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Factors and Barriers of Lean Implementation A Delphi Model Development in the Freight Transportation Sector

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Abstract

Lean management assessment and readiness starts with developing a gap analysis between the factors and barriers that create or impede successful lean implementation. The article presents the main factors and barriers that sustain or prevent the lean process implementation in the freight transportation industry. In regard to the freight transportation sector, seven criteria of assessment were taken into consideration for developing a Delphi model of consultation of the experts. The lean implementation criteria refer to: cost/benefit, employees training and growth, effective leadership, financial capabilities, technical factors, organizational culture and synchronization between lean goals and actual practices. The results of Kendall's coefficient analysis reveal with high level of consensus between experts that VSM, JIT, TQM, TPM, TMS and RFID implementation depends mostly on the organizational culture of transportation companies based on innovation, clear strategies of senior management, easy access to financial resources and simulations for effective measurement. Based on experts' consultation, the study concludes that the lack of research and development activities, top management resilience to change, poor tools of performance measurement and lack of integrated strategies constitute the essential barriers of lean application in the freight transportation sector.

Keywords: lean implementation, factors, barriers, freight transportation sector, VSM, JIT, TQM, TPM, TMS and RFID.

JEL Classifications: M110

1. Introduction

The lean paradigm was first mentioned in the scientific literature by Krafcick (1988) and has constantly evolved in the last 40 years, encompassing a broader set of principles and practices, being spread globally across many industries and fields of activity. The follow-up publications of Womack et al. (1990) capture the differentiation process between the TPS (Toyota Production System) model and

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the new lean paradigm incorporating practices such as Kanban, JIT (just-in time) production and delivery, TQM (total quality management), quality circle or cross-functional teams. The new "lean production" incorporates principles, practices and techniques developed by the Japanese automotive companies in the past century. (Emiliani, 2006; Sone, 2012) The superiority of the new lean management is reflected in terms of high productivity, increased processes velocity, quality and flexibility. (Schonberger, 2007) In addition, other researchers agree on the idea of multiple practices combinations in lean management, with the difference of a more holistic approach. Successful lean implementation assumes perfect supplier alignment and integration, and lean is talking about creating long-term partnerships with suppliers who share the same philosophy and practices of value creation and continuous improvement (Dyer and Hatch, 2006; Manfredsson et al. 2019; Shah and Ward, 2007). Despite of the positive results of lean thinking application especially in the manufacturing sector, many publications highlight issues and failures in lean implementation related to employee's stress and human resources management. An extended literature provides evidence of challenges when it comes to combining lean techniques into a coherent, integrated management system. A large number of articles pinpoint resistance factors and barriers in successful lean implementations in reference of workforce training and labour issues. (Stone, 2012) Hence, setbacks of lean implementation were explained by means of a poor understanding of the employee empowerment principle or lack of training management system. Bhasin and Burcher (2006) underline some certain issues related to lean application, explaining the poor rate of lean implementation within companies. There are other opinions that depict more resistance to change when it comes to innovative manufacturing improvements and less flexibility to adapt in particular situations (shut-downs, accidents, machine burned-out). In his research, Mousa (2013) underlines some inefficiency in JIT deliveries that quite often may cause employees' dissatisfaction, delays or freight claims due to shortages. The research of Chan et al. (2019) underlines the importance of leadership strategies and communication quality in lean application.

Using the field force analysis as the primary research method and also the fuzzy logic method, Baskaran and Lakshmanan (2019) have represented mathematically in their study a plethora of factors and barriers in lean manufacturing. Previous studies confirm the results, the emphasis on successful lean implementation relying mostly on management commitment, empowered workforce, and technological support. As far as the barriers concern, resource constraints, investment restrictions and exterior factors (fluctuations in demand) are amongst the preventing factors of lean application. Proper lean management application contributes to continuous improvement, process optimization and waste minimization, creating more balance between efficiency and resilience in unpredictable situations. (Păunescu and Argatu, 2020) The present research presents the specific of the transportation sector in regard to the most influential factors/barriers in lean practices implementation.

