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An empirical investigation of workplace factors affecting lean performance

Introduction

The lean concept 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; Ōno, 1988). Traditionally, it focuses on the removal of obstacles ('wastes') that hinder unremitting flow of work processes (El-Khalil and Zeaiter, 2015; Liker, 2004). The successful implementation of lean requires, among others, full consideration of its processes rather than commitment to pure economical advancements or cost reductions (El-Khalil, 2015). By itself, "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" (Bonaccorsi et al., 2011: 429). Therefore, organizations, interested in achieving desirable lean performance drive their employees towards a more sufficient way of performing their task,

As lean goes beyond the mere production process also focusing on people management issues, workplace practices of managing and deploying human capital have been recognized by many scholars as a critical success factor for lean (e.g., Agrawal and Graves 1999; Bamber and Dale 2000; Yauch and Steudel 2002). Indicatively, Womack et al. (1991), identified the importance of people and their involvement in product quality, continuous improvement and problem solving distinguishing in this way lean from massive production (Niepce and Molleman, 1998; Parker, 2003; Taira, 1996). Additionally, Bidanda et al. (2005) studied cellular manufacturing and acknowledged that human capital is critical for the implementation

of advanced manufacturing technologies (e.g., effective training programs, employees' participation, pilot projects, empowerment at lower level employees).

Accordingly, the practices implemented by an organization to manage and deploy its human capital have an impact on the effectiveness of lean (e.g., map and improve value streams, remove non-value added activities, and re-define value offered to end users). Pil and McDuffie (1996), identified certain high-involvement work practices with an impact on lean, such as job rotation, suggestion programs and decentralization of quality efforts. Olivella et al. (2008), supported that continuous training and learning, standardization, compensation and rewards affect the success of lean. And, Worley and Doolen (2006), recognized that many work factors, such as management support and organizational communication could also drive lean, either to success, or failure.

On the other hand, lack of attention on people management issues often lead to poor lean performance or lean failures (e.g., Bhasin and Burcher, 2004; Chung, 1996; Lathin and Mitchel, 2001; Vlachos, 2015). Agrawal and Graves (1999) found that organizations often adopt practices which are not always supportive for improving lean performance. Examples include but are not limited to employees' isolation, rigid organizational structures and lack of an appropriate organizational culture (Bamber and Dale, 2000). Instead, McDuffie (1995) indicated that human resources practices might enable organizations to achieve 'organization logic' which will lead them to successful lean performance.

As the success of lean is also subject to human capital (Agrawal and Graves, 1999; Bamber and Dale, 2000; Carter et al., 2011; Nicholas 1998; Yauch and Steudel, 2002), attention needs to be paid to the workplace practices for managing people and to certain factors which affect them. However, the majority of the research work has

been conducted in discrete manufacturing industries in developed countries, overlooking other sectors like oil and energy and other parts of the world (Batt, 1995; Krafcik, 1988; Womack et al., 1991). As Forza (1996) also observed, extant literature fails to come to a consensus on which workplace practices affect lean performance. A plausible explanation could be the tendency by many scholars to perceive lean differently that explains why it is difficult to be imitated (Al-Najem et al., 2012).

Yet, recently, scholars in the field have identified with more uniformity, the impact of workplace practices on lean performance analyzing linkages between training and successful lean outcomes as well as the role of culture in lean implementation. For instance, Ichimura et al. (2008) in a study conducted in UK-based manufacturing companies consider training as the “backbone of the implementation process” of lean production. Wong (2007: 415) stressed the importance of culture as an adaptive mechanism which also promotes the collaboration between employees “during the process of being lean”. Angelis et al. (2011), reported the vital role that supportive cultures play in building employees’ commitment in lean systems. Even more, Dombrowski et al. (2012) recognized the significance of managing knowledge in lean performance.

