
Lean Manufacturing and Six sigma: Challenges for SME's

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Abstract: *Now A days every MNC's are moving towards Lean manufacturing and Six Sigma approach. So they also want their vendor to do so mainly for cost effectiveness and zero defects. When their vendor, mostly SME's want to do the same they need a good amount of capital to implement it and if the implementation is not successful then its a big deal to get the capital back. SMEs also want right pathway and proper training to get the implementation. So in this paper the tough condition of SME's and pros and cons about the challenges they faces is narrated mostly for developing countries.*

1. Introduction: Lean manufacturing concepts had been brought out by Japanese company Toyota right after Second World War. So for near about seventy years they are nurturing with lean manufacturing.[1] Lean manufacturing is an integrated socio-technical system, whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability. In a nutshell, lean manufacturing is aims to achieve the same output with less machines, less time, less space, less human effort, less cost.

Lean manufacturing is set for increasing productivity but it is not that simple. The complex concept and want of huge capital making this implementation really tough for SME's.

In manufacturing MNCs it's possible to implement these kinds of practices but it will affect their capital as well as confidence in lean philosophy tremendously if they fail to implement it successfully.

The implementation of lean and six sigma approach in small and medium enterprises is quite tough as they need implementation cost and subsequent benefits of lean manufacturing adoption, be projected upfront before they are able to commit.

2. Methodology: This paper is to discuss the approach of six sigma and lean manufacturing in SMEs and their probable challenges for implementing and continuing. However, as highlighted in the introduction, SMEs have certain constraints that encounter problems regarding implementation of lean production in their organisation.

To identify the problems, challenges and constraints that SMEs face, the methodology adopted was the structured literature review. The literature review is based on books, monographs, and mainly peer reviewed journal papers. The key topics under investigation was the existing lean implementation frameworks presented up to now and the key studies presented on SMEs and lean manufacturing.

3. Lean and six sigma implementation: The lean manufacturing and six sigma are going side by side, so for implementing these practices framework is necessary from ground level.

3.1 Academic framework: The first roadmap was introduced by Shingo, suggesting the key lean initiatives should be introduced with in the first year of lean journey of the country. There are several tools for lean manufacturing like SFMC, lean line design, poka yoke, kanban, levelling, standardized work ,one piece flow etc. Kowalski and beck road maps are compared in Fig 1.

For the implementation of lean, Hilbert [9] suggested a two-phase model. The first phase is composed of seven steps that need to be completed, namely identifying a launch team, a production team and key leadership; establishing a shared a production team and key leadership; establishing a shared vision among

stakeholders; establishing a method of evaluating the performance of the change effort; establishing evaluating the performance of the change effort; establishing stability of current system; providing a definition for suitable stability of current system; providing a definition for suitable policy to integrate social and technical aspects of “lean” elements; creating design process with regard to coordinating hardware and software resources to “leanness”; and offering necessary alternatives to solving the probable conflicts. The second phase is composed of four key stages: building a shared vision, planning and designing the change, managing the change, and celebration and continuous improvement. It is evident that Hilbert focus more on social, cultural, and educational aspects instead of just the use of tools and their operational components (in comparison to the approach proposed by Singo [6], Kowalski [7] and Beck [8]).

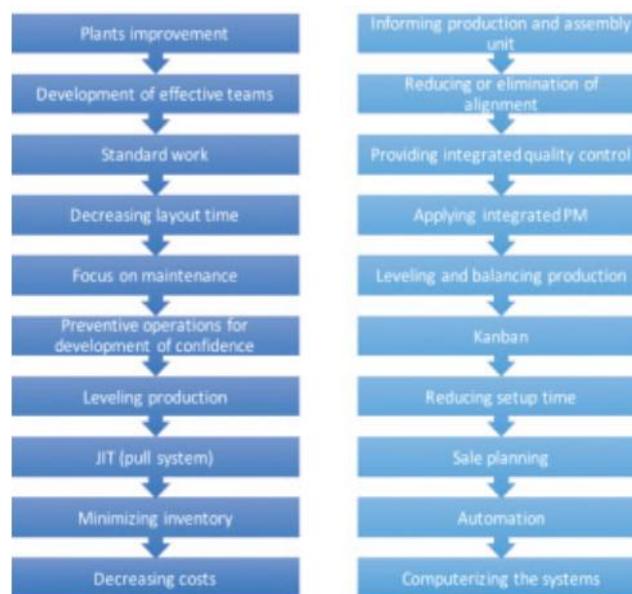


Fig. 1. Comparison of Kowalski (left) and Beck (right) roadmaps to leanness.