The purpose of the present paper is to identify the factors and barriers that influence the extent to which lean implementation in the freight transportation sector proves its effectiveness.

Therefore, the article is structured as followed: introduction, literature review revealing the previous findings of researchers with regard to determining factors or barriers in lean practices deployment, methodology description, presenting the Delphi model development, research results and conclusions.

2. Problem statement

2.1. Lean practices application in the context of digitization and globalization of the freight transportation processes

Operations management literature provides the most important lean manufacturing practices that usually lead to superior operations and financial performance. (Olsen, 2004) However, the literature proves its scarcity in regard to certain practices adopted in the freight transportation sector. The traditional manufacturing lean practices, namely JIT, TQM and TPM (total preventive maintenance) know an extensive and enlarged area of effectiveness when are backed-up by practices related to the digitization trends. The adoption of the new TMS (transportation management system) or RFID (radio frequency identification) systems support and sustain transportation lean objectives of zero waste, continuous improvement, high velocity of the transportation fulfilment and consistent visibility. (Popescu, 2020, June).

The achievement of transportation leanness implies factors consideration such as time, cost, flexibility and visibility. In the light of lean practices application, an integrative freight transportation business model assumes reduced transportation cycle time, decreased shipping/receiving time, minimized idle time; in terms of cost, an increased employee effectiveness within the warehouse management processes, no paperwork inaccuracies and product rejected, avoided traffic jams with no fuel waste; in terms of visibility, no product shortages, re-routing the drivers in a timely manner avoiding delays and fines, increased safety avoiding fleet shut-downs and accidents; and not the least flexibility in terms of innovation, ability to adapt to changes, proper workforce training and management involvement in the decision making process. The greatest ability required in a sustainable lean paradigm is to acquire and retain customers through visibility and effective communication (Păunescu, Popescu and Duennweber, 2018).

2.2. Factors and barriers influencing lean adoption within freight transportation companies

Literature review and lot of studies dedicated to lean manufacturing and freight transportation underline the importance of joint lean practices application. Operational and financial performance in freight transportation is positively

influenced by the extent to which joint implementation of VSM (visual stream map), JIT, TQM, TMS and RFID is fulfilled (Popescu, 2020, June).

However, there are many companies that register failures in lean management application, even though only few of them make statements and reports in the matter. According to Salonitis and Tsinopoulos (2016), the frequent causes of unsuccessful lean application directly connects with the quality of leadership, the level of employees' training and involvement and the business strategies in lean practices adoption. The study also implies that poor resource allocation and resistance to change can constitute negative factors affecting the lean implementation process. In fact, top management can be a supporting factor of lean application in case of positive initiatives, long term lean objectives and clear strategies or, on the contrary, a delaying determinant. Other research findings justify the employees' or management resilience to change due to the fears of possible job loss, of lack of necessary skills that might end in unemployment or not seeing the necessity of change management process.

Deal and Kennedy (1988) emphasize on organizational culture as an important factor in lean management decision and application. The study reveals that corporate culture based on organizational readiness, research and development activities through experts' consultation and employment, effective resource allocation to support the new systems introduced and teamwork, is the key element in successful lean application. However, there are situations in which lean practices adoption fails due to poor lean training, insufficient focus on the customers' needs or communication issues between departments.

The general opinion of scholars depicted from literature state that small and medium companies don't always understand the principles of lean philosophy (decreasing the inventory level, supplier reduction and integration, JIT delivery) or that there is no concordance between them and their partners.

In a recent research of Jadhav et al. (2014) in regard to JIT implementation, twelve barriers that might negatively affect successful lean practices implementation were presented. The authors underline that lack of management commitment, poor training and education and financial constraints gained the highest ranking. Other barriers refer to organizational cultural differences, poor strategies and communication employees' resistance in regard to multiple tasks assignment and fear of unemployment, poor facility layout and lack of consistent working methods. However, in large organizations innovation and new technologies are easily adopted, due to resource availability (Kaynak, 1996).