This study contributes to the literature on the effects of workplace practices on lean performance by empirically examining a lean implementation. Based on the extant literature, three constructs were selected: training, knowledge acquisition and organizational culture. Such constructs “reflect the managerial vision of each individual company, the industrial context, the labor market, the cultural context, and the sector and country involved” (Forza, 1996: 59). Furthermore, following prior research, lean performance operationalized using non-financial performance measures (Anand and Kodali, 2008) the appropriateness of which has been recognized by many scholars

(e.g.., Abdel-Maksoud et al., 2005; Fullerton and Wempe, 2009; Ittner and Larcker 1998 in Said et al. (2003). These measures are: (i) continuous improvement, (ii) waste management, (iii) ergonomy and (iv) product quality. The study context was a big oil and energy company. An employees' survey collected empirical data and regression analysis shed light on the linkages between workplace practices and lean performance.

The rest of the paper is organized as follows: the subsequent section presents a literature review on training, knowledge acquisition and organizational culture and their relationship with lean performance, thus developing the rationale behind the research hypotheses. The third section outlines the study methodology. The fourth presents the empirical results which are discussing in the fifth section. The conclusions of the study are remarked in the sixth and the last section along with the implications for theory and practice.

Literature review and hypotheses development

Training

Training and development at work is one of the HRM practices (along with selection, recruitment, performance evaluation, etc.) that values among the high-performance workplace practices (e.g., strict selection, team performance, pay-for-performance, etc.) (Hartog and Verburg, 2004). It is often operationalized in terms of similar and aligned practices (e.g., employee development, skills training and/or career planning) and has been widely investigated in relation to employees' personal and professional development (e.g., Bartel, 1994) as well as organizations' profitability, growth and increased performance outcomes (Aguinis and Kraiger, 2009; Delaney and Huselid, 1996; Knoke and Kalleberg, 1994; Russell et al., 1985). The contribution of training to

organizational performance is also supported by the human capital theory which advocates that: “firms train workers (and pay for the training) if doing so enhances the *firms’ profits*” (Baron and Kreps, 1999: 372). Many studies have supported the linkages between training and organizational effectiveness (e.g., Aragon-Sanchez et al., 2003; Arthur et al., 2003) and financial performance (e.g., Guerrero and Barraud-Didier, 2004).

In lean philosophy, training is perceived as one of the crucial working practices enabling organizations to improve the product quality, cost and delivery performance (Herron and Hicks, 2008). “B*y 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” (Birdi et al., 2008: 471). Along the same line, McLachlin (1997), recognized the applicability of training in just-in-time lean practices with an impact on the organizational performance. And, recently, Yang et al. (2011), noted that lean manufacturing requires from employees to be involved in actions which might increase the dissemination of knowledge such as training, autonomous teams and empowerment.

Traditionally, employees who are involved in complex tasks and activities should be provided with ‘extensive training’, which is a term coined 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 (Karlsson and Åhlström, 1996). As lean implementation requires from employees to be involved in multi functions thus being multi-tasked and multi-skilled, training should be an ongoing process rendering employees capable of performing lean outcomes (Niepcel and Molleman, 1998).

Training is required when a company upgrades from another management system to lean (Ichimura et al., 2008). The importance of training in lean extends beyond the mere production as it might also identify what type of knowledge, skills and ability (KAS) should employees have (Bidanda et al., 2006). As also the importance of multifunctional teams of which their members are capable of undertaking decentralized responsibilities has been discussed by many scholars in the field (e.g., Åhlström and Karlsson, 1996; Karlsson and Åhlström, 1995), cross-training could be also viewed as an appropriate type of training yielding beneficial performance outcomes (Landsbergis et al., 1999).

Training offered to employees when their organization is upgrading to lean enables them to develop the appropriate lean mindset, as, for example, “that waste is bad and should be removed” (Hines, et al., 2004: 1001). Equally, it might 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 and capable of lean processes, thus assisting organizations to achieve desirable performance outcomes. Therefore, it is hypothesized that

H1: Training positively affects lean performance.

