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The Human Dimension of Lean: a literature review

*Florian Magnani*¹

*Valentina Carbone*²

*Valérie Moatti*³

ESCP Europe, Paris

¹ ESCP Europe, Information and Operations Management Department, 79 Avenue de la République, 75011, France
Phone : +33679757921, email : florian.magnani@edu.escpeurope.eu

² vcarbonate@escpeurope.eu

³ moatti@escpeurope.eu

Abstract

Interest in lean, the managerial system exemplified by the Toyota Production System, has gradually spread throughout different industries since the 1980s. Compared to mass production systems, lean systems ultimately transform the way employees act within their work environment. Despite significant improvements in operations management, the human dimension of lean has received surprisingly limited attention from the academic realm, until recently. This study serves primarily as a literature review of articles at the crossroads between the technical part of lean and its human-related issues. We reviewed 95 articles and our analysis provides a clearer view of the evolution of lean literature with regard to its human elements. The different levels of analysis can be summarised as follows: lean's impact on working conditions and employee outcomes, HR practices as facilitators of lean adoption, and employee development as a moderator of lean adoption. We conclude with a framework that serves as a potential guide to include the human dimension of lean in research.

Keywords: Lean Management, Toyota Production System, Human dimension, Literature review

Lean is a widely studied concept with many applications in services and industries. Lean studies began when American researchers became interested in the way Toyota made their cars using the Toyota Production System (Cusumano 1988; Krafcik 1988; Monden 2011). In the early 1980s, an MIT study group – International Motor Vehicle Program – launched an international investigation of motor vehicle production and discovered a significant paradigm shift in mass production methods (Fujimoto 1999; Womack, Jones, and Roos 1990), which led to an increase in both quality and productivity. They characterised this shift as *lean production* (Krafcik 1988) to describe the system exemplified by Toyota: the Toyota Production System (Monden 2011). Practices associated with lean then began to spread across the supply chain (Buonamico, Muller, and Camargo 2017; Lemieux et al. 2012; Sánchez and Pérez 2001) and service industries (Zhu, Johnson, and Sarkis 2018). While lean and TPS have been studied by researchers as innovative operations and organisation management concepts, the second part of Toyota's motto— 'We do not just build cars, we build people' —has not been fully taken into consideration (Koenigsaecker 2010).

Few researchers have studied the technical dimension of lean and its interaction with its inherent human dimension (Jayamaha et al. 2014). Neither Ohno (1988) nor Womack, Jones, and Roos (1990) have constructed explicitly clear theories concerning the inclusion of the human dimension during lean adoption. Fujio Cho, then president of Toyota, introduced 'The Toyota Way' , the human dimension of TPS, as a new set of values that guide the development of employee competencies and work conditions interconnected with the technical dimension of TPS. 'Making things' (Monozukuri) was the nature of the industry, but the Toyota Way added the 'educating people' dimension (Hitozukuri), promoting the ongoing development of skills and abilities in an environment of mutual trust (Saito 1995). The Hitozukuri dimension,

also known as 'respect for people' (Sugimori et al. 1977), is reflected in human mechanisms and benefits the organisation by providing employees with the opportunity to contribute and achieve self-realisation while maximising their performance (Emiliani and Stec 2005). The Respect for People principles presented in the Toyota Way demonstrates one of the prevalent convictions that Toyota cultivates: TPS was first and foremost a human-based system in which people were engaged in the continuous improvement of organisational processes and in which people's needs were both understood and respected (Dahlgaard and Dahlgaard-Park 2006). At that point, Toyota demonstrated that the Just-In-Time system and Quality Management system (Basu and Miroshnik 1999) were built upon and deeply rooted in 'Respect for People' (Liker and Hoseus 2010). Even though the human dimension described in the Toyota Way appears to be explicitly related to its technical dimension, a comprehensive characterisation of the human dimension of TPS remains absent from the literature.

Recently, researchers have highlighted that lean primarily focuses on employees, at least in the TPS (Jayamaha et al. 2014). Specifically, these new studies consider the human dimension as undoubtedly one of the most influential parameters in the successful adoption of lean by an organisation (Bortolotti, Boscari, and Danese 2015). Some lean research has been devoted to topics connected to the human dimension, such as the human resources system or its cultural embeddedness, without ever explicitly referring to the human dimension. A well developed research stream emphasising the cultural embeddedness of lean principles (Bortolotti, Boscari, and Danese 2015) seeks a finer understanding of the human dimension related to a company's cultural factors. Some studies have tried to understand the reasons behind the differences between Toyota and other companies' adoption of lean—highlighting the specificities of Japanese culture

in comparison with Western culture (Taira 1996), whereas others have focused on other contextual factors such as national culture or organisational culture (Kull et al. 2014). Lean appears to be anchored in its contextual factors, which explains why lean adoption has proven to be a challenge outside of Toyota (Arlbjørn and Freytag 2013). And the contextual factors seem to be embedded in the human dimension. Accordingly, a better understanding of the influence the human dimension has on lean adoption may help to better understand the mechanisms involved during the adoption process.

