

IMPLEMENTATION BARRIERS OF LEAN MANUFACTURING IN THE PRODUCTION SECTOR

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ABSTRACT There are numerous publications on Lean Manufacturing (LM) which extensively describe specific tools used in the lean framework, the necessary steps towards implementation of the concept as well as benefits following from its implementation. However, it appears that despite the expected positive results, the companies which implement LM increasingly cease further activity in this area. The causes have not been fully recognized and the reason for the situation can be both the superficial knowledge of the LM as well as a lack of consistency in the decisions taken. Thus the aim of this Article is to identify the barriers to their introduction among the companies which are currently struggling with the LM implementation and the companies which have already completed it. Based on a conducted CATI survey, an attempt has been made to identify both the internal and external barriers. Furthermore, the expertise of companies was examined in terms of knowledge of lean tools, including the awareness of the expected benefits from Lean Manufacturing implementation. The study involved Polish manufacturing companies operating in the Zachodniopomorskie Voivodeship.

Introduction

Modern enterprises operating in the age of the ever-increasing globalisation are forced to respond quickly to changes in the environment. Fast technical and technological progress, increasing customer awareness and expectations, as well as shortening the life-cycle of products are among many factors which contribute to the daily struggle of production companies. But this does not mean that organizations are doomed to fight the unknown.

It occurs that the concept of lean management is helpful in this area. As indicated by E. Lodgaard et al. (2016, p. 595) "lean (...) has been introduced by almost all significant actors and has been known as a crucial strategic weapon". Therefore it is fair to say that the Lean Management is an essential component for any manufacturing organization which aspires to compete on the international market. This also applies to the Polish market, on which the number of actors implementing lean is still unsatisfactory. Thus, it is necessary to conduct research in order to identify and understand the barriers encountered in implementing the LM in manufacturing companies. In turn, the research problems have been formulated as follows:

1. What internal barriers hinder the enterprises from implementation or the completion of the implementation of further Lean Manufacturing instruments?
2. What external barriers impede the implementation of Lean Manufacturing?
3. What is the LM expertise of the enterprises?
4. What are the benefits of the implementation of LM in the opinion of the production companies?

For the realisation of the scientific objective there was carried out a CATI (computer-assisted telephone interviewing) survey among Polish companies (in Zachodniopomorskie voivodship), which allowed for collection of responses to the identified research problems.

Literature review

According to the National Institute of Standards and Technology Manufacturing Extension Partnership's Lean Network, Lean Manufacturing (also called Lean Production) is defined as "a systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in the pursuit of perfection" (Kilpatrick, 2003, p. 2).

Therefore, it is possible to achieve perfection by the implementation of the rich spectrum of LM tools in order to both improve the functioning of the organization and to respond quickly and adapt to the upcoming changes in the environment. Yet, each company is different, hence it is reasonable to match these tools to the vision of the development of a particular organization.

Hence the particular importance has identification and understanding explanatory reasons, why the rate of failure is so high in order to plan implementation properly (Frankowska, Myszak, Sowa, 2017, pp. 431–440). Looking at the current researches in the academic literature relating to manufacturing companies, some barriers to lean implementation are often repeated, what was presented in Table 1.

In fact, the literature includes an abundance of research on the reasons for hindering the implementation of LM; what is problematic is their synthetic presentation and comparative analysis. These difficulties stem from the fact that the studies have been conducted in different countries and sectors of the economy, on different research samples and by means of a variety of methods, techniques and analytical tools. Nevertheless, as shown in Table 1, some examples of the research on the barriers in lean implementation in the production sector show certain convergent aspects, such as the up-to-date character of the raised considerations or the selection of the sample from the same production sector. In view of the above, it was decided to highlight common areas of barriers specific to production companies implementing LM. Primarily these include the so-called "soft" factors, among others: unsuitable leadership (including a lack of incentives), corporate culture unsupportive of change (employees resistant to change, lack of employee engagement and commitment to change) or absence of training, which in turn translate to the inadequacy of employee's knowledge, skill and expertise in terms of LM concept. Other barriers

