

A Study on Total Quality Management and Lean Manufacturing: Through Lean Thinking Approach

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Abstract: Lean Manufacturing arose from the Toyota Production System. The variants of Lean Manufacturing, such as TQM, were originally founded in the Japanese automotive industry, but their evolution was mostly carried out in the West. The aim of this paper is to produce a comparative study between Total Quality Management and Lean Manufacturing with an emphasis on the Lean Thinking approach. The paper systematically categorizes the related literature of various studies, analyzes the literature and finally reviews it methodologically. The results of this research reveal that Total Quality Management and Lean Manufacturing have much in common. Based on Lean strategies, Total Quality Management, similar to numerous improvement approaches, can be a tool to support and create synergy for inducing a more competitive market among companies.

Key words: Lean Manufacturing • Lean Thinking • Total Quality Management

INTRODUCTION

Different management theories have been presented over the years, some of which could be argued to be management fads and they have been criticized for having four major defects (Carson *et al.*, 1999). Total quality management (TQM) and Lean Manufacturing (LM) are two management approaches to optimization, but there are various ideas and views of them. Are they the same or not?

TQM is “The management of quality at every stage of operations, from planning and design through self-inspection, to continual process monitoring for improvement opportunities” [1]. However, different definitions of TQM have been presented over the years. Boaden [2] claims that: “attempting to define TQM is like shooting at a moving target”. Some argue that TQM is a corporate culture characterized by increased customer satisfaction through continuous improvement, in which all employees in the companies participate actively. Dale [3] claims that TQM is both a philosophy and a set of guiding principles for managing an organization. TQM focuses on control of business processes and customer satisfaction. Activities such as improvement, statistical control, supply control and quality engineering are

ingredients of TQM. TQM as a concept emanates from the academic field and has contributors such as Feigenbaum, Juran and Deming.

LM, or Lean Production (LP) which is often known simply as ‘Lean’, is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful and thus a target for elimination; basically, more value with less work. LM is a generic process management philosophy derived originally from the Toyota Production System (TPS) [4]. The term ‘Lean’ was probably coined by Womack *et al.* [5] in their book ‘The Machine that Changed the World’. Some authors’ state that a definition of Lean includes both the people and the process components on the one hand and internal (related to the firm) and external (related to supplier and customer) components on the other hand. In this sense, Shah and Ward’s [6] definition of LP highlights mechanisms needed to achieve the central objective of waste elimination.

So, LM is the production of goods using less of everything. In using LM with your company, the goals would be to use less waste, less human effort, less manufacturing space, less investment in tools and less engineering to develop a new product. LM is renowned for its focus on the reduction of waste, which in turn

improves overall customer value. There are however some key perspectives to implement with it. TQM has Kaizen as a tool for continuous work; this is visualized by the Deming's wheel. Statistical control is a powerful tool to gain control of manufacturing defects and it correlates to measurement. Further, there are many concepts of TPS found in TQM, such as Kaizen and Process Mapping [7]. As a result, LM is a manufacturing philosophy that shortens the time between the customer order and the product build/shipment by eliminating sources of waste.

This study asks whether Lean differs from other improvement methods (TQM) and two of the differences are particularly noteworthy. First, Lean focuses on improving entire value streams, whereas most of the other improvement methods tend to focus on individual processes. The second important difference is that most process improvement methods tend to focus on improving the productivity or efficiency of major value-adding processes, whereas Lean emphasizes reducing or eliminating non-value-adding activities (waste).

The rest of this paper is structured as follows. In the next section, an overview and background of TQM is presented. In section 3 an overview of the concepts of lean, lean thinking approach and leanness is given. Section 4 will focus on similarities and differences between LM and TQM. Then, there were compared based on "basic assumption", "change principles" and "interventions". Discussions and conclusion are drawn from the study in section 5.

Total Quality Management

Definition and Concepts of TQM: A variety of definitions of TQM have been offered over the years. Reviewing previous contributions [8, 9] a dominant insight among experts seems to define TQM as an approach to management characterized by some guiding principles or core concepts that embody the way the organization is expected to operate, which, when effectively linked together, will lead to high performance. Although there are some differences of opinion, there is a general agreement regarding the assumptions included in the TQM concept that can be summarized in three main points [10].