Knowledge acquisition

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 1982 as cited Dombrowski et al., 2012). Organizational knowledge can be either tacit or explicit and is considered as a crucial factor of production, which often leads to increased firm performance (Barney, 1991;

Grant, 1991; Penrose, 1959; Wernerfelt, 1984). In the era of knowledge economy, organizations should enrich and integrate the knowledge already possess by acquiring new knowledge that is often sourced outside their boundaries. Knowledge acquisition is often linked to organizational learning and has been seen as, either a driving force for growth and development (Penrose 1959), or 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 of lean management (Dombrowski et al., 2012).

As discussed above, the successful lean performance outcomes require, among others, knowledgeable employees in more than one work domains with a broaden skillset in order to concurrently perform different tasks and solve problems. El-Khalil and Zeaiter (2015), who viewed work standardization as the most critical antecedent to lean, identified specific knowledge which needs to be possessed by those involved in the implementation of lean. Such knowledge could be related to the course of actions undertaken by the operator, the required production rare as well as the appropriate inventory. Both tacit and explicit knowledge are required to be transferred for the successful implementation of lean processes. Herron and Hicks (2008) identified that certain lean tools, such as statistical process control, tool proofing and process mapping, require explicit knowledge sharing that is easily codified. While, the maintenance of total production, work standardization and policy deployment require tacit knowledge to be shared/transferred. Although valuable for lean effectiveness, tacit knowledge sharing, is, by its nature, a time-consuming process which often needs extensive support from top executive administration, training and cultural changes to be easily absorbed and applied in the day-to-day tasks and activities.

To facilitate those who are involved in lean implementation processes to better absorb the required knowledge, Helper and McDuffie (1997) identified the necessity of structured knowledge management systems (KMS). During the implementation of lean, knowledge invisibly flows between the involved parties who accumulate it, either through well-defined and well-structured procedures or randomly over unplanned processes. However, research suggests that, although, the majority of lean organizations implement similar systems, there is no uniformity regarding the processes of knowledge acquisition and its accumulation (Dombrowski et al., 2012). One plausible explanation could be the fact that lean makes existing knowledge easily obsolete.

Irrespective of how the new knowledge flows between all interested parties, employees at all levels have to acquire new knowledge related to the ongoing day-to-day lean operations. Employees should learn, for instance, 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). Moreover, 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 stated "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".

Thus, far, a well-performed knowledge acquisition process facilitates organizations to improve lean performance. Therefore, we hypothesize,

H2: The acquisition of new knowledge positively affects lean performance.

Organizational culture

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 often promise improvements in organizational performance, while, at the same time, affect positively employees' behavior.

Since, early 1990s the literature demonstrates a significant body of empirical research focusing on the linkages between organizational culture and successful lean performance (Gordon and DiTomaso, 1992). Indeed, Al-Najem et al. (2012: 120) aptly stated that "one of the most prominent factors that could impact directly on lean journey is the organizational culture". In other words, organizational culture reflects the way organizations do things (Schein, 2009). And, since "lean calls for cultural change" (Napoles and Quintana, 2008), organizations, in order to improve their performance with lean tools and practices, should develop and promote a supportive culture (Vest and Gamm, 2009:5).

When an organization is moving from a management system to lean thinking, several cultural changes need to be addressed. Leadership adjustments to lean should be on a day-to-day basis (Anand et al., 2011) focusing mainly on the employees' empowerment and involvement (Angelis et al., 2011). At the same time, employee participation in the decision-making process should be equally secured. Al-Najem et al. (2012) characterized cultural changes as such as being open and

proactive to describe a shift from bureaucratic systems to customer satisfaction, from rigid hierarchies to employee participation and from individual tasks to collaborative work design. Other modifications might include the adaptation of an extrovert organizational mind-set as well as re-design of existing business processes and value identification (Piercy and Rich, 2009).

Many scholars have extensively stressed the importance of building an appropriate culture to promote employees' commitment. For example, Angelis et al. (2011: 569) referencing previous research accurately stated that "lean proponents view committed workers as necessary for such duties" (Adler, 1993; Wickens, 1987; Womack et al., 1991; Schonberger, 2007). In the same research work, important linkages between employees' commitment and lean outcomes were also highlighted (e.g., Adler, 1993; Parker, 2003; Shadur et al., 1995; Vidal, 2007; Wickens, 1987). Besides, an appropriate organizational culture could also facilitate employees to better understand lean thinking and philosophy (Kaplan and Norton, 2004). Having a thorough understanding of the principles and fundamentals underpinning lean, employees promote reciprocal collaboration (Taleghani, 2010), accept changes as well as contribute to continuous improvements (Radnor et al., 2006).