Generally, the digitized systems of RFID and TMS require a change management process visualized as a continuous adaptation of employees' tasks and assignments, new schedules and responsibilities which infer new organizational culture based on innovation and flexibility as key determinants of successful implementation. Lack of simulations, performance measurement instruments and poor monitoring and control systems create the conditions for lean practice application failure. There were also reported situations in which, companies returned to the old traditional practices when setbacks were encountered (Su, 1994).

It is mandatory for freight transportation companies to carry out a business impact analysis that refers to preventive measures taking into consideration possible situations of transportation disruptions created by the new lean practices introduced. The study of Păunescu, Popescu and Blid (2018) reveals the significant correlation between technology, data communication and business impact analysis.

The freight transportation sector is affected by numerous delays, long hours of shipping and receiving and poor commodity visibility when there is no JIT practice alignment and synchronization between the carrier and the shipper or there is no use of TMS system capable to better monitor the drivers and the freight. Poor information sharing results in the increase of the transportation lead time, more situations with paperwork inaccuracies and disruptions in the whole freight transportation process. (Popescu, 2020, June)

3. Research Questions

After a consistent study of scientific literature in regard to factors and barriers in lean practices implementation the following statements were formulated:

P1: There are certain factors such as *senior management commitment* and *organizational culture* based *on innovation* that positively influence the lean process application in the freight transportation industry.

P2: There are several barriers such as *top management resilience to change* and *poor measurement tools of performance* that prevent successful lean implementation in the freight transportation industry.

4. Research Methods

Literature review provides articles and research studies that confirm situations of failure in lean implementation, especially amongst manufacturing companies. One of the present research objectives is to identify the factors/barriers that facilitate/hinder successful lean application in the freight transportation industry. With this regard, the Delphi panel of experts' consultation was deployed, all the persons interviewed being involved in the lean implementation process providing their experience and opinions.

The experts' purpose consultation was to identify for each lean practice what are the factors and barriers that contribute or prevent the implementation process. The factors and barriers in the aforementioned practices application involve seven criteria of assessment: cost/benefit (Robinson, 2018), employees' training and growth, effective leadership (Worley and Doolen, 2006), financial capabilities (Bhasin, 2008), technical factors and organizational culture (Jedynak, 2015) divided also in subsets of 42 (statements) questions.

4.1. Panel of experts' selection

The researcher have selected a database of 8 experts, from which one of them has experience in oversized load dispatching, one proved expertise in multi modal transportation with large applicability of lean practices, two proved also their

expertise in logistics and Supply Management integration methods, an expert in freight brokerage, one expert in lean transportation operations and integration of digitized tools into the traditional methods, and practitioners from the transportation industry, specialized in lean practices adoption, risks and cost/benefits of implementation. The panel includes also 1 scholar, professor and author in the field of VSM, TQM, JIT and TPM implementation. All eight people willing to participate in the panel have proved their expertise in lean performance application and lean factors or barriers in lean adoption. Due to a high level of consensus obtained in the first round the second one wasn't necessary. The experts agreed to participate in the panel in March 2020 and the data processing was completed in May 2020.

The participants were asked to support each statement in a certain degree using also the Likert scale from 1 to 5 from which: 1. totally disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. totally agree. The compelling results were obtained through data processing in SPSS program by analysing the Kendall's coefficient of consensus.

4.2. Criteria of analysis in Delphi model application

The factors and barriers in freight lean implementation have been evaluated using seven criteria, namely, cost/ benefit (1), employees training and growth (2), effective leadership (3), financial capabilities (4), technical factors (5), organizational culture (6) and synchronization between lean goals and actual practices (7). Each subset of factors or barriers were coded using numerical and literal items denoting as follows:

1. Cost/ benefit criteria

In identifying the factors of lean practices application, in terms of cost/ benefits criteria 5 factors and 5 barriers were identified. The factors facilitating lean implementation refer to *technical support*, *specialized companies in counselling support*, *management commitment*, *resource management* and *employees' management*. Barriers preventing lean application infer *high implementation costs*, *security issues*, *administration costs*, *low return on investment* and *employees' resilience to change* as cost, time consuming.