Firstly, the core concepts of TQM can be classified into two broad categories or dimensions: social or soft TQM and technical or hard TQM [11-14]. The social issues are centered on human resource management and emphasize leadership, teamwork, training and employee involvement. The technical issues reflect an orientation toward improving production methods and operations

and seek to establish a working method through the establishment of well-defined processes and procedures to make possible the constant improvement of goods and services to customers [10].

Secondly, the management of social or technical TQM issues cannot be performed in isolation. Social and technical dimensions (and the core concepts that form them) should be interrelated and mutually support one other [15, 16] reflecting the holistic character of TQM initiatives. This holistic character is also extended to the expected results of a TQM initiative because a balance of the stakeholders' interests should be considered when the firm defines TQM practices [17].

Thirdly, the literature suggests that the optimal management of TQM core concepts will lead to better organizational performance, as studies such as Kaynak (2003) have verified. The basic theoretical foundation for this relationship is based on the assumption that TQM provides superior value to the customer by identifying customers' expressed and latent needs, responsiveness to changing markets, as well as through improving the efficiency of the processes that produce the product or service [18, 19].

Therefore, TQM includes both an empirical component associated with statistics and an explanatory component that is associated with management, of both people and processes. The terms 'hard' and 'soft' are commonly used to represent these two components. TQM brought recognition to the fact that tasks can be categorized as value adding or not. The obvious corollary is that non-value adding tasks would be eliminated and the value adding ones improved. Many process design and operation tools have been highlighted in TQM, such as statistical process control, Kanban and flexible organization. Different definitions and views of TQM are as following:

TQM is an integrated management philosophy and set of practices that emphasize continuous improvement, meeting customer requirements, reducing rework, long-range thinking, increased employee involvement and teamwork, process redesign, competitive benchmarking, team-based problem solving, constant measurement of results and closer relationships with suppliers [20]. TQM is a philosophy or an approach to management that can be characterized by its principles, practices and techniques. Its three principles are customer focus, continuous improvement and teamwork [21]. Common guiding TQM precepts can be conceptually distinguished into three clusters (a) focusing on customer satisfaction (b) stressing continuous improvement and (c) treating the

organization as a total system [22]. TQM is an approach to improving the quality of goods and services through continuous improvement of all processes, customer driven quality, production without defects, focus on improvement of processes rather than criticism of people and data-driven decision making [15].

Methodologies and Tools: Hellsten and Klefsjö [23] argue that methodologies are “ways to work within the organisation to reach the values”. A methodology, according to Hellsten and Klefsjö [23] “consists of a number of activities performed in a certain way”. They define tools as: “rather concrete and well-defined tools, which sometimes have a statistical basis, to support decision-making or facilitate analysis of data”. Tools that are frequently mentioned in the TQM literature include the seven quality control tools, see Shewhart [24] and Ishikawa [25] and the seven management tools, see Mizuno [26]. The improvement cycle is also a common methodology used in order to improve the business, according to Evans and Lindsay [27]. The improvement cycle is composed of four stages: plan, do, study and act (PDSA).

Therefore, Quality management can be described: 1) As a management revolution, a revolutionary philosophy of management, a new way of thinking about the management of organizations, a paradigm shift, a comprehensive way to improve total organizational performance, an alternative to management by control or as a framework for competitive management [28]. 2) As a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction by some of its proponents [29].

In the end, an interesting part of the TQM concept is that quality awards are offered by different foundations such as Deming Prize, European Foundation of Quality Management (EFQM), Malcolm Baldrige and so on. The concept of TQM can give competence, so benchmarking could be used to accomplish this. TQM is an extensive method and requires specialist or consultant help that can implement [7].

Criticism of TQM: The failures of TQM implementation have been well documented: Brown *et al.* [28, 30-33]. In more detail, Harari [31] states that, after studying all the independent research conducted by consulting firms, the conclusion is that only about one-fifth, or at best one-third, of the TQM programs in the USA and Europe have

achieved significant or even tangible improvements in quality, productivity, competitiveness or financial results. As shown above and described in Boaden [2] and Hellsten and Klefsjö [23], opinions differ about what TQM really is. As it is more widely practised and other initiatives emerge, the emphasis on different aspects will change.

Moreover, Van Der Wiele *et al.* [34] discuss whether TQM is a fad, fashion, or fit. A fit of TQM into normal management practice means that the original fad will have affected the normal way of working within the whole organization and not just a small part, such as would be the case in the adoption of a mere fashion. The fieldwork from van der Wiele *et al.* [34] shows that a change to a fit of TQM to other management theories will only occur when there is a strong internal motivation for and emotional involvement in, the implementation of TQM.

