The moderation of lean manufacturing effectiveness by culture: testing practices-OC congruence hypotheses

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Abstract

Successful implementation of lean practices not only involves radical changes at organisational level on structure, strategy but also need to pay attention to creating right culture across different levels and to develop culture for the change. Therefore, an in-depth understanding of the role of OC in successfully implementing lean practices requires a comprehensive view of the phenomenon. Questionnaire survey was adopted for this study. A draft questionnaire was developed based on existing scales found in the literature. The final survey instrument was sent to British manufacturers from different industry sector. Hypothesis testing is conducted using hierarchical linear model.

Keywords: Lean practices, OC, operations performance

Introduction

Driven by the success achieved by Toyota, in last two decades business organisations have adopted various lean practices to generate returns by reducing their costs and by eliminating non-value added activities in order to improve their business performance and gain competitiveness. Although lean is a powerful managerial approach widely recognised, the general outcome of linking lean to performance has been mixed. For example, Dean and Snell (1996) could not identify any significant relationship between lean and performance. Pay (2008) highlights that less than five percent of companies that implemented lean programs achieved their anticipated results. Comacho-Minano et al. (2013) concluded in their empirical studies that the relationship between lean practices and financial performance is inconclusive. Such mixed results have been explained by the fact that previous research has neglected the introduction of contextual and interacting factors (MackeOrang and Nair, 2010). It was pointed out that exploring the moderating effect of OC (OC) may resolve the inconsistency in previous studies (Hewett et al., 2002). Some authors even see OC as the cause of the poor effectiveness of lean implementation (Liker, 2004, Sim and Rogers, 2009) and stated that companies need to adjust their OC in order to improve the chances of lean being successful (Bhasin and Burcher, 2006).

While there is a large amount of study in the literature in lean and culture, the extant studies focused on examining different dimensions of OC on specific lean practices, like

quality management and JIT, to achieve a superior performance (Detert et al., 2000 and Narasimhan et al., 2012). In fact successful implementation of lean practices not only involve a radical change on structure and strategy but also need to pay attention to creating the right culture cross different levels and to developing culture for changes. Therefore, an in-depth understanding of the role of OC in successfully implementing lean practices requires a comprehensive view of the phenomenon. This study thus is to understand of the role of OC across different levels of an organisation in successfully implementing different lean practices.

Questionnaire survey was adopted for this study. A draft questionnaire was developed based on existing scales found in the literature. A pilot study was conducted to pre-test the draft questionnaire with academics and practitioners. The final survey instrument was sent to British manufacturers from different industry sectors randomly selected from online databases. The sample size was decided after considering the expected response rate and the requirements for performing statistical analysis. Owing to the nature of the questions, the target respondents for the survey were middle-level managers with relevant experiences such as production and operations management.

This study is to contribute in several ways to the debate on the importance of OC in implementing lean practices. First, compared to previous studies, this study aims to develop a more comprehensive understanding by considering various dimensions of OC, lean practices, and operations performance, rather than focusing on a specific set of variables. In addition, by investigating differences in lean practices between different sizes and different industry sectors, we can identify whether and which OC dimensions make a difference. Finally, by investigating different level of OC, we intend to further analyse the role of the culture in implementing lean practices successfully.

The paper is organized as follows. First, we review the existing literature on the relationship between lean practices and OC and develop research hypotheses in Section 2. Section 3 presents the data collection, research sample, variables and scales used, and date analysis results. This is followed by the discussion of the results found, research limitations and opportunities, and the conclusion.

The impact of OC on lean practices

OC is built on shared values and ideas. It is a pervasive entity and effects the way that an organisation operates in countless ways. Since the 80s a relevant number of studies have been developed to examine the role of OC in determining organisation success on various management practices (Kull and Wacker, 2010; Ouchi, 1981 and Peters and Waterman, 1982). As such, OC is becoming increasingly clear that it can and does play an important role in many facets of organisations (Denison and Mishra, 1995). From later 1990s, it was stressed that lean should not be viewed in the narrow sense of a set of tools, techniques and practices, but rather as a holistic approach affecting all operational aspects as well as the entire organisation. Recognizing the shortcomings and failures of adopting “pure” lean tools, there was a gradual widening of focus away from the shop floor implementation. OC thus has been discussed by many literatures as a critical element for lean implementation in various forms (Achanga et al., 2006 and Bates et al., 1995). At this stage, lean was emphasised as the principle of system-wide optimisation, which needs organisations to devote effort and resources to implement lean from various aspects (Åhlström, 1998). The human-related factors, such as top management leadership for quality, group work for problem solving, and employee training have been particularly promoted (Womack and Jones, 1996; Åhlström, 1998 and Hines et al., 2004).