Reading through the academic literature on lean dealing with aspects of the human dimension, one finds a surprisingly large variety of approaches, questions, and definitions that have been adopted. Even though Shah and Ward (2003) described lean constituents, including human resources management (HRM), the diverse interpretations of lean have made it difficult for researchers to determine the effects that lean has on performance (Buonamico, Muller, and Camargo 2017; Lemieux et al. 2012), on employees (Parker 2003) or its impact on HRM (Forrester 1995). The relationship between lean constituents and its human dimension shows us the impact of JIT/TQM/TPM bundles on HRM, such as consequences on employees (Jackson and Martin 1996) or the human influence during the adoption of technical bundles (Oliver 1990). Some studies (Lewchuk and Robertson 1996; Parker 2003; de Treville and Antonakis 2006) aim to better understand the consequences that lean work practices have on employees. The first relationship, between lean and employees' issues, has been depicted alternately as positive, negative, or controversial. The second relationship can be summarised as HRM support of technical bundles (Furlan, Dal Pont, and Vinelli 2011). Here we find that some authors see potential in creating conditions that effectively tap into and develop the human dimension (Power and Sohal 2000), such as the supportive role of HR practices (Deshpande, Golhar, and Stamm 1994) or the HR function's role and its interaction with other departments' support of the

technical bundles (Palo and Padhi 2005). The transition from one relationship to the other can be understood by looking at the adjustment of Japanese management practices (Aoki, Delbridge, and Endo 2014). For example, the HR practices associated with Japanese management practices were adapted to facilitate transferability (Basu and Miroshnik 1999) during the adoption of new technical bundles. A possible explanation for these differing points of view amongst theorists rests on the posture researchers or practitioners adopt depending on the way they perceive lean and, respectively, its human dimension. Distinguishing between these sometimes contradictory results requires a finer understanding of the existing relationships between the lean technical dimension and its human dimension.

Recent studies have depicted lean as a sociotechnical system (Soliman, Saurin, and Anzanello 2018), which consequently opened the door to discussions about the human (soft) dimension (Jayamaha et al. 2014; Preece and Jones 2010; Taylor, Taylor, and McSweeney 2013) and its interactions with the technical (hard) dimension. As a result, there has been a shift from seeing lean as purely a process-oriented strategy to lean as a people-oriented strategy (Jayamaha et al. 2014; Marodin and Saurin 2013). However, there remains a notable lack of theoretical considerations associated with the human dimension (Taylor, Taylor, and McSweeney 2013). Studies that explored the interaction between lean's technical dimension and its human dimension took into account a variety of human-related definitions, approaches and questions. This meant that the emerging literature lacked a common vocabulary, which is needed in order to theoretically frame lean and its human dimension relationships. The following table (Table 1) points out the different connotations of the word 'human' used in articles dealing with the human dimension in a lean context:

----- Insert table 1 -----

The term 'human' has multiple meanings in the lean literature. However, the concept of HRM frequently incorporates a combination of all or many of these connotations. Often referred to as personnel management or labour relations (Forrester 1995; MacDuffie 1995) in recent usage, HRM has been regarded as the philosophies, policies, procedures, and practices that relate to effective people management and positive employee outcomes in an organisation. However, the terms do not make a clear distinction between the impacted employee and the people influencing the adoption. The term 'human dimension' aims to encompass all these connotations.

Consequently, we wish to address the following gaps identified in the introduction: the lack of a characterisation of the human dimension of lean, of understanding the influence of the human dimension during the adoption process, and of clarity concerning its relationship with the technical dimension. This paper attempts to answer Marodin and Saurin's (2013) call to identify effective theories and practices to manage the systemic, human and organisational dimensions of lean. To do so, we decided to study how the literature has addressed the combination of the lean technical dimension and its human dimension. Through a literature review (Methodology), this article aims to build upon the human dimension perspectives (Results) found in articles examining lean and the characterisation of the human dimension addressed therein. Finally, we will discuss the results (Discussion) and map out potential future research directions (Research agenda).

Methodology

To assess whether and how lean and its human dimension have been analysed in research, we conducted a structured literature review. By making a finer analysis of previous literature (Denyer and Tranfield 2009), this literature review initiates a theory building process. This section describes the review methodology and offers a descriptive analysis of the results.

Review methodology

We chose to perform a structured literature review to increase reproducibility and to provide an appropriate means for synthesising a growing field of knowledge such as lean literature (Marodin and Saurin 2013). We gathered and summarised the research findings pertaining to the human dimension of lean found in the existing literature in relevant journals across the fields of Operations Management, Human Resources, Psychology and Sociology. In order to reduce bias and to increase research transparency, a detailed description of the steps taken to select and analyse the literature is provided below (Denyer and Tranfield 2009). In conducting the literature review, we followed the steps presented in Figure 1.

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The first stage of the structured literature review called for a keyword search of journal articles in all major databases, such as EBSCO host (Business Source Premier), Scopus, Springer, Web of science, ScienceDirect, etc. We aimed to cover the human dimensions of lean or TPS through our choice of keywords. Our search consists of a combination of terms related to both lean and its human dimension. Details regarding the keyword combinations used for the search are provided in Table 2. We chose these words in order to find any possible combination of 'human', 'HR', 'people', 'worker' etc., terms used interchangeably to signify the human dimension and the human resources (employees) themselves. In studies that try to investigate in depth the lean and TPS concepts, it is difficult to find unequivocal definitions or clear-cut distinctions to differentiate the two concepts (Jayamaha et al. 2014; Jones 1992). Consequently, we included both terms in our search, taking into consideration that many authors use the two concepts interchangeably.

