

Study of Various Quality Processes and Company Culture

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Abstract— Purpose – The authors analyze the principles and results of lean production and compare the lean production philosophy with the six sigma quality process and the principles of total quality management (TQM). At the end of the paper, it is explained how to build the necessary company culture for having success with these principles/management philosophies. **Findings –** It is shown that the lean production philosophy and the six sigma steps are essentially the same and both have developed from the same root – the Japanese TQM practices. The advancement process from six sigma, the DMAIC process, can be observed as a short version of the Quality Story, which was advanced in Japan in the 1960s as a standard for QC-circle presentations. We conclude that the reference book of lean production and six sigma quality are examples of new alternative TQM field guides. We also wind up that especially with lean production and six sigma quality there seems to be too much focus on training people in tools and techniques and at the same time too little focus on understanding the human factor, i.e. how to build the right company perception. **Originality/value –** The detailed and classical analysis of six sigma quality, lean production and TQM combined with a focus on the human factor and the needed corporate culture.

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

I. INTRODUCTION

There is a widespread confusion and misunderstanding of what is “lean production”.

Is it just an old “fad” which can be ignored like most other fads or should companies, begin to understand what it is? The same confusion may also be related to the “new” old fad – “six sigma quality” and its relation to total quality management (TQM) . What are the differences and similarities between lean production, the six sigma quality process and TQM? There seems to be a need to analyze these popular and often misunderstood concepts together and to relate them to the relatively well-established management philosophy TQM. Six Sigma can be defined as a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimise waste and resources while increasing customer satisfaction by some of its proponents. Lean can be defined as a systematic approach to identifying and eliminating waste through continuous improvement, running the product at the pull of the customer in pursuit of perfection. TQM is sometimes defined: . . as a continuously evolving management system subsisting of values, methodologies and tools, the aim of which is to increase

external and internal customer satisfaction with a reduced amount of resources. Another widespread confusion and 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. LEAN PRODUCTION SIX SIGMA AND TQM

The origin of lean production is Japan

Lean production or lean thinking (Womack et al., 1990; Womack and Jones, 1996) has its origin in the philosophy of achieving improvements in most economical ways with special focus on reducing muda (waste). Among the several quality management concepts that have been developed, the lean concept, as in lean assembling, 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). While there are many formal definitions of the lean concept, it is generally understood to represent a systematic approach to identifying and eliminating elements not adding value to the process. Importances of this are striving for perfection and a customer-driven pull of the process. Thus, the definition of NIST is relevant: A systematic approach to identifying and eliminating waste through repeated improvement, flowing the product at the pull of the customer in pursuit of accomplishment (NIST,2000).

Methodologies and tools. Lean principles are fundamentally customer value driven, which makes them suitable for many manufacturing and circulation situations. 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 organising a continuous flow through the production or supply chain rather than moving products in large batches.
- (4) *Pull.* Demand chain management prevents from producing commodities to stock, i.e. customer demand pulls finished products through the system.
- (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" We know today that the Toyota Production System became so competitive that Toyota and other Japanese car manufacturers gradually increased their market shares all over the world. But it is important to remember that the so-called Toyota Production System was not a traditional quality assurance system as, e.g. an ISO9000-based quality system. It was first of all a human-based system where people were involved with continuous improvements, and the foundation for the system was leadership and empowerment through education and training.

Lean production, quality management and waste

In our further analysis of the relationship between TQM and lean production we will use the following definition of 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 accordance 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.

Total quality management (TQM)

Quality has been an important issue for organisations for many years. The early attention on quality evolved from inspection to quality control and later to quality assertion, according to Dale (1999). During the 1990s, TQM evolved as a common term among organisations. Different definitions of TQM have been granted over the years. Dahlgaard et al. (1998) view TQM as: . . . a corporate culture characterised by increased customer satisfaction through continuous improvement, in which all employees in the firm actively participate.

Shiba et al. (1993), on the other hand, present support that: TQM is an evolving system of practices, tools, and preparing methods for managing companies to provide customer satisfaction in a speedily changing world.

Hellsten and Klefsjö (2000) support the view that TQM is an evolving system. Hellsten and Klefsjö (2000) define TQM:

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

In the book *Lean Thinking*, the very first word is interestingly the Japanese word for waste (*muda*), and it is decided that *muda* is everywhere. This is a very important observation not only in relation to lean production but also to TQM.

By defining waste as the excess resources used compared with perfection we can say that the aim or objective of lean production is to eliminate waste. What then constitutes waste? In order to be able to work with a generic definition we suggest the following definition of waste:

Waste is everything that increases cost without adding value for the customer.

