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Towards a theory for lean implementation in supply networks

Thomas Bortolotti [a], Pietro Romano [b,*], Pedro José Martínez-Jurado [c], José Moyano-Fuentes [d]

[a] School of Management, University, Swansea University, Swansea, UK
[b] Polytechnic Department of Engineering and Architecture, University of Udine, Udine, Italy
[c] Centro Universitario de la Defensa-Zaragoza, Zaragoza, Spain
[d] Department of Business Organization, Marketing and Sociology, University of Jaén/ Escuela Politécnica Superior de Linares, Linares (Jaén), Spain

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ABSTRACT

This paper aims to investigate the supply network (SN) characteristics affecting the extension of lean programmes to SN and the interactions between lean practices and these characteristics to understand how to create more favourable conditions for lean extension programmes. A multiple case study methodology is implemented to analyze different lean programmes in SNs and different contextual conditions in which they are implemented. Three different SNs have been analyzed to provide insights on the whole value stream of the Andalusian aeronautics SN. This study finds that there is a recursive influence between SN characteristics and lean practices, and explains how this interaction takes place. The choice of lean practices to adopt, their aim and implementation mode are influenced by the state of SN characteristics companies face at the beginning of the programme and the SN distance (i.e. number of SN echelons) between lean knowledge owners and recipients. This study explains also how lean practices can modify the state of SN characteristics and suggests managers a sequence of phases and sets of actions to use depending on the initial state of SN characteristics.

1. Introduction

Originating from the Toyota Production System as a method to systematically reduce waste and maximize value in manufacturing processes, lean is now being adopted also in non-production areas. Womack and Jones (1996b) and Liker (2004)'s books contributed to expand the scope of lean beyond manufacturing by distiling the essence of lean into principles applicable to any organization. Womack and Jones (1996a)'s article represents a further step in lean evolution. Here the authors claimed that lean principles should be applied beyond firms' boundaries to maximize value to customers. Companies in SNs should cooperate and use lean practices to improve the value streams involved in supplying goods or services to final customers. Existing research seems to agree that expanding the scope of lean programmes to SNs requires the involved organizations to implement lean within each company and at the interfaces across-companies (Kannan and Tan, 2005; Hsu et al., 2009; Danese et al., 2012; Chavez et al., 2015). In other words, each SN member should adopt lean internally to become a so-called "lean company" (Womack and Jones, 1996a), and the network of lean companies should be connected using lean at their interfaces. One of the most common cases of extension of the scope of lean programmes is a lean company which decides to diffuse lean to its upstream SN (Wee and Wu, 2009). However, Choi et al. (2001) provided a vivid description of how the individual firm's efforts to manage SNs are often unsuccessful due to the dynamic and complex nature of SNs. In addition, Nahapiet and Ghoshal (1998) observed that each company is "embedded" in its SN as its decisions can change the characteristics of the network but are simultaneously influenced by these characteristics. Viewed through the contingency theory lens, this phenomenon happens since companies should adapt their strategy to maintain fit with their changing context (Donaldson, 2001). From the literature it is known that certain characteristics of SNs such as the relationships among counterparts (e.g., Simpson and Power, 2005; Moyano-Fuentes et al., 2012), the SN structure (e.g., Hines, 1994), and the level of adoption of lean within the individual companies (e.g., Womack and Jones, 1996b) can affect the possibility to extend lean to SNs. However, as Taylor (2006) notes, most of previous contributions concentrate on outlining long term benefits of lean in a SN, while they do not adequately investigate the prerequisites and actions to favour the extension of lean to SNs. Recent research on embeddedness in SNs (Kim, 2014) indicates the mutual influence between the firm and its SN as an interesting and relatively unexplored research area. The embeddedness concept and the contingency paradigm seem to admit that SN

* Corresponding author.
E-mail address: pietro.romano@uniud.it (P. Romano).

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characteristics can influence the implementation of lean practices within the companies and at their interfaces and simultaneously such lean practices can change the network characteristics creating new conditions that can influence the adoption of further lean practices. However, from the literature it is not clear how this interaction takes place. This paper intends to investigate the mutual influence between lean practices and SN characteristics during the programme for the extension of lean to the upstream network of a lean company with a leading position in its SN. The aim is to provide managers with a theoretically robust and empirically grounded interpretation framework which can increase their understanding of the dynamic relations between SN characteristics and lean practices and supports their decision making during the implementation of lean practices across SNs.

The paper is organized as follows. The literature review discusses the practices commonly implemented to extend lean programmes to SNs and identifies the SN characteristics which can influence this extension. The methodology section motivates the choice of the multiple-case study method and case selection. After the cases description, we will conclude with the analysis and discussion, conclusions and implications for future research.

