CHALLENGES AND SUCCESS FACTORS FOR IMPLEMENTATION OF LEAN MANUFACTURING IN EUROPEAN SMES

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Abstract:

Small and medium-sized enterprises are crucial to value creation in the European economy. The SMEs need continuous improvement initiatives to stay competitive. However, SMEs are less likely to implement lean practices compared to larger companies. Limited research exists on the factors that are vital for succeeding with Lean implementations in SMEs. A case study of Norwegian and Belgium SMEs has been conducted in the European research project ERIP (European Regions for Innovative Productivity). Six critical success factors are suggested, which correspond well with previous research: 1) Ensure strong management involvement. 2) Develop thorough employee participation. 3) Allocate sufficient time for preparing the organisation. 4) Focus on creating motivation to complete initiatives. 5) Build competence internally in the organisation. 6) Establish a performance evaluation system.

Keywords:

Lean, small and medium-sized enterprises, continuous improvement, change management

INTRODUCTION

The importance of SMEs in the European economy

Small and Medium-sized Enterprises (SMEs) are a critical component of the European economy. These companies employ a large percentage of the total work force and contribute with a significant proportion of the value creation in our economy.

The importance of strengthening the competitiveness of SMEs has been the incitement for the European Commission's Interreg programme to support the project "European Regions for Innovative Productivity" (ERIP). This paper will study lean implementation initiatives in SME case companies in two of the participating countries – Norway and Belgium.

In Belgium, 99% of business enterprises in Flanders are SMEs. Taking into account the SME definition of the European Union (less than 250 employees), 60.4 % of the total employment in Flanders is at SMEs (RSZ Belgium, 2010). In Norway, 99.4 % of business enterprises are SMEs. (An SME is here defined as an enterprise with less than 100 employees). In Norway, as many as 69.7 % of the total workforce are employed in SMEs (Statistics Norway, 2010).

The "footprint" of SMEs is larger than may be seen at a first glance (Antony *et al*., 2005). Many SMEs are suppliers to larger organisations. They form a network of small and often specialized businesses, and serve as a foundation for a well-functioning economy. Larger firms require their SME suppliers to provide high quality products or services at low cost. One way in which this can be achieved is through adopting principles of continuous improvement.

The importance of lean production for SMEs

Western-European countries are known for their high wages and high production costs. Due to tough competition, companies need to keep a strong focus on cost reduction. Due to the lower wages in the East and due to the increasing mobility, there is a big shift towards production in Eastern-Europe or Asia. Standard products that can be assembled in mass production were the first ones to move to lower-cost economies. As a consequence, companies in Western-Europe have the biggest competitive advantage if they can produce high-quality customized products, and if they can produce it with a short lead time. Unfortunately, many of our SMEs are not ready for this switch yet.

In the past decades SMEs have been used to produce in big lot sizes and with a long lead time. Now many of these SMEs are forced to change their strategy in order to stay competitive. Producing more customized products, in smaller batch sizes and with a shorter lead time has a big influence on the production process, requiring many types of process improvements. Practices and techniques from lean manufacturing can help in implementing these improvements.

Lean Manufacturing is a collective term for production practices aimed at increasing value creation and reducing waste in all forms. Lean Manufacturing focus on shortening the timeline between customer order and shipment, as well as cutting costs and improving quality, by identifying and eliminating waste in the value stream. Its roots comes from the Toyota Production System from the 1950s, whereas the term “lean” was first introduced by Krafcik (1988) where he stated that “plants operating with a *lean* production policy are able to manufacture a wide range of models, yet maintain high levels of quality and productivity”. The lean concept got widely spread by Womack, Jones and Roos (1990) in the book “The Machine that Changed the World”. Here they gave the following characteristics of Lean Manufacturing:

> *“It uses less of everything compared with mass production – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. 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 products.”* (Womack, Jones and Roos, 1990, p. 13)

Purpose of the paper

Both White *et al* (1999) and Shah & Ward (2003) found empirical evidence from the US that large manufacturers are more likely to implement lean practices than small manufacturers. Therefore, it is interesting to study which are the challenges and critical success factors for European SMEs striving to succeed with improvement efforts based on Lean manufacturing.

The aim of this paper is twofold: first, the paper will study current research in the intersection between Lean manufacturing and SMEs. Smaller companies do not have the same access to resources as larger companies. What are the issues that smaller companies should consider when implementing different lean practices?

Second, this paper presents research from a European research project where the Lean methodology is being adapted to SMEs. The paper presents preliminary findings from case implementations in Norwegian and Belgium SMEs. A proposal of critical success factors for Lean implementations in these SMEs is given.