Lean Manufacturing

What is LM?: There are many different definitions and perspectives of LM, depending upon the industry, the source, how long the organization has been learning about Lean and what that organization's real objectives are for adopting Lean. The following is a definition from MIT's International Motor Vehicles Program (IMVP):

LP (a term coined by IMVP researcher John Krafcik) is ‘Lean’ because it uses less of everything when compared to mass production – half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time [5]. Also, it requires keeping far less than half the needed inventory on site, results in many fewer defects and produces a greater and ever growing variety of productions.

LM refers to an evolving dynamic new process of production covering the total enterprise, embracing all aspects of industrial operations (product development, manufacturing, organization and human resources, customer support) and including customer-supplier networks, which is governed by a systemic set of principles, methods and practices. Key Lean principles are perfect first-time quality, waste minimization by removing all activities that do not add value, continuous improvement, flexibility and long-term relationships.

LP is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer and internal variability [6]. LP can be considered to be an essential element of all the main improvement approaches with the theme of eliminating seven types of Muda (waste: excess production, waiting, conveyance, motion, the process

itself, inventory and effects). The ultimate goal is to manufacture products after an order is made, however, many products do have a production lead-time that is too lengthy to be acceptable to customers. A first approach to improvement with LP is leveling of flow, from tact production to customer need [7].

The key issues of Lean can be considered as [4]: 1) Value – The starting point for Lean Thinking (LT) is ‘value’ as defined by the end customer. It is providing the customer with the right product/service, for the right price at the right time. 2) Value Stream –The set of actions from a product/service concept to realization, order to delivery and so on. 3) Flow – Seamless movement through a series of value-creating steps. 4) Pull – Acting only to satisfy customer needs. 5) Perfection – continuously improving the value, value stream, flow and pull in business operation. Organization resistance is hard to tackle with Lean because this concept is a very extensive method to use for improvement. Implementation support is lesser with Lean because in many cases it merely describes desired results, not how to acquire them [7].

The main concern of LM design is to eliminate waste. The main desire is to reduce the production cycle and this would be accomplished by the elimination of waste. Lean also has a focus on retaining tasks that add value and eliminating non-value adding tasks. Other concepts having to do with time and waste are important to LM. LM is normally driven by customer demand. This brings up the point about what the driver of a business process should be. The two concepts are push and pull. Most concepts of Lean involve a pull scenario; this is in comparison to the ‘traditional’ push scenario. In the good old days companies manufactured to stock, filling warehouses with product that marketing was responsible for emptying out. The push method involves carrying costs and results in various types of waste, especially as the product lifetime came to an end. NIST [35] defines lean: “as a systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection”.

Among the several quality management concepts that have been developed, the Lean concept, as in LM, LP and so on, is one of the more widespread and successful attempts. Briefly, Lean is about controlling the resources in accordance with the customers’ needs and to reduce unnecessary waste (including the waste of time). Although 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. Consequences of this are striving for perfection and a customer-driven pull of the process. Thus, NIST’s definition of Lean is relevant: “A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection” [35].

Methodologies and Tools: Lean principles are fundamentally customer value driven, which makes them appropriate for many manufacturing and distribution situations. Five basic principles of LM are generally acknowledged:

- Understanding customer value. Only what the customers perceive as value is important.
- Value stream analysis. Having understood the value for the customers, the next step is to analyze the business processes to determine which ones actually add value. If an action does not add value, then it should be modified or eliminated from the process.
- Flow. Focus on organizing a continuous flow through the production or supply chain rather than moving commodities in large batches.
- Pull. Demand chain management prevents producing commodities to stock, i.e. customer demand pulls finished products through the system. No work is carried out unless the result of it is required downstream.
- Perfection. The elimination of non-value-adding elements (waste) is a process of continuous improvement. “There is no end to reducing time, cost, space, mistakes and effort” [36].

Lean Principles Do Not Always Apply: However, Lean principles do not always apply when customer demand is unstable and unpredictable. The main elements contributing to the elimination of non-value-added activities are the 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. Tools used include Kanban cards for pull through the supply chain and the closely related Just-In-Time (JIT) system for inventory reduction.

