Managing upgrade to lean: an empirical investigation of work practices and organizational culture effects.

Abstract

Although human capital has recognised as an important factor for the effective implementation of lean, current research lacks sufficient empirical evidence to support and identify direct linkages between certain work practices and lean production (LP). Using data from 126 managers employed at a global company, which recently upgraded to lean, this study contributes empirical evidence to examine the role of training, knowledge acquisition and organizational culture in upgrading to lean. Results indicated that from the aforementioned selected variables, only organizational culture might holistically affect LP in its multidimensional nature. Training and knowledge acquisition offer partially effects on LP with training to contribute mostly to predicting continuous improvements. Knowledge acquisition alone, however, has significant yet negative impact on LP. Even more, when training is combined with knowledge acquisition the results are different. The study findings provide useful implications for both theory and practice and discusses its limitations.

Keywords: lean production (LP), work practices, training, knowledge acquisition, organizational culture, survey.

INTRODUCTION

The concept of lean production (LP) originates from the Toyota Production System (TPS), a manufacturing philosophy, which initially was implemented by the Japanese engineers Taiichi Ohno and Shigeo Shingo (Inman, 1999). Despite, the absence of a common and comprehensive definition of LP, it could be defined as "*an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability*" (Shah and Ward, 2007: 791). In terms of our interest, we consider the configuration approach that views LP as an alignment of practices and tools. Such an approach facilitates both academics and practitioners to investigate and explain how an effective lean system must apply into an existing organisation. As LP goes beyond the mere production process, also focusing on the work organization, product design, relationships with the suppliers and sales (Niepcel and Molleman, 1998), we recognise human capital as a significant part of this system. Consequently, the practices implemented by an organization to manage and deploy its human capital might have an impact on LP.

Despite the success of LP (Howell and Ballard, 1998; Hines *et al*., 2004; Vlachos and Bogdanovic, 2013), many lean projects still fail to deliver the expected results (The Manufacturer Magazine, 2011). However, there is little empirical evidence of what factors contribute to either lean failures or success (e.g., Cooney, 2002; Cox and Chicksand, 2005). For instance, current research recognises that many sociocultural factors, such as management support and organizational communication, could drive lean implementation, either to success, or to failure (Worley and Doolen, 2006). These, studies, however, do not offer explicit linkages between certain factors enabling organizations to achieve lean outcomes. Equally, current research lacks clear evidence to support which factors prevent organizations from lean.

As aforementioned, human capital, has recognised as an important factor for the effective implementation of lean (Agrawal and Graves 1999; Bamber and Dale 2000; Yauch

and Steudel 2002). However, research, up to date, lacks evidence to support and identify certain work practices which either enabling or preventing organizations from effective lean implementation. To the best of our knowledge, only few studies (e.g., Martinez-Jurado *et al*., 2014; Pil and McDuffie, 1996; Olivella *et al*., 2008; Vlachos, 2015) refer to the effects of work characteristics and organisational settings on upgrading to LP. For instance, Pil and McDuffie (1996) identified certain high-involvement work practices with an impact on LP; whereas, Olivella *et al*. (2008) empirically supported that work practices, such as continuous training and learning, standardization, compensation and rewards, etc. affect the implementation of lean.

In an attempt to extend this line of research, and identify certain work practices and business settings with an impact to lean, we examine the positive effects of training and knowledge acquisition (as work practices) on LP. Furthermore, we provide a more nuanced understanding of managing upgrade to lean by examining the effect of organizational culture construct on lean when business settings are also taken into consideration. By doing so, we utilise data from a global company, which, has recently upgraded its operations to lean production.

This study makes three significant contributions: Firstly, it provides empirical evidence on the effects of work practices and organizational settings on upgrading to LP. In so doing, it contributes in building a theory of LP that incorporates sociocultural factors while organizations upgrading to lean. Secondly, it highlights the role of specific work practices (i.e., training and knowledge acquisition) and business settings (i.e., organizational culture) and quantifies their effects using analytical methodologies. Although current research (e.g., Doolen and Hacker, 2005) recognizes the significance of people management in the implementation of lean, there are no explicit evidence to support direct effects of training and knowledge

acquisition as well as organizational culture on lean processes. Thirdly, it provides managerial recommendations for organizations aiming to upgrade their operations to LP.

The rest of the paper is set out as follows: the next section provides a literature review on the concept of LP, the work practices of training and knowledge acquisition as well as the construct of organizational culture and develops the rationale behind the research hypothesis. The third section presents the study methodology and its findings. The fourth section discusses the empirical results whilst the fifth and last section concludes the paper.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Lean Production

Despite the lack of a universal definition of LP, there is a consensus between both scholars and practitioners that LP eliminates wastes in operations, while, at the same time, adds value to the end users (Womack and Jones, 2005). Traditionally, lean thinking focused on the removal of obstacles ('wastes') that hinder unremitting flow of work processes (Liker, 2004). This approach emphasizes more on process and operational issues than social, human, or workplace characteristics. Accordingly, waste can be anything other than the equipment, materials, parts, space, and working time required to provide the service. Extant literature identifies seven types of wastes, which are subject of mitigation based on the lean thinking and philosophy: transport; inventory; motion; waiting; over-production; over-processing and defects (Vlachos, 2015). Moving from operations towards workplace issues, recently an eight type of waste has been included, that of employees' skillset, with specific reference to underutilization of capabilities or delegating tasks resulting from inadequate training. Bonaccorsi *et al*. (2011: 429) stressed, "*lean is not centered on reducing employees and assets but by directing people's energy on creative tasks by improving the operation through the continuous purging of waste, idle time, paper work and bureaucracy*". Lean does not arbitrarily reduce staff levels but increases

available capacity, eliminates waste and adds value to customers by training employees to work smarter, better and faster (Paluch, 2008). Womack and Jones (2004: 258) argued that the "*application of lean procedures will cut human efforts in half as rework and indirect activities are removed from the process*". Therefore, by adopting to lean, companies expect to use the same number of people to produce more (almost doubled their job in half the time) by turning underutilizing skills into productive skills and developing new ones. In essence, a waste-reduction project only upgrades to LP when employees perceive that there is a supportive business culture, which facilitates them to embrace it (Lloyd *et al*., 2009).

Despite the success of LP across diverse industries such as construction (Howell and Ballard, 1998), aerospace (Hines *et al*., 2004), and tourism (Vlachos and Bogdanovic, 2013), many lean projects fail to deliver the expected results having success rates lower than 5% (The Manufacturer Magazine, 2011). However, there is little empirical evidence to support which factors contribute to either lean failures or success (Cooney, 2002; Cox and Chicksand, 2005). Recently, Vlachos (2015) reviewed extant literature from 1993-2011 and classified lean failure factors under three categories: leadership, business culture and people issues, and action plan customisation.

Bamber and Dale (2000) have also reported that although an aerospace manufacturer achieved satisfactory lean outcomes with the assistance they received from external lean consultants, they couldn't cultivate a lean culture in the organization since, after the consulting team departed, interest in the LP evaporated, inhibiting improvements within the factory. Additionally, Chen and Meng (2010) identified four reasons for lean failures in Chinese Mainland: (i) lack of long term strategic commitment to LP; (ii) abandonment of lean with the first failure; (iii) imitation of LP from foreign companies without adopting them to their own business culture and (iv) superficial know-how regarding lean tools and lack of analytical skills to pinpoint and solve problems. In this vein, Carter *et al*. (2011) reported that a lean

implementation failure in public sector (HM Revenues and Customs - HMRC) attributed mainly to people issues. Even more, Emiliano (2011) attributed lean failures to the managers and consultants characterised lean management as a zero-sum outcome resulting in expense of employees. Consequently, in order for organizations to upgrade to lean, employees should start working together effectively for the accomplishment of new or redefined tasks. Additionally, they should receive support by the top management executives which, in turn, will facilitate them to perceive that the culture of their organization is strong and supportive following the lean philosophy (Ōno, 1988).

