steps of the strategy (e.g., the gauge R&R technique proposed for Harry's step 3, "Validate measurement system"), other are more general (e.g. statistical estimation). Some tools and techniques are statistical, other are Non statistical.

(4) *Concepts and classifications.* In order to convey the elements above, the Six-Sigma programme offers concepts (such as the hidden factory and CTQ) and classifications (the phases Measure, Analyse, Improve, Control; the difference between vital Xs and trivial Xs).

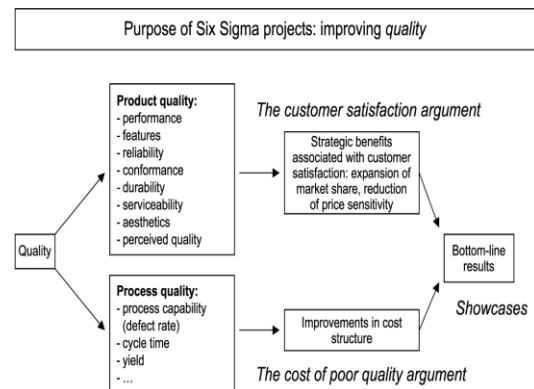


Figure 1. Rational reconstruction of Six Sigma's Business context

Lean

Among the several quality management concepts that have been developed, the lean concept, as in lean manufacturing, lean production, etc. is one of the more wide-spread and successful attempts. Briefly, lean is about controlling the assets in accordance with the customers' needs and to reduce unnecessary waste (including the waste of time). The concept was introduced at a larger scale by Toyota in the 1950s, but not labelled lean manufacturing until the now famous book about the automobile appeared in 1990 (Womack et al., 1990). Thus, the definition of NIST is relevant: A systematic approach to identifying and eliminating waste through regular improvement, flowing the product at the pull of the customer in pursuit of perfection.

Methodologies and tools

Lean principles are fundamentally customer value driven, which makes them relevant for many manufacturing and distribution positions. Five basic principles of lean manufacturing are generally acknowledged:

(1) *Understanding customer value.* Only what the customers feel as value is important.

(2) *Value stream analysis.* Having understood the value for the customers, the next step is to evaluate the business processes to determine which ones actually add value. If an activity does not add value, it should be altered or wiped out from the process.

3) *Flow*. Focus on organizing a continuous flow through the production or supply chain rather than moving commodities in large batches.

(4) *Pull*. Demand chain management prevents from producing goods to stock, i.e. customer demand pulls finished products through the system. No work is toted out unless the result of it is required downstream.

(5) *Perfection*. The elimination of non-value-adding elements (waste) is a process of continuous improvement. "There is no end to lessening time, cost, space, mistakes, and attempt"

Lean principles do not always apply, however when customer demand is uncertain and unreliable. The main elements assigning to the elimination of non-value-added activities are following: excess production, excess processing, delays, transport, inventory, defects and movement. A variety of approaches are available for reducing or eliminating waste. These approaches include value stream analysis, total productive maintenance, Kaizen costing and cost analysis, engineering and change management, and document management.

TQM

TQM is a company culture characterized by increased customer satisfaction through continuous improvements, in which all employees actively participate. By comparing this definition of TQM with the ultimate objectives of the lean producers as described above it is obvious that there do not seem to be any contradictions between the two objectives. This is not a coincidence because the roots of TQM can be traced back to the Japanese quality evolution, where Toyota was one of the pioneering companies. Toyota practiced the philosophy and principles of TQC so early as in the last part of the 1950s. The Japanese version of TQC became later on in the last part of the 1980s the main reference when the term TQM was born.

III. SIMILARITIES AND DIFFERENCES

In this section, some similarities and differences between TQM, six sigma and lean are presented. The overall similarities and differences between the concepts, regarding origin, theory, process view, approach, methodologies, tools, effects and criticism, are also presented in Table I.

IV. PROCESS VIEW AND APPROACH

The improvement projects in a six sigma programmed are conducted in a wide range of areas and at different levels of complexity in order to reduce variation. When the project members have reduced the variation in a process, and hence achieved the business goals, increased the profit or lowered the cost, this improvement is visualized to the top managers at the company. Often some of the top managers are also involved in the performed improvement projects. As a result, the six sigma programmed receives necessary support from the top managers at the company, as the managers recognize the economical impact of it. This could be one explanation for the documented successes of six sigma compared with TQM, i.e. six sigma programmers talk the top managers' language (the economical gains of the improvement). Lean, on the other hand, is a discipline that focuses on process

speed and efficiency, or the flow, in order to increase the customer value. In lean manufacturing, project groups are usually the approach to perform the necessary improvements. While six sigma and lean focus on performing improvements mainly through projects, TQM has sometimes a different approach. TQM emphasizes the commitment and involvement of all employees. In TQM, there is also, like six sigma and lean, a strong focus on processes. It is the authors' opinion that the main objectives of the process work within TQM are to alternatively improve and uniform the processes.

V. METHODOLOGIES

The improvement cycle is composed of four stages: PDSA. In six sigma there are two major improvement methodologies, one for already existing processes and one for new processes, see above. The lean principles could in this context be regarded as a methodology. The principles of lean are: understanding customer value, value stream, analysis, flow, pull and perfection. There are many similarities between the improvement cycle in TQM and the methodologies of six sigma; i.e. the methodologies are cyclical and consist of similar phases. One could argue that the methodologies in six sigma are a further development of the improvement cycle, which first was developed by Deming. The lean principles are different compared to the methodologies in TQM and six sigma, as they are not cyclical in nature and are not focused on how to perform improvements. Tools in six sigma, lean and TQM, there are many different tools that could be used in order to find out what is wrong with the system. TQM normally consists of tools that have either a statistical or an analytical base. Among others, the seven quality control tools and the seven management tools are frequently applied in TQM. In general, six sigma programmers have been successful at integrating advanced improvement tools with the methodologies. The tools range from design tools to management tools and from very simple tools to more advanced statistical tools. During the training programmes in six sigma, one learns how to choose the most appropriate tool and how it should be applied. In addition, one must verify the selection in order to assure that the appropriate tool was chosen. In general, six sigma programmers have successfully emphasized the statistical part in quality management. In lean, a variety of tools is available for reducing or eliminating waste sees above. In summary, the tools in the lean concept are more analytical in nature compared to the more statistical tools used in TQM and six sigma.

VI. CONCLUSION

The purpose of this paper is to describe similarities and differences between TQM, six sigma and lean. With parallels to the fable described above, one could argue that the blind men's visions about the whole are very similar; the three presented concepts have many similarities, especially concerning origin, methodologies, tools and effects. However, the blind men's vision about the whole also differs slightly in some areas; especially concerning the main theory, approach and the main criticism. Comparing the different quality management concepts, TQM and six sigma

shows many similarities, while the lean concept is slightly different compared to the previous two. However, it is the authors' recommendation that there is a lot to gain if organizations are able to combine these three concepts. Indeed, the concepts are interdependent; especially six sigma and lean are excellent road-maps, which could be used one by one or combined, in order to strengthen the values of TQM within an organization. Even if some of the presented concepts have been accused for being management fads, see above, it is the authors' opinion that organizations continuously need to work with customer-orientated activities in order to survive; irrespective of how these activities are labeled today and in the future.

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