Effects: There are many reasons to introduce Lean techniques in an organization because it may contribute substantially to cutting costs and providing competitive advantages. Lean benefits include reduced work-in-process, increased inventory turns, increased capacity, cycle-time reduction and improved customer satisfaction. According to a recent survey [37], of 40 companies that had adopted LM, typical improvements are visible in three areas. These improvement areas are: operational improvements (reduction of lead time, increase in productivity, reduction in work-in-process inventory, etc.), administrative improvements (reduction in order processing errors, streamlining of customer service functions so that customers are no longer placed on hold, etc.) and strategic improvements (reduced costs, etc.).

Lean Approach and Trend: Lean exists at two levels, having both strategic and operational dimensions [38]; neither of the positions is more correct than the other. In addition, Lean can be seen as having both a philosophical as well as a practical orientation [6].

Lean can be characterized in four different ways through adapting and combining the four approaches to Lean suggested by Hines *et al.* [38] and Shah and Ward [6]. The four definable approaches to LP are illustrated in Table 1; the bracketed terms are the ones suggested by Hines *et al.* [38] and Shah and Ward [6] respectively. The terms ‘practical’ and ‘philosophical’ are substituted by the terms ‘performative’ and ‘ostensive’. The terms ‘operational’ and ‘strategic’ are substituted by the terms ‘discrete’ and ‘continuous’.

In the Table 1, four different approaches to LP are presented. The term ostensive signifies a shift of focus from general philosophy towards issues that can only be defined by examples, whereas performative and practical signify a focus on the things that are done. The term discrete signifies a focus on isolated events, such as individual improvement projects using the ‘Lean toolbox’ [39, 40], or the final state of ‘Leanness’ [41]. By contrast, the term continuous signifies a process-oriented perspective that focuses on

continuous efforts: the philosophy of ‘Lean Thinking’ or ‘the Toyota way’ [42, 43] or the process of ‘becoming Lean’ [44, 45].

Although the score is not perfect, Lean seems to be a reasonably consistent concept comprising JIT practices, resource reduction, improvement strategies, defects control, standardization and scientific management techniques. However, it is hard to formulate a clear definition that captures all the elements of Lean and integrates the various goals in the reviewed literature. In other words, Lean can be said to (barely) pass the convergent validity test, although there is no clear agreement among the authors as to the overall purpose of the concept.

Lean Thinking: Lean Thinking does not provide a new management ‘program’ for the one-minute manager. Instead, it offers a new way of thinking, being and doing for the serious manager – one that will change the world [43]. Perhaps the best definition of Lean that we have encountered is based upon a story told by Ohno; Ohno in a discussion with Cho (the future president of Toyota Motor Manufacturing Company, Georgetown KY) about the origins of the TPS, indicated that (what we now call Lean) is a manufacturing phenomenon that seeks to "maximize the work effort of a company's number one resource, the People." Lean is therefore ‘a way of thinking’: to adapt to change, to eliminate waste and continuously improve. There are a number of tools and techniques, to be used in concert, to achieve maximization of the effort of the workforce and to operate as a Lean enterprise.

Hines *et al.* [38] provided a set of resources that shows the evolution of LT; its focus is on quality during the literature of the early 1990s, through quality, cost and delivery, to customer value from 2000 onwards. Furthermore, they presented a framework of LT (see Figure 1). In this structure, LT as a perfection of Lean, is helped and fed by other improvement tools such as: TQM, total quality control, agile manufacturing, 6 sigma, statistics process control, total preventive maintenance and so on.

Table 1: Approaches to Lean. [6, 38]

| Approaches | Discrete (operational) | Continuous (strategic) |
|---------------------------|------------------------|------------------------|
| Ostensive (philosophical) | <i>Leanness</i> | <i>Lean Thinking</i> |
| Performative (practical) | <i>Tool box Lean</i> | <i>Becoming Lean</i> |

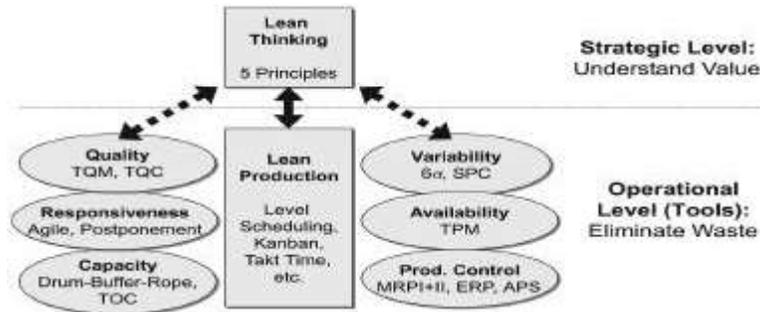


Fig. 1: Lean – framework (adapted from Hines et al. [38]).