Lean production and work practices

Lean production is associated to both work characteristics and employee outcomes (Parker, 2003). According to Womack and Jones (2003) lean thinking and production attempts to minimize time consuming tasks, thus maximizing "*the value-adding proportion of working time*", while, at the same time, the maximum workload is ensuring. In lean systems, employees have greater autonomy while performing the tasks assigned to them. Additionally, LP requires from employees to be knowledgeable in more than one work domains/aspects, to develop a broaden skillset enabling them to perform a variety of different tasks and solve problems adequately. Parker (2003: 620) has accurately affirmed, "*the system involves multi-skilled operators, typically organized into small teams, being responsible for quality, continuous improvement, and problem solving*".

As discussed above human capital has been considered "*a significant issue in the implementation of lean*" (Doolen and Hacker, 2005: 56). Specifically, in a research conducted in electronic manufacturing organizations, Agrawal and Graves (1999) found that the practices adopted by organizations are not always supportive for the successful implementation of lean as they might prevent the "*separation between design, board fabrication, assembly, and test operations*". The isolation of product designers, either in terms of functionality in day-to-day

operations, or geographical location, or distance across organizations might also limit the effectiveness of lean in organizations. In this vein, Bamber and Dale (2000) support that rigid organizational structures are "*the single biggest obstacle to the adoption of lean production*", thus making the more flexible organizational design fundamental to lean. According to McDuffie (1995), flexible systems might enable organizations to achieve 'organization logic' in order for the existing work practices to be consistent to manufacturing practices. In this manner, organizations may pursue ongoing productivity, at the same time, as they retain the high quality of their offerings. Similarly, Sakakibara *et al*. (1997) have also considered the required conjunction of HRM activities with other practices (such as TQM), which are considered as critical factors whose effectiveness might either facilitate or impede the successful implementation of just-in-time (JIT) and total productive maintenance (TPM) lean practices.

To achieve a better understanding regarding upgrading to lean we select three variables associated to work practices, which are found to be common in organizational efforts to upgrade to lean (Smeds, 1994). Specifically, the framework analyzed in this study based upon two work practices that of training and knowledge acquisition as well as the construct of organizational culture whose relationship with the LP is discussing in the sections that follows. The rationale behind the selection of the specific work practices (i.e., training and knowledge acquisition) reflects the needs of a lean organization whilst, the construct of organizational culture draws particular attention to organizational settings required for upgrading to lean.

Hypotheses Development

Training and lean production

Training and development at work is one of the HRM practices (along with selection, recruitment, performance evaluation, etc.) and it is "*usually seen as a single HRM practice*" (Hartog and Verburg, 2004: 56) with high value among the high performance work practices

(e.g., strict selection, team performance, pay-for-performance, etc.). Extant HRM literature has operationalized training in terms of similar and aligned practices such as employee development, skills training and/or career planning (Hartog and Verburg, 2004). Workplace training and development have been widely investigated in relation to employees' personal and professional development as well as organizations' profitability, growth and increased performance outcomes (Aguinis and Kurt, 2009). However, a common definition of this practice to encompass its multifaceted importance is hard for scholars to give. In general terms, training could be seen as an ongoing and methodological development of employees' knowledge, abilities and skills (KAS) required to effectively perform the tasks assigned to them (Patrick, 2000). According to Landy (1985: 306) training is "*a set of planned activities on the part of an organization to increase the job knowledge and skills or to modify the attitudes and social behavior of its members in ways consistent with the goals of the organization and the requirements of the job*".

Despite its various definitions, training, as also stated earlier, is explicitly linked to employees' performance (e.g., Bartel, 1994) as well as organizations' performance outcomes (Bartel, 1994; Delaney and Huselid, 1996; Knoke and Kalleberg, 1994; Russell *et al*., 1985). The training that is provided to employees aims at the development of their skills and abilities and as Birdi *et al*. (2008) accurately stated "*by upgrading employees' skills and knowledge, they are in a better position to produce high-quality products and services in the most cost-effective way, adapt to change, and contribute to company competitiveness through product or process innovation*". As such, employees involved in complex tasks and activities whose accomplishment requires a wide range of skills and abilities should be provided with 'extensive training'; a term used by Pfeffer (1998: 96) to reflect the importance of training in assisting employees to develop a wide spectrum of skills and abilities rather to perform restricted tasks.

According to Human Capital Theory "*firms train workers (and pay for the training) if doing so enhances the firms' profits*" (Baron and Kreps, 1999: 372). In this vein, Aragon-Sanchez *et al*. (2003) have investigated the benefits of training in relation to organizational performance and concluded that certain types of training such as on-the-job training and internal training delivered by in-house trainers resulted in profitability and organizational effectiveness. Equally, Guerrero and Barraud-Didier (2004), based on answers provided by 1530 HR directors employed by large organizations in France, found that training affects the financial performance of organization. In a meta-analysis, Arthur *et al*. (2003) also found support to the benefits of training at organizational level indicating, however, that the types of training, the method of its delivery as well as the skills and abilities to be trained are subject to its effectiveness (Aguinis and Kraiger, 2009).

As stated by Birdi *et al*. (2008), training is among the three work practices (along with empowerment and teamwork), which have been all theoretically associated to lean philosophy. LP requires from employees to be involved in multi functions thus being multi-tasked and –skilled. And, as Niepcel and Molleman (1998: 266) state "*indeed, in LP workers are supposed to carry out a wide range of duties and they are trained to carry out all kinds of different tasks*". Specifically, training facilitates employees to enhance their understanding towards the LP and its requirements as well as towards the effective utilization of problem-solving techniques. McLachlan (1997) recognized education and training among the factors suggested by the literature, which should be implemented as part of just-in-time lean practice. Later on, Yang *et al*. (2011) noted that lean manufacturing requires, among others, from employees to be involved in actions which might increase the dissemination of knowledge such as training, autonomous teams and empowerment.

Consequently, it could be supported that training enable employees to develop the appropriate mindset, which facilitate them to understand how to reduce costs, improve the

quality and increase their productivity while interacting in a lean context. In other words, training could render employees knowledgeable of how to minimize wastes. In turn, such an understanding could also increase organization's reputation, profitability and productivity and decrease employee turnover.

The aforementioned rationale leads us to postulate that training might facilitate lean in organizations, thus forming the first hypothesis of our study as follows:

H1: *Training positively affects LP***.**

Knowledge acquisition and lean production

"*Knowledge is a multifaceted concept with multilayered meanings. The history of philosophy since the classical Greek period can be regarded as a never-ending search for the meaning of knowledge*" (Nonaka, 1994:15). In general terms, knowledge in an organizational context could be seen as a combination/synthesis of experiences, contextual information, values and expert approaches, which frame the background for assessing and incorporating new experiences and data (Davenport 1998 as cited Dombrowski *et.al.,* 2012). Even if its importance has been strategically recognised as source for organizations' competitive advantage (e.g., Kogut and Zander, 1992; Prahalad and Hamel, 1990; Starbuck, 1992) none of the current definitions comprehensively deliver the meaning of organizational knowledge; than that it is considered as an intangible asset. Organizational knowledge can be either tacit or explicit and considered as a crucial factor of production available to organizations that is also often promising increased performance outcomes (Barney, 1991; Grant, 1991; Penrose, 1959; Wernerfelt, 1984). In the era of knowledge economy, organizations should enrich and integrate the knowledge they already possess through the acquisition of new knowledge that sourced outside their boundaries.