Additionally, lean requires simple organizational structures which could be easily changed and adopted to lean philosophy (Smeds, 1994). Taleghani (2010) stated that despite the fact that organizations make effective and appropriate use of the available tools, procedures and mechanisms, lack of a well-built lean culture results in lean failures. Equally, Al-Najem et al. (2012), drawing on the Toyota paradigm, stressed the importance of a lean culture that is widely accepted and thoroughly understood for the successful performance outcomes. The discussion leads us to hypothesize that

H3: Organizational culture positively affects lean performance.

As aforementioned, four distinct lean performance indicators were selected to operationalize the variable of LP, i.e., (i) continuous improvement, (ii) waste management, (iii) ergonomy and (iv) product quality (all discussed in details below). As such, the three study hypotheses summarizing the effects of the three aforementioned workplace practices on each lean performance indicator are formed as follows:

H1: Training positively affects (a) continuous improvement, (b) waste management, (c) ergonomy, (d) product quality.

H2: Knowledge acquisition positively affects (a) continuous improvement, (b) waste management, (c) ergonomy, (d) product quality.

H3: Organizational culture positively affects (a) continuous improvement, (b) waste management, (c) ergonomy, (d) product quality.

[Place Figure 1 about here]

Methodology

Instrument development and data collection

Despite the fact that lean has attracted particular attention by an increasingly large-number of organizations operating in various industries other than manufacturing, current literature lacks substantial research on oil and gas industry. Additionally, albeit each oil and gas project requires an individual approach and repetition is limited, organizations operating in this industry consistently implement lean, for instance, to overcome obstacles related to exploitation and extraction from difficult environments, maximize customer service at the lowest possible cost, and effectively manage

energy. Therefore, conducting research in an oil and gas industry is found to be an interesting case of analysis.

A detailed questionnaire sent to employees of a multinational oil and gas company operated for over forty years (called with the pseudonym company Alpha), which have recently involved in lean practices, processes and procedures. Alpha has been operating exploring and extracting oil and gas in Nigeria, the key oil and gas producer in Africa (Taiwo, 2010).

Following Dillman's (2000) Total Design Method, that is implemented extensively in operations research (e.g., Koufteros et al., 1998; Nahm et al., 2003; Shah and Ward, 2007) a pilot test was conducted to assess the validity of the questionnaire by sending the questionnaire to 10% of employees working in a similar company like the case study (i.e. Alpha). Minor revisions were applied to questionnaire based on pilot test. As a result, sixteen variables were included in the questionnaire. The Cronbach's Alpha coefficient obtained in pilot phase was 0.881, which indicates high reliability. At the time of our study the company Alpha employed 220 employees. Out of the 220 questionnaires distributed, 196 returned completed, corresponding to 89.1% response rate. Table 1 shows the characteristics of employees surveyed.

[Place Table 1 about here]

Measures

Principal component analysis with varimax rotation conducted to assess the underlying structure for the workplace variables in the questionnaire. After rotation, three main factors were emerged: organizational culture accounted for 27.83% of the variance, knowledge acquisition for 22.62% and training for 17.85% (Table 2). We used the Anderson-Rubin method, which ensures orthogonality of the estimated

factors, to produce factor scores. Table 3 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.

[Place Table 2 about here]

[Place Table 3 about here]

Independent variables: The first factor, measuring the organizational culture was labeled as ‘culture’ (five items, α= 0.917). The second factor, measuring the acquisition of new knowledge labeled 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 labeled as ‘training’ and included four items (α=0.821) measuring the organization’s emphasis on training its personnel on lean practices. All three factors had significantly high scale composite reliability (Cronbach α) and were included in the hierarchical analysis model.