Zero defects and decentralization and integration of functions should be first steps in implementation of lean. He identified as core principles the elimination of waste, setting up multifunctional teams, and pull scheduling. For making the process of zero defects six sigma approach is required. Six sigma is introduced by Motorola and later GE used this approach very successfully.

Three major stages can be identified when implementing a lean implementation framework: Preparation, design and Implementation. The lean steps that compose these stages are shown in table 1. Based on their findings the authors suggested a dynamic model for a lean roadmap to account for the volatile conditions and the high variability of the environment.

Table 1: The three lean implementation stages and the steps as suggested by Anvari et al [9]

Lean stage	Step
Stage 1: Preparation	<ul style="list-style-type: none"> Gap assessment strategic planning Understanding waste Establishing the objective Lean principles Creating an implementation team Suppliers and customers involved Training the staff in team building

Stage 2: Design

Mapping the value streams
Analyzing the business for improvement
Opportunities
Planning the changes
Identify indicators to measure
Performance

Stage 3: Implementation

Starting with pilot project
Evaluating and sustaining changes
Changing the material SC systems and
Philosophies
Selling the benefits of lean thinking

Lean aerospace initiative [10] group at MIT developed the Enterprise level roadmap” as a set of Process and steps that senior management can use moving to the enterprise to higher levels of lean performance. The roadamp is simply given in three different strategies the entry, the long term and short term. The key points of road maps should be discussed .The issues, enablers, barriers and reference material related to each task in frameworks should be highlighted. In lean Implementation they should follow some tools like VSM, VSD, QFD, SWOT analysis etc.

3.2 Industry framework: Womack presented a roadmap for implementing tools. The various lean tools are sequenced in a logical order. Indicatively, the process starts with the formation of a team, and then several lean tools are to implemented such as 5S, TPM, Value stream mapping for the identification of the various types and sources of waste, etc. The idea behind the framework is to allow the introduction of line balancing the process line, introduction of pull (one-piece flow), and cellular manufacturing. The ultimate goal is to introduce a Kaizen philosophy in the organization. Obviously, the framework is not to be adapted as-is but requires adapting to the specific needs of the organisation.

Harbour [11] in a technical report oriented to the automotive industry, identified the importance of “people systems”, as the critical factor for success in a lean implementation programme. He acknowledges that lean tools and methods are valuable, but the success depends on the way and methods are valuable, but the success depends on the way and methods are valuable, but the success depends on the way these are implemented. Thus he states that the success lies on the selection of the proper people’s system, definition of the roles and responsibilities and the proper training. He has suggested four phases for the implementation of lean, namely: suggested four phases for the implementation of lean, namely: organizational development (phase I), discipline building organizational development (phase I), discipline building (phase II), lean tools of quality, delivery and cost, improvement (phase III) and continuous improvement and collaboration (phase IV). In six sigma also they need to work in essential softwares and tools like Minitab software, they need to learn SPC so that they can control the process fruitfully with removing waste. Obviously, this is not an exhaustive list of the various lean implementation frameworks and models presented in the literature. However, the key finding out of this literature review is that there is no lean implementation framework developed specifically for the needs of SMEs.

4 Challenges for SME’s for implementing lean and six sigma : Surveys in various countries with regards the success of lean implementation, the critical success factors and the barriers have been reported. For six sigma DAMIC implementation need to be done with proper training of staffs.