Various studies have identified that certain characteristics of national culture have an impact on the efficacy of various lean practices in the early of the 21th century. There is

considerable empirical studies supporting that the success of lean practices depends to a certain extent on its national cultural environment (Kull and Wacker, 2010 and Wiengarten et al., 2011).

Recent years research stated that culture should not be emphasised only on culture at the national level but also at organisational level (Wong and Cheah, 2011). Rother (2009) analysed Toyota's organisational routines, i.e., patterns of thinking and behavior, concerning how the firm approaches the continuous improvement and coaching individuals. Philip (2010) mentioned that lean can not exist in an organisation where the culture against it, and OC determines the success of lean or any other change initiative. It has been stated that OC is the cause of the poor effectiveness of lean management (Liker, 2004; Atkinson, 2010 and Liker and Rother, 2011). Bhasin and Burcher (2006) proposed that companies implementing lean practices need to adjust their OC in order to improve the chances of lean being successful. Among these studies, the vast majority have focused on the fit between different dimensions of OC and specific practices (Detert et al., 2000, Nahm et al., 2004 and Narasimhan et al., 2012). Bortolotti et al., (2015) focused on organisaiontal culture and soft lean practices. Wiengarten et al. (2015) investigated the influence of cultural collectivism on the efficacy of lean practices. The underlying assumption is that there isn't a universal OC profile that always guarantees the success (Prajogo and McDermott, 2011). In fact, the existence of different and heterogeneous ideal OC profiles works as a driver for a particular management program or improvement initiative (e.g., Detert et al., 2000).

Hypothesis Development

Lean is an integrated, complex management system that spans the entire company (Ahlstrom and Karlsson, 1996), where all people at all levels have to be involved and committed to continuous improvement (Furlan et al., 2011). Although it is acceptable to start with the physical changes to production management systems and cultural dynamics must be changed at the same time (Mann, 2005). The essence of lean is to integrate all business processes and functions into a unified, coherent system in order to provide better value to customers (Shingo Prize, 2010). Successful implementation of lean practices not only involve a radical change at organisational level on structure, strategy but also need to pay attention to creating the right culture cross different levels and to develop culture for the change

OC supports lean as an integrated, complex management system that spans the entire company (Ahlstrom and Karlsson, 1996), where people at all levels have to be involved and committed to continuous improvement (Furlan et al., 2011). It was recognised as a system composed of highly integrated elements and a wide variety of management practices (Delbridge, 2003). Differences in OC are mainly expressed through differences at the level of practices while the core of OC is conceptualised through its values (Hofstede et al., 1990). Thus this study follows Hines et al. (2004) and believe that lean has evolved from merely a shop floor practice to an organisational-wide managerial philosophy and needs. This study adopts a practice-culture congruence theoretical perspective to hypothesize why OC at different levels moderate lean practices' effect on operational performance in British manufacturing companies.

Individual level-- Individuals in the organisation need to implement lean with their hands, hearts, and minds in order to achieve of continuous product flow through the restructuring of the physical and control mechanisms. OC should consist of the beliefs and behaviours characteristic of employees that understand their company goal and objective are and the purposes of lean improvements. Shook (2010) suggested that firms should start by defining the way people act, giving employees the means by which they

can successfully do their job, and providing adequate training. The main challenge for lean implementation is to create an aligned organisation of individuals who make continually improvement and to add value (Liker, 2004). Bhasin and Burcher (2006) also highlighted that lean practices require a culture of decision-making starting at the lowest organisational level, implying a group-based approach to problem solving. Therefore, OC at the individual level was recommended to incorporate in the fundamental lean practices, which brings the employees to work, communicate and grow together (Little and McKinna, 2005).

