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Improving Quality Management Methods in Manufacturing SMEs: A Conceptual Framework

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Abstract

The purpose of this paper is to deliver a critical review of quality management process improvement methods, determine the critical success factors to Lean Six Sigma implementation in manufacturing SMEs and design the conceptual execution framework to Lean Six Sigma implementation successfully in manufacturing SMEs. A variety of methods are available for implementation in quality management process improvement. In this paper four of the well-known methods have been briefly described including Total quality management (TQM), Lean Manufacturing, Six Sigma and Lean Six Sigma (LSS). The previous studies showed that all the four methods have some barriers and challenges that requires an elimination, Lean Six Sigma which is a combination of both Lean Manufacturing and Six Sigma is considered as the most updated method with less barriers in implementing quality management process in manufacturing SMEs.

Keywords: *Quality Management, Total Quality Management, Lean Manufacturing, Six Sigma, Lean Six Sigma, Critical Success Factors, Small to Medium -Sized Enterprises.*

1. Introduction

In this era quality management is widely known as the most critical part in today's industrial business. Quality management is the general expression for all activities prompting quality. Therefore, manufacturers are tending to implement high levels of quality management techniques to get the customers satisfaction by producing high quality products and achieve the company targets such as cutting the production cost while maintain high quality products. There are plenty of methods for quality management improvement which includes procedure improvement, employee improvement and product improvement. The most common quality management methods and techniques that guide to quality improvement are Total Quality Management (TQM), Lean Manufacturing, Six Sigma and Lean Six Sigma (LSS). In this paper, these methods are briefly described and lists of common characteristics and individual limitations are developed.

2. Process Improvement Methods

A. Total Quality Management (TQM)

TQM consider as one of the most well-known and important techniques that manufacturing SMEs tend to implement in business. Furthermore, SMEs was used mainly by manufacturing industry [11]. Based on the previous studies positive relationship exist between organizational performance (OP) and total quality management implementation. The TQM fundamentals summarized in figure 1 based on numerous studies. It is supposed that this will offer a general framework for implementing TQM successfully in different countries.

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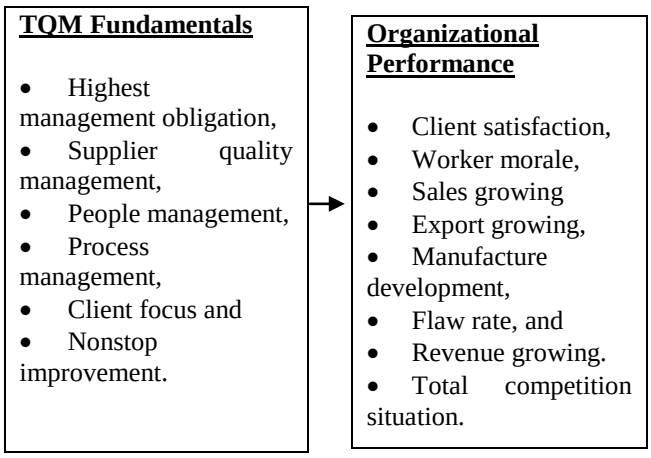

Figure 1: TQM theoretical framework [11]

1) Barriers and Challenges of TQM Method:

In the fact that successful TQM implementation practices have helped manufacturing SMEs achieving the required goals specifically improved manufacturers performance, client satisfaction and profitability. Implementing and practicing TQM faces many obstacles and barriers stated in table 1.

Table 1 : Barriers of TQM implementation [16]

Barrier No.	TQM Barriers
1	Insufficient of highest management obligation.
2	Worker's resistance to modification.
3	Shortage of appropriate knowledge and training.
4	Human resource obstacle.
5	Insufficient coordination amongst all work sections.
6	Absence of constant development culture.
7	No benchmarking.
8	Weak preparation.
9	High turnover at management level.
10	Insufficient use of authorization and teamwork.
11	Behaviour of workers to quality.
12	Shortage of communication.

B. Lean Manufacturing

Lean Manufacturing technique originated inside the Japanese cars manufacturing after the World War II and can be mainly depending on the TBS (Toyota Production System). Lean Manufacturing is much greater than a mixture of tools, principles. It is the mindset of everybody who functions inside the manufacturer. From the beginning of Lean Manufacturing thinking at Toyota Company, these values have encouraged to other Japanese motorized manufactures and after that to the American motorized manufacturers [6].

1) Barriers and Challenges of Lean Method:

The barriers and obstacles that forbid the execution of Lean Manufacturing successfully in manufacturing SMEs are presented in table 2.