Although the acquisition of organizational knowledge has been broadly discussed by scholars in various fields (e.g., innovation, strategic management, organizational behaviour),

extant literature fails to provide a comprehensive definition of this process. Some scholars equate the acquisition of new knowledge that is externally derived with the concept of absorptive capacity, i.e., an organization's ability to make effective use of existing knowledge in order to recognise the value of the new knowledge to be acquired, assimilate it and implement it in daily routine tasks and activities (Cohen and Levinthal, 1990). While others (e.g., Gold *et al*., 2001) describe the acquisition of new knowledge in the context of knowledge management oriented processes. Gold *et al*. (2001) have also identified a variety of synonymous terms (such as, seek, generate, create, etc.) which have been used by the scholars in this field in their attempt to accurately define the accumulation of new knowledge. Regardless of how the acquisition of knowledge is labelled/called it is often linked to learning and has been seen, among others, as either a driving force for growth and development (Penrose 1959), or as a prerequisite for an organization's ability to exploit new opportunities (Spender and Grant, 1996), or, in terms of our interest, as an essential work practice for the successful implementation of LP (Dombrowski *et al*, 2012).

As discussed earlier, the successful implementation of LP requires, among others, knowledgeable employees in more than one work domains with a broaden skillset enabling them to concurrently perform a variety of different tasks and solve problems. Furthermore, according to Helper and McDuffie (1997), lean implementation requires structured knowledge management systems (KMS) facilitating those who are involved in lean processes to better absorb technical knowledge. During the implementation of LP, knowledge invisibly flows between the involved parties, thus they accumulate it either through well-defined and – structured procedures or randomly over unplanned processes. Research suggests that, although, the majority of lean organizations implement similar systems, there is no uniformity regarding the flow of knowledge and its accumulation (Dombrowski *et al*, 2012). One plausible explanation could be the fact that lean makes existing knowledge easily obsolete, thus

rendering the acquisition of new knowledge a required ongoing day-to-day operation, which, in turn, could change existing knowledge flows. If this is the case, employees should learn how to effectively acquire new knowledge while they concurrently perform "*traditional skills such production scheduling, workforce planning and data management*" (Helper and McDuffie, 1997:23).

Furthermore, in Toyota paradigm, the acquisition of 'deep technical knowledge' is considered a 'base line skill' and part of the lean process. As Liker and Morgan (2006: 11) accurately state "*a lean product development system is a knowledge work job shop, and as such you can continuously improve it using adapted forms of tools used in repetitive manufacturing processes, such as value stream mapping and queuing theory, to eliminate waste and synchronize cross-functional activities*".

In line with extant literature, we suggest that organizational knowledge, i.e., the knowledge possessed or that acquired by organizations, is essential for the successful implementation of LP. Building upon the aforementioned discussion, we postulate that the acquisition of new knowledge positively affects LP, thus forming the second hypothesis of our study as follows:

H2: *The acquisition of new knowledge positively affects LP.*

Organizational culture and lean production

Organizational culture dominates the literature since the early 1980s and is, often, linked to HRM (Hartog and Verburg, 2004). It is usually seen as one of the determinative organizational factors, which distinguishes successful organizations from less successful ones, as the first articulate and share a spectrum of well-defined and -established norms and values within their boundaries (Deal and Kennedy, 1982; Kilmann *et al.*, 1985; Ouchi and Price, 1978; Peters and Waterman, 1982; Schall, 1983; Schein, 1985; Weick, 1985). According to Deal and Kennedy (1982), strong organizational cultures are often promising improvements in organizational

performance, while, at the same time, affect positively employees' behavior. Strong cultures "[…] *encourages the participation and involvement of an organization's members appears to be one of its most important assets*" (Denison, 1984: 5). Since, early 1990s the literature demonstrates a significant body of empirical research focusing on the linkages between organizational culture and performance outcomes (Gordon and DiTomaso, 1992).

Despite the increased interest in the literature regarding organizational culture, it is hard for both scholars and practitioners to conceptualize it as it exists at several levels within an organization and many different factors might affect it. Schein (2009), identifies three levels of organizational culture: the artifacts, espoused values and underlying assumptions and defines it as "*a pattern of shared tacit assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems*" (Schein, 2009: 27). Since organizations are built on their human capital functioning in its boundaries, organizational culture not only drives employees' behavior but also reflects the way they learn, share, make assumptions and experience the reality of their organizations.

In other words, organizational culture reflects the way organizations do things (Schein, 2009). Consequently, it might also affect the way organizations upgrade into lean. According to Napoles and Quintana (2006) "*lean calls for cultural change*" to facilitate organizations to achieve the five lean principles (i.e., specify value, identify the value stream for each product, make a non-interrupted product flow, purse perfection and give value to the end-user) (Vest and Gamm, 2009:5). Moreover, a lean organizational culture could also facilitate employees to better understand the lean thinking and philosophy, thus rendering them able to implement the above-mentioned principles in the day-to-day operations and resist less to change.

Lean requires, among others, simple organizational structures which management team should support (Smeds, 1994) as they reflect the culture dominates organizations. Meaning further that supportive cultures develop corresponding employees' values which are aligned to corporate spirit as well as motivate employees to work together to attain similar goals and share knowledge. In this vein, supportive cultures could also promote lean thinking (Kaplan and Norton, 2004). Loconci *et al*. (2011) also indicated that employees' beliefs could be seen as an intrinsic factor influencing their perceptions regarding lean transformation and the overall success of lean outcomes. The aforementioned rationale is summarized in the third and last hypothesis of our study as follows:

H3: *Organizational culture positively affects LP*.

METHODOLOGY

Instrument development and data collection

A detailed questionnaire sent to employees of a multinational oil and gas company operated for over forty years (called as company Alpha) which had recently implemented lean practices. The study population was 118 functional, 52 supervisory and 26 managerial level employees (196 employees in total). One hundred and twenty-six of the population is males and 70 are females.

A pilot study has been conducted to ensure that the results of the questionnaire are valid and meet the objectives of this study. Based on the feedback from the pilot test, slight modifications were made to some sections of the questionnaire. Two hundred and twenty questionnaires were distributed within Alpha Company, using a systematic random sampling and directed to three levels (functional, supervisory and managerial) of respondents. Out of the two hundred and twenty questionnaires distributed, 126 returned completed, corresponding to 89.1% response rate.

Table 1 shows the characteristics of employees surveyed. Nineteen point four per cent of the respondents were below 30 years of age, 47.4% were between the ages of 31 to 40 years, and 24.5% were between ages 41 to 50 while 8.7% were above 50 years old. Out of the 196 respondents, 60.2% were functional level employees, 26.5% were of the supervisory level while 13.3% belonged to the managerial level and above. Fifty-two per cent of the respondents were technical staff while the remaining 48% were non-technical staff. The years of work experience of the respondents varied; 27% of the respondents have been in employment for between 0-5 years, 34.7% have worked for between 6-10 years, 24% have worked for 11-20 years and the remaining 14.3% respondents have worked for more than 21 years of their existence.

[Place

*Table **1**about here]*

Measures

Principal component analysis with varimax rotation conducted to assess the underlying structure for the sixteen variables in the questionnaire. After rotation, four factors were emerged: *culture* accounted for 27.83% of the variance, *knowledge acquisition* for 22.62%, *training* for 17.85%, and *resistance to change* for 8.81% (Table 2). We used the Anderson-Rubin Method, which ensures orthogonality of the estimated factors, to produce factor scores. Table 2 contains the items, the scale composite reliability (Cronbach α), and factor loadings for the rotated factors, with loading less than 0.40 omitted to improve clarity.

Independent variables

The first factor, which included items measuring the *organizational culture* was labelled as 'culture' (five items, α= 0.917). The second factor, measuring the *acquisition of new knowledge* labelled as 'knowledge' and included items measuring the employees' knowledge about lean practices (four items, α= 0.911) without distinguishing between tacit and explicit knowledge.