H1 posits a moderating effect of culture at the individual level, which suggests that appropriate OC at the individual level enhances the impact of lean practices on performance

Team level-- Lean practices such as cellular manufacturing, Kanban and pull production system are based on a group oriented working culture (Ohno, 1988 and Rother, 2009). The success of lean implementation requires collectively knowledge and understanding with a long-term perspective. A cross-functional teamwork, commitment, active participation among team members are inevitably influenced by current OC. Companies that have successfully created a lean culture needs team-directed solutions, which influences the behavior of internal employees in terms of information sharing, teamwork and risk taking (McCarter *et al.*, 2005). Lean practices also expose employees to a group-oriented learning process because production systems are too complex to be understood and managed by individuals (Rother, 2009). Bhasin and Burcher (2006) also stated that the need of OC at the lowest organisational level to change employees' attitude and develop a group-based approach to problem solving. In addition, in order to achieve continues improvement and a long term sustainable business development, everybody within the organisations must understand that their contribution is essential for their teams.

H2 posits a moderating effect of culture at the team level, which suggests that appropriate OC at the team level enhances the impact of lean practices on performance.

Managerial level-- Lean is interpreted as a managerial system that integrates specific practices and techniques to reduce internal and external process variability, as the principal source of production problems from a lean standpoint (Shah and Ward, 2007). The organisation must build continuous improvement culture by establish a practice leadership involvement and continually engage rapid improvement events. This includes the training and educating of the workforce about the challenges and benefits of lean practices. This would imply that management could change workers' behaviour through implementing and enforcing their own OC (Ogbonna and Harris, 2000; Naor et al., 2010).

H3 posits a moderating effect of culture at the managerial level, which suggests that appropriate OC at the managerial level enhances the impact of lean practices on performance.

Organisational level-- Lean thinking regarded as a key philosophy needs a mutual and combined effort between employees to execute tasks and permanently improve processes and quality (Womack et al., 1990). Lean practices should be implemented in a comprehensive and holistic in scope and content (Wong, 2007). Many researchers have argued lean implementation usually involves a radical change in terms of structure, strategy and technical organisations (Lacksonen *et al*., 2010). Organisations have little chance to implement lean practices unless they have paid at least the same attention to creating the right culture, and the terms and conditions that may become the basis for implementing the change. An Aberdeen reported in 2006 (Aberdeen Group, 2006) identified a large performance gap between those manufacturing firms that had applied lean practices solely on the shop floor, as opposed to those that had developed a lean

culture throughout the organisation. To achieve strategic fit and sustainable business performance, lean has to be applied much more broadly as a complete business system (Grasso, 2005, Kennedy and Widener, 2008, McVay et al., 2013)

H4 posits a moderating effect of culture at the organisational level, which suggests that appropriate OC at the organisational level enhances the impact of lean practices on performance.

Our research model is depicted in Figure 1.

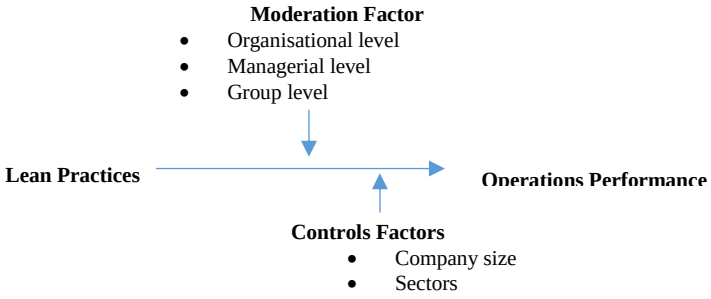

Figure 1: Research Framework

Questionnaire design and development

The questionnaire was developed in various stages. First, a draft questionnaire was developed based on existing scales found in previous research studies. Lean practices scales were based on those developed by Li et al. (2005). The specific lean practices that we include in this paper are equipment layout (i.e. extent of use of cellular manufacturing), Kanban (i.e. extent of use of the concept of Kanban), batch sizes (i.e. extent to which the plant utilises or works towards using small lots in production), order release into manufacturing (i.e. extent of existence of a pull production system), and maintenance and housekeeping. Operations performance focuses primarily on a production line as the unit of analysis: quality, delivery, flexibility and cost. OC was measured by scales developed by Verbeke (2000), who extended and developed Hofstede et al's (1990) organisational practices tool to ensure additional reliability and validity and individual, team, managerial and organsiaiotnal levels.