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In the second stage, we categorised the results according to their sources (academic journals, book reviews, newspaper articles). We limited the review exclusively to academic peer-reviewed publications in order to ensure the academic credibility of the study and that the analysed work met certain standards. We did not specify particular journals, as we wanted to observe a broad range of research and reflect the diversity of approaches in the field. Regarding the time frame, no starting date was specified and we searched up to September 30, 2018. We manually excluded database subjects that were unrelated to social sciences or to our areas of interest, such as FOOD and MEDICAL studies, where 'lean' has a different meaning. In the end, we obtained a total of 136 articles from the database. After a careful reading of the 136 articles, we reduced the corpus to the 95 articles that explicitly deal with the central focus of our review: the human dimension of lean or TPS. Drawing on our preliminary results, we selected articles based on the following criteria: (1) focus on the relationships between lean/TPS and the human dimension; (2) focus on the impact of lean on the human dimension and (3) focus on the influence of the human dimension on lean.

Descriptive analysis

In this section, we will describe the remaining articles and their contributions to understanding the human dimension of lean. Figure 2 shows the evolution in the numbers of articles published. It is important to note the scarcity of articles dealing with lean and its human dimension compared to the 1000+ academic articles dealing solely with the technical dimension of lean.

----- Insert figure 2 -----

More than half of the papers (52/95) were published between 2013 and 2017. This shows a recent, increasing interest in lean topics linked to human dimensions. Most of the research takes a qualitative approach (41), but quantitative (32) and conceptual studies (6) are also represented. Single-case studies dominate the sample. The complexity of the topic makes it difficult to model and test relationships through survey data, so researchers prefer in-depth studies with only one or a few subjects. Moreover, emerging fields of research are predominantly conceptual and qualitative, as researchers in this phase try to establish a common vocabulary, define concepts, and explore causal relationships. Table 3 shows the distribution of methodologies applied in the articles.

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Before starting our qualitative analysis of the articles, we decided to focus on the ones that used a literature review methodology to gather most of the information that would help us during the review process. Three of the literature reviews focused on the impact lean has on employees, particularly regarding work and health. One focused on HRM in companies that adopted lean and one focused on lean enablers that can foster employee participation in improvement initiatives. Table 4 presents preliminary results of the two main perspectives: organisational and team-level enablers' perspectives and the impacts of lean on employees' health and work.

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Of the 95 articles reviewed, the results show that more than 50% of the articles discussed the human dimensions in terms of positive and negative impacts of lean on employee conditions, such as work transformation or social impacts. We also identified an emerging interest in the human dimension as a potential facilitator of lean, i.e. transformation of policies within HR practices that facilitate lean adoption. Looking carefully at how lean was implemented in

organisations, we found that lean was either described as a process-oriented strategy, focusing especially on its technical dimension, or as a people-oriented strategy, focusing primarily on its human dimension. These preliminary results pertain to the purpose of lean and the type of relationship between the technical and human dimensions.

Looking at employees, we noticed that they were considered either as impacted, impactor or neutral during the lean adoption. There is also a distinction to be made between the operating, supervising and intermediary roles they play during the lean adoption. In light of these preliminary results, our literature review aims to bring into focus the different characteristics of the human dimension (Table 5). To accomplish this task, we proceeded by reading and individually evaluating each article, looking for consistencies within the aspects of the human dimension cited above. We then designated sets of 'key topics' and human dimension characteristics, which acted as codebooks and provided guidance to structure our findings. The key topics emerged from the first round of article screening. This classification process was conducted by two researchers. After thorough consideration, we agreed upon a classification of the 95 articles in relation to the human dimension. This study was built on the matrix of categories presented in Table 5, which offers a foundation for comparing and contrasting the levels of analysis considered in the literature.

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Review results

In this section, we examine the results of the literature review by analysing the human dimension addressed in research articles. We found three perspectives: lean's impact on employees, HR practices that facilitate lean adoption, and employee behaviours related to human development.

Lean's impact on employee conditions and outcomes

After looking at the transformation of work characteristics brought about by lean, this first section deals with articles that investigate the nature of employee outcomes during the lean adoption process.

Job characteristics and work transformation

Researchers discovered that lean leads to a modification of work characteristics, in contrast to mass production methods (Anderson-Connolly et al. 2002; Parker 2003). These modifications were brought about using lean methods and can be summarised as follows: intensification of work (Perez Toralla, Falzon, and Morais 2012), increased autonomy (Anderson-Connolly et al. 2002), and increased skills and team work (Cullinane et al. 2013). They are presumed to impact each employee's role: employees display higher levels of competency and problem solving capabilities, as well as increased cooperation, responsibility and continuous motivation to improve processes (Seppälä and Klemola 2004).

Work transformation causes a change in the workplace environment. Some researchers asserted that taking work hazards and variability into account in the design of new work processes may help to improve working conditions (Perez Toralla, Falzon, and Morais 2012). They concluded that lean involved employees in business processes that went beyond the scope of their specific jobs by incorporating methods that foster innovative behaviours. These behaviours, in turn, led employees to move beyond their assigned, compartmentalised tasks and to moderate the effect of lean practices on employee outcomes.

