

THE ROLE OF THE KEY ENTERPRISE OF THE SUPPLY CHAIN IN LEAN PRODUCTION

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Abstract

In today's globalized world the cooperation and close connection between enterprises reduce the mutual boundaries between them. Competitiveness of enterprises is nowadays a value-added challenge rather than a question of "how much to produce" or "how much to buy". Lean production methods and supply partnerships allow enterprises "to produce more with less" resources, costs and time. Supply chain networks integrate, coordinate, and manage the movement of goods, materials and information from the supplier to the end customer. At the heart of these business-to-business relationships is a key managing enterprise (key link) that guides individual flows and maintains linkages between connected enterprises with a perspective of long-term partnership based on cooperation and mutual exchange of information. The paper deals with the definition of a key enterprise of the supply chain and its role and importance for the lean production methods. The authors present the results of the questionnaire survey, which was focused on the use of methods of lean production in enterprises from the perspective of enterprises position in the supply chain. The results show that there is not a positive correlation in the use of lean manufacturing methods between the enterprises identified as key enterprise and dependent enterprise. This conclusion applies to both new and traditional lean production methods. The most used are the CIP and EDI. The lean supply chain can be created regardless of the existence of a key enterprise through workgroups, virtual organisations or consulting companies which support the coordination role.

Keywords: Supply chain, key enterprise, lean production

1. INTRODUCTION

In the last century, enterprises could be characterized as unique and independent internal units. Nowadays, however, enterprises are considered as a part of an external supply chain system. Supply chains are now operating in a world where the pace of change continues to rise. Enterprises are positioned in different places in the supply chain. Within the context of their position, they all require planning, sourcing, making, delivering, and returning processes. The central idea of supply chain management is to apply a total system approach to managing the flow of information, materials, and services from raw material suppliers through factories and warehouses to the end customer [1].

The article deals with the question of whether lean manufacturing methods are used more by enterprises in a key position in the supply chain network than companies in a dependent position. If there is no key company in the network, then the possibilities to coordinate and manage supply chains are virtual organization, working groups or other concepts for example based on fourth-party (4PL) logistics. The difference between key enterprise concept and other concepts lies in the participation of companies in supply chain on coordination and managing role. The implication of today's turbulent and unpredictable business environment is the new solution "demand chain management" [2]. Demand chains will use new manufacturing techniques (such as additive manufacturing) and enhanced information flows, exhibiting both lean and agile characteristics. The need for greater interconnection of enterprises in supply chain networks is supported with the use of lean manufacturing methods such as Just-in-Time, Kanban, Pull system, VSM etc. Lean production is primarily focused on simpler and less demanding activities that do not require demanding investments. Implementation

of these methods affects the entire supply chain and its successful management requires the willingness of all enterprises involved in the supply chain network.

2. THEORETICAL BACKGROUND

The concept of supply chain management is relative new - first defined in Financial Times by Arnold Kransdorff in the article on Booz Allen's "*rather grandly titled supply chain management concept*" [3]. Supply chain management is a very complex term that includes more functional areas of the organization, including raw materials, transport throughout the production process, stock and distribution. The word "chain" should be replaced by "network" to reflect fact that the chain should be driven by the market, not by suppliers and there will normally be multiple suppliers to suppliers' relationships as well as multiple relationships with customers included in the system [3]. Supply chain management involves parties upstream and downstream agreeing to work together by joining their respective logistics systems together. These logistics networks are a subset of supply chain networks, the key difference being the crucial interfaces between each supplier-buyer combination [4]. The truly central position in network is reserved for those nodes (enterprises) that are simultaneously part of many large clusters [5]. In the supply chain context, the connectivity distribution of efficient supply chain systems follow a power law for all connection types as indicated by the presence of hub firms (sellers to those with many alternative vendors). Thus hub firms are essential for the efficiency of a supply chain [6].

It is necessary to design and follow strategy for the whole network, which behaves like a complex system. Christopher [3] proposes the establishing of a supply chain "control tower" that will formally constantly monitor, control and manage complex relationships within supply networks to ensure that the intended events and outcomes happen as planned. The supply network is usually centrally managed by one large enterprise, called a "focal enterprise", "head player", "key player", "key enterprise", a network integrator who has a leading role in supply chain management [7]. Supply chains often operate in a decentralized form in which can be guided and overlooked by a key player [8]. Some coordination mechanisms are often applied in order to avoid the profit loss of supply chain members after changing decisions [9]. Particular attention as a key role in the supply chain has plants discussed in the context of the production network and examines the relationship between factory role and coordination [10]. A lack of coordination in supply chains leads to firms behaving out-of-unison with one another resulting in many inefficiencies, duplications and an inability to adapt to change [6]. Focal enterprises collaborate with suppliers on supply chain management initiatives where vendors can steer a sustainable leadership vision. That is viewed as a characteristic of leadership [11]. Focal companies should play a leading role and apply different leadership styles towards different tiers of suppliers in the implementation of sustainability initiatives [12].