The third factor, measuring *employees training* labelled as 'training' and included four items (α=0.821) measuring the organization's emphasis on training its personnel on lean practices. The fourth factor, labelled *resistance to change*, included three items (α=0.670) measuring the employees' attitude towards change. However, statistical power of this fourth factor is lower than the other three factors. Nevertheless, we included this factor in the regression analysis as we found challenging to see plausible linkages to lean. All four factors had significantly high scale composite reliability (Cronbach α) and were included in the hierarchical analysis model. All measures in this study used a five-point Likert scale where 1 = strongly disagree and 5 = strongly agree.

Dependent variable

LP assessed using four different measures, i.e. (i) continuous improvement, (ii) waste management (iii) ergonomy and (iv) product quality. Respondents were asked to indicate their firm's performance as compared to the industry's average in the above items using a 5-point Likert scale, where 1 = bad and 5 = very good.

Control variables

We made use of five control variables to test for confounding effects derived from the individual characteristics of the respondents. We used categorical scales for all control variables to facilitate regression analysis. Specifically, the following scales were used: sex (male, female), age (below 30, between 31-40, between 41-50 and over 50), job level (functional, supervisory, managerial), job type (technical, non-technical), and years of experience (0-5, 6-10, 11-20, and over 21).

***Common Method Variance* (CMV)**

As in all self-reported studies, the possibility of common method variance (CMV) should be addressed. When both the outcome measure (i.e. performance of LP) and the workplace practices as well the construct of organizational culture were self-reported on the same survey

instrument, all measures share CMV. There are a number of techniques, which can be used to minimise CMV (Podsakoff *et al*., 2003). We used the Harmon's factor test to examine whether or not CMV in the predictor and outcome variables inflates the empirical relationships among the variables and found that the largest factor (which, in cases of CMV, would account for a majority of the variance) only accounting for 22.134% of the variance. Thus, CMV is unlikely to bias this sample.

[*Place Table 2 about here*]

Findings

Univariate analysis

Table 3 presents the Pearson's correlation analysis. The control variables (sex, age, job level, job type and years of experience) showed high correlation with the LP variables as well as with each workplace practices variables (i.e., training and knowledge acquisition). The workplace factors that resulted from the factor analysis (training, knowledge acquisition, resistance to change) showed no significant association with LP variables. Specifically, *organizational culture* showed significant association with *continuous improvement* (r=.-.698, p<.01), *waste management* (r=.-.342, p<.01), *ergonomy* (r=.-.631, p<.01), and *product quality* (r=.-.596, p<.01), (ii) *knowledge acquisition* showed significant association with *waste management* (r=.177, p<.01) and ergonomy (r=.-.147, p<.1), (iii) training showed significant association with *ergonomy* (r=.244, p<.01), and *product quality* (r=.-.221, p<.1).

[*Place Table 3 about here***]**

Hierarchical model

To explore the relationships between work practices and business settings (in terms of organizational culture) and LP, a hierarchical regression analysis utilised. We run four multiple regressions, one for each individual LP variable (i.e., continuous improvement, ergonomy, product quality and waste management). We entered variables in three steps creating thee

models. In Step 1, we entered only the five control variables (sex, age, job level, job type and years of experience) in the regression equation creating the Control. In Step 2, labelled as the Independent model, we added the four work practices into the regression equations. Finally, in Step 3, we entered the six interactions of the four factors into the regression equations creating the Interaction model. Tolerance tests showed no significant collinearity among variables.

Hierarchical regression results Table 4 reports the *continuous improvement* and *waste management*; Table 5 presents the *ergonony* and *product quality* performance variables. The beta weights, presented in Table 5 suggest that *organizational culture* (β=0.9, p<.001) and *training* (β=0.32, p<.001) contribute most to predicting *continuous improvement*. *Knowledge acquisition* had a significant yet negative effect on *continuous improvement* (β=-0. 34, p<.001). This indicates that *continuous improvement* is a lean issue that is directly related to creating a lean culture and the tacit knowledge of existing working practices may inhibit its application. *Continuous improvement* depends on tacit knowledge on how to improve processes, identify non-value added activities and remove waste. In this way, explicit knowledge may not affect this performance measure to the extent that tacit knowledge does.

Particularly, for *continuous improvement*, the change in adjusted R square value (ΔR) was 0.835, p<.001 (F=202.2, p<.001). This means that *work practices* increase for 83.5% the *continuous improvement* in performance with *culture* and *training* having the largest effects. *Waste management* is also improved but at a very slight percentage. Particularly, the Independent model produced a change in adjusted R square value (ΔR) equal to 0.08, p<.001 (F=29.564, p<.001) with the adjusted R square value to be .564 Although the impact on *waste management* is less that the impact on *continuous improvement,* still an improvement of 8% in waste reduction should be considered significant. *Organizational culture* (β=0.28, p<.001), and *knowledge acquisition* (β=0.26, p<.01) contributes most to the Independent model. *Training* (β=-0.24, p<.1) had a negative impact on *waste management* which can be attributed to the

demographics of the sample, since waste reduction depends mostly on the *experience* (β=-0.48, p<.001) and *Age* (β=-0.40, p<.001). The Interaction models for both *continuous improvement* and *waste management* did not produce statistically significant results.

Regarding *ergonomy performance* variable, the Independent model produced statistically significant change in adjusted R square value (ΔR) equal to 0. 605, p<.001 (F=72.77, p<.001) *culture* (β=0.73, p<.001) and *training* (β=0.13, p<.1) were the two factors with a significant positive beta value. Like *continuous improvement*, *knowledge acquisition* had a negative impact on *ergonomy* (β=-0.18, p<.01), which can be interpreted in a similar manner with the *continuous improvement* variable. The Interaction model for *ergonomy* performance variable did produce a significant change in adjusted R square value (ΔR) equal to 0. 016, p<.1 (F=46.71, p<.001). Similar results found for the *product quality* as dependant variable in the regression model. In this case, the change in adjusted R square value (ΔR) was equal to 0. 486, p<.001 (F=40.98, p<.001) and the factors with high beta values were *organizational culture* β=-0.71, p<.01), *training* β=-0.13, p<.1), and *resistance to change* (β=-0.13, p<.1). Interestingly, the only Independent model with *resistance to change* having significant beta values was the one with *product quality* as dependent variable, indicating that employees used to follow specific procedures referring to product quality and lean techniques are hard to change the employees' perceptions of product quality.

DISCUSSION

Upgrading traditional manufacturing practices to LP has not proven always a successful business practice (Howell and Ballard, 1998; Hines *et a*l., 2004; Vlachos and Bogdanovic, 2013; The Manufacturer Magazine, 2011). Still, there is little guidance from both theory and practice of how to avoid failure and build a coherent lean transition plan (Cooney, 2002; Cox and Chicksand, 2005). Prior studies have indicated that work practices and organisational

settings may play a significant role in upgrading to LP (Vlachos, 2015). This study examined the role of three factors (training, knowledge acquisition, and organisational culture) on upgrading to LP in order to provide clearer insights regarding the factors, which might facilitate organizations to achieve effective lean outcomes. The study results in interesting affirmations whether the aforementioned factors could be considered as organizational factors under either failure or success to certain lean performance variables.

This study makes three significant contributions: (i) it contributes in building a theory of LP that incorporates workplace and sociotechnical factors, (ii) it quantifies the impact of specific workplace practices (i.e., training and knowledge acquisition) and organizational settings (i.e. organizational culture) on LP and (iii) it provides managerial recommendations for companies aiming to upgrade their operations to LP. These contributions are discussed in the sections below.