Worker perception and social outcomes

Researchers suggested that lean adoption can have a positive impact (Conti et al. 2006; Cullinane et al. 2013; Longoni et al. 2013; Losonci, Demeter, and Jenei 2011; Perez Toralla, Falzon, and

Morais 2012; Seppälä and Klemola 2004; Shadur, Rodwell, and Bamber 1995), a negative impact (Bouville and Alis 2014; Genaidy and Karwowski 2003; Lindsay et al. 2014; Mathew and Jones 2013; Parker 2003; Stewart et al. 2010) or an indeterminate impact (Distelhorst, Hainmueller, and Locke 2016; Landsbergis, Cahill, and Schnall 1999) on employees' psychological and physical health. Lean practices make heavy demands on workers' muscular, cognitive, and emotional resources (Genaidy and Karwowski 2003). However, Parker (2003) explained that the negative effects can be attributed to the employees' perceptions of deteriorating work characteristics.

Knowing which lean practices these companies adopted could help to understand the reason for the different outcomes (positive and negative). It has been suggested that if lean is inadequately understood or not wholly integrated, it can result in 'lean-type approaches' (Lindsay et al. 2014). Similarly, it has been shown that short-term, profit-maximising strategies can depreciate human assets and create merely the illusion of empowerment (Jones, Latham, and Betta 2013). In addition, it has been argued that management interests inevitably diverge to some extent from those of the workers (Taira 1996). These factors, as well as the manner in which lean is adopted, contribute to the inconsistent employee outcomes. These studies suggest that negative employee outcomes should be analysed with a finer understanding of the organisational context in which lean is adopted and also taking management's underlying intentions into consideration.

Some researchers were interested in identifying the factors that might minimise such negative outcomes (Mathew and Jones 2013). They stressed how lean's new work organisation can positively influence health-related outcomes through job enrichment (Cullinane et al. 2013), empowerment (Landsbergis, Cahill, and Schnall 1999), and involvement and learning (Bouville and Alis 2014; Seppälä and Klemola 2004; Sterling and Boxall 2013). Other researchers proposed integrating the interests of workers with those of the organisation and considering

whether individual factors are compatible with each other and to what degree they are compatible with contextual factors (Losonci, Demeter, and Jenei 2011; Shadur, Rodwell, and Bamber 1995) and contextual factors (Seppälä and Klemola 2004). Lean's impact on employee outcomes remains a very controversial topic. On the one hand, lean is found to impose greater demands and work pressures on employees, while on the other hand, lean is seen as a human-centred system generating positive outcomes from an employee perspective. Thus, internal and external factors appear to explain the positive or negative outcomes concerning the impact that lean has on employee working conditions.

HR practices that facilitate lean adoption

This section examines the arguments researchers made about HR practices that foster lean adoption while mediating its potentially negative effects on employees.

HR Practices that moderate employees' perception of lean

Some authors described the roles employees played during the paradigm shift in a lean adoption (James and Jones 2014; Winfield 1994): they were operating, supervising or moderating the lean adoption. HR practices help employees adopt these new roles by improving their capabilities, increasing their motivation, and ultimately by mediating operational and social outcomes (MacDuffie 1995). Because lean adoption is contingent upon the sociocultural, historical and environmental context of the host nation and company (James and Jones 2014), HR practices regulate the employees' role during the lean adoption while maintaining reciprocal social relationships (Winfield 1994). Recent studies have suggested that, through appropriate HR practices, the possible negative outcomes—poor health outcomes, work density, and resistance—could vanish (Bonavia and Marin-Garcia 2011; Martínez-Jurado, Moyano-Fuentes, and Gómez

2013). HR practices that develop and maintain an entirely co-operative and committed workforce support the standardisation of work processes and its improvements during a lean adoption (Bonavia and Marin-Garcia 2011).

Researchers stress the need to take into account the different phases of lean adoption in order to fully appreciate the potential contributions of HR practices. Accordingly, in the pre-adoption phase, external change agents and internal managers may take steps to avert employee passivity or lack of interest. In the post-adoption phase, HR practices focused on training, communication and recognition may contribute to employees voluntarily embracing and anchoring the lean adoption (Martínez-Jurado, Moyano-Fuentes, and Gómez 2013). Acknowledging these phases enhances the adaptability of HR practices: lean can be fostered by improving HR's selection and hiring processes (Suaréz-Barraza and Ramis-Pujol 2010) or generally developing the human capital value stream. These studies demonstrated how HR practices facilitated the adoption of lean while simultaneously increasing the return on investment in human capital, instead of merely serving as support for management.

Management's role in facilitating employees' lean adoption

Researchers observed a significant increase in lean adoption levels when HR practices supported the lean implementation initiative through the managerial role (Camuffo, De Stefano, and Paolino 2017; Olivella, Cuatrecasas, and Gavilan 2008). Lean adoption depends on employee involvement in lean practices, which is achieved by direct managers empowering them and providing them with more training, information and new forms of recognition (Marin-Garcia and Bonavia 2015). For example, managers typically train their workers and improve their employment security (Bonavia and Marin-Garcia 2011; LaScola et al. 2002). Managers' roles and behaviours positively influence employees' perception and adoption of lean (Gelei, Matyusz,

and Losonci 2015; Van Dun, Hicks, and Wilderom 2017). Managers foster collaborative problem-solving and help create a supportive environment where employees act as creative thinkers (Huo and Boxall 2017, 2018). Researchers acknowledged adapted HR practices (Olivella et al, 2008), such as trust building and competency development activities (Anand and Kodali 2010; Bonavia and Marin-Garcia 2011; Martínez-Jurado, Moyano-Fuentes, and Gómez 2013; Preece and Jones 2010). HR practices focused on such activities are predictors of lean adoption (Spasojevic Brkic and Tomic 2016) and contribute to greater adoption involvement: employee and manager involvement positively affects the adoption of lean. Researchers showed that a performance appraisal linked to an employee reward and recognition system could potentially drive the adoption (Karlsson and Åhlström 1996), inspiring employees and managers to become active participants during the transition (Emiliani and Stec 2005; Worley and Doolen 2006).