On the other hand supply chain management can take over a virtual enterprise that enables high dynamism, flexibility and adaptability. The virtual supply chain is characterised by a dynamic and flexible network of risks sharing, information, costs, and partnership competencies [13]. With virtual logistics, physical and information aspects of logistics operations are processed independently of each other and the ownership and control of resources is caused through Internet. Networking at the level of network management and individual partners can be transferred to a virtual enterprise that performs individual network tasks without physical existence [14]. Another way to virtual managing of supply network is called working groups, composed of specialists from different network organisations which meet regularly a share common tasks and functions important for supply chain management. Other concepts of managing supply chain are outsourcing to service providers or new concept called fourth-party (4PL) logistics. 4PL model include systems architecture and integration skills, supply chain control room, ability to capture and utilise information across the network and access to "best of breed" asset providers [3].

Enterprises forming lean supply chains apply the lean production philosophy [15]. These methods were developed in the automobile industry (Toyota) and centred on the philosophy of continuously improving

performances by systematically eliminating wastes in the manufacturing floor [16]. Many of the lean production methods have been improved thanks to modern technologies during the period of fourth industrial revolution characterized primarily by digitization, robotics and artificial intelligence. Improvements do not only concern the current production, but the entire value chain, from the development of new products through production to recycling at the end of their life. The relationships among lean supply chain methods (practices) tend to conflict when are concurrently implemented [17].

The traditional methods in our research include such methods that have been known since half of last century: Just-in-Time (JIT) followed by Kanban, Electronic Data Interchange (EDI), and continuous improvement processes (CIP). The method Just-in-Time is based on reducing inventory and storage space by delivery the necessary items in the correct quality and the necessary quantities only when they are needed. Then Kanban cards then extend this method to the possibility of a self-regulating production system that fulfils the function of orders. EDI is an important method of informational technology, making the communication between enterprises easier via digitalization. CIP is a process-focused approach to achieve continuous, measurable improvement in the workplace. The success of this system lies in an organized form of activities that support employees in implementation, monitoring and analysing the processes.

The new methods in our paper include 5S, TPM (Total productive maintenance), VSM (Value stream management), and computerized management of production (CAM). These methods are referred to as the new methods and we are exploring their implementation both in relation to traditional methods. The essence of the 5S method is to organize the workplace through five steps (sort, set in order, shine, standardize, and sustain) to reduce waste by maintaining and organizing production and offices. Purpose of VSM method is to enhance transparency and support improvements within the production process [18]. The TPM method intends to maintain the facility and equipment when needed, neither earlier nor later. Maintaining is supervised by the workers who work with the machines and easily recognize possible problems. The method of CAM includes number of computer supported activities which integrate manufacturing system or at lower levels contain partial methods of computer-based management, planning or design.

3. METHODOLOGY

The aim of the research was to find out the differences in the use of the main lean production methods according to their importance (whether an enterprise is considered a key or dependent link) in the supply chain. The methods of lean production are partial tools, useful under particular conditions, which enterprises have to meet. The methods are divided into two main groups: traditional and new methods.

The research is based on 90 questionnaires, which were filled in with the managers by the students of the University of South Bohemia in České Budějovice, Faculty of Economics in 2016. The sample consists of 29 % small enterprises (up to 49 employees), 38 % medium-sized enterprises (50-249 employees) and 33 % large enterprises (over 250 employees). According to the type of industry, the sample consists of enterprises: 50 % engineering industry, 19 % electro-technical production, 27 % production of products for domestic use, and 4 % production of food industry.

The questionnaires were first analysed by enterprise size, business specialization and Classification by ownership relations in research paper [19]. In this paper, the importance of position in the supply chain is analysed. The results obtained were subjected to statistical analysis by „individual tests of equal and given proportions without correlation to continuity“. In the case of multiple comparisons of relative frequencies, Holm's method of adjusting the level of significance reached was used. The results are interpreted at alpha significance level = 0.05, resp. with 95 % reliability. For reasons of clarity, only significant results, including achieved level of significance (p-value), are given in the text. Statistical evaluation of individual tests was performed using R 3.3.3 programming environment.

4. RESULTS

The research sample consists of 90 enterprises (as mentioned in methodology), but only 72 enterprises responded whether they are a key or dependent member of supply chain network. This means that about 20 % of enterprises were unable to determine whether they had a managing role in the supply chain network. The results of the research are divided into the traditional and new methods.