Table 1. Examples of barriers in Lean Manufacturing implementation

Author	Research sample	Barriers
R. Kumar, V. Kumar (2014)	Large and medium sized manufacturing companies	<ul style="list-style-type: none"> – management (lack of management focus, lack of urge to create sense of urgency, lack of management support, lack of long term vision), – resources (lack of labour resources, lack of capital fund, lack of communication, lack of idea innovation, mediocre consultants, lack of time), – knowledge (lack of training, lack of understanding about lean, lack of implementation know-how), – conflicts (conflicts with other initiatives, disparate manufacturing environments, demand volatility, company culture, conflicts with erp implementations), – employee (resist to change, middle management resistance), – financial (no direct financial advantage, financial benefits not recognised, no financial targets), – past experience (past experience of failure, lack of staying power)
K. Salonitis, Ch. Tsinopoulos (2016)	All companies from the manufacturing sector	<ul style="list-style-type: none"> – lack of employees engagement and commitment to change (fear of losing their job, inertia to change, lack of understanding of the need for change and of knowledge on the actual tools to be used), – financial barriers (necessity of high investments/costs), – misunderstanding lean concept (it is not possible to have commitment from high management and workforce on something that they do not really understand), – lack of lean training, – lack of leadership commitment and engagement, – customer focus (lean can be revealed only through more structured and better customer engagement), – lack of lean introduction method (employing a external lean expert is not a common practice in Greece, expert should be a part of the company, fear that the external expert will try to copy the implementation plan that may have worked in another company)
H. Moradlou, T. Perera (2017)	SMEs manufacturing sector	<ul style="list-style-type: none"> – lack of top management support (lack of establish clear communication between production managers and employees, lack of commitment on training other members of the organisation), – financial and resource constraints (in addition to the capital required for each tool, there is a cost for the external consultancy and training; the resistance of the companies towards dedicating extra capital on proces improvement), – lack of employee's skill and expertise (lack of training, education and technical knowledge), – organizational culture (employee resistance to changes and lack of focus on their long-term roles)

Source: own processing.

identified include resource restrictions as well as financial aspects (implementation costs) and no observable positive financial effects. Interestingly, factors related to the management and human factors constitute the most significant barrier group.

Method

On the basis of previously developed, integrated array of lean implementation conditions (Frankowska, Myszak, Sowa, 2017, pp. 431–440) there have been identified internal (endogenous – directly associated with the company, including financial factors, human resources or production system) and external (exogenous – relating to the environment in which the company operates e.g. requirements of customers or expert support) conditions, which refers to the concept of lean supply chains (Jones, Womack, 2017, p. 15). This has helped to respond to the identified research problems (Figure 1). There was conducted a detailed review of the literature (theoretical and empirical) for LM implementation barriers. Then the survey methodology was determined, as a result of which there had been developed a survey questionnaire dedicated to businesses which had the experience in the LM implementation. In parallel there has been created a database of 250 manufacturing companies located in the territory of West Pomeranian Voivodship.

The research involved telephone interviews, as a result of which the information was collected from 40 manufacturing companies, among which 20 complied with the pre-set criteria, i.e. had undertaken activities towards implementation of the LM. The entities surveyed were mainly medium (10) and big companies (7). Small companies represented three entities and there were no micro-enterprises. In most cases they were of foreign capital (10), but also domestic capital (9) and one entity was public enterprise. There was big diversity relating the time of the functioning of the companies: four companies had operated on the market for less than 5 years, the remaining six entities had operated for 6–10 years, four entities for 11–20 years and six companies had had a record of functioning for more than 25 years. The respondents in the survey were primarily representatives of middle management (8), as well as senior management (6) and specialists (6) on quality assurance in the companies surveyed.