RESEARCH METHODOLOGY

Two main methods have been employed in this paper: a literature review, and a multiple case study from Norwegian and Belgium SMEs in the European research project ERIP.

Literature review

A study of current literature on the interface between Lean and SMEs has been conducted. Five different databases were used to search for journal articles from the last 20 years, using a combination of the two key word groups "lean" and "SMEs". This search resulted in a list of journal articles that seemed relevant for the topic. After assessing the articles, a smaller set of papers were identified as pertinent to the subject. The content of the relevant journal articles are presented in a separate chapter on findings from existing literature.

Time period	Databases employed	Keywords group 1	Keywords group 2
1992-2011	o ABI inform o Science Direct o ISI web of knowledge o SpringerLink o Google Scholar	o Lean o Lean manufacturing o Lean production o Lean implementation	o SME o SMEs o Small and Medium-sized Enterprises

Table 1: Details on literature search

Case company implementations in SMEs

The importance of SMEs in Europe, and their struggles to build competence to boost productivity was the backdrop for the EC to support the ERIP project through the Interreg North Sea Region programme. The project consists of 6 partner countries (Norway, Belgium, Sweden, Germany, the Netherlands and United Kingdom). In each country 4 to 7 test-SMEs got selected. A common methodology to facilitate Lean manufacturing practices was developed by the ERIP partners and has been tested in the participating SMEs.

In each country, a knowledge network has been created in the project, the so-called "Innovative Productivity Centres". These networks provide support, training and knowledge exchange, and bring together universities, research centres, regional development agencies, larger exemplar companies and a set of SMEs which are the case companies for testing the "Lean Change Methodology" developed in the project.

In Belgium, 7 case companies have been involved, and in Norway the research team has cooperated with 4 case companies. The companies represent several industries, but have all a strong focus on manufacturing of products that needs to hold high quality standards to meet customer demands.

Data has been gathered through a series of joint workshops between a team of researchers and each case company. Several critical success factors for lean implementation have been identified in the case company workshops. These factors where then analysed, categorised and validated in transnational workshops with researchers from the ERIP countries.

FINDINGS

Existing literature

Although much has been written on Lean implementations, the topic has rarely been studied in a SME context. The literature review of articles from the last 20 years revealed only 16 journal articles with the combination of "lean" and "SMEs". After assessing the papers, only 9 articles addressed the topic in particular. These articles have been summarized in terms of their methodology employed, focus of research and main findings. The results are summarized in table 2 below.

#	Authors	Methodology	Focus of research	Main findings and critical success factors (if addressed)
1	Achanga *et al.* (2006)	o Literature review o Cases: 10 SMEs (UK)	Critical success factors for Lean implementation in SMEs	o Critical success factors: - leadership - management - finance - organisational culture - skills and expertise
2	Kumar *et al.* (2006)	o Case: 1 SME (India), automobile accessories	Framework combining Lean Six Sigma with Lean Manufacturing	o Implementation of the proposed framework shows dramatic improvement in the key metrics and substantial financial savings in the case SME o Critical success factors not addressed
3	Jiju *et al*. (2005)	o Survey - UK SMEs o (literature review)	Strengths and weaknesses of SMEs, Six Sigma projects and lean	o Companies do not have resources to implement Lean Six Sigma projects o Lean and Six Sigma not popular among SMEs o Critical success factors: - Management involvement and participation - Linking Six Sigma to customers - Linking Six Sigma to business strategy
4	Kumar *et al*. (2009)	o Survey – UK manufacturing SMEs (64 responses of 500)	Quality improvement initiatives, Six sigma and lean	o Factors critical to success of quality initiatives are equal in importance, irrespective of type of initiatives implemented by the firm. o Critical success factors: - Management involvement and commitment - Communication - Link Quality Initiative to employee - Cultural change - Education and training
5	Wilson & Roy (2009)	o Literature review o Theoretical model with case	Lean procurement	o The barriers faced by SMEs trying to implement a lean procurement philosophy are significant. o Low volumes, small lot sizes and high frequency purchases incur significant additional distribution costs o Critical success factors not addressed
6	Thomas *et al*. (2008)	o Single case – UK SME	An integrated approach to lean and six sigma model.	o Showcases a successful implementation of the Lean Six Sigma model in the SME case company. The lean approach developed a culture towards continuous improvement throughout the organisation o Critical success factors not addressed
7	Grewal (2008)	o Single case – India SME	Value Stream Mapping	o Value Stream Mapping proved useful to company o Critical success factors not addressed.
8	Shah & Ward (2008)	o Survey of US plans with 1757 valid responses	22 management practices from lean and six sigma	o Strong support of the proposition that large plants (large companies) are more likely to possess the resources to implement lean practices than smaller plants o Critical success factors not addressed.
9	Yang & Yuyu (2010)	o Survey of 100 SMEs in Wenzhou region in China	Barriers to SMEs implementation of Lean	o Countermeasures to barriers to Lean implementations in SMEs: - attention and involvement of senior managers - good communication platform - learning organizations - establishment of performance evaluation system
10	White *et al. (1999)*	o Survey, US	Comparing 10 JIT practices in small and large firms	o Larger companies more likely to implement JIT (lean) practices o Performance also dependent on manufacturer's size.