Previous research has assessed the impact of various contextual factors on the success of implementing lean manufacturing practice bundles (Hines et al., 2004). As noted in the extant study size and industry seem to have a significant impact on the success of lean practices (Shah and Ward, 2003). In order to make our results more conclusive and increase its generalizability, this study also includes firm size and industry type as control variables. Firm size (number of employees) and industry type (industry sector) were added as a control variable for possible differences in operational performance measures (Shah and Ward, 2003 and Douglas and Fredendall, 2004).

A pilot study was conducted to pre-test the draft questionnaire with academics and practitioners for content validity (Carmines and Zeller, 1979). All constructs were measured on a five-point Likert scale, where 1= "strongly disagree" and 5= "strongly agree".

Data collection and analysis

The final survey instrument was sent to British manufacturers from different industry sectors randomly selected from online databases. After three follow-up contacts, a total of 295 useable questionnaires were collected for subsequently analysis, which gives an overall response rate of 19.7 percent. This response rate is regarded as satisfactory as it

is still higher than the average for survey based studies in operations management (Malhotra and Grover, 1998; Frohlich, 2002). Company sizes ranged from small companies, with less than 50 employees, to very large plants with more than 10,000 workers, with the majority of respondents falling into the medium to large sized categories.

Table 1 lists the respondent titles and company sizes. The majority of respondents were from middle-level management or higher. Typical respondents to the survey held the title of production and operations manager (51%). A total of 82% of the respondents were companies with over 100 employees. This statement suggests that our sample can be regarded as a fair representation of British manufacturing. This statement suggests that our sample can be regarded as a fair representation of British manufacturing.

Table.1: Demographic characteristics of respondents

Demographic characteristics		No.	(%)	Demographic characteristics		No.	(%)
Respondent job titles	Production manger	95	32	Industry Sector	Chemical and pharmaceutical	43	15
	Operation manager	86	29		Automotive and aerospace	27	9
	Supply chain manager	53	18		electrical/electronic	12	4
	General manager	45	15		food	31	11
	Other managerial areas	16	6		mechanical	28	9
	Total	295	100		Utility	71	24
number of employees	<100	54	18		Textile goods	74	25
	100- 499	53	18		Other	9	3
	500-1000	24	8				
	1000+	164	56				
	Total	295	100		Total	295	100

Non-response bias and common-method bias

Before any further analysis can be undertaken, we examine the possible non- response bias and the generalization of findings to the population. We compared the early and late responses following the approach suggested by Armstrong and Overton (1977) Lambert and Harrington, 1990). Five items used in the questionnaire were randomly selected to compare the first 20 and last 20 returned questionnaires using the χ^2 test. All the significance values of the selected items were above 0.01, which implies an absence of non-response bias. Harmans single factor (one-factor) test was also adopted to identify the potential effects of common-method bias (Boyer and Hult, 2005). All the variables were loaded into an exploratory factor analysis, which indicates that common-method bias is not a threat in this study.

Assessment of validation and reliability

Construct validity was established through convergent validity and discriminant validity. Convergent validity was assessed through confirmatory factor analysis (CFA). Table 2 provides measurement values for the mean, standard deviation, factor loading, Eigen-value, and Cronbach α. The results in Table 3 indicate good convergent validity among the items of each construct. Furthermore, the average variance extracted (AVE) of each construct exceeded 0.5 as the recommended minimum value, which indicates strong convergent validity (Fornell and Larcker, 1981, Wong *et al.*, 2011). The several iterative and continuous development and design stages of this well-established survey instruments assured content validity. Table 2 and 3 indicate that convergent validity (the degree to which items measure their underlying construct) was acceptable. Furthermore, the items load significantly and unidimensionally on the proposed latent variables. Subsequently, construct validity was confirmed through establishing content validity, reliability and convergent and discriminant validity (Narasimhan and Schoenherr, 2012).