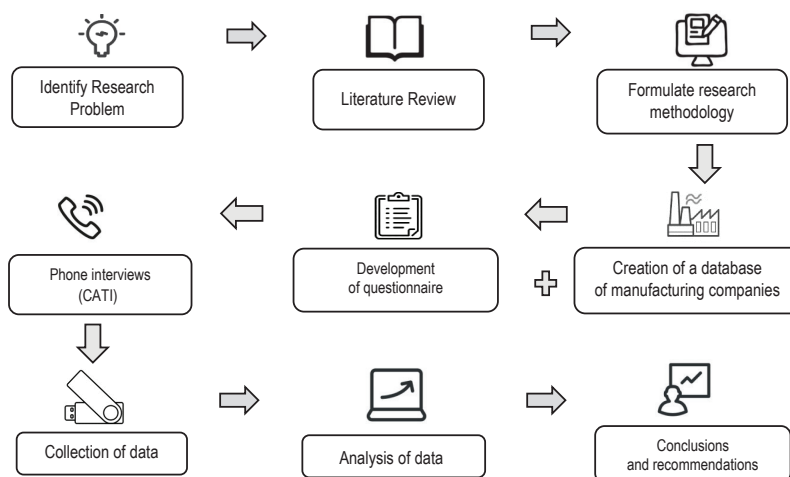


Figure 1. Research methodology

Source: own processing using draw.io program.

The research material was submitted for analysis on the basis of which there were drawn conclusions and proposed preliminary recommendations. Unfortunately, the research sample obtained is not representative and therefore the results of the research are of probing character and require confirmation in further research.

Results and discussion

Enterprises were asked to indicate when the first implementation of LM occurred (Figure 2). It turns out that 40% of respondents have no more than one year of experience in the implementation of LM. The other respondents have longer experience, including 1/4 of respondents implementing the first LM tools over 6 years ago.

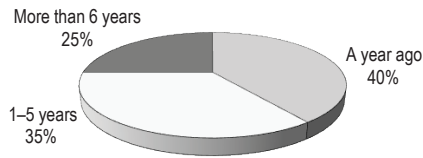


Figure 2. The first implementation of the Lean Manufacturing tool in an enterprise

Source: own processing.

Subsequently, the respondents were asked to indicate the LM tools they know (prompted awareness) and those that were implemented in their enterprises (Figure 3). The knowledge of the respondents goes significantly beyond the scope of LM implementation in their companies. On average, the respondents know 6.7 LM tools, while 3.2 LM tools were implemented in the surveyed enterprises. Tools that are known to at least half of the respondents include: 5S (16), Kaizen and standardized work (each 14), kanban and SMED (each 13), MUDA mapping and Poka-Yoke (each 12), Six Sigma and Andon (each 10). Closer analysis of the data proves that in the case of groups of respondents, the greatest knowledge about LM tools is possessed by specialists and middle management personnel. In turn, the most frequently implemented tools in the surveyed enterprises include: 5S (15) and Kaizen (10). The other five companies that did not implement 5S as the basic tool chose: standardized work (3), Kaizen (2), MUDA Mapping (1) or Value Stream Mapping (1).

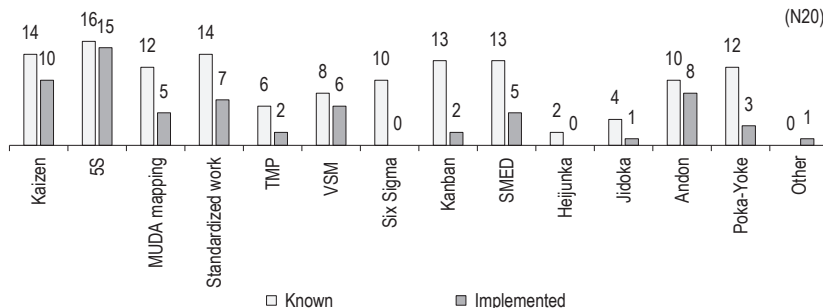


Figure 3. Knowledge and implementation of lean tools

Source: own processing.