4.1. Traditional lean production methods

Table 1 describes the use of traditional methods in enterprises in relation to their position in supply chain network. These methods are: Just-in-Time (JIT); Kanban; Electronic Data Interchange (EDI) and Continuous improvement process (CIP). The percentage for each method shown in the **Table 1** is calculated from the number of enterprises in column "number". If there is more than one answer to one question, it exceeds the sum of 100 %.

The overall results show that there is not a statistically significant difference (p-values) in the use of traditional lean production methods among the enterprises identified as "key" and "dependent enterprise". This means that the observed differences are minor and do not provide a reason for distinguishing between the uses of lean methods based on a position in the supply network.

Table 1 Traditional methods of lean production (%)

Categories of companies	Number	JIT is used	Kanban is used	EDI	CIP
Key enterprise	43	27.91	25.58	51.16	46.51
Dependent enterprise	29	13.79	17.24	34.48	37.93
p-value	-	0.26	0.59	0.25	0.63

Source: authors

The most used traditional lean production methods by enterprises are EDI and CIP with the highest % scores. These methods are highly evaluated for both key and dependent enterprises. The most widely used traditional lean production method is EDI, which makes the communication of two subjects easier, by converting the data from one system to another faster. Questionnaires have revealed that the Just-in-Time method is used only partially in enterprises, mostly in enterprises in key supply chain position. Surprisingly, there is a low use of the JIT in enterprises, although the method allows closer cooperation in supply chain network.

4.2. New lean production methods

Table 2 summarizes the use of new lean production methods in enterprises according to their position in supply chain network. These methods are: Total productive maintenance (TPM), Value stream management (VSM), and computerized management of production (CAM). The percentage for each method shown in the **Table 2** is calculated from the number of enterprises in column "Number". If there is more than one answer to one question, it exceeds the sum of 100 %.

Table 2 New methods of lean production (%)

Categories of companies	Number	5S	TPM	VSM	CAM
Key enterprise	43	37.21	32.56	32.56	20.93
Dependent enterprise	29	20.70	34.48	34.48	17.24
p-value	-	0.22	1.00	0.70	0.93

Source: authors

The overall results suggest that there is not a statistically significant difference (see p-values) in the use of new lean production methods among the enterprises identified as "key enterprise" and "dependent enterprises". The results found that the criterion of position in the network is not important even with the use of new lean production methods. Almost no differences in usage by network position can be found for methods TPM and VSM. There is a little dominance of the dependent enterprises over the key enterprises in usage of these methods.

4.3. Discussion

The research results show that there is no statistically significant difference in using lean manufacturing methods between the enterprises according to their position in supply chain. The explanation for this result may be the fact that some lean production methods are focused more into internal enterprise environment such as improvement of production and manufacturing (especially methods 5S, CIP, Kanban, CAM). Their implementation and deployment therefore do not depend on the external environment and the supply chain network position. Enterprises can use these lean production methods independently of their business partners.

On the other hand there may be very close interconnection of enterprises, which is supported by smaller differences between results of the key and the dependent enterprise. In other words, all enterprises may be involved in supply networks in some ways. Such involvement creates a long-term cooperation and integration of information systems and the implementation of similar lean production methods (especially JIT, CAM, VSM, EDI). Without implementation of these lean production methods, it is not possible for these enterprises to join the supply chain network and use the benefits of this connection. For this reason, these methods are used in the supply chain by most enterprises, regardless of their positions (key or dependent).

Finally, research also found that more than 20 % of enterprises were unable to determine whether they were a key link. The position does not have to be priority in the supply network, and in fact, no such key enterprise may exist. The enterprises can be in dependent position to key enterprise, but without more information about this enterprise. So they didn't answer the question in questionnaire. Some of the enterprises may be connected to supply chain networks that are not managed or controlled by a specific key member, but rather by a competency group [20] or virtual enterprise [13]. This result brings other questions regarding the definition of key enterprise itself.

5. CONCLUSION

In the paper, the importance of using the lean production methods in the supply chain context is analysed. The results show that there is not a statistically significant difference in the use of lean manufacturing methods between the enterprises identified as "key enterprise" and "dependent enterprise". Traditional and new lean production methods are used by enterprises connected in the supply chain regardless of their position in the network. It means that lean supply chain can be created regardless of the existence of a key enterprise, but some degree of coordination is always necessary. This can be achieved through the use of working groups, virtual organizations or consulting companies. The researched enterprises use most the CIP and EDI lean methods. The importance of these methods with regard to their focus lies in promoting and improving cooperation within the supply chain network. So, we recommend start implementation of lean supply chain with these methods.

A new question for future research has been occurred then was expected. First, the more clear definition of the position in the supply chain (the key enterprise definition) will be necessary to formulate. Another issue is the analysis of situations where authorities and competencies for supply chain management are shared through multiple enterprises in the supply chain network. It will be necessary to find out whether the supply chain networks use a different way of supply chain management such as working groups or outsourcing through consulting companies.

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