Juran (1951), who was one of the experts on quality control invited to Japan in 1954, was may be the first to deal with the different forms of waste. Since, then identification and reduction of waste has become one of the core activities of quality management. Juran (1951) called wastage for "the gold in the mine" or "quality costs" and later on (Juran, 1989) he called it "the cost of poor quality (COPQ)". In relation to waste and lean production it is interesting to compare Juran's definition from 1951 to his 1989 definition:

- (1) *1951. Quality costs* – the costs which would disappear if no defects were produced.
- (2) *1989. The COPQ* – is the sum of all costs that would disappear if there were no quality problems.

Comparing these two definitions we should understand that in 1951 quality control was regarded as a narrow engineering discipline and the main activities were focused on defects in production. In 1988, quality control had developed into a holistic management philosophy called TQM, which was not only dealing with production but also all other processes in the company and all types of industries including services of any kind.

The principles of lean production and Motorola's "six steps to six sigma"

The following five principles for reducing waste and building lean enterprises were given by Womack and Jones (1996, p. 10) after about 6 years of thinking following the publication of the book *The Machine that Changed the World* in 1990:

- (1) specify value by specific product;
- (2) determine the value stream for each product;
- (3) make the value flow without delays;
- (4) let the customer pull value from the maker; and
- (5) pursue perfection.

Motorola was the first company to launch a six sigma programme in the mid-1980s (Rancour and McCracken, 2000). In 1988, Motorola received the Malcolm Baldrige National Quality Award, which led to an enlarged interest of

six sigma in other organisations. Today, a number of global organisations have developed six sigma programmes of their own and six sigma is now established in almost every industry.

Six sigma is defined as a business process that allows companies to drastically improve their bottom line by conspiring and controlling everyday business activities in ways that minimise waste and resources while increasing customer satisfaction by some of its proponents, see Magnusson et al. (2003).

Six sigma could also be described as an improvement programme for reducing variation, which focuses on continuous and findings improvements. Improvement projects are directed in a wide range of areas and at different levels of complexity, in order to reduce variation. The main purpose of reducing variation on a product or a service is to satisfy customers. The target of six sigma is that only 3.4 of a million customers should be unhappy, see Magnusson et al. (2003).

Methodologies and tools

Henderson and Evans (2000) claim that the dominant components for a successful six sigma application are management involvement, Organization, infrastructure, training and statistical tools. Eckes (2001) also points out the importance of having an infrastructure before starting an improvement programmed, like six sigma, and further claims that “successful organizations use a model for upgrade” rather than working adhoc without a model.

There are two major improvement methodologies in six sigma, one for already existing processes and one for new processes. The first methodology used to improve an existing process can be divided into five phases, see Pyzdek (2003) and Magnusson et al. (2003). These are:

- (1) *Define*. Define which process or product that needs advancement. Define the most suitable team members to work with the advancement. Define the customers of the process, their needs and necessities, and create a map of the process that should be improved.
- (2) *Measure*. Identify the key factors that have the most influence on the process, and decide upon how to amount them.
- (3) *Analyse*. Investigate the factors that need improvements.
- (4) *Improve*. Design and implement the most effective solution. Cost-benefit analyses should be used to identify the best solution.
- (5) *Control*. Verify if the implementation was successful and ensure that the improvement sustains over time.

The second methodology is often used when the existing processes do not satisfy the customers or are not able to achieve strategic business objectives, see Eckes (2001). This methodology can also be divided into five phases; define measure, analyze, design, verify, according to Magnusson et al. (2003). In summary, the two

Different methodologies have obvious similarities.

III. THE ROADMAP OF TQM, LEAN PRODUCTION AND SIX SIGMA QUALITY

From the previous analysis, we conclude that both lean production and six sigma quality comprise management and manufacturing philosophies and concepts, which have the same origin as the management philosophy called TQM – namely Japan’s quality evolution. We also conclude that the principles, concepts and tools of lean production and six sigma quality should not be seen as alternatives to TQM but rather as a collection of concepts and tools, which support the overall principles and aims of TQM.

But we also conclude that this collection of concepts and tools is something more. Both lean production and six sigma quality recommend simple and clear roadmaps to follow for companies which have decided to embark on a quality journey to TQM and world-class quality. But, as our analysis has shown, we may hesitate to call these roadmaps for totally new roadmaps because we can find previous roadmaps in the quality literature which cover the same or almost the same steps.

But we also argue that other simple roadmaps developed, for example, within TQM, such as Motorola’s six steps to six sigma, have shown the same impressive results (Voehl, 2000). In fact as said above, our literature studies have shown us that the origin of the principles/concepts of both lean production and six sigma quality are the same – namely Japan. Both lean production and six sigma quality are results of the quality evolution process in Japan, where the Japanese companies from 1950 and onwards gradually moved through the following four stages (Dahlgaard-Park, 2000):

- (1) Awareness of the need to learn about quality control and improvement methods (1945).
- (2) Importing, adopting and learning about quality control and improvement methods through systematic education and training (1950).
- (3) Digesting, implementation, Japanisation, internalisation, people involvement/participation.
- (4) Mastery (company wide quality control), world-leader of quality (1975).