2. Theoretical background

2.1. Extending lean programmes to SNs

Inspired by the seminal works of Lamming (1993) and Womack and Jones (1996a), many companies, after having launched lean implementation programmes to eliminate internal waste, concentrate on improving extended value streams, which requires the involvement of SN counterparts. From the literature it emerges that extending the scope of lean programmes to SNs requires the implementation of practices coherent with lean principles both within the individual companies and at their interfaces.

As Shah and Ward (2007) stated, lean can be defined as an integrated socio-technical system that aims at eliminating waste by reducing internal and external variability along the supply network. Therefore, the extension of lean programmes should include practices that involve suppliers in finding and reducing problems that affect internal and external processes (Jones and Womack, 2002; Taylor, 2006; Bortolotti et al., 2015a, 2015b; Chavez et al., 2015). As the main aim of the extension of lean programmes is to minimize variability in the SN, all the SN actors should streamline and align their internal production systems, and connect them by ensuring that suppliers deliver just-in-time (Shah and Ward, 2007). However, to be able to obtain the full adoption of lean in the SN, it is important that SN actors are committed, share the same lean knowledge, and their production systems are synchronized (Dyer and Nobeoka, 2000; Simpson and Power, 2005; Agndal and Nilsson, 2008; Chavez et al., 2015). Past studies describe practices used to transfer lean knowledge, increase commitment and align production systems, that can be either implemented in a one-way mode (i.e. from customer to supplier) or in a bi-directional mode (i.e. from customer to supplier and vice-versa) depending respectively on the unbalance (on-way) or balance (bi-directional) of knowledge, commitment and alignment of customers and suppliers.

Based on these premises, we classified practices for extending the scope of lean programmes to SNs into four groups: supplier involvement, knowledge transfer, lean programme commitment and lean programme alignment. Table 1 reports the practices considered, their definition and scope (i.e. internal vs. interface).

2.1.1. Supplier involvement

The first group of practices is related to the involvement of suppliers in identifying and reducing waste in the internal systems and at their interface.

Jones and Womack (2002) describe the extended value stream mapping (EVSM) as a practice that involves SN counterparts in joint improvement initiatives addressing a wide range of processes, from materials management to design. The main goal of EVSM is to identify waste along the SN and find possible solutions to reduce it (Wee and Wu, 2009). Simons and Taylor (2007) argue that SN actors should map material and information flows within and between plants and assess the related performance targeting the final customer requirements. Other scholars focus on the design process and describe supplier–customer new product development (NPD) teams as a relevant interface practice that exploits both customer and supplier expertise to reduce errors, speed up time-to-market as well as satisfy final customer needs (Arkader, 2001; Ehret and Cooke, 2010). External expertise can be also useful to make lean tools more effective in solving problems affecting internal production processes. In particular, supplier–customer lean problem-solving teams are often created to reorganize process flows within a plant (Simpson and Power, 2005; Taylor, 2006). Supplier involvement is also crucial to introduce a pull system at the customer–supplier interface (Bortolotti et al., 2015b; Chavez et al., 2015). According to this practice, customers receive small lots of materials at regular and short intervals following the pace of the end-user demand, thus increasing operational performance of the entire SN (Danese et al., 2012).

2.1.2. Lean knowledge transfer

This set of practices refers to the transfer of knowledge on lean between actors in SNs.

Lean training support is a practice commonly adopted by lean companies to transfer their knowledge to suppliers that start their lean transformation. It often takes the form of basic training courses and implies an intense teaching effort for the customer (Simpson and Power, 2005). As observed by Dyer and Nobeoka (2000), the success of Toyota largely depends on its effectiveness at facilitating inter-firm transfers of explicit and tacit knowledge. While explicit knowledge refers to easily codifiable information and could be transferred during basic training courses, tacit knowledge involves know-how that is complex to codify and difficult to transfer with the basic training support, thus more effectively addressable through guided tour of the customer's plant (i.e., open-door policy). Transfer of lean knowledge can occur not only when there are differences in lean competences between partners, but also when companies show similar expertise. In this case the transfer can be bi-directional. For example, Bruun and Mefford (2004) maintain that the creation of a shared database facilitates mutual learning about lean successful experiences of SN partners.

2.1.3. Lean programme commitment

The extension of lean programmes to SNs often starts from a lean company that has to stimulate non-lean counterparts to implement lean. Dyer and Nobeoka (2000) describe how Toyota monitors suppliers' progress in their lean implementation and rewards partners who make exceptional contributions to the network by giving them additional business. Lean customers can also punish suppliers to deter opportunistic and adverse behaviours by reducing or even making them lose business (Simpson and Power, 2005). In any case, providing regular acknowledgements of lean progress to suppliers helps them to feel motivated and continue the lean transformation (Dyer and Nobeoka, 2000). Extending lean programmes to SNs does not require commitment exclusively from suppliers. Incentive schemes based on