As the main objective of the research was to identify barriers to the implementation of LM in manufacturing enterprises, the respondents were asked to assess the internal barriers to LM implementation. Most assessments fluctuate around average results (Figure 4). It seems that the relatively biggest barrier (3.5/5.0) is having the right resources understood as the right number of employees, the right amount of time and their range of knowledge. On the background of moderate responses, four additional barriers attract attention, these are: organizational factors and the way of managing the company (3.1/5.0), attitude and competences of the management staff, including their conviction about the rightness of implementation and the support (3.1/5.0), as well as involvement in the implementation of LM's tools and convincing about equity by other employees (3.1/5.0). The specificity of the

technology used in enterprises may also be problematic, especially its level of advancement (3.1/5.0). It seems that the relatively smallest barrier is the specificity of the production system of the surveyed companies (2.8/5.0) understood as the type of production used and the number of positions and/or plants.

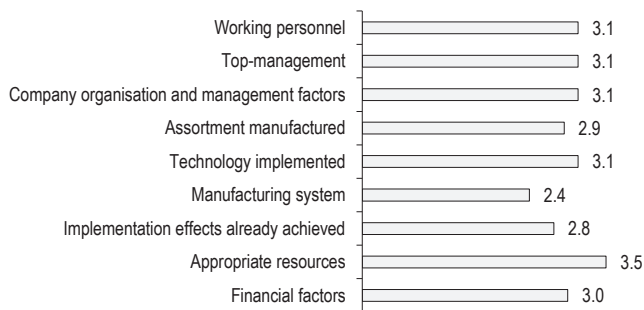


Figure 4. Average rating of internal barriers for the implementation of Lean Manufacturing

Source: own processing.

Next, respondents were asked to assess external barriers, i.e. environmental factors that inhibit the implementation of LM in the surveyed enterprises (Figure 5). These factors were related to business partners in the supply chain (customers and suppliers), the availability of expert knowledge and financial resources, as well as knowledge of the knowledge about LM among enterprises. It turns out that in the opinion of the respondents there are no significant external barriers, and the largest of them is low LM knowledge among enterprises (3.4/5.0). This may be related to the limited interest of suppliers in improving the organization of deliveries (3.1/5.0) or information flows based on the use of ICT systems (3.1/5.0). Interestingly, LM's lack of interest among customers is no longer such a significant problem (2.3/5.0). It seems that this may be related to combining LM tools mainly with improving the efficiency of production processes and the supply phase of the enterprise logistics system. At the same time, respondents indicated that access to LM experts (2.3/5.0) as well as external financing (2.6/5.0) is not a significant difficulty in their opinion.

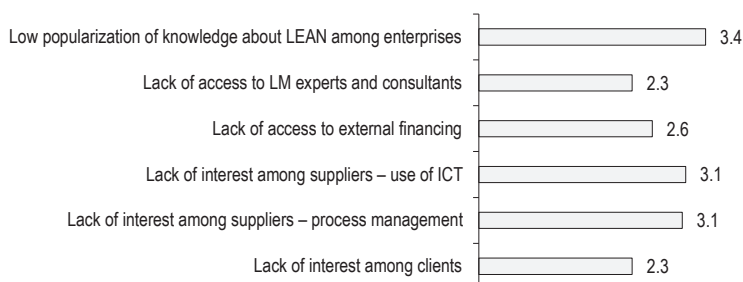


Figure 5. Average assessment of external barriers for the implementation of Lean Manufacturing

Source: own processing.

Comparing the assessment of internal and external barriers and making them aggregate, it can be seen that they are similarly evaluated (Figure 6). Internal barriers (3.0/5.0) are slightly more important than external barriers (2.8/3.0).

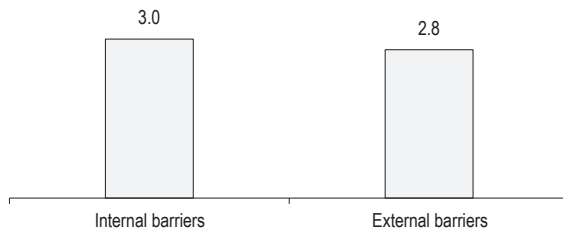


Figure 6. Average assessment of Lean Manufacturing implementation barriers

Source: own processing.