Employee behaviours related to development

While the previous sections looked at articles that discuss lean's impact on employee conditions and the HR practices that facilitate lean adoption, those presented in this section depict employee behaviours as facilitators or inhibitors of the adoption.

Participation in improvement activities

Studies have shown that significant improvements in work quality can be attributed to the individual learning that takes place when employees participate in the adoption process. Following the 'respect for people' principle (Sugimori et al. 1977) developed by Toyota, consideration of workers' capabilities is emphasised by entrusting them with greater responsibility and authority. Workers show higher levels of acceptance of new practices and propose a greater number of improvements (Mothersell 2009) when they are given the opportunity to display their capabilities in full by actively learning in their own environment

(Yasukawa, Brown, and Black 2014). The latter has been shown to lead to an overall increase in the motivation of workers involved in lean adoption, as well as managers' opportunities to learn from them (Sterling and Boxall 2013). Employee participation in improvement activities also largely depends on the clarity of their directives, the quality of their individual learning experiences and the collective acceptance of the adoption (Alagaraja and Egan 2013).

Competencies development

Researchers suggest that workforce competencies, not only technical but also soft skills (Shokri, Waring, and Nabhani 2016), act as moderators of lean adoption (Uhrin, Bruque-Cámara, and Moyano-Fuentes 2017). Employee development is often done by an in-house lean training system (Martínez-Jurado, Moyano-Fuentes, and Gómez 2013; Tortorella and Fogliatto 2014; Winfield and Hay 1997) capable of capitalising on the collective willingness to adopt new working practices. Worker capability development (Liker and Hoseus 2010) and empowerment (de Treville and Antonakis 2006) are processes grounded in management behaviours (Camuffo, De Stefano, and Paolino 2017). Researchers supporting this idea explained that the system relies on management's willingness to learn, adapt, and help employees solve problems. Lean managers promote lean adoption through mentoring/coaching activities at the individual level, interpersonal communication and group activities at the team level, as well as problem solving development and guidelines deployment at the organisational level (Tortorella et al. 2015). These interactions moderate employee outcomes and facilitate the alignment of individual and organisational lean adoption (Gagnon and Michael 2003). These 'action-based' educational activities (Winfield and Hay 1997) lay the foundations for greater levels of trust between managers and employees.

Strategic Human Resources Management

In addition to these developmental activities, Beauvallet and Houy (2010) started to discuss the human dimension as a key to understanding the technical part of lean differently. Alagaraja and Egan's (2013) research exemplified the influencer role of cross-functional human principles, through HRM, while adopting lean (Yorks and Barto 2013). Subsequently, HRM can be considered as the reflection of the human dimension of lean. Researchers evaluated HRM systems and human-oriented principles as a support for lean adoption (Anand and Kodali 2010; de Koeijer, Paauwe, and Huijsman 2014; Gollan, Kalfa, and Xu 2014; Sparrow and Otaye-Ebede 2014). Researchers argue that there is a symbiotic relationship between the human and technical dimensions of lean (Anand and Kodali 2010; Gollan, Kalfa, and Xu 2014). HRM participates in translating continuous improvement mechanisms to boost the effectiveness of human dimension integration (Sparrow and Otaye-Ebede 2014). Some researchers argue that HRM, while focusing on the development of shared lean competencies, seems to progressively foster strategic employee behaviours that assist in improving the lean adoption process (de Koeijer, Paauwe, and Huijsman 2014). Researchers add that when HR professionals do not participate in the adoption, employees and managers are more reluctant to fully adopt lean practices (Thirkell and Ashman 2014).

In this literature review, we have attempted to explain the perspectives of the human dimension studied in lean research. The different levels of analysis can be summarised as follows: lean's impact on employee outcomes, HR practices as facilitators of lean adoption, and employee behaviours as a moderator of the outcomes.

Discussion

Although the human dimension is intrinsic to the original TPS concept, we have evidence of an overall scarcity of research on the human dimension of lean and, therefore, suggest avenues for future study. Our research helps to better understand the human dimension as studied in existing literature. We propose a framework that presents the human dimension components found in the literature.

Different views for lean and its human dimension

Our results reveal firstly that the human dimension supports lean adoption. HRM systems and guiding principles, a reflection of the human dimension, foster collaborative employee behaviours. It seems relevant to study the characteristics of HRM systems, such as HR practices related to competency development in companies adopting lean. HR practices appear to shape worker perceptions of the transformation cultivated by lean and to guide expected behaviours. Secondly, lean impacts employee development, specifically through continuous learning and group activities. Thirdly, developmental systems and interactions between managers and employees seem to facilitate the alignment of individual and collective lean practices. Our literature review also contrasts positive and negative outcomes of lean adoption from an employee perspective. Some explanatory factors for such divergent results that emerged from our analysis could be linked to which phase of the lean adoption was observed by the researchers, along with cultural and/or organisational aspects. These contextual factors need to be clarified in order to better understand the specificities of the human dimension and the employee outcomes of lean. The human dimension represents a key to understanding the technical dimension and the overall adoption process. Figure 3 is a representation of the human dimension framework that emerged in our literature review.