Dependent variable: Lean performance 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. Lean is a business philosophy; thus it is hard to measure and its performance measurement cannot be discounted into operational improvements only such as reduction of inventory.

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., lean performance) and the workplace factors were self-reported on the same survey instrument, all measures share CMV. 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 (Podsakoff et al., 2003) 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.

Analysis and results

Univariate analysis

Table 3 presents the Pearson's correlation analysis and the study findings can be summarized as follows: (i) the control variables (sex, age, job level, job type and years of experience) showed high correlation with the lean performance variables as well as with training and knowledge acquisition (ii) 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).

Hierarchical model

To explore the relationships between training, knowledge acquisition, organizational culture and lean performance, a hierarchical regression analysis utilized. hierarchical regression models outperform simple regression models in making more accurate predictions. We run four multiple regressions, one for each individual lean performance 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, labeled as the Independent model, we added the three independent variables into the regression equations. Finally, in Step 3, we entered the six interactions of the three variables into the regression equations creating the Interaction model. Interactions of independent variables can reveal moderation effects and whether the combination of variables produce better results than without interaction. 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<.01) 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 dependent 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) 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.

[Place Table 4 about here]

[Place Table 5 about here]

Discussion

The study results in interesting affirmations regarding the impact of training, knowledge acquisition and organizational culture on lean performance. Specifically, it was found that all the selected variables (i.e., training, knowledge acquisition, culture) have positive but varying effects on the lean performance. These empirical findings contribute in building a theory that incorporates certain workplace factors with an impact on lean performance. Additionally, it provides managerial recommendations for organizations which aim to achieve successful lean performance and discussed in details below.

Organizational culture and lean performance

Findings indicate that organizational culture shows significant association with continuous improvement, waste management, ergonomy, and product quality. This variable was the only one that significantly influences all lean performance indicators. This finding, in line with the extant literature, confirms that the 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 improve its lean performance (Tsasis and Bruce-Barrett, 2008).

Current research suggests that despite the positive impact of business culture on lean performance, a number of failed attempts highlight that many organizations, in their effort to increase lean performance, 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). Since organizational culture needs time to cultivate, we may confirm that successful lean outcomes should be seen as a long-term perspective. Such longevity is also required for the acquisition of new knowledge and its effective implementation in existing practices, which are found to be prerequisite to lean performance. Relying also on a set of repetitive appropriate training events organizations may achieve the expected lean outcomes. However, it is the combining effect of training, knowledge acquisition and organizational culture that showed the highest impact on a successful lean performance.

Training and lean performance

The study findings support that training significantly affects ergonomy and product quality but it contributes mostly to continuous improvement. As suggested by the literature, appropriate training on an ongoing basis render employees eligible to achieve sustainable lean outcomes for their organizations. This, in turn, it could minimize plausible employee turnover, increase organization’s reputation, profitability and productivity (Paluch, 2008). As such, one of the immediate actions that organizations should undertake in their attempts to successfully implement lean is to constantly train those who are involved in lean projects. Ongoing training allows

employees to develop the appropriate mind- and skill-set, thus becoming lean thinkers (Niepcel and Molleman (1998).

However, study results support that training negatively affects 'waste management', thus contradicting the narrative of lean theory (Womack and Jones, 2005). Although such contradiction seems to be meaningful, the context of the study itself, i.e., the case company is an established company in oil and energy sector, adds useful insights. Meaning further that, in the particular context, the transmission to a new system does not guarantee success. Training may be not sufficient to produce expected results, especially when employees perceive that the previous system did not produce 'wastes'. In addition to this, results indicate that demographic variables such as experience and age, influence waste reduction to a greater extent than training itself. Therefore, experienced employees may not require training, or training may have adverse effects to experienced personnel. Training alone is not enough to change the mindset of employees which are either deeply rooted in their prior experiences, or beliefs or personal characteristics.

Another interpretation regarding the negative effects of training on 'wastes' could be the frequently observed failure of organizations to provide employees with inappropriate training. Inappropriately trained or ill-prepared employees are not in the position to understand the lean principles and fundamentals. Instead, superficial know-how of lean operations and fundamentals is what they often acquire (Chen and Meng, 2010). This, in practice, prevents them from achieving desirable performance outcomes.