Criticism of Lean: Despite the several success stories associated with the Lean concept, it does have some shortcomings. Examples of shortcomings that can be found in the literature on the subject are the following:

The Lean organization may become very susceptible to the impact of changes. The Leanness in itself leads to reduced flexibility and less ability to react to new conditions and circumstances [46]. JIT deliveries cause congestion in the supply chain that lead to delays, pollution, shortage of workers and so on [47]. To summarize, Lean requires a stable platform from which scale efficiency can be maximized. Highly dynamic conditions cannot be dealt with because there is no room for flexibility due to the focus on perfection, which is always a function of particular market conditions at a certain period of time [48].

Similarities and Differences

Lean Approach: A five-step thinking process was proposed by Womack and Jones, authors of the ‘LT’ manual, to guide managers in their attempts to introduce Lean principles into production. The five principles are [43]:

- Setting the value of each product family from final customer’s point of view.
- Identifying all activities on the value stream of each product family, eliminating as much as possible those waste-generating activities.
- Ranking value-adding activities in a sequence (flow) of clearly identified steps, so that the product should reach the final customer through a process that should be as continuous as possible.
- After value stream is established and introduced, each internal or external customer / beneficiary can apply the ‘pull’ system to pull the product from the production line.

- After the value is set, the value-adding activities identified and those generating waste eliminated and the value stream set and introduced, the process can be operationalized and repeated until it reaches the optimal level of maximum value and no waste.

In this section, some similarities and differences between TQM 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 Tables 2.

As a result, the analysis is done with three different aspects: basic assumptions, change principles and interventions.

Basic Assumptions: Quality In Lean, quality does not receive the same amount of attention as in the TQM literature. The main focus in the Lean literature is on JIT production. JIT is assumed to decrease total cost, as well as highlight problems. This is done through reducing the resources in the system, so that buffers do not cover up the problems that arise. In the short-term perspective, the reduction of resources implies a direct reduction of cost. In the long run, the reduction and subsequent elimination of buffers is assumed to highlight the problems that exist in production, thus being a vital source of continuous improvement [4, 41, 49]. A common opinion is that the purpose of Lean is waste elimination; the literature review does not show support for this being the purpose, but waste elimination is definitely an important aspect of the concept. Some authors argue that waste is reduced in order to increase the value for the customer [39, 50], whereas others argue that it is a strategy for reducing cost [4, 51]. Reducing waste is also a significant part of TQM, but under the banner of poor-quality-costs [52, 53]. A major difference between TQM and Lean in this aspect is the precision in defining waste. In the majority of the Lean

Table 2: An Abstract of Similarities and differences between TQM and Lean [7 & 48]

| Subject | TQM | Lean |
|---------------------|--|--|
| Origin | Japan | Japan |
| Approach | Quality; Focus on customer | Understanding customer value, Elimination of waste |
| Process view & | Improve and uniform processes | Improve flow in processes; |
| Time phase | Continuous improvement | Continuous improvement |
| Fundamental concept | Data-based, employee driven, orientation towards customers and suppliers | Continuously improving the value created for the customers by letting them pull value through a streamlined value stream |
| Participation | Normally everyone and suppliers; Let everybody be committed | Everyone participates |
| Methodologies | Plan, do, study, act | Customer value, value stream, analysis, flow, pull, perfection |
| Tools | Analytical and statistical tools | Analytical tools |
| Primary effects | Increase customer satisfaction | Reduce lead time |
| Secondary effects | Achieves customer loyalty and improves performance | Reduces inventory, increases productivity and customer satisfaction |
| Change introduced | Slow, incremental | Could be dramatic as well as incremental |
| Implementation time | Long term, 5-10 years | Long, many new things are to be learned |
| Criticism | No tangible improvements, resource-demanding, unclear notion | Causes congestion in the supply chain |

literature, waste or muda is based on the seven forms defined by Ohno [4], whereas TQM has a very general definition of poor-quality-costs, including everything that could be eliminated through improvement [53].