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These perspectives reveal how lean and its human dimension have evolved. The human dimension of lean in the 'Respect for People' concept has rarely been put into practice by managers (Emiliani 2003) and, consequently, has been kept in the dark for a long time. After the first appearance of the term lean, its definition varied depending on the author or period. Holweg (2007) showed that the definition and understanding of lean continues to change so much that, at some point, it may no longer be recognisable. These changes led to confusion among academics and practitioners: some talk about fake lean, others about lean-type approaches (Lindsay et al. 2014). Stakeholders' understanding and perception of lean seems to be the moderator variable of its adoption and its human dimension. Clarifying the definition of lean, and thus deepening stakeholders' understanding of it, can lead to improvements in operational efficiency that will consequently have a positive impact on employee satisfaction and motivation regarding lean adoption (Hopp 2018).

Moderator variables that explain the controversial outcomes

Our analysis suggests that lean itself is not necessarily the primary cause of employee outcomes, inasmuch as it is a question of the 'how' and the context of its adoption (Beauvallet and Houy, 2010). These reflections imply that analysts such as Krafcik (1988) and Womack, Jones, and Roos (1990) downplayed the importance of the context in which lean is introduced. Political, economic and social contexts are crucial in determining employee outcomes (Turner and Auer 1996). Thus, lean's impact on employees can be the result of systemic issues and constraints in the organisational context (Stanton et al. 2014). Looking at the 'respect for people' principle on

which the lean philosophy is based reminds us that employee development was the central focus of lean systems.

Evidence of the impact of lean can be difficult to assess given the often contradictory or ideological research designs that are used. Accordingly, it is interesting to look at the different lean schools of thought (Hoss and ten Caten 2013) and how they view the human dimension in order to gauge the impact each school of thought has on research and results. They all agree on the manner in which HR systems, as the reflection of the human dimension, emerge and sustain cohesion to foster employee support. Only two lean schools point out employee development or the 'Respect for Humans' system, as a moderator of employee outcomes. We observe that studies from the mechanistic schools of thought first identified and gave instructions on how to apply lean practices, then evaluated employee outcomes. Only studies taking an interpretive approach of the evolutionary school of thought have tried to explain the inherent human dimension of lean while interpreting employee outcomes.

Another major point of our analysis brings to light an emerging stream of research focusing on HR practices as facilitators of lean adoption through the monitoring of employee participation and the development of a trusting environment. Soft aspects have a positive impact on hard aspects and indirectly contribute to the success of continuous improvement initiatives (Zeng, Anh Phan, and Matsui 2015). A lean environment reinforced by HR practices can assist employees in harnessing their intellect and becoming creative system thinkers. Thus, organisations that consistently integrated their HRM (soft) and technical (hard) systems outperformed the others.

Implications & directions for further research

This paper contributes to lean research by clarifying the inherent human dimension in the following areas: lean adoption can affect employees' working conditions and organisational

practices can facilitate lean adoption. In addition to these, the assumptions and the organisational initiatives for employee development can mediate the effects on employee behaviours throughout the adoption. In the absence of a definition for the human dimension of lean, we propose to define it as the sum of the following elements: (1) employees' individual and collective characteristics, (2) employees' interactions with organisational factors, (3) employees' behaviours, which can positively or negatively influence the steps of the lean adoption process. This is the first attempt to define the human dimension. However, in order to more greatly benefit from this human dimension, we suggest that practitioners focus on the interactions among employees and their associated behaviours, and therefore maximise the positive interactions among employees that will sustain motivation and operational efficiency. Employee developmental activities at all levels of the organisation seem to provide the necessary supportive environment to achieve these two objectives.

Before conducting lean research, researchers should consider the academic discipline through they were originally introduced to lean ideas and the lean schools of thought that will be acknowledged in the study. It would be interesting to compare the different employee outcomes identified in each study, taking into consideration the researcher's concern with lean (theoretical or practical) and the lean schools of thought that guide their understanding. We already know that lean schools of thought such as System Engineering and Organisational Development have been the most influential in the evolution of thinking about lean. Consequently, we consider that it is necessary to first carry out more in-depth empirical research that mobilises qualitative and quantitative methodologies from an evolutionary perspective and that takes the organisations and their environments into account.

Moreover, separating lean's technical dimension from its human dimension can lead to harmful consequences in both the academic and organisational realms. Finally, Thirkell and Ashman (2014) called for a conceptual clarification on how lean can be maintained while practices are adapted to specific contextual conditions. More research is necessary to understand the human dimension's role in helping to ensure that lean adoption is successful. Seeking to align ourselves with this idea, we recommend that theory-testing research be done on the interactions between lean and its human dimension, paying close attention to the adoption phase and contextual factors.

Conclusion

Throughout this paper, we have sought to depict the human dimension of lean. We have explained the controversial aspects and the differences in employee outcomes during a lean adoption from an employee perspective. The results of this review carry a number of specific implications for organisations pursuing a lean adoption, with special attention given to integrating the human dimension. Our results reveal firstly that the human dimension supports lean adoption. We present a framework comprising the three main perspectives: the impact of lean on employees' work, practices that facilitate lean adoption and employee behaviours related to development. Finally, we provide a definition of the human dimension of lean. This framework should be used in future research on real cases of lean adoption to examine the human dimension of lean and its alignment with the technical dimension.