Table 2. Surveys in different countries with regards the success of lean Implementation

Country	Key Findings
Australia[12]	Assessment of the degree of lean thinking Introduction in 42 SMEs in Australia
Bangladesh[13]	Lean tools adoption of lean tools in 9 garment manufacturing SMEs
Egypt[14]	Major challenges and changes to be undertaken prior to implementations in 94 local firms.
Greece[15]	lean understandings and challenges for Greek SME's
India[16]	Assessment of the degree of adoption of lean tools into the continuous process industry and comparison to the discrete manufacturing
India [17]	Investigation of the rationale behind using Lean in electrical and electronics manufacturing in India. The key (unexpected) result is that lean manufacturing is not adopted in order to win high market share in the international market but for preventive maintenance
Italy[18]	Comparison of the practices and expectations and perceptions of lean between lean implementing SMEs and SMEs that are thinking in initiating lean projects in Italian manufacturing sector. 105 SMEs participated in the survey.
Malaysia[19]	Investigation of the adoption of lean manufacturing and the extend of adoption of lean techniques in the electrical and electronics industry in Malaysia.
USA[20]	Investigation of the significant performance/practice differences between lean suppliers and non-lean suppliers 103 American first tier automotive suppliers participated in the survey.

5 Why lean initiatives fail: Implementing lean manufacturing can be considered as any other change introduced to company. Change is identified as behavioural shift as a whole instead of change one part to another. Laclai and Rao[41] echoed Kotter 's research including that 58% initiatives fail to reach the expected return. Eaton [42] presents even more dramatical data, based on Carmeron Group survey in 1997 , stating that 75% of the change programmes eventually fail. In general, in literature it is easier to find reports of successful change programmes, rather than failures, as these are kept confidential due to the than failures,

as these are kept confidential due to the profound cost incurred. Some of the failures though are profound cost incurred. Some of the failures though are disclosed, mainly due to the high profile of the projects. Therefore it is not a surprise that there are not many studies on lean

Manufacturing and six sigma implementation failures, mainly since companies wish to protect and not disclose their investments that failed. However, it is a common understanding that many implementations do fail. In the few studies presented about failing implementations, the common root cases identified are related to:

-) Lean suppliers
-) Leadership and management
-) Training and involvement
-) Tools and techniques

Kumar and Kumar [21] focused on the barriers in the implementation of lean manufacturing, and grouped them into seven categories: management, resource, knowledge conflicts, employee, financial and past experience. Management can be both barrier and driver for lean implementation. If the management doesn't have the urge of urgency or long term vision to fruitful the initiative then the mission goes in vain.

Per Kumar and Kumar [21], lack of necessary resources (labour, capital, communication etc.) prohibit the implementation of lean manufacturing and six sigma. Furthermore, lots of companies that attempt to introduce lean practices (and eventually thinking) rely on consultants, thus resources for consultancy are key as well. The quality of the consultant is also critical, and in many cases superficial knowledge of the subject and lack of implementation practices results into confusion about Lean Manufacturing and six sigma, can become an obstacle in those implementation. It is thus evident that knowledge of the subject is of paramount importance as well. Absence of knowledge on lean philosophy and the various tools can be a great barrier in the implementation.

Critical success factors for lean implementation are:

- 1.Top management
- 2.Training and education
- 3.Working culture
- 4.Communication
- 5.Customer focus



Fig 2. Drivers and barriers in an organisation

6.Drivers and Barriers for lean manufacturing: The review of the papers with regards implementation of lean manufacturing in SMEs indicated the key drives and the main barriers for a company to introduce lean manufacturing.

The drivers, besides the obvious and well-advertised benefits (increase market share, increase customer satisfaction, increase sustainability of the company), are also having to do with improving the internal performance of the company (such as increasing flexibility, introduction of realistic and meaningful key performance indicators, desire). In some more mature companies participated in these studies, the goal was simply to employ the best practices. Resources are critical as well, and their lack is a major barrier. The way of introducing lean (internally or externally through a consultant) is critical as well. Absence of knowledge on

lean philosophy and the various tools can be a great barrier in the implementation. Resistance to change by the employees is a common barrier as well. This resistance can be rooted to the fear of the unknown, fear of failure and complacency. Salonitis and Tsinopoulos [15] classified the barriers into four groups: financial, top management related, workforce related and other barriers.

7. Conclusions: In the present duty challenges for SME's face when they begin their lean journey have been discussed through a structured literature structured literature review. Various lean implementation frameworks were reviewed, as well several studies focused on the implementation of lean on SMEs in various countries around the globe. The article focuses on roadmap based lean implementation approaches. There are however lean implementation frameworks based more on the lean principles rather than on a series of steps. Drivers and barriers to the implementation were identified and presented in the form of a force field analysis. The key conclusion drawn is that is no unique roadmap to "leanness" and six sigma; this needs to be tailored for every different organization.

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