Implications for theory

Although human capital has been considered among the critical factors for the implementation of lean, research regarding the effects of individual oriented work practices on LP seems to be relatively narrowed. In an attempt to provide more useful insights regarding which work practices affect the implementation of lean we empirically analyzed the processes of training and the acquisition of new knowledge in an international company that has recently implemented lean practices. Additionally, the impact of organizational culture has been analyzed in the context of organizational settings with an impact on lean. We found empirical support of our findings to argue that (i) training and knowledge acquisition affect LP but not holistically. Specifically, training significantly affects ergonomy but it contributes mostly to predicting continuous improvements in LP when appropriate business settings exist (i.e., supportive organizational culture), (ii) training negatively affects waste management, (iii) knowledge acquisition alone has negative impact on continuous improvements in LP as well

as on ergonomy; while significantly affects *waste management*, (iv) training together with the acquisition of knowledge positively affects LP and (v) organizational culture showed significant association with the four dimensions of lean performance (i.e., continuous improvements, ergonomy, product quality and waste management).

Training and lean production

One of the immediate actions that organizations should undertake striving to upgrade to LP is to train their employees in a way that they develop skills allowing them to adopt and develop themselves into the new production system (Niepcel and Molleman (1998). The study findings support that *training* significantly affects *ergonomy* and *product quality* but it contributes mostly to *continuous improvement* when the environment is supportive, i.e., when the appropriate business culture dominates the organization. This finding partially confirms the first hypothesis of our study, which postulated that *training* positively affects LP.

In line with current research, our study also confirms that the recently added eighth type of waste in lean thinking that of the underutilization of skills or the delegation of tasks without appropriate training, affects LP. Training enables employees to develop the appropriate mindset in order to better comprehend the meaning of wastes thus implementing lean practices and techniques in their day-to-day tasks and activities. Even more, ongoing appropriate training could also render employees eligible to achieve sustainable lean outcomes for their organizations, which, in turn, might minimize plausible employee turnover, increase organization's reputation, profitability and productivity (Paluch, 2008). In other words, training could develop employees' skillset towards the lean principles and fundamentals. In turn, as organizations are built on their people, training facilitates organizations to improve their performance on an ongoing basis.

However, study results demonstrate that training negatively affects *waste management*, thus contradicting the narrative of lean theory (Womack and Jones, 2004). The study results

also indicate that demographic variables such as *experience* and *age* influence waste reduction to a greater extent than training itself. Such an important finding highlights the fact that training itself is not enough to change the mindset of employees which are either deeply rooted in their prior experiences, beliefs and personal characteristics and confirms the theory of unlearning. However, when training is combined with *knowledge acquisition* the results are different and discussed in the section that follows.

Knowledge acquisition and lean production

In Toyota Production System, the acquisition of 'deep technical knowledge' has been considered as a 'base line skill' and part of the lean process, which has been seen as a 'knowledge work job shop′ (Liker and Morgan, 2006). Findings of this study reveal that the *acquisition of new knowledge* had a significant yet negative effect on *continuous improvement*. At first sight, this finding could be seen as controversial; yet it indicates that *continuous improvement* is subject not only to the mere acquisition of new knowledge but also to the appropriate implementation of the newly acquired knowledge to existing organizational practices, routines and activities before it becomes obsolete. Lean practices also require appropriate, effective and on-time dissemination of knowledge within the involved parties. As lean is directly linked to organizational culture, it could be also suggested that appropriate business settings could enable the sharing of tacit knowledge to promote lean; a process which, by its nature, is complicated and time consuming and might inhibit the lean application.

Continuous improvement depends, to a great extent, on the dissemination of tacit knowledge since it is built on employees' cognitive background on how to improve processes, identify non-value added activities and remove waste, which by its nature is difficult for organizations to turn it into explicit knowledge and disseminate it effectively. Following the aforementioned rationale, it could be argued that, explicit knowledge might not affect this

performance measure in the extent tacit knowledge does. Hence, the effects of these two types of knowledge (i.e., tacit and explicit) on lean performance should be separately tested.

The successful implementation of lean practices requires, among others, knowledgeable and multi-skilled employees (Dombrowski *et.al*, 2012). This also indicates a possible path dependence of training before actual knowledge acquisition takes place as well as the need to create a supportive business culture. *Knowledge acquisition* showed significant association with *waste management* and a negative impact on *ergonomy*. According to Helper and McDuffie (1997), lean implementation requires structured knowledge management systems facilitating those who are involved in lean processes to better absorb technical knowledge. Upgrading to LP might render existing knowledge obsolete and skills reluctant, which might also stress employees to change or resist to new *ergonomy*. In this case, employees should acquire lean knowledge, at the same time as they perform traditional skills (Helper and McDuffie, 1997).

Organizational culture and lean production

Findings indicate that *organizational culture* showed significant association with *continuous improvement*, *waste management*, *ergonomy*, and *product quality*. This variable was the only variable that significantly influenced all LP variables. Therefore, we found full empirical support to the third hypothesis of our study, which postulated that organizational culture positively affects LP. This finding, in line with the extant literature, confirms that philosophy of lean thinking is much more than implementing lean tools; meaning that an organization should encompass a set of principles and a business philosophy to upgrading to lean (Tsasis and Bruce-Barrett, 2008).

Despite the positive impact of business culture on the successful transition to lean, a number of failed attempts highlights that many organizations in their effort to excel in lean practices ignore the importance of lean culture. As we already mentioned, organizations are

not able to cultivate lean outcomes without developing and securing appropriate and strong business cultures (Bamber and Dale, 2000). Chen and Meng (2010) also argued that the imitation of LP practices, although it is not an appropriate technique, should be adjusted to existing business settings in order to yield lean outcomes. The negative effects of overlooking that "*lean calls for cultural change*" (Napoles and Quintana, 2006), were also reported in studies by Carter *et al*. (2011) and Emiliani (2011) who attributed lean failures to inappropriate business cultures dominate public sector. In essence, a waste-reduction project only transitions to LP when strong and supportive cultures assist employees to embrace it (Lloyd et al., 2009).

Since organizational culture needs time to cultivate, we may confirm that the transition to lean should be seen as a long-term perspective. Such a longevity is also required for the acquisition of new knowledge and its effective implementation in existing practices, which are found to be prerequisite to LP. Relying also on a set of repetitive appropriate training events organizations may achieve the expected lean outcomes. However, it is the combining effect of the training and the organizational that showed the highest impact on the success of LP.

Implications for practice

Practitioners in charge of lean management should be mindful of the influence of workplace practices and business settings on lean performance, attributing primarily importance to culture and training. Organizational culture affects employees' values, beliefs and attitudes, which could be related to their motives and expectations regarding the accomplishment of a task. Both organizational culture and training could facilitate employees to share their perceptions towards ongoing changes that take place through lean and overcome plausible resistance to adjust to these changes and start lean thinking. Practitioners should also consider that the mere acquisition of new knowledge is not always the appropriate path to achieve lean. Even more, they should pay particular attention to the types of training they implement to grow their employees as well as on the development of appropriate business settings to promote the

sharing and the dissemination of tacit knowledge. Simultaneously, employees' development should be critical to the degree that influence people perceptions and mind set regarding the accomplishment of a task. Finally, there should be awareness regarding the specific areas of lean applications such as workplace practices and business settings as was shown in the current research. The consideration of the above would assist to the development and the implementation of appropriate lean processes in conjunction with the HRM dominate an organization, which deploys its human capital along with the existence of effective performance evaluation systems, and processes.