Employees and the Quality of Their Work: One major critique of the Lean concept is that it is generally weak concerning the employees' perspective. The proponents of LP usually have a strong instrumental and managerial perspective and discuss employees in terms of components in the production system [54-56]. The extensive discussion about jidoka and poka yoke in the Lean literature suggests that employees cannot be trusted to produce good quality, thus creating a necessity for removing the possibility of human error from the system.

Organizations as Systems: One thing that Lean and TQM have in common are seeing the organization as a system [39, 43], but there is a slight difference in perspective between the two concepts. Whereas TQM has a strong focus on the internal structure and integration of departments within the organization, Lean stresses a supply chain perspective and sees the internal production operations as a part of a value stream from the sub-suppliers to the end customer [57, 58].

Quality is the responsibility of senior management. This is another perspective that Lean and TQM share, but again with some differences. TQM-managers should create structures that support the employees in producing products of high quality [52, 59]. The idea is the same in Lean, but the rationale for doing this seems to be centered on eliminating the human factor from the system through jidoka and poka yoke. Using the terminology of McGregor, one could argue that TQM seems to be based on theory Y, whereas Lean seems to be based on theory X [60].

Change Principles

Focus on Processes: Within the Lean concept the term 'value stream' is usually preferred [43]. The term 'process' is usually used at a lower level of abstraction that TQM theorists would call sub-processes or activities [61]. TQM and Lean also share the conception that management should analyze and improve the processes and train the employees.

Management by Fact: The literature on Lean does not really stress management by facts explicitly. However, this is implicit in the description of Lean practices, many of which are analytical tools designed to help achieve JIT production. Although this is a shared perspective

between Lean and TQM, there is a difference. Within TQM the analysis of variability through the use of statistical tools is a central concept [52]; in the Lean tradition, this is not seen as equally important. In fact, some authors argue against the use of statistical tools for analyzing production performance and they recommend alternative tools such as increased inspection and visualization of problems [42, 50].

Learning and Continuous Improvement: In the words of Hackman and Wageman [52], TQM is “pro-learning, with a vengeance”; the learning aspects are not emphasized as much in literature on Lean. As discussed above, the Lean literature is generally weaker on the human behavior side, focusing more on instrumental techniques for improving system performance. There is a clear focus on continuous improvement, which implies that some form of learning is required. However, the question is who is learning. TQM is focused on stimulating creativity and individual efforts for improvement [52], whereas Lean places strong emphasis on the standardization of work and collective learning [62, 63].

Interventions

Analysis of Customer Requirements: Customer focus is one of the hallmarks of TQM, where every improvement should be based on an investigation of the customer’s requirements, whether the customer is internal or external. The Lean concept does not emphasize customer interests. Some authors argue that the very purpose of Lean is to please the customer [50], whereas Lean is a discipline that focuses on process speed and efficiency, or the flow, in order to increase the customer value [64].

Supplier Partnerships: The suppliers are seen as important in both Lean and TQM. They both stress the point that long-term partnerships should be made with suppliers and that improvements should be done in collaboration with them. Although all the authors in this analysis go not discuss this matter, the majority of them do.

Improvement Teams: Quality circles have a central role in much of the TQM literature and can be put to use in problem solving or improvement activities. In the Lean literature, Improvement teams are explicitly discussed by just about half of the reviewed authors. However, they are often implicated in discussions about improvement activities.

Scientific Methods for Performance Measurement and Improvement: Both TQM and Lean employ various scientific methods for analysis and evaluation of performance. However, these methods differ significantly and the tools associated with one concept are generally not mentioned in literature on the other one. The purpose of measurements also differs. In TQM measurements are done in order to identify problems and to document improvement, whereas Lean theorists argue that measurements should be made for planning and synchronization purposes, for example for setting production rate [4, 39].

Process Management Techniques: As discussed above, the term process is used in slightly different ways by authors on TQM and Lean. In the Lean literature, different techniques are presented for both overall process level and individual activities. At an organizational level value stream mapping (VSM) can be used for highlighting several kinds of problems in the processes [58]. In-control processes are more commonly associated between Lean and TQM programs [65].