There has been serious dissonance in most 'lean' systems, which, paradoxically, do not incorporate the necessary human dimension. We suggest that more studies be conducted on the human dimension in order to fully acknowledge the transformation from an employee perspective. Without understanding how the two dimensions fit and work together, it is difficult

to objectively assess lean's impact. Surprisingly, many organisations emulate Toyota's technical systems rather than their human system. Human resources management, labour relations and organisational learning participate in maintaining lean adoption. This is quite possibly the reason so many organisations struggle to sustain their lean adoption (Marksberry 2012).

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Authors	Connotations of 'human':
de Treville and Antonakis (2006)	Employee: workforce as a resource
Lewchuk and Robertson (1996)	Impacted employees: distinction between managers and workers
Sparrow and Otaye-Ebede (2014)	HR functions: the department responsible for management of personnel
MacDuffie (1995)	HR practices: activities that facilitate HR Management and HR Development
Martínez-Jurado, Moyano-Fuentes, and Gómez (2013)	HR management: the management of working conditions
Alagaraja and Egan (2013)	HR development: employee skills and abilities development

Table 1. The connotations of 'human' found in the lean literature

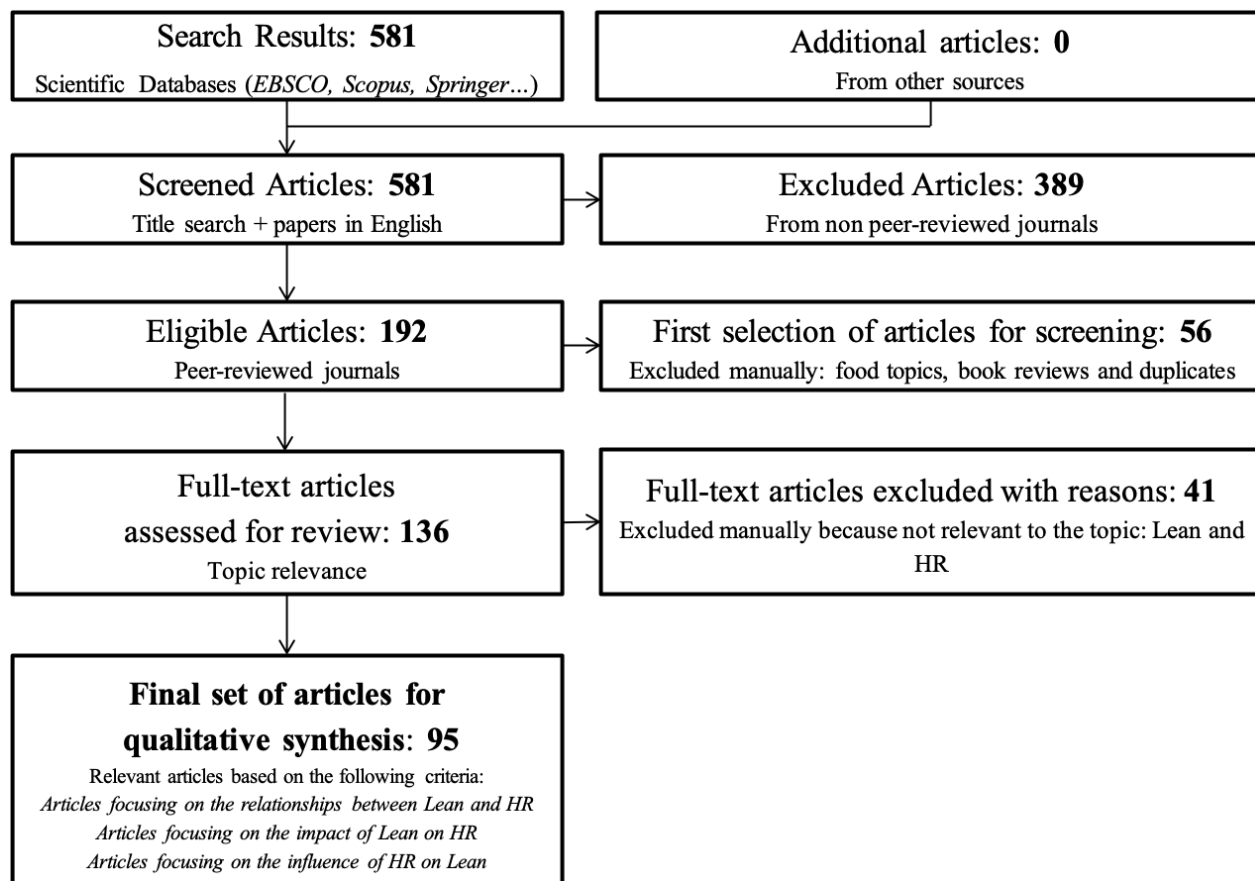


Figure 1. Search process and results

Combination		Results	Combination		Results
Lean	Human	7	Toyota	Human	6
	Human resource	14		Human resource	2
	Employee	22		Employee	4
	People	4		People	1
	HR*	9		HR*	0
	Labor	12		Labor	0
	Worker	8		Worker	0
	Workforce	1		Workforce	0
	Manager	5		Manager	0
Total		82	Total		13

Table 2. Results of the combination of words link to lean and its human dimension