Limitations

The present study has some theoretical, methodological and sample limitations that need to be considered and addressed in future research. As literature on the examined topic is /narrowed, a review of critical themes took place for the study background and analysis. The sample is limited (only from one company of a specific origin) whereas it could be broader, where comparison of research findings could take place. As all participants are considered employees of the company, this study reflects merely employees' perceptions without exploring the influential factors of humans' perceptions. Four different measures of the performance of LP were chosen. However, to some, extent, lean effectiveness measures, might be biased due to subjectivity issues, as they rely only on self-reported responses. A wider variety of measures of the performance of lean and workplace practices and business settings need to be considered so that more interconnections to be analysed. The workplace practices and business settings should be enriched also including factors such as: the role people play in the implementation of lean, the ways people are managed to adjust to changes happened when organizations make the decision to apply lean until its implementation, the role of people management issues (e.g., communication, rewards and job design) and intrinsic factors (e.g., commitment values and beliefs). Furthermore, a thorough and contextualized approach towards the term 'performance

of LP' is needed, specifying the stage/s of such performance where workplace practices and business settings are involved. For instance, whether it refers to adjustment to changes when lean applications are introduced or/and to results which are brought about with the completion of such applications.

CONCLUSION

In conclusion, the present study provides insights into the important role of training, knowledge acquisition and organizational culture in upgrading to lean. To this end, we examined the direct effects of the three aforementioned variables on certain dimensions of lean performance, i.e., continuous improvement, ergonomy, product quality and waste management). Using data from a global company, which has recently upgraded to lean, the study findings supported interesting effects of the aforementioned variables on LP showing that work practices and business settings alone cannot holistically affect LP. That is, the combination of work practices and business settings that matters, yielding lean outcomes.

REFERENCES

Agrawal, Ashutosh and Robert J. Graves, 1999, "A distributed systems model for estimation of printed circuit board fabrication costs". *Production Planning & Control*, **10**(7): 650-658.

Aguinis, Herman and Kurt Kraiger, 2009, "Benefits of training and development for individuals and teams, organizations, and society". *Annual Review of Psychology*, **60**: 451-474.

Aragon-Sanchez, Antonio, Isabel Barba-Aragón and Raquel Sanz-Valle, 2003, "Effects of training on business results". *The International Journal of Human Resource Management*, **14**(6): 956-980.

Arthur Jr., Winfred, Bennett Jr. Winston, Edens Pamela S. and Bell Suzanne, 2003, "Effectiveness of training in organizations: a meta-analysis of design and evaluation features". *Journal of Applied Psychology*, **88**(2): 234-245.

Bamber, Linda and Barie G. Dale, 2000, "Lean production: a study of application in a traditional manufacturing environment". *Production Planning & Control*, **11**(3): 291-298.

Barney, Jay, 1986, "Organizational culture: can it be a source of sustained competitive advantage"? *Academy of Management Review*, **11**(3): 656-665.

Barney, Jay, 1991, "Firm resources and sustained competitive advantage". *Journal of Management*, **17**(1): 99-120.

Baron, James N. and David M. Kreps, 1999, "Consistent human resource practices". *California Management Review*, **41**(3): 29-53.

Bartel, Ann, 1994. "Productivity gains from the implementation of employee training programs". *Industrial Relations*, **33**: 411-425.

Birdi, Kamal, Chris Clegg, Malcolm Patterson, Andrew Robinson, Chris B. Stride, Toby D. Wall and Stephen J. Wood, 1990, "The impact of human resource and operational management practices on company productivity: A longitudinal study". *Personnel Psychology*, **61**(3): 467-501.

Bonaccorci, Andrea, Gionata Carmignani and Francesco Zammori, 2011, "Service Value Stream (SVSM): developing lean thinking in servicing industry". *Journal of Service Science and Management*, **4**(4): 428-439.

Carter, Bob, Andy Danford, Debra Howcroft, Helen Richardson, Andrew Smith and Phil Taylor, 2011, "Lean and mean in the civil service: the case of processing in HMRC". *Public Money & Management*, **31**(2): 115-122.

Chen, Lixia and Bo Meng, 2010, "Why most chinese enterprises fail in deploying lean production". *Asian Social Science*, **6**(3): 52-57.

Cohen, Wesley M. and Daniel A. Levinthal, 1990, "Absorptive capacity: a new perspective on learning and innovation". *Administrative Science Quarterly*, **35**(1): 128-152.

Cooney, Richard, 2002. "Is 'Lean' a universal production system? Batch production in the automotive industry." *International Journal of Operations & Production Management*, **22** (10): 1130–1147.

Cox, Andrew and Dan Chicksand, 2005. "The limits of lean management thinking: Multiple retailers and food and farming supply chains". *European Management Journal*, **23**(6), 648-662

Davenport, Thomas, H., 1982, "Putting the enterprise into the enterprise system", *Harvard Business Review*, **76**: 121-31.

Deal, Terrence E. and Allan A. Kennedy, 1982, *Corporate cultures: The rites and rituals of organizational life*. Reading, MA: Addison-Wesley.

Delaney, John T. and Mark A. Huselid, 1984, "The impact of human resource management practices on perceptions of organizational performance". *Academy of Management Journal*, **39**(4): 949-969.

Denison, Daniel R., 1984, "Bringing corporate culture to the bottom line". *Organizational Dynamics*, **13**(2): 5-22.

Dombrowski, U. and Mielke T. Engel, C., 2012, "Knowledge management in lean production systems". *Procedia CIRP*, **31**(3): 436-441.

Doolen, Toni L. and Marla E. Hacker, 2005, "A review of lean assessment in organizations: an exploratory study of lean practices by electronics manufacturers", *Journal of Manufacturing Systems*, **24**(1): 55-67.

Gold, Andrew H., Albert H. Segars and Arvind Malhotra, 2001, "Knowledge management: An organizational capabilities perspective". *Journal of Management Information Systems*, **18**(1): 185-214.

Gordon, George G. and Nancy DiTomaso, 1992, "Predicting corporate performance from organizational culture" *Journal of Management Studies*, **29**(6): 783-798.

Grant, Robert M, 1991, "The resource-based theory of competitive advantage: implications for strategy formulation". *Knowledge and Strategy*, **33**(3): 3-23.

Guerrero, Sylvie and Valérie Barraud-Didier, 2004, "High-involvement practices and performance of French firms". *The International Journal of Human Resource Management*, **15**(8): 1408-1423.

Hartog, Deanne N. and Robert M. Verburg, 2004, "High performance work systems, organisational culture and firm effectiveness". *Human Resource Management Journal*, **14**(1): 55-78.

Helper, Susan and John Paul MacDuffie, 2002, "Creating lean suppliers: Diffusing lean production through the supply chain". *California Management Review*, **39**(4): 118-151.

Hines, Peter, Matthias Holweg, and Nick Rich, 2004, "Learning to evolve: A review of contemporary lean thinking". *International Journal of Operations and Production Management*, **24**(10): 994-1011.

Howell, Greg, and Glenn Ballard, 1998, "Implementing lean construction: Understanding and action". Proceedings of 6th Annual Conference of the International Group for Lean Construction (IGLC-6), Guaruja, August 13–15.

Inman, R. Anthony, 1999, "Environmental management: new challenges for production and inventory *managers"*. *Production and Inventory Management Journal*, **40**(3): 46-49.

Kaplan, Robert S. and David P. Norton, 2004, *Strategy maps: Converting intangible assets into tangible outcomes*. Boston, MA: Harvard Business Press.

Kilmann, Ralph H., Mary J. Saxton and Roy Serpa, 1985, *Gaining control of the corporate culture*. San Francisco: Jossey-Bass Inc Pub.

Knoke, David and Arne L. Kalleberg, 1994, "Job training in U.S. organizations". *American Sociological Review*, **59**: 537-546.

Kogut, Bruce and Udo Zander, 1992, "Knowledge of the firm, combinative capabilities, and the replication of technology". *Organization Science*, **3**(3): 383-397.

Landy, Frank J., 1985, *Psychology of work behavior*. Homewood, IL: Dorsey Press.

Liker, Jeffrey K., 2004, *The Toyota Way: 14 management principles from the world's greatest manufacturer*. NY: McGraw-Hill,

Liker, Jeffrey K. and James M. Morgan, 2006, "The Toyota way in services: the case of lean product development". *The Academy of Management Perspectives*, **20**(2): 5-20.