In the following, the respondents were asked to evaluate the benefits obtained from the implementation of the LM (Figure 7). The vast majority, 85% of respondents declared that their companies are benefiting from the introduction of LM, 5% stated that no benefits were observed, while 10% did not have knowledge in this respect. It is worth adding that these 15% of the surveyed companies have started the implementation of LM tools in the current year and it may be too short a time to observe positive effects.

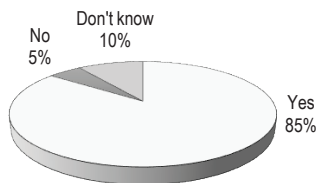


Figure 7. Lean implementation and achieving benefits by companies

Source: own processing.

Respondents who noticed the positive effects of LM implementation were asked to indicate the greatest benefits (Figure 8). It turns out that the improvement of work organization (4.8/5.0) as well as reduction of production costs (4.5/5.0) is assessed best. In addition, the average quality of products (4.3/5.0) and the faster time of performing operations (4.2/5.0) are also above average. In this statement, the relatively least benefits are observed in terms of greater timeliness of orders (3.8/5.0).

Due to the observed positive effects of the implementation of the LM interesting was the position of surveyed companies regarding the continuation, including new LM tools (Figure 9).

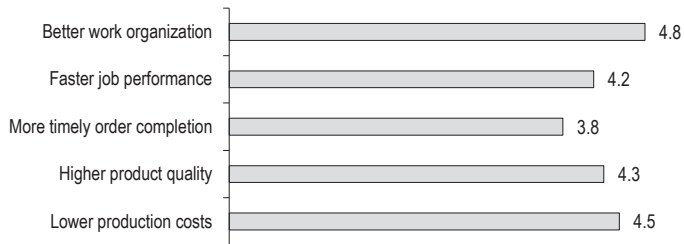


Figure 8. The average assessment of the benefits following from the implementation of the LM

Source: own processing.

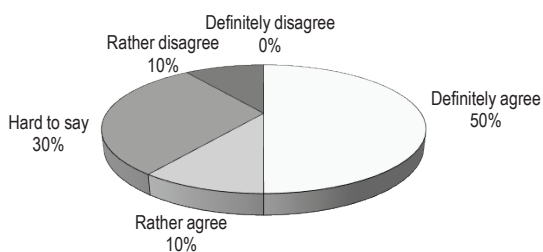


Figure 9. The planned continuation of lean implementation

Source: own processing.

Half of the respondents are definitely in favor of the continuation of the implementation of the LM (50%), and every tenth company is considering such a positive decision (10%). In turn, 10% of respondents also rather not planned further implementations, about 1/3 had no opinion in this respect (30%).

Conclusions

To summarise, it should be noted that the study conducted has enabled the implementation of the research objectives presented at the outset. The respondents have quite good knowledge of the available LM tools (on average they know 6.7 out of 13 listed tools), but more extensive knowledge is displayed by middle-level managers and specialists rather than top management. The companies studied have noted benefits from LM implementation, which primarily include better work organization and reduction of the production costs. The study also allowed for finding major internal (lack of appropriate resources, staff-related barriers at different levels and management styles) and external barriers (low level of LM dissemination among enterprises, including partners in the supply chain i.e. suppliers and clients). The analysis has provided further details of the highly differentiated responses. However, in terms of average assessment it is found that companies which have implemented LM do not notice significant barriers encountered in implementation (the average assessment is around 3.0 in scale up to 5.0). It is therefore vital to view the data with caution and be aware of restrictions of the study method (CATI) and the relatively low research sample (20 companies met the adopted criteria). The study confirmed the significance of the various barriers identified on the basis of the subject matter literature analysis, yet for the better understanding a different

study method (qualitative research) would be required. The triangulation of research methods would be consistent with the postulate of the methodological pluralism (Sulkowski, 2015, p. 35) and would allow for better explanation of the observed phenomenon of the limited scope of the LM application in manufacturing companies, as proven by this study.

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