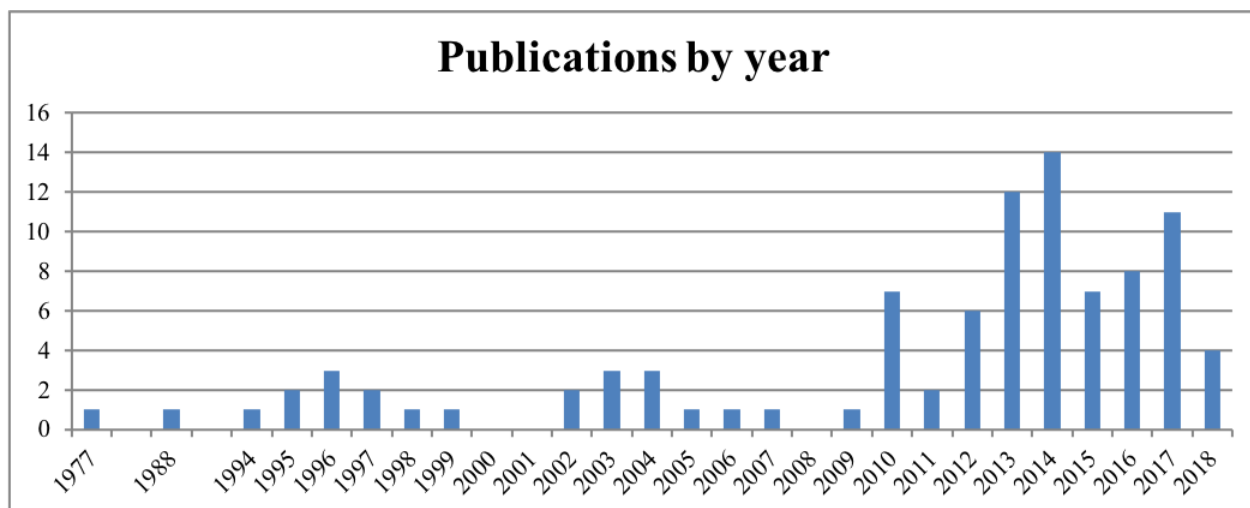


Figure 2. Number of publications per year

Qualitative			Mixed methods	Quantitative surveys	Conceptual /Theoretical	Literature review	Editorial	Commentary
Single- case	Multiple- cases	Action research						
27	11	3	6	32	6	5	2	3

Table 3. Research methods used in the articles

Organisational level enablers	Team level enablers	Individual level effects	
		Effects on Job and Working environment	Effects on Health and Well-Being
High-level leadership support	Organisational commitment		
Strategic and structural clarity	Knowledge sharing	Job satisfaction	Meaning of work
Human resource policy	Conflict management	Skills development	Worker fatigue
Reward and recognition system	Performance monitoring	Increase in responsibilities	Stress
Middle management support	Team leadership	Rewards based on collective performance	Depression
Operator control system	Team cohesion	Skill variety	Injuries
Resource abundance	Team member support	Decrease of control and autonomy	Pressure
	Psychological safety	Repetitive work & intensification	Tension and conflicts
	Innovation	Layoffs, employee turnover	Social issues

Table 4. Preliminary results from existing literature reviews (Beauvallet and Houy 2010; Hasle et al. 2012; Landsbergis, Cahill, and Schnall 1999; Rampasso et al. 2017; Van Dun and Wilderom 2012)

	Human status	Human role
Workers	object/impacted/recipient	operating
Managers	subject/impactor/performer	supervising
Lean expert	assistant/neutral/promoter	intermediary

Table 5. Human dimension characteristics

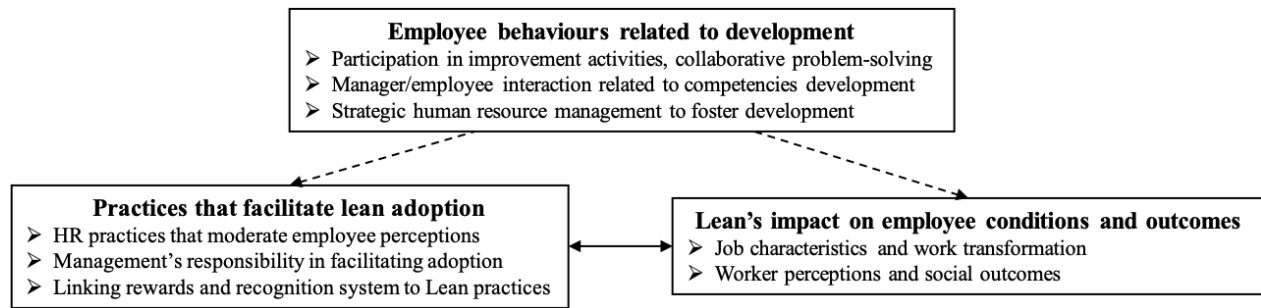


Figure 3. Human dimension framework emerging from the literature review

Florian Magnani is a PhD student at ESCP Europe and Arts & Métiers ParisTech within the framework of an industrial agreement with the PSA group. His research focuses on the characterisation of the human dimension of Lean during its historical evolution. Florian also participated in the creation of a training and experimental platform in Aix-en-Provence, France.

Valentina Carbone is Professor of Operations and Supply Chain Management at the Paris Campus of ESCP Europe and scientific co-director of the Deloitte Chair on the Circular Economy and Sustainable Business Models. Her current research covers the sustainable dimension of SCM, corporate social and environmental responsibility, and sharing and circular economy business models.

Valérie Moatti is Professor of Supply Chain Management and Strategic Management at ESCP Europe. She is currently the Dean of Faculty. She is the scientific director of the Lectra Chair on Fashion & Technology. Her research covers growth strategies and the interface between strategy and supply chain management.