Table 2: Barriers of Lean Manufacturing Implementation [13]

Barrier No.	Lean Manufacturing Barriers
1	Necessity of high investments / costs.
2	Weak obligation from the workers because workers fear of losing their job, modification was not shared and weak knowledge.
3	Interruptions / slowdowns due to fire fighting on other projects / difficulties.
4	Weak obligation from the management because of poor certainty on the method, poor knowledge and highest management last too shortly.
5	Several manufacturing locations.
6	Struggle in counting the profits upfront.

C. Six Sigma

The academic and expert management and manufacturing press have been giving growing attention to Six Sigma. Several definitions of what Six Sigma is and the way it is explained. It has been composed in many papers the requirement to standardize the true definition. Brady and Allen [4] undergo a number of these variations into the definition, beginning with Lindeman [14] definition and also go through several different writers that provide their opinions about how it should be defined. Finally, Six Sigma used to remove the eight types of waste: Time, Motion, Inventory, Waiting, More than production, Defects and abilities, over processing. Also, Six Sigma means continuous improvement, and goals to remove waste by improving standardized actions and processes. This history began at Motorola in 1986 and they could modify the mindset which enhancing quality costs. They demonstrated that enhancing quality really decreased operating costs and improved customer satisfaction [14].

1) DMAIC Process:

DMAIC approach consider as the critical Six Sigma technique which involves five stages starts with "Define" where the project scheme is defined, "Measure" the stage where the data gathered, "Analyse" the stage of collecting data, "Implement" it is the stage of action where any

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required correction take place and lastly "Control" it is the stage where to maintain improvement.

2) Critical Success Factors for Implementing Six Sigma:

The Essential success factors recorded by George [8] for Six Sigma have been recorded below:

- Voice of the Client (VOC) is the client communicating exactly what they need.
- Prerequisites are conditions and measurable fundamentals communicated from the client.
- Design for Six Sigma will be to design the products and processes depending on the client's necessities.
- Flaws will be the products that are not delivered to the client's CTQ.
- Critical to Quality (CTQ) is the prerequisite most significant to the client.

Table 3: Barriers of Six Sigma Implementation [7]

Barrier No.	Six Sigma Barriers
1	Shortage of dedicated Six Sigma professionals.
2	Less stress on the voice of client.
3	Resistance to change.
4	No cross-functional team.
5	Struggle to maintain Six Sigma developments.
6	Absence of helpful organizational culture.
7	High start-up cost for Six Sigma projects.
8	Doubt of Six Sigma results.
9	Uncertain prioritization of Six Sigma projects.
10	Complex Six Sigma tools and practices.
11	Difficult to recognize process parameters.
12	Insufficient dealing with client variability.

D. Lean Six Sigma (LSS)

The first time were Lean Six Sigma as concept was formed in 2001, through a book named "Leaning into Six Sigma: The Path to integration of Lean Enterprise and Six Sigma" written by Wheat [17]. Six Sigma and Lean Manufacturing have been contiguously improved through the past 20 years through the tools used by manufacturers. Lean Six Sigma method is a mixture of two quality tools; Lean Manufacturing and Six Sigma where it tries to maximize the scope of implementation successfully for both concepts. However, each company and individual have their own perception of implementing LSS successfully. Some would consider LSS as a fully integrated system combines both Six Sigma and Lean Manufacturing, on the other hand, some would consider Lean Six Sigma as two different principles which has been adapted in parallel [3]. With the execution of both Lean and Six Sigma collectively, the returns could be continuing as revealed in figure 2.

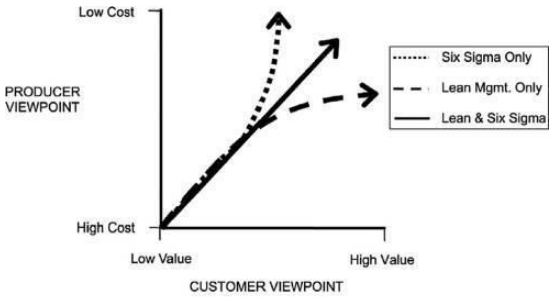

Figure: 2 Nature of competitive benefit [2]

Based on the previous research a summarized comparison between Lean Manufacturing and Six Sigma stated in table 4.