2. Employees training and growth

Regarding the employees training and growth, two factors and two barriers were identified: *multifunctional teams* and *employee empowerment* as facilitators and *high consuming time of training* and *resilience to change* as barriers in lean application.

3. Effective leadership

The effective leadership criteria analysis includes three factors namely *vertical communication between departments, cross-functional teams, decentralized leadership* and as far as barriers concern, the most cited factors in literature refer to *poor quality control of implementation*, *poor abilities in finding the right*

measurements of performance, and *lack in research and development activities* within company.

4. Financial capabilities

As financial criteria concern, the following statements were depicted as important in lean practices deployment: *unbalanced resource allocation* as a barrier and *easy access to resources* as a factor of opening the pace to lean.

5. Technological criteria

The technical criteria include three factors and three barriers in lean application. The factors that facilitate lean deployment refer to *technological changes made in steps*, *experimental teams* and *simulations for measuring the effectiveness* before lean tools implementation. As part of the barriers, the need for substantial changes are imposed sometimes in different lean tools, usually *time-consuming* causing along the way disruptions in process implementation that might produce poor transportation operation.

6. Organizational culture

Organizational culture criteria include five factors and three major barriers in lean implementation. The new context of globalization invites companies to create their business *model based on innovation* as the main factor in gaining competitive advantage and also for customer satisfaction. (Ahmad et al. 2004) Companies based on principles of *market share pursuit* and extended operations are more open to lean innovation. The strategies and consensus through innovation technologies deployment constitute part of the organizational culture definition. The barriers in lean innovation due to the framework of the organizational culture refer to *high distance from authority* and high *management resilience to change* (Fullerton and Wempe, 2009).

7. Synchronization

An important aspect related to successful lean practices implementation arises in regard to *synchronizing moments* of different lean practices within the same company or with their partners. According to Ahmad et al. 2007 and Wakchaure et al. 2014 operational and financial performance must be ensured with the simultaneous implementation of JIT, TQM and TPM. In order to decrease the shipping/ receiving time and to improve communication and also to avoid paperwork mistakes, RFID and TMS, the digitized tools must be implemented in a strategic bundle. Different stages of lean practices deployment between stakeholders can create *disruptions*, preventing the vertical integration objective to be achieved.

Each tool practice analysed will be coded according to each sub-criterion, using the criterion code as follows: TMSF1a- TMS application depending on 1a factor; TMSB1a- TMS application depending on the 1.a barrier).

5. Research findings

The Delphi model has reached high level of consensus (Kendall's coefficient over the value of .600, high level of significance, .000<.05, chi square over the value of 100) with regard to factors and barriers of lean implementation in transportation. Table 1 summarizes the results of experts' opinions, concluding high level of agreement concerning organizational culture, synchronization of the processes with the partners, effective leadership and financial criteria as important factors in lean implementation in the freight transportation industry.

Table 1. The results of Delphi model concerning the factors of lean application

Factors	**VSM/Kendall coefficient-.698/sig. 0<.05/chi square 128.5**	**JIT/Kendall coefficient- .703/sig. 0<.05/chi square 129.3**	**TQM/Kendall coefficient-.782/sig.0<.05/ chi square 143.9**	**TPM/Kendall coefficient-.767/sig. 0<.05/chi square 149.1**	**TMS/Kendall coefficient-.806/sig.0<.05, chi square 122.5**	**RFID/Kendall coefficient-.891/ sig.0<.05, chi square 106.3**
1.Competitive advantage gained through innovation	Mean rank-20.63	Mean rank-19.38	Mean rank-19.56	Mean rank-20.38	Mean rank-13.75	
2.Senior management based on clear strategies	Mean rank-18.44	Mean rank-19.38	Mean rank-19.56	Mean rank-20.38		
3.Focusing on customer satisfaction		Mean rank-19.38	Mean rank-19.56	Mean rank-20.38		
4.Easy access to financial resources					100% consensus	Mean rank-17.13
5.Simulations for effectiveness measurement					100% consensus	Mean rank-17.13
6.Technological changes made in steps				100% consensus	100% consensus	Mean rank-17.13
7.Good technical support						Mean rank-15.88
8.Vertical communication between departments					100% consensus	