Table 2: Reviewed articles studying Lean manufacturing in SMEs

The low number of articles in the intersection between lean manufacturing and SMEs indicates that this topic is under-researched, and that more research on SMEs is needed. According to Shah and Ward (2003), there is relatively little published empirical evidence about the factors that influence the implementation of lean practices. Notable exceptions are White *et al.* (1999) and Achanga *et al*. (2006).

SME characteristics and barriers to Lean implementations

In order to understand the difficulties SMEs can face when implementing lean, one can study three dimensions that differentiates SMEs from larger companies: Resources, Management, and Organization (Von Axelson, 2007). In terms of resources, SMEs face significant constraints. SMEs often have limited resources in terms of man power, access to skills and financial strength for investments (Antony *et al.,* 2005).

Management styles can be short-term oriented (Antony *et al.*, 2005) and there can be a lack of focus on performance follow-up (Smart *et al*, 2004). However, there are factors in SME management characteristics that are positive for Lean implementations. The management is usually small, informal and "hands-on" (Von Axelson, 2007; Smart, 2004).

The organisational structure in SMEs is often flat and less hierarchical than in large companies (Antony *et al*, 2005). An informal climate with flexible work planning (Antony *et al*, 2005; Von Axelson, 2007) could harm standardisation of processes. Still, several aspects of SME organisational characteristics can be seen as positive for a Lean initiative, such as large flexibility and high impact of the individual on company performance (Smart *et al,* 2005).

Although there exist several characteristics of SMEs that provide a suitable environment for succeeding with Lean, there are also obstacles and barriers that can be identified. Based on the literature review, the following five aspects summarizes the main barriers to lean implementations in SMEs, mainly based on Achanga *et al* (2006) and Yang & Yuju (2010):

1. *Unfamiliar with Lean Manufacturing.* The company must be familiar with the Lean production philosophy and its techniques. Unless managers in the company know about the potential in Lean, improvement initiatives are less likely to be initiated.
2. *"Not for us" - misunderstanding of the lean concept.* There exist some misconceptions that Lean requires significant financial investments or is only fit for specific industries.
3. *Not sufficient resources*. Not all SMEs have sufficient resources to allocate personnel to lean improvement projects. Training budgets and staff development programs are often limited due to a focus on reaching short-term objectives.
4. *Staff resistance to lean production*. There is an inherent resistance to change in most humans. For instance, the implementation of 5S will affect the way shop floor staff organize their daily working routines. A lean improvement initiative can also be perceived by employees as a way to get rid of work force by increasing productivity.
5. *Implementing lean without adapting it to the company specific setting.* Lean production has gradually developed based on Toyota's specific environment. When Lean is implemented it needs to be adapted to the specific requirements of that company and the requirements of the customers of that specific company. This can be the reason why many larger companies are now adapting Lean to become their own company specific production system.

Summary of findings on critical success factors

Based on the literature review, a set of areas were identified as potential important factors for succeeding with Lean implementations in SMEs:

- Leadership and management involvement
- Employee involvement and sufficient participation
- Change in organisational culture and the time factor

- Motivation and learning
- Performance evaluation systems
- Communication of goals and objectives with improvement initiatives
- Linking improvement initiatives to business strategy and customers

Guidelines for Lean implementations in SMEs

Lean Manufacturing is a production philosophy with a broad set of techniques and practices. Achieving a successful implementation requires careful analysis of how to decompose the Lean concept into a practical set of actions. The implementation process needs to be adjusted to specific external and internal characteristics of each organisation.

The purpose of this paper is not to provide a complete set of guidelines for implementing lean. The guidelines below where selected based on circumstances that were identified as particularly critical or challenging when studying the case companies in the study.

Experiences from the case companies from Norway and Flanders, Belgium were assessed using the main categories of topics identified through the literature review. This resulted in the guidelines that are presented below. Each guideline is discussed with the experiences from the case companies' implementation of Lean manufacturing.