Table 4: Lean Manufacturing vs Six Sigma [12]

Differentiations	Lean Manufacturing	Six Sigma
Concept	Eliminate waste.	Decrease variation.
Method	5S, visual control, setup reduction.	Main method is DMAIC.
Concentration	Efficiency, cost and waste reduction.	Client, process variation and statistical decision making.
Company	All company levels commitment.	Specialist hierarchy.
Effectiveness	Reduced variation, decrease flow time, uniform results, minimum inventory, and improved quality.	Rapid throughout, minimum waste, fluctuation, minimum inventory and better quality.
Limitation and criticism	Expensive execution, statistical analysis not value and questionable flexibility.	Structured execution, expensive projects, system interaction not considered and process development independently.

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1) Barriers and challenges of Lean Six Sigma Method:

Based on the previous studies, 12 obstacles were recognized that need to be considered while implementing Lean Six Sigma in manufacturing SMEs.

Table 5: Barriers of Lean Six Sigma Implementation [1]

Barrier No.	Lean Six Sigma Barriers
1	Insufficient of highest management obligation and contribution.
2	Shortage of education and training.
3	Poor project prioritization and selection.
4	Shortage of resources (financial, technical, human, etc).
5	Resistance of culture variation.
6	Incorrect selection of Lean Six Sigma tools.
7	Shortage of understanding of the different types of clients.
8	Poor selection of applicants for belts training.
9	Lack of clear vision and a future plan.
10	Time consuming.
11	Lack of understanding of how to get started.
12	Weak communication.

3. Results and Discussion

A. Proposed Critical Success Factors (CSF) for Lean Six Sigma Implementation

The identification of critical success factors for Lean Six Sigma will provide a clear vision to companies on how to come out with an appropriate implementation plan [5]. Based on an intensive literature review in journals related to quality management improvement and Lean Six Sigma, it was shown that there are ten critical success factors that must be follow to make Lean Six Sigma victories [15].

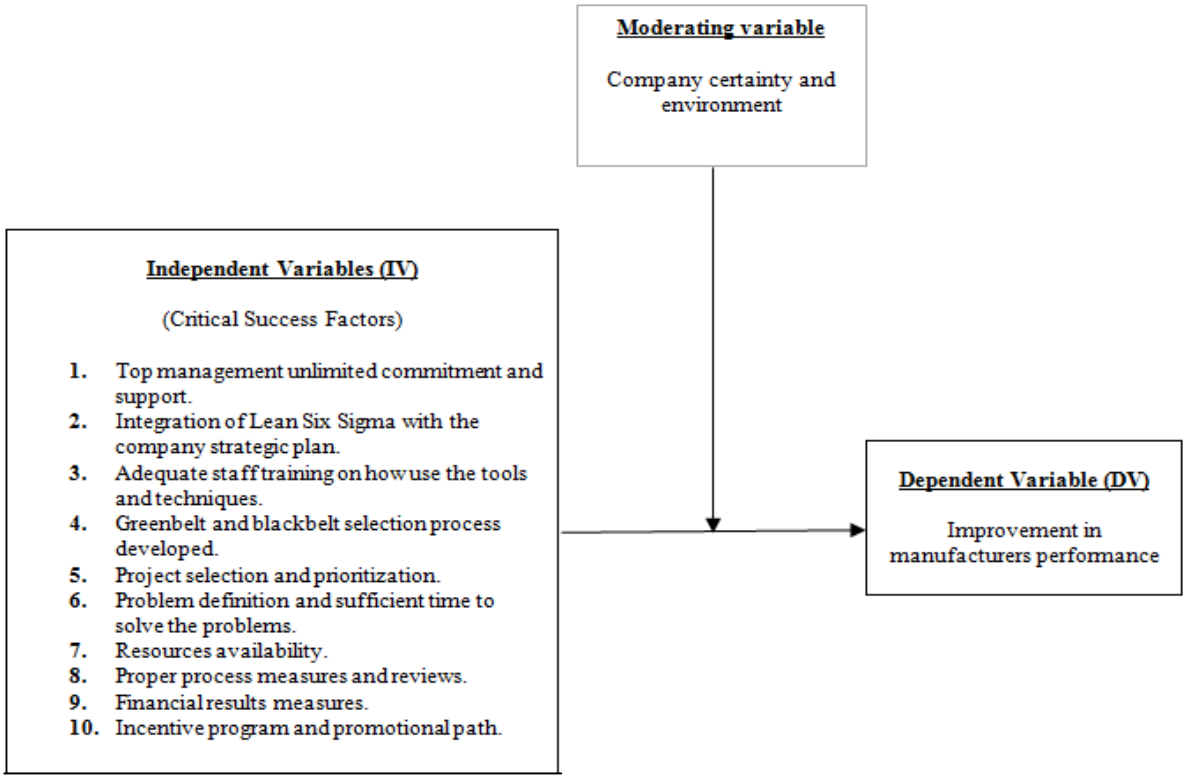

Figure 3: CSF theoretical framework

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E. Conceptual Framework for Lean Six Sigma Implementation

Lean Six Sigma framework has five phases with each phase providing an easy and structural guide towards root-cause identification of a problem, hence proposing and implementing possible solution to eliminate the root cause through continuous improvement. As mentioned earlier, the developed framework is based on the suitability of the environment where Lean Six Sigma is has been implemented.