In summary, although Lean and TQM both aim to improve quality, TQM reaches a certain point or stage at which no more improvements can be made. LM, however, focuses on taking quality improvement to the next level. Another major difference between the two is the approach they take. TQM views quality as a conformance to internal requirements, whereas LM focuses on reducing the number of defects. LM helps organizations reduce operational costs, cycle time and cost savings. It tries to eliminate costs that are of no value to the customers such as costs incurred due to waste. TQM focuses more on improving individual operations within unrelated business processes, whereas LM tries to improve operations within a single business process. In more general terms, LM requires the skills of trained professionals and TQM may not. TQM may only be a ‘part time’ thing and can be done with anyone; dedicated or not.

DISCUSSIONS AND CONCLUSION

Even though TQM and Lean have the same origin (the quality evolution in Japan), the concepts have developed differently. TQM became a very popular notion at the start of the 1990s among researchers and practitioners who wanted to describe how organizations should work to obtain better performance and customer satisfaction. TQM is often associated with the prominent figures within the field of quality management, for

example, Deming and Juran, but they have in general not used the term TQM. In particular, Deming [59] has stated that: “the trouble with TQM, the failure of TQM, you can call it, is that there is no such thing”.

However, LP is not a singular concept and it cannot be equated solely to waste elimination or continuous improvement, which constitute its guiding principles, nor to JIT, pull production, kanban, TQM, or employee involvement, which make-up some of its underlying components [6]. LM has recently become pervasive as the primary strategy for manufacturing performance enhancement. Many companies now realize that business success in the short, medium and long term is predicated upon outstanding performance in the quality of products and efficiency of manufacturing operations. These companies recognize that consistent and disciplined application of LM strategies, with the emphasis on waste elimination and process streamlining, can offer a steady path towards business excellence [66].

Although Dahlgaard and Dahlgaard [67] state that there is not any contradiction between the objectives in Lean and TQM, the Lean principles are different compared to the methodologies in TQM because they are not cyclical in nature and are not focused on how to perform improvements [48].

In the comparative study by Andersson *et al.* [48] they claim that the Lean approach is project management and Lean is not applicable in all industries! Obviously, one of the Lean principles is continuous improvement. Radnor [1] states that we should consider the notion of ‘Lean Principles’ or a ‘Lean Philosophy’, which relates ideas and concepts whose fundamental ideas lie in continuous improvement, elimination of waste, process flow and systems thinking developed throughout the organization. Continuous improvement is defined as: day-to-day activities performed to improve business processes in response to changing market conditions; called ‘kaizen’ in Japanese, which literally means ‘change for the better’ and is often interpreted as ‘continuous improvement’. Lean utilizes specific processes and tools to achieve improvements (Emiliani, 2004) and Kaizen is one the important techniques of Lean!

A LP system pushes all decisions as close to the source of the problem as possible [68]. A value stream includes all the operations and processes to transform raw materials into finished goods or services, including non-value adding activities [69]. According to Shah and Ward (2003), Lean practices are prevalent in all industries and studies of LM need not be restricted to industries associated with discrete part manufacturing. Radnor [1] found that Lean methods were applicable to

the public sector; Lean practices are found in plants in all industries [70].

Lean Service: Many manufacturing and some service businesses today are using Lean management principles and practices as a means to improve business processes, which in turn improves productivity and competitiveness and delivers greater value to end-use customers [71-73]. Also, Emiliani [72] demonstrated that the applicability of Lean principles and practices is effective in service businesses and in the achievement of improved outcomes. So, LM principles have been successfully applied to manufactured products for several decades through significantly reducing inventory in the supply chain and by increasing productivity as well as the quality of the products. However, it is not clear whether such principles can be similarly applied to information intensive services that usually do not carry inventory.

According to our review of the literature, there is not common point of Lean and TQM clearly. Since LM evolution is LT. The idea of a LP system is reviewed in LT[68]. According to Syrett and Lammiman [74], considering the fundamental ideas of LM and LT it is possible to develop the concept of Lean ways of working or Leanness. Consequently, since LM reconsidered to LT, according to Hines *et al.* [38] TQM similar to others can be tools and techniques of Lean (see Figure 1). Because, based on the new Lean approach, Lean is not just a box of tools; it is a system, philosophy and thinking! Therefore, LT is better and will be created a synergic power for implementation of LM, as if TQM and other tools/improvement approaches as a tool support that.

RECOMMENDATION

In this study, by using the lean thinking approach, we compared LM and TQM. A comparison of two management philosophies is the limitation of this study. The authors suggest that a comparative study among more than two management philosophies (e.g. LM, TQM, TPM, CWQC, 6Sigma....) considering new approaches can be done in future research.

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