Some items displayed low factor loadings and were not considered for further analysis to ensure the quality of the measure. CFA also allows examining the measurement model

adequacy. The overall fit for the measurement model was good: χ^2=207.73, df=116 and RMSEA=0.045. An RMSEA between 0 and 0.05 indicates a good fit. All other relevant measures (RMR=0.041; NNFI=0.94; CFI=0.91; IFI=0.95) are also within an acceptable range. Overall, the results indicate reliability in our constructs.

Table 2: Measurement values

	Mean	**Standard Deviation**	**Factor Loading**	**Eigen value**	Cronbach's α		**Mean**	**Standard Deviation**	**Factor Loading**	**Eigen value**	Cronbach's α
I1	2.18	1.10				**O1**	2.72	1.66	0.73	53.60	0.68
I2	2.27	1.21				**O2**	3.02	1.48	0.74		
I3	2.63	1.21				**O3**	2.92	1.31	0.58		
I4	4.08	1.01				**O4**	3.72	1.45	0.44		
I5	3.28	1.06				**O5**	3.25	1.29	0.73		
T1	3.09	1.11	0.70	48.68	0.84	**OP1**	3.60	0.84	0.76	51.24	0.81
T2	4.05	0.96	0.75			**OP2**	3.69	0.76	0.69		
T3	3.87	1.21	0.65			**OP3**	3.26	0.88	0.67		
T4	3.98	1.08	0.69			**OP4**	3.27	0.88	0.71		
T5	3.83	1.16	0.65			**OP5**	3.33	0.91	0.72		
T6	3.71	1.00	0.74			**OP6**	3.32	0.95	0.74		
T7	4.05	1.01	0.76								
T8	2.74	1.14	0.68								
M1	3.59	1.03	0.69	55.19	0.73						
M2	2.92	1.13	0.73								
M3	3.16	1.32	0.80								
M4	3.76	0.96	0.75								

Table 3: Correlation Values

	PR	**ER**	**OR**	**O**	**OM**	**IS**	**EN**
Individual	1						
Team	-.160**	1					
Managerial	-.186**	.645**	1				
Organisational	-.136*	.201**	.357**	1			
OM	-.047	.353**	.394**	.299**	1		
IS	.088	.005	.051	.066	-.053	1	
EN	.030	-.034	.046	.208**	.043	.145*	1
Mean	3.25	3.67	3.36	3.13	3.39		

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Research Results

Hierarchical linear model approach

Hypothesis testing is conducted using hierarchical linear model (HLM) (Raudenbush et al., 2004). HLM are specifically designed to overcome the weakness of the disaggregated and aggregated approaches and to deal with hierarchically nested data structures. In this study, HLM uses random coefficients to model a culture moderation of lean practices effect on operations performance. Data analysis is organized into two levels: level-1 data contain questionnaire responses for organisation *i* within industry *j* for both lean practices and OP, and level-2 data contain all culture value scores for organisation *i*. The random-coefficients with level-1 covariate model is shown below, with (1) representing the level-1 facility effects, and (2) and (3) giving the level-2 industry effects.

(1) $OP_{ij}=\beta_{0j}+\beta_1(SIZE_{ij})+\beta_{2j}(LEAN_{ij})+r_{ij}$

(2) $\beta_{0j} = r_{00} + r_{01}(INDUSTRY_j) + u_{0j}$

(3) $\beta_{3j} = \gamma_{30}+\gamma_{31}(IN_j)+\gamma_{32}(TE_j)+ \gamma_{33}(MA_j)+ \gamma_{34}(OR_j)+ u_{3j}$

In (1), the variance of relative facility operating performance is explained by a random intercept varying by industry $\beta_{0j,}$ non varying organisational size β_1, the relative influence of lean practices varying by industry β_{2j} and error r_{ij}. An average operations performance with typical levels of lean practices is represented by the parameter β_{0j}, which is explained in (2) by an intercept parameter, industry and error. No cultural dimensions are included

in (2) in order to be consistent and focus on the culture-as-moderator perspective (Snijders and Bosker, 1999). Culture is included in (3), where the influence of lean practices β_{2j} is explained by a culture-neutral impact of lean practices represented by γ_{30}, cultural influences represented by $\gamma_{31}, \gamma_{32}, \gamma_{33}, \gamma_{34}$ and error u_{3j}.