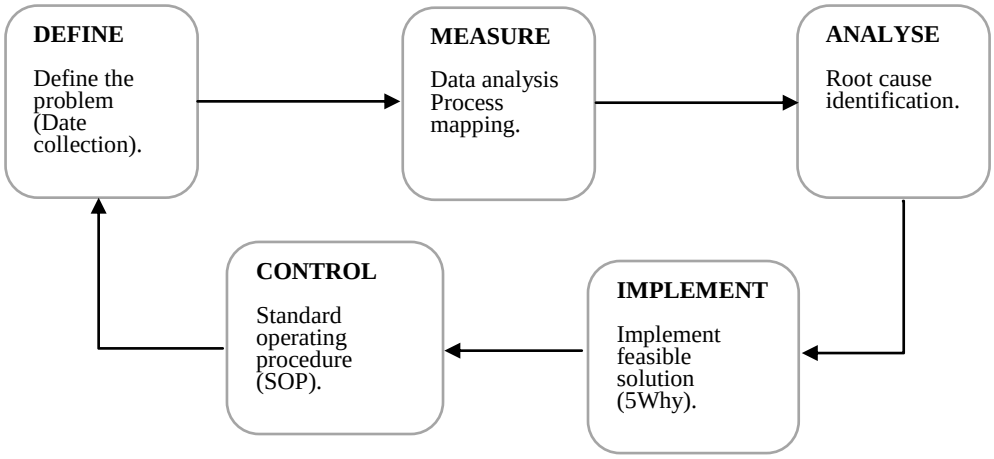

Figure. 4 Conceptual Framework for LSS Implementation in Manufacturing SMEs

4. SMEs Quality Management Challenges

SMEs adopt quality management methods slower than larger establishments. Antony [9] deliver his opinion along with the viewpoint of other Lean Six Sigma experts on the question; 'could Lean Six Sigma be efficiently implemented in SMEs?' His study presented that SMEs could implement Lean Six Sigma more effectively than large establishments, if there is high commitment from the top management. In this paper we are focusing on two types of SMEs "Small and Medium" due to the minimum requirement of quality management needed to proceed this study which will be difficult to find it in "Micro" SMEs. Small companies, in specific, lack proper human resources to classify roles and designate the typical Lean Six Sigma hierarchy needed for its successful implementation [9]. Yet, when Motorola first came out with Six Sigma method, they didn't know anything about Black Belts; what the needed was extensive workers training combined with top management commitment. Additionally, higher consultants' charges are another critical challenge to small SMEs. Therefore, Antony [9] support the role of national academic institutes to provide a budget Lean Six Sigma methodology. Medium companies lack the essential quality awareness, and the loss of appropriate vision could be considered as an important challenge. Also, financial is a critical factor to consider, yet with the help of an appropriate strategic planning this problem can be addressed. Sajid [10] emphasized that best level of quality could be attained by adopting Lean Six Sigma through emerging a special combination of capabilities and available resources to understand the benefits of Lean Six Sigma.

5. Conclusions

To sum it up the process improvement methods and techniques share several of common characteristics. They absolutely share the attitude that the process can always get improved. Also, they share the hypothesis of statistics and measurement being a roadway to improvement. Additionally, all method shares the believe on labours power to be side to side with the process in order to be able to improve the whole process. Based on the previous studies; Six Sigma is considered as the second generation of TQM by adapting all of it is content from TQM. Six Sigma strengths the weakness of TQM and sustain it is strengths. But the best method developed yet is LSS which is the combination of both Lean Manufacturing and Six Sigma. It enhances more tools, overview at extra circumstances and attains outcomes faster than Six Sigma alone. Furthermore, a theoretical framework developed for Lean Six Sigma implementation successfully in manufacturing SMEs and most of the critical success factors has been identified. Finally, the process conceptual executive framework designed in order to achieve a successful implementation of Lean Six Sigma in manufacturing SMEs.

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