Source: by author's own research

According to the results, the main factor of lean application refers to the organizational culture of a company based on competitive advantage gained through innovation and focus on customer satisfaction. The innovation process strictly correlates with continuous learning and companies aligned to those

types of organizational culture more inclined to develop innovative ideas (Sehested and Sonnenberg, 2011).

The idea of innovation infers business vision and a clear lean roadmap. It involves senior management based on clear strategies in consensus of lean implementation, according to the customer requirements and market demand. The results confirm previous research studies of Kaynak (1996) and Solaimani et al. (2019).

Other important factors that sustain lean implementation in the freight transportation sector include good technical support, easy access to financial resources, technological changes made in steps and simulations for effectiveness measurement (Minh et al. 2015ș Zhu et al. 1994).

With regard to barriers, Table 2 shows that lean practices application can register certain rate of failure due to gaps in *effective leadership*, *financial restraints* and *technological issues.* In the moment of lean deployment, the management must have a set of *clear tools of performance measurement* in order to properly quantify the benefits of lean practices application (Easwaramoorthi et al. 2011; Netland, 2016). *Top management resilience to change* may constitute a factor of lean failure. The top management is required to have a long-term strategy for lean adoption, facilitating the change management process through a proper allocation of material and human resources (Chan et al. 2019).

Table 2. The results of Delphi model concerning the barriers in lean implementation

Barriers	**VSM/ Kendall coefficient-.616/ sig.0/ chi square 78.8**	**JIT/ Kendall coefficient-.705, sig. 0/ chi square 95.9**	**TQM/ Kendall coefficient-.754/ sig.0/ chi square 102.4**	**TPM/ Kendall coefficient-.739/ sig.0/chi square 100.5**	**TMS/ Kendall coefficient-.782/ sig. 0/chi square 106.3**	**RFID/ Kendall coefficient-.759/ sig.0/ chi square 103.2**
1. Effective leadership	Mean rank-15.88					
2. Lack of research and development activities	Mean rank-15	Mean rank-16			100% consensus	Mean rank-13.94
3. Lack of integrated business strategy	Mean rank-15		Mean rank-15.53	Mean rank-15.94	Mean rank-14.56	
4. Poor measurement tools of performance		Mean rank-17.06	Mean rank-16.88	Mean rank-15.44	100% consensus	Mean rank-13.94
5. High level of time consuming		Mean rank-15.53	100% consensus	Mean rank-13.69		Mean rank-13.94
6. Top management resilience to change		Mean rank-16.31	Mean rank-15.50		Mean rank-11.63	
7. Unballanced resource allocation						Mean rank-13.94

Source: by author's own research

The new innovative lean practices application can create disruptions in the freight transportation process; therefore, simulations and proper implementation are the necessary actions to be taken. Unbalanced resource allocation to new innovative practices can create disruptions and may affect the dynamic of the transportation activities (Netland, 2016).

Conclusions

The lean transportation business model based on innovation emphasizes on *organizational culture committed to innovation*, on the importance of defining clear strategies and consensus amongst top management, proper resource allocation and simulation prior implementation, continuous training and learning and not the least strong alliances for network development and integration. Therefore, Statement 1 proved its validity. *Top management resilience to change*, *poor measurement tools of performance* and *technological issues* constitute the main barriers in lean deployment in transportation. Therefore, S2 also proves its validity.

Limitations: The factors and barriers drafted do not include other factors concerning demand fluctuations, the external economic context and other political or governmental regulations that may affect lean implementation and deployment.

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