Table 4 and Table 5 present the HLM analysis results. Computing the percent variance explained (R^2) requires an "empty" model without explanatory variables in order to estimate a base variance of OP, both within-country σ^2 and between-country τ_0^2. As explanatory variables are added, the percent reductions in error variance at each level give the model R^2 (see Snijders and Bosker (1999, p.99). Table 4 first compares the empty model to Model 0, which includes only the fixed control variables SIZE. The control is statistically significant in Model 0, showing that the size of company has no effect. The reliability estimate for the randomly varying intercept parameter is 0.857, revealing relatively high between-count OP variance. The Model 0 variance reduction in facility-level σ^2 and country-level τ^2 are 35.7% and 36.0% respectively, indicating industry explains little of facility-level operations performance variation.

Table 4: HLM analysis

Model	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.357[a]	.124	.77881	.127	41.343	1	283	.000
2	.360[b]	.120	.78076	.002	.292	2	281	.747
3	.736[c]	.528	.57189	.412	49.550	5	276	.000

Table 5: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25.076	1	25.076	41.343	.000[b]
	Residual	171.651	283	.607		
	Total	196.727	284			
2	Regression	25.432	3	8.477	13.906	.000[c]
	Residual	171.295	281	.610		
	Total	196.727	284			
3	Regression	106.460	8	13.307	40.689	.000[d]
	Residual	90.267	276	.327		
	Total	196.727	284			

a. Dependent Variable: OpenCons b. Predictors: (Constant), LeanCons c. Predictors: (Constant), LeanCons, Manufacturing Sector, No Employees d. Predictors: (Constant), LeanCons, Manufacturing Sector, No Employees, InCons, TeCons, processcons, MaCons, ORCons

Table 6 shows the results of testing H1 through H4, gamma parameters are estimated in HLM using a generaliSed least squares (GLS) procedure that weights the level-2 regression in favour of industry with more precise level-1 estimates (Hofmann, 1997). That is, level-1 and level-2 parameters are estimated for each industry and combined via an empirical Bayesian procedure that optimally weights the ordinary least squares (OLS) level-l estimates and the level-2 predicted values for these same estimates. Thus, point estimates and significance levels for each parameter are given to test hypotheses. All four cultural dimensions and industry are initially included, followed by stepwise removal of the most statistically insignificant variables until a final set of significant coefficients remains. In this way, HLM is used to fit the multilevel model and to test the research hypotheses

Table 6: Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.372	.160		14.846	.000
	LeanCons	.315	.049	.357	6.430	.000
2	(Constant)	2.375	.204		11.620	.000
	LeanCons	.319	.050	.362	6.355	.000
	Manufacturing Sector	.012	.022	.032	.568	.571
	No Employees	-.019	.033	-.033	-.583	.560
3	(Constant)	.494	.386		1.281	.201
	LeanCons	.180	.039	.205	4.570	.000
	Manufacturing Sector	.012	.016	.030	.728	.467
	No Employees	-.028	.026	-.048	-1.079	.281
	Individual	-.128	.065	-.083	-1.959	.051
	Team	.506	.053	.458	9.576	.000
	Managerial	.108	.049	.092	2.207	.028
	Organization	.304	.054	.273	5.585	.000

Hypothesis 1 examined the mediating effect of culture at an individual level on the influence of lean and operational performance. The results show that individual culture has a negative impact on OP (β=-0.128; p<0.05). Hence Hypothesis 1 is rejected. As individual level culture puts individuals ahead of team work, or organisational coherent, its postulated that the individual focused organisation may take short-cuts in lean implementation or deviate from existing procedures, thereby increasing process complexity (Verbeke, 2000;Marley et al 2014) Hence, the negative relationship between individual culture and OP may be expected as previous research demonstrates that internal complexity may stifle operating performance in terms of productivity and lead-times (Bozarth et al, 2009, Mazacatto et, al 2014). For example, Forza and Flippini (1998) find that while a continuous improvement philosophy is related to improved operating performance, employee fulfilment is not linked to operating performance metrics such as customer satisfaction (Forza and Flippini, 1998).