Strong management involvement

Without management support, continuous improvement projects have almost no chance to succeed. Management support is of course also important for big companies, but we believe it is even more important for SMEs. We see several reasons for this:

- Impact on time allocation: one can only improve if time is invested in looking and discussing waste, improvement opportunities, problems, etc. If management does not want to free up time to work on continuous improvement, not much can be achieved. In SMEs there usually is a very big focus on production and on fixing the problems that occur at that specific moment ('fire fighting'). If you want to fix problems on the long run, you will have to free up time and work on improvement initiatives now.
- Impact on the motivation of employees: in SMEs, management is often closer to employees and thus, they have a big influence on the motivation or demotivation of their employees. If management does not support the changes that were made by the improvement team, motivation will decrease fast. It will be hard to keep the employees motivated to put extra effort in continuous improvement
- Impact on small investments: in big companies there is a budget allocated for investments. In several of our SMEs, even small investments had to be discussed and approved by the management. If you want to improve, big investments are often not needed, but one might have to buy extra material, equipment, repaint the floor etc. If the management team does not approve the investment costs that are needed for the lean team to move forward, chances are real that the improvement project will fail.

All these reasons show us that management support is highly important. Concerning the Flemish SMEs, 3 out of 7 SMEs did not achieve the full potential of the project due to the lack of management support. One of those companies changed management during the project. As a consequence the new management had a stronger belief in the implementation of continuous improvement and much more was achieved.

Sound involvement of employees

A successful implementation of continuous improvement can only be achieved if (most of) your employees believe in the change that is about to happen. In many companies the concern raises on how to get the employees believe that this change is needed and that it will improve their way of working.

We have seen that the way you build up the improvement programs and the amount of people you involve is a critical success factor. Two different situations are discussed:

- Involving too few people: in one of our smaller SMEs (40 employees), the main driving force behind the improvements is the operations director. Almost all improvement initiatives are executed by himself and one other employee. As a consequence, he has a very good overview of what needs to be done and how to do it. Unfortunately, every time he is abroad, visiting their plant in Czech Republic, the implementation of the initiatives slows down. We believe he did not reach the critical mass yet, which is needed to make continuous improvement a company culture and make it really continuous.
- Involving too many people from the start: of course, the end goal is to create a company culture that stops to fix problems and that continuously looks at eliminating waste. We have seen that in order to reach this company culture, it might be better to start with a smaller group of people that can 'infect and inspire' the other employees. The resources at an SME are limited. Therefore it is very hard to start with continuous improvement in the whole plant. It is better to focus the energy in one area and achieve good results and improvement in that area. The employees will see the effects and can promote the improvements among the other colleagues. In this way your whole factory can get inspired and motivated to start working on continuous improvement. As a consequence we had not to fight a whole group of non-believers but we were able to select the believers to join the project and to achieve the first promising results.

As a conclusion one can say that it is needed to reach the 'critical mass', enough employees to make the improvement initiatives really an ongoing effort. The way to reach the critical mass is an important issue.

Allocating sufficient time for change

SMEs are most often working from priority to priority. In fact "I have no time" does not exist, but "It is not a priority at the moment" does exist! Even though they all agree that continuous improvement should be a constant priority, it is often tempting to complete other more urgent tasks. Nevertheless, these tasks are less important and keep the SME from a habit of continuously improving. Therefore it is important to free up time, week after week. The time that you invest now can improve your processes. By improving your processes you will free up additional time that can be used for future improvement initiatives.

On top, the improvement pace of an SME is rather slow and variable. We have experienced it is very important to keep this in mind. Due to the fact that we are working in companies with relatively few employees, it makes sense to have workshops on continuous improvement if the key persons are available. But this have in some cases proved difficult due to holidays, illness or other priorities.

Every SME is different and wants to improve with a different pace. Many SMEs have seasonal demand and thus, the ability to work on improvement initiatives varies from month to month. It is important to make sure the already made improvements are kept during the busy months and that new improvement initiatives are executed during the less busy months. During the start-up of the implementation of continuous improvement it is therefore important that enough time is made available in order to achieve results and momentum for further improvements.

Motivation

SMEs often have a culture of “fire-fighting” and thus waiting to solve problems until they become serious and influence the production output drastically. As a consequence, many of the improvement initiatives were only done when they became urgent. In practice, this meant right before the external knowledge partner (team of researchers) was about to visit the company. All SMEs agreed that “external eyes force to act” and thus a close follow-up from the knowledge partner was highly appreciated and needed to create the external pressure to keep the internal improvement programmes running. In the second part of the project we had developed an online tool to monitor the achievements at the SME. While having a weekly online follow-up meeting we managed to “force” them to act every week, as the ‘external eyes’ would look over the shoulder by the end of the week.