Knowledge acquisition and lean performance

The findings reveal that the acquisition of new knowledge has a significant yet negative effect on continuous improvement. Like training, at first sight, this finding appears

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. It is the practice of learning not the mere acquisition of knowledge that improves operations. 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 acquisition of tacit knowledge to promote lean; a process which, by its nature, is complicated and time consuming and might inhibit the lean application.

As theory claims, the successful implementation of lean also requires knowledgeable and multi-skilled employees (Dombrowski et al., 2012). 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). This also indicates a possible path dependence of training before actual knowledge acquisition takes place.

Furthermore, study findings support that knowledge acquisition is significantly associated to waste management yet it negatively affects ergonomy. According to Helper and McDuffie (1997), lean implementation requires structured KMS facilitating those who are involved in lean processes to better acquire technical knowledge. As the newly acquired knowledge easily becomes obsolete, employees might be requested to change the way and place they operate, which directly affects their ergonomy. Such change might stress employees who are attached to the existing ergonomy and render them less productive.

Limitations

The present study has some theoretical, methodological and sample limitations that need to be considered and addressed in future research. First, the sample is limited (only from one company of a specific origin) whereas it could be broader, where comparison of research findings could equally take place. Second, as no other factors were taken into consideration during the study analysis, a bidirectional relationship between training, knowledge acquisition, organizational culture and LP cannot be confirmed. The theoretical justification of the proposed model requires to test for mediating and moderating effects in the relationship between the three workplace factors and the non-financial performance measures. The moderating effect of variables such as leadership, operational efficiency, and information management may be also examined. Third, four different non-financial measures of LP were chosen. 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 analyzed. Fourth, the workplace practices should be enriched by also including factors such as: the role employees play in the implementation of lean, the ways employees are managed to adjust to changes; the role of people management issues (e.g., communication, rewards and job design) and intrinsic factors such as commitment values and beliefs). Fifth, this study was based on one case company; expanding the survey to an industry and/or country would help generalize the results to a wider population. Last, a thorough and contextualized approach towards the terms leanness and LP is needed, specifying the stages of such performance where workplace practices are involved.

Concluding remarks

This study identifies tentative relationships between training, knowledge acquisition and organizational culture and lean performance. Analyzing concurrently more than one workplace practices in the same facility/organization it seems that their combination could lead to successful lean outcomes. Each of the variables under study offers significant correlations with the four dimensions of lean performance, thus providing useful insights for the successful implementation of lean.

Practitioners in charge of lean management should be mindful of the influence of workplace practices and business settings with an impact on the successful implementation of lean, attributing primarily importance to culture. Organizational culture affects employees' values, beliefs and attitudes, which could be related to their motives and expectations vis-a-vis the successful implementation of lean. Organizational culture could facilitate employees to share their perceptions towards their organization's decision to improve their production operations to lean. Employees' development needs to be critical to the degree that influence their lean mind-set. The mere acquisition of new knowledge could not be always considered as the appropriate path for organizations in the need of being lean. By itself knowledge acquisition is a time-consuming process. As such those who are involved in the implementation of lean should recognize its value in use rather than considering knowledge acquisition as a mere part of the process of lean implementation. The aforementioned consideration would confirm the need for aggregated workplace practices for deploying human capital when an organization is transforming to lean.

The importance of paying attention to effective management of workplace practices as well as the development of appropriate business settings also raises key questions, which form the basis for future research. For instance, how can organizations interested in achieving successful lean outcomes equally achieve an

effective combination of the aforementioned or other workplace variables? Is there any framework which could lead those who are involved in lean projects to achieve superior lean performance? Which types of training promote leanness? How can organizations increase their lean performance? Last, we should also acknowledge that the study results, are not definitive, but novel and highlight a need to increase awareness regarding the antecedents and prerequisites of the successful implantation of lean. This relates directly to the existing discussions on successful or failed lean outcomes and would open up new understandings and insights into lean management.

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