Hypothesis 2 examined the mediating effect of culture at a group level on the influence of lean and operational performance. Hypothesis H2 is supported as there is a significant positive relationship between team culture and operational performance (β=0.506; p<0.05). While it was shown in Hypotheses H1 that individual culture is negatively related to lean implementation and operational performance, this relationship has significantly impact on lean performance. This is an interesting result, however it may be explained by the idea that while lean practices and individual skills are important for initially introducing/training employees in lean implementation (Vlachos and Siachou, 2018), a team oriented culture has more significantly impact on operating performance in the long-run.

Hypothesis H3 examined the mediating effect of culture at a managerial level on the influence of lean and operational performance. Results also supported this hypothesis (β=0.108; p<0.05), which indicates a positive relationship between OC, and lean implantation and operational performance. Hypothesis H2 is positive relationship. It can be observed that with the support of managerial culture may perhaps aid lean implementation and operational performance.

Hypothesis 4 examined the mediating effect of culture at an organisational level on the influence of lean and operational performance. Results also supported this hypothesis (β=0.304; p<0.05), which indicates a significant positive relationship between OC, and lean implantation and operational performance. In fact Cua et al (2001) find that a culture cross the organisation which advocates continuous improvement, JIT and TPM practices

is more likely to achieve cost, productivity and lead-time improvements and that overall OP is contingent on the level of implementation of these programs (Cua et al, 2001).

Discussion

Research on OC and performance has increased substantially during the past decade (Cousins et al, 2008). When viewing lean as more than just a bundle of practices, but rather a philosophical mind-set that executes its vision through practices, lean practices clearly need cultural elements attached to them (Bhasin and Burcher, 2006; Shook, 2010). Large-scale studies found thaT organisations performance is attributable to OC and lean practices (Denison, 1990; Rousseau, 1990; Calori & Sarnin, 1991; Gordon & DiTomaso, 1992; Kotter & Heskett, 1992; Marcoulides & Heck; 1993; Denison & Mishra; 1995).

In this study, it is interesting to see that individual culture was found not to be significant in relation to the impact on lean practices and operations performance. Our multilevel simultaneous dimensional test supports our hypotheses that lean practices are most effective with the support of team, managerial related and organizational level OC. In line with other empirical research, this study has examined the importance of OC on lean implementation at different aspect. 1) Lean culture highlights values such as teamwork and cooperation and thus encourages employees to collaborate with internal and external partners (Naor *et al.*, 2008). 2) Lean tools were designed to make it easy to see problems, solve problems, and learn from mistakes. To learn from mistakes and learn from each other, Bhasin and Burcher (2006) highlight that the need of OC at the lowest organisational level to change employees' attitude and develop a group-based approach to problem solving. 3) Lean is an integrated, complex management system that spans the entire company (Ahlstrom and Karlsson, 1996), where all people at all levels have to be involved and committed to continuous improvement (Furlan et al., 2011). Although it is acceptable to start with the physical changes to production Mann (2005), management systems and cultural dynamics must be changed at the same time. The organizational must build the process improvement culture by establish a practice leadership involvement and continually engage rapid improvement events**.** 4) Lean needs not only to integrate internal functions for operational aspects, but also to involve the up- and downstream supply chain partners for sharing information and adapt to new opportunities (Zahra *et al.*, 2004). Therefore, lean manufacturing needs to be supported by OC to develop and manage long term business relationships with customers and suppliers and to coordinate cross-functional cooperation.

Conclusion

This study is to contribute in several ways to the debate on the importance of OC in implementing lean practices. First, compared to previous studies, this study aims to develop a more comprehensive understanding by considering various dimensions of OC, lean practices, and performance, rather than focusing on a specific set of variables. In addition, by investigating differences in lean practices between different sizes and different industry sectors, we can identify whether and which OC dimensions make a difference. Finally, by investigating differences in lean practices, we intend to further analyse the role of these practices in implementing lean practices successfully.

A number of limitations of the current study have also emerged. First, the data was collected from different manufacturing industry sectors and might be criticised for service sectors. Second, future project can test longitude data to identify the impact of OC on lean and performance in a long term. Third, further study take the perspectives from supply chain would accompaniment the findings of this research,

Reference as request