Losonci, David, Krisztina Demeter and István Jenei, 2011, "Factors influencing employee perceptions in lean transformations". *International Journal of Production Economics*, **131**(1), 30-43.

Loyd, Nicholas, **Lauren C. Jennings, Jeff Siniard, Michael L. Spayd, Anthony Holden and George Rittenhouse**, 2009, "Application of lean enterprise to improve seaport operations". *Transportation Research Record: Journal of the Transportation Research Board*, **2011**: 29-37.

Martínez-Jurado, Pedro José and José Moyano-Fuentes, 2014, "Lean management, supply chain management and sustainability: a literature review". *Journal of Cleaner Production*, **85**: 134-150.

McDuffie, John Paul, 1995, Organizational logic and flexible production systems in the world auto industry. *Industrial and Labor Relations Review*, **48**(2): 197-221.

McLachlin, Ron, 1997, "Management initiatives and just-in-time manufacturing". *Journal of Operations Management*, **15**(4): 271-292.

Napoles, L. and M. Quintana, 2005, "Developing a lean culture in the laboratory", *Clinical Leadership & Management Review: the journal of CLMA*, **20**(4): E4-E4.

Niepcel, Willem and Eric Molleman, 1998, "Work design issues in lean production from a sociotechnical systems perspective: Neo-Taylorism or the next step in sociotechnical design"? *Human Relations*, **51**(3): 259-287.

Nonaka, Ikujiro, 1994, "A dynamic theory of organizational knowledge creation". *Organization Science*, **5**(1): 14-37.

Olivella, Jordi, Lluís Cuatrecasas and Nestor Gavilan, 2008, "Work organisation practices for lean production". *Journal of Manufacturing Technology Management*, **19**(7): 798-811.

Ōno, Taiichi, 1988, *Toyota Production System*. Portland, OR: Productivity Press,.

Ouchi, William G. and Raymond L. Price, 1978, "Hierarchies, clans, and Theory Z: A new perspective on organization development". *Organizational Dynamics*, **7**(2): 25-44.

Paluch, J., 2008, "What does lean mean". *Landscape Management*, **47**(8): 4-74.

Parker, Sharon K., 2003, "Longitudinal effects of lean production on employee outcomes and the mediating role of work characteristics." *Journal of Applied Psychology*, **88**(4): 620-634.

Penrose, Edith T., 1959, *The theory of the growth of the firm*, GB: Basil Blackwell and Mott Ltd.

Peters, Thomas J., Robert H. Waterman and Ian Jones, 1982, "In search of excellence: Lessons from America's best-run companies". *The Wilson Quarterly*, **7**(24): 53-56.

Pfeffer, Jeffrey, 1998, *The human equation: Building profits by putting people first*. Boston, MA: Harvard Business Press.

Pil, Frits and John Paul McDuffie, 1996, "The adoption of high involvement work practices". *Industrial Relations*, **35**(3): 299-333.

Polanyi, Michael, 2012, *Personal knowledge: Towards a post-critical philosophy*. University of Chicago Press.

Prahalad, Coimbatore K. and Gary Hamel, 1994, "Strategy as a field of study: Why search for a new paradigm"? *Strategic Management Journal*, **15**(2): 5-16.

Radnor, Zoe J., Matthias Holweg and Justin Waring, 2012, "Lean in healthcare: the unfilled promise"? *Social Science and Medicine*, **74**(3): 364-371.

Russell, James S., James R. Terborg and Mary L. Powers., 1985, "Organizational performance and organizational level training and support". *Personnel Psychology*, **38**(4): 849-863.

Sakakibara Sadao, Barbara B. Flynn, Roger G. Schroeder and William T. Morris, 1997, "The impact of just-in-time manufacturing and its infrastructure on manufacturing performance". *Management Science*, **43**(9): 1246-1257.

Schall, Maryan S., 1983, "A communication-rules approach to organizational culture". *Administrative Science Quarterly*, **28**(4): 557-581.

Schein, Edgar H., 1985, "Defining organizational culture". *Classics of Organization Theory*, **3**: 490-502.

Schein, Edgar H., 2009, *The corporate culture survival guide*. San Francisco, CA: John Wiley & Sons.

Shah, Rachna, Susan Meyer Goldstein and Peter T. Ward, 2002, "Aligning supply chain management characteristics and interorganizational information system types: An exploratory study". *Engineering Management, IEEE Transactions*, **49**(3): 282-292.

Shah, Rachna, and Peter T. Ward, 2003, "Lean manufacturing: context, practice bundles, and performance," *Journal of Operation Management*, **21**(2): 129-149.

Smeds, Riitta, 1994, "Managing change towards lean *enterprises"*. *International Journal of Operations & Production Management*, **14**(3): 66-82.

Spender, J- C. and Robert M. Grant, 1996, "Knowledge and the firm: overview", *Strategic Management Journal*, **17**(2): 5-9.

Starbuck, William H., 1992, "Learning by knowledge-intensive firms". *Journal of Management Studies*, **29**(6): 713-740.

Sullivan, Robert, 2000, "Entrepreneurial learning and mentoring", International *Journal of Entrepreneurial Behavior & Research*, **6**(3): 160-175.

The Manufacturer, 2011. "The lean report 2011". *The Manufacturer Magazine*..http://issuu.com/themanufacturer/docs/leanreport2011/1 [Accessed: December 11, 2014].

Tsasis, P. and Bruce-Barrett, C., 2008, "Organisational change through lean thinking". *Health Services Management Research*, **21**(3): 192-198.

Vest, Joshua R. and Larry D. Gamm, 2009, "A critical review of the research literature on six sigma, lean and studer group's hardwiring excellence in the United States: The need to demonstrate and communicate the effectiveness of transformation strategies in healthcare". *Implement Sci*ence, **4**(1): 35-.44.

Vlachos, Ilias and Aleksandra Bogdanovic, 2013, Lean thinking in the European hotel industry". *Tourism Management*, **36**: 354-363.

Vlachos, Ilias, 2015, "Applying lean thinking in the food supply chains: A case study". *Production, Planning and Control*, **26**(16): 1351-1367.

Wall, Toby D. and Stephen J. Wood., 2005, "The romance of human resource management and business performance, and the case for big science". *Human Relations*, **58**(4): 429-462.

Weick, Karl E., 1985, *The significance of corporate culture*. Beverly Hills, CA: Sage.

Wernerfelt, Birger, 1984, "A resource-based view of the firm". *Strategic Management Journal*, **5**(2): 171-180.

Worley, June and Toni Doolen, 2006. "The role of communication and management support in a lean manufacturing implementation", Management Decision, **44**(2): 228-245.

Womack, James P., Daniel T. Jones and Daniel Roos, 2003, *The machine that changed the world: The story of lean production*. NY: Rawson Associates.

Womack, James P. and Daniel T. Jones., 2005, "Lean consumption", *Harvard Business Review*, **83**(3): 1-12.

Yang, Ma Ga Mark, Paul Hong and Sachin B. Modi, 2011, "Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms". *International Journal of Production Economics*, **129**(2): 251-261.

Yauch, Charlene A. and Harold J. Steudel, 2002, "Cellular manufacturing for small businesses: key cultural factors that impact the conversion process". *Journal of Operations* Management, **20**(5): 593-617.