IV. THE CORPORATE CULTURE TO PRACTICE LEAN PRODUCTION AND SIX SIGMA

There are many definitions on TQM. In the definition we emphasised that:

TQM is a corporate culture characterized by increased customer satisfaction through continuous improvements, in which all employees actively participate.

Besides being a corporate culture we also emphasised above that TQM is a management philosophy. The aim of this management philosophy is to change corporate cultures from a passive and defensive culture to a pro-active and open culture where the basic TQM principles increased customer satisfaction, continuous improvement and everybody’s participation are applied everywhere in the organisation. To have success with such a change process the fourth TQM principle – leadership – must also be applied (Dahlgaard et al., 1998a). This is exactly the same pre-condition for having success with the five principles of lean production and/or the six sigma improvement processes.

The essence of TQM, lean production and six sigma quality may be boiled down to Leadership, efficient CFM, empowerment and partnerships. For example, the flow and pull principles of lean production cannot function without efficient CFM, but this is not enough to have success with TQM, lean production and six sigma quality. Empowerment and partnerships are the foundation on which TQM and its related principles, concepts and techniques have to be built. The pre condition for building an excellent enterprise is empowerment. More and more traditional management activities must gradually be delegated to ordinary employees together with the necessary authority and capability (education and training) to plan, check and improve these activities (eliminate waste) to the benefit of themselves and the company. The employees must be given both the freedom to plan and to decide, and the capability to take over this responsibility.

Partnerships are needed in all internal customer-supplier relations, in all external supplier relations, in external customer relations and between managers and their subordinates. The clue is to build a total system of customer-supplier relations, which are working close together in their own interest for reducing waste. This requires a lot of the managers. They need what the man, who taught the Japanese about quality – Deming (1900-1993) – called “profound knowledge” (Deming, 1993):-appreciation for a system;

-knowledge about variation;

-theory of knowledge; and

-psychology.

To have success with flow and pull there is especially a need to have profound knowledge about systems and psychology. The first is needed in order to understand that optimisation of a production system can never be achieved if the components of the system – the departments and all other customer/supplier components – are trying to sub-optimize with conflicting aims. The latter is needed in order to be able to build efficient win-win partnerships, which can survive in the long run. A pre-condition for building such partnerships is that they are built eternal core values (CV) such as genuine trust and respect. To have success with TQM, six sigma quality and lean production requires a company culture where everybody is proactively working in reducing waste and in helping each partner (internal and/or external partners). Everybody understands that his/her contribution is essential for the team in which he/she is a member and for the customer. If she is not there – physically as well as mentally – there is a risk that the work will not be done as efficiently as possible. The success of the system depends on everybody’s participation (one of the core principles or TQM). This requires leadership for organisational excellence! But what is organisational excellence?

V. SOME CORE AIMS AND ELEMENTS OF A QUALITY STRATEGY

Relating our discussion in the previous paragraphs to the challenge of designing a quality strategy, which focus on building a company culture, which support lean production, six sigma quality and TQM, we conclude the following:

The first aim of a quality strategy is to build quality into people through strengthening of both CV and CC. The quality strategy should always be implemented both through a top-down and a bottom-up strategy. The strategy should follow the policy deployment approach which has both the top-down and the bottom-up strategy included. Such an approach provides a frame for building quality into the following three levels:

- (1) individual level;
- (2) team level; and
- (3) organisational level.

VI. CONCLUSIONS

In the paper, we have tried to clear up some confusion, which has been relatively common in the business community as well as in academics, on what are the essentials of lean production, six sigma quality and TQM, what are the similarities and what are the differences, if any. It has been shown that the lean production philosophy and the six sigma steps are essentially the same, and both have developed from the same root – the Japanese TQM practices (company wide quality control).

During the 1990s, a lot of criticism has come up on TQM, its principles and related theories or lack of theoretical support. It is our intention with this paper not to contribute to this discussion, but to contribute with examples and analyses showing that TQM is not a static management philosophy. TQM is the result of an evolution starting in Japan about 50 years ago, where continuous improvement gradually became the most important management principle. Because of this important principle we can conclude that TQM is a management philosophy the contents of which continuously have to change when new theories and results show that there are better roadmaps to follow than previously known roadmaps. The roadmaps of lean production and six sigma quality are examples of such new roadmaps, which should only be regarded as alternative new roadmaps to follow when companies have implemented TQM or are in the process of implementing the TQM principles, tools and techniques.

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