Another way of creating the external pressure is peer pressure. Networks of companies with the same struggle and challenges create an inspirational environment to keep on investing time in continuous improvement initiatives. By sharing experiences on similar issues with different companies, great ideas are transferred and implemented faster. Even between different industries, the same challenges seem to appear.

“Learn it – don’t buy it”

The aim of this project was to install a true mind-shift of the participating companies and their employees towards an attitude of stopping to solve problems, looking continuously at the various forms of waste that are in their daily work and to continuously think about ways to improve their working situation.

In order to achieve this mind-shift, short improvement programs led by external consultants are not enough. This project was from the start meant to be a do-it-yourself project. Only in this way the employees can really become convinced of the impact continuous improvement can have on their situation. These employees will also be the ones that will continue the improvement initiatives after the project is over. Building the competence of your staff is vital: this type of knowledge should be developed in the organisation in stead of buying “finished” lean implementation programs from outside.

Performance measurement and KPIs

In all companies a variety of data is gathered and some key performance indicators are used. Unfortunately, too many companies only measure and discuss financial indicators. Fewer SMEs measured their operational processes, even though these measures have a direct influence on financial performance, and is a good tool to identify improvement areas.

We have seen that by setting up a small range of important performance measurements and by making them visible on the shop floor, a positive influence can be experienced. When workers see the indicators, they are more likely to take active part in improving them and looking better after the quality they produce, etc. If the indicators are well defined, they for can lead to desired behaviour and priorities at the shop floor.

Once the key performance indicators are measured and followed-up upon, one can start analysing the indicators and start working on improving the situation in a structured way.

On top, management is interested in the exact return on their investments. By introducing indicators one can prove that the improvements really had a positive effect. Therefore, a good mix of global performance indicators (lead time, delivery schedule adherence, etc.) and local performance indicators (quality, OEE, throughput of a machine, etc.) is vital to the success of any improvement program.

CONCLUSIONS

Contribution to practice and implications for managers

The study confirms findings from previous research, although the number of studies is limited. The critical success factors that have been suggested are:

1. Ensure strong leadership and management involvement
2. Allow for thorough employee involvement and sufficient participation
3. Allocate sufficient time for preparing the organisation
4. Make sure that there exist sufficient motivation for completing initiatives
5. Build competence in the internal organisation
6. Make sure a performance evaluation system is established in parallel

This paper can contribute to practice by having a set of guidelines that can assist SMEs in their quest to implement Lean manufacturing. SMEs have limited access to personnel and skills. With tight budgets and time pressure, there is little room for failure. Achieving a mindset of continuous improvement by all employees can create significant tangible results, visible on the shop floor and in the financial reports. This paper is based on the practical experiences of a set of SMEs. Therefore, it can be beneficial for other companies to avoid the pitfalls and challenges met by these SMEs.

Research limitations and implications for future research

One important limitation of this research so far is that the case companies have been selected based on companies that have shown active interest in Lean manufacturing principles. It can therefore be questioned if the set of case companies are representative for a broad spectrum of SMEs.

Second, it can be added that most of the companies have a firm size between 40-180 employees, and one can ask if the case companies are representative for micro and small enterprises from 2 – 50 employees.

Third, one can ask if results from the two countries, Norway and Belgium, are transferable to other European countries. The Norwegian business culture can be characterised by flat structures and strong focus on employee participation. In Belgium, business culture also can between the different regions, where culture in the Flanders region can be closer linked with Germany and The Netherlands. The ERIP team has reflected on this issue in our joint transnational workshops. Even though some differences have been seen in meeting culture and operating practices, it seems like the challenges met by the SMEs in the 6 different countries are quite similar.

The following areas have been identified as suggestions for future research:

- Research to provide more empirical data on critical success factors – which ones are particularly important for SMEs?
- Further developing sound and simple frameworks for introducing Lean as a part of regular operations in SMEs.
- How do national and regional differences in business culture and practices influence Lean implementations in European SMEs?

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BIOGRAPHY

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ACKNOWLEDGEMENT

This paper has been made possible by the ERIP project, funded by the INTERREG program. We would like to thank our colleagues from all six countries in the research team that are all taking part in developing the Lean Change Methodology. We also thank student Sergio Brembilla, a research intern at SINTEF, for his researching skills and efforts contributing to the literature review in this paper. And most importantly, we want to thank the case companies in Norway and Belgium that have opened their doors to us for honest and constructive discussions.