Table 1 Characteristics of Respondents

Characteristics	Percentage
Sex	
Male	64
Female	36
Age	
Below 30	19
31-40	47
41-50	25
Above 50 years old	9
Job Level	
Senior	60
Supervisory	26
Managerial	14
Job Type	
Technical	52
No-Technical	48
Years of Work Experience	
0-5	27
6-10	35
11-20	24
Over 20	14

Table 2 Factor Analysis - Rotated factor loadings for the four Work Practices

	Factor loadings			
	Culture	**Knowledge**	**Training**	**Resistance to**
Have you ever heard of the lean concept?	**.893**			
Is continuous improvement culture necessary to sustain lean?	**.914**			
Should the lean concept be implemented in isolation i.e. within a division/department in an	**.884**			
Can the lean concept and other similar concept be used together to improve the overall efficiency in	**.904**			
Are you aware that lean concepts originated from the manufacturing sector?	**.788**			
I am favorably disposed to the transition from the closed office to an open office.		**.841**		
Are you aware that lean concepts originated from the manufacturing sector?		**.898**		
I will crave the work space in the closed office to be replicated in the open office.		**.887**		
Do you think the lean concept can be applied in many environments/context?			**.813**	
Does lean involve cultural transformation?	.561		**.670**	
I believe all the steps in the lean concept should be sequential.	.404	**.595**	-.525	
I believe that training (formal and informal) of staff contributes to waste reduction in the supply chain.			**.736**	
I believe that top management drives all efforts at reducing and eliminating wastes within the			**.832**	
I am not favorably disposed to major change of processes in the work place.				**.872**
I would not assign a task to a subordinate when i believe i can handle it myself.		.618		**.473**
There are so many negative consequences when a change is implemented		.762		**.461**
Initial Eigenvalues	5.242	3.958	2.520	1.390
Initial percent of variance explained	30.837	23.280	14.825	8.174
Rotation sum of squared loadings (total)	4.731	3.846	3.035	1.498
Percent of variance explained	27.830	22.624	17.851	8.810
Cronbach α (sample N)	.917	.911	.821	.670

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations.

Table 3 Means, Standard Deviations and Correlation Matrix

Variables	Mean	StD	1	2	3	4	5	6	7	8	9	10	11	12	13
Control Variable															
1. Sex	1.36	0.48	1	.541**	.878**	.201**	.775**	.165**	.434**	-.333**	-.412**	.044	.212**	-.041	-.056
2. Age	2.22	0.86	.**	1	.578**	.132*	.443**	.053	.384**	-.331**	-.088	-.066	.323**	-.163*	-.098
3. Job Level	1.53	0.72			1	.022	.737**	.156**	.466**	-.387**	-.387**	.006	.092	-.110	-.117
4. Job Type	1.48	0.50				1	.106	.107	.350**	.217**	.046	.106	.455**	.246**	.218**
5. Experience	2.26	1.01					1	.279**	.406**	-.292**	-.458**	.188**	.327**	.119	.128*
Human Resources Factors															
6. Culture	0.00	1.00						1	-.009	.023	-.027	.698**	.342**	.631**	.596**
7. Knowledge	0.00	1.00							1	-.026	-.123*	-.175**	.177**	-.147*	-.087
8. Training	0.00	1.00								1	.011	.234**	-.001	.244**	.221**
9. Resistance Change	0.00	1.00									1	.002	-.033	.054	.101
Lean Performance															
10. Continuous Improvement	1.89	0.99										1	.267**	.811**	.743**
11. Waste	1.83	0.98											1	.390**	.482**
12. Ergonomy	1.91	0.98												1	.862**
13. Product	1.87	0.99													1

** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed). Std: Standard Deviation

Table 4 Hierarchical regression results of Work Practices on Continuous Improvement and Waste Management

Variables		Continuous Improvement			Waste Management		
		Step 1	**Step 2**	**Step 3**	**Step 1**	**Step 2**	**Step 3**
Control variable							
Sex		-0.1 -0.7	0.21 3.32**	0.16 2.34*	0.02 0.20	0.04 0.34	0.11 0.72
Age		-0.1 -1.1	0.15 4.35***	0.16 4.30***	0.45 6.26***	0.40 5.48***	0.40 4.91***
Job Level		-0.1 -0.6	0.08 1.21	0.04 0.57	-0.8 -6.2***	-0.97 -6.74***	-1.00 -6.65***
Job Type		0.08 0.99	0.04 1.24	0.03 1.02	0.25 4.10***	0.18 2.55*	0.16 2.23*
Experience		0.41 3.14**	-0.08 -1.66*	-0.01 -0.14	0.75 7.73***	0.48 4.48***	0.57 3.81***
HR Factors							
Culture	(F1)		0.90 35.8***	0.91 33.8***		0.28 5.24***	0.31 5.38***
Knowledge	(F2)		-0.34 -8.32***	-0.25 -3.65***		0.26 3.00**	0.35 2.37*
Training	(F3)		0.32 9.64***	0.36 9.69***		-0.24 -3.44***	-0.21 -2.61**
Resistance Change	(F4)		0.05 1.69*	0.01 0.21		-0.10 -1.56	0.10 0.86
Interactions							
F1* F2				0.06 1.39			0.09 0.90
F1 *F3				0.02 0.69			0.04 0.55
F1 * F4				-0.06 -1.29			0.21 1.94*
F2 * F3				0.00 0.10			0.09 0.88
F2 * F4				0.00 0.08			0.11 1.37
F3 * F4				-0.05 -1.49			-0.09 -1.35
F Value		2.922**	202.2***	125.0***	38.52***	29.05***	17.93***
Adjusted R^2		0.046	0.902	0.905	0.490	0.564	0.565
ΔR^2		0.071*	0.835***	0.005	0.503***	0.080***	0.014

*Standardized regression coefficients are reported. Within cells, first row figure is beta coefficients and second row the t-test values, significant at: *p <0 .10, **p <0.01, ***p <0.001.*

Table 5 Hierarchical regression results of Work Practices on Ergonomy & Product Quality

Variables	Ergonomy			Product Quality		
	Step 1	**Step 2**	**Step 3**	**Step 1**	**Step 2**	**Step 3**
Control variable						
Sex	-0.1 -0.6	0.15 1.54	0.21 1.93*	-0.2 -1.2	0.08 0.69	0.19 1.45
Age	-0.1 -2.0*	-0.03 -0.63	-0.06 -1.14	-0.0 -0.7	0.04 0.64	-0.03 -0.51
Job Level	-0.2 -1.4	-0.12 -1.19	-0.16 -1.49	-0.3 -2.0*	-0.35 -2.75**	-0.33 -2.54*
Job Type	0.20 2.56*	0.15 2.98**	0.16 3.05**	0.16 2.04*	0.03 0.49	0.04 0.66
Experience	0.47 3.75***	0.01 0.24	-0.10 -0.94	0.59 4.77***	0.23 2.45*	0.07 0.56
HR Factors						
Culture (F1)		0.80 20.5***	0.81 19.5***		0.71 14.8***	0.74 14.6***
Knowledge (F2)		-0.18 -2.95**	0.00 0.03		-0.03 -0.49	0.12 0.95
Training (F3)		0.13 2.59*	0.14 2.57*		0.13 2.03*	0.13 1.84*
Resistance Change (F4)		0.06 1.37	0.14 1.67*		0.13 2.26*	0.19 1.79*
Interactions						
F1* F2			0.10 1.45			0.02 0.27
F1 *F3			0.13 2.30*			0.22 3.27**
F1 * F4			0.10 1.32			0.15 1.58
F2 * F3			-0.09 -1.25			0.01 0.19
F2 * F4			0.02 0.46			0.08 1.16
F3 * F4			-0.00 -0.08			-0.02 -0.41
F Value	7.942***	72.77***	46.71***	8.218***	40.98***	26.94***
Adjusted R^2	0.151	0.768	0.778	0.156	0.648	0.666
ΔR^2	0.172***	0.605***	0.016*	0.177***	0.486***	0.027*

*Standardized regression coefficients are reported. Within cells, first row figure is beta coefficients and second row the t-test values, significant at: *p <0 .10, **p <0.01, ***p <0.001.*