The moderating effect of Industry clockspeed on Lean Manufacturing implementation in Zimbabwe

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Abstract

Purpose: The study focusses on the analysis of the moderation effect of Industry Clockspeed (IC) on the relationship between Lean Manufacturing (LM) practices and operational performance. A model for evaluating the effect of LM is developed and the moderating effect of IC is taken into consideration as a fundamental variable that affects the causal relationship between LM practices and operational performance.

Design/ Methodology: A structural equation model was proposed and investigated across two groups based on IC levels (Group 1: low IC and Group 2: High IC). A structured survey questionnaire was used to collect empirical data from 600 companies listed by the Confederation of Zimbabwean Industries (CZI). A total of 214 usable responses were obtained giving a response rate of 35.6%. The data was analyzed using Smart PLS 3 and SPSS version 25.

Findings: The results revealed that LM practices directly and positively affected operational performance and IC had a positive moderation effect on the relationship between LM practices and operational performance. The results indicated that the structural equation model remained invariant across the groups. This showed that IC had a moderating effect on the relationship between LM practices and operational performance for both low IC and high IC industries.

Originality/value: The study analyzed the moderating effect of industry clockspeed in Zimbabwean industries. The study provides further evidence to managers on the effect of LM practices on operational performance in developing countries.

Keywords: Lean Manufacturing, Operational performance, Industry Clockspeed, Structural Equation Modelling

1. Introduction

Lean manufacturing (LM) emerged from the Toyota Production System (TPS) and has been used by many manufacturing organizations to improve productivity. Companies in Zimbabwe have also been part of the quest for eliminating waste in manufacturing processes. Many manufacturing companies have implemented the philosophy in order to reduce production cost so that their products can compete with those that are imported from other countries worldwide. While the economic challenges facing Zimbabwe has hindered most companies from implementing other performance improvement strategies (Goriwondo and Maunga, 2012), LM has continued to be applied by many firms in order to boost capacity utilisation and eliminate waste (Goriwondo et al., 2011). However, the effects LM has on operational performance remains largely unknown, causing some managers to be hesitant to adopt the philosophy.

Shrafat and Ismail (2018) state that several researchers have established that more studies need to be conducted to gain an understanding of the effect of LM practices on operational performance in developing countries. The number of studies on LM implementation in developing countries is relatively low compared to developed countries (Panizzolo et al., 2012). Wilson (2009) also states that researchers in developing countries have misled the manufacturers in these countries on the difficulty of implementing LM. This has led companies in developing countries to be sceptical on the benefits of implementing the management practice. This research seeks to evaluate the effect of implementing LM practices on operational performance in Zimbabwean industries.

Diverse research models with different constructs have been developed to evaluate the effect of LM on operational performance. The objectives of such studies include the evaluation of the effect of LM tools on operational performance, measuring how organizations adopt LM and quantifying the maturity level of LM implementation in different organizations (Santos Bento and Tontini, 2018). Some empirical studies have shown that LM implementation results in increased operational performance (Shah and Ward, 2003) while others have shown that the implementation of LM has little or negative impacts (Bhasin and Burcher, 2006, Browning and Heath, 2009). Many organizations face challenges when trying to implement LM (Chiarini et al., 2018). A review by Negrão et al. (2016) revealed that five studies had shown that LM implementation had a negative impact on operational performance.

Institutional and contingency theories may provide insight into some of the aforementioned contradictions. The institutional theory states that organizations mimic the actions and practices of other organizations because of the pressure to remain competitive. Organizations in the developing countries seem to have been imitating the Toyota Motor company that has been successful in implementing LM. Most organizations in these developing countries concentrate on implementing the various Lean practices in their organizations, focussing on the production system rather than accepting the Lean concept as an organizational philosophy. These two different paradigms have been referred to as the Lean toolbox and Lean philosophy respectively (Bengt, 2013). Some organizations also rush to implement the LM tools without considering the strategic actions that will make the implementation to be fruitful (Choudhary et al., 2019). Thus, implementing LM can only be successful when the philosophy behind the technique is fully understood (Mårtensson et al., 2019).

On the other hand, the contingency theory states that corporations are organized according to external situations. Their effectiveness emanates from fitting organizational characteristics to contingencies (McAdam et al., 2019) which may be the environment they operate in. Therefore, organizations will imitate the structures and actions of other companies to improve their operations depending on the environment within which they are operating. Related to the contingency theory is the effect of IC. The rate of change within an industry can affect the influence that LM has on operational performance. This is referred to as the impact of Industry Clockspeed (IC). In a high-paced industry, products and processes are constantly changing, hence positive results might not be noticed quickly compared to a slow-paced industry. This may imply that the implementation of LM in a slowly changing industry may appear to have quickly yielded positive results than in the high-paced industry. This is part of the postulations in this work's hypothesis. Part of the challenge faced by the manufacturing sector in Zimbabwe is the effect of IC on their manufacturing processes coupled with globalization that makes the implementation of improvement strategies to be difficult.

There are relatively few researches that have evaluated the effect of IC on the association between LM practices and operational performance. Chavez et al. (2013) analyzed how internal LM practices affected operational performance through the moderating effect of IC, where internal Lean practices are said to be tools and methods that address issues inside an organization and external practices are techniques that are related to customers and suppliers. The results indicated that the internal LM practices positively affected delivery, flexibility and quality. The study used only two internal LM practices (process setup time reduction and JIT), but for successful LM implementation, external practices have to be considered. This study, therefore, extends the body of knowledge by testing the moderating effect of IC on the relationship between LM internal and external practices and operational performance.

The following questions were addressed in this study:

1. What are the effects of internal and external LM practices on operational performance?
2. Does IC have a moderating effect on the association between LM practices and operational performance?

The paper is divided into 6 subsections. Section 1 describes the background of the problem and the research questions. Section 2 gives a the literature review. Section 3 describes the statistical methodology that was used to assess the moderating role of IC on the causal relationship between LM practices and operational performance. The results and discussion are presented in Sections 4 and 5 respectively. Section 6 concludes the study.

2. Literature review

This review focuses on the studies that have investigated the relationship between LM and operational performance.

2.1 LM practices implemented by Zimbabwean industries

The Zimbabwean manufacturing sector has been declining due to a shrinking domestic market, low capacity utilisation, hyperinflation and reduced demand for local products due to high prices (Damiyano et al., 2012, Goriwondo et al., 2011). To confront this situation, most companies are implementing LM in order to improve their operational efficiency and production costs in order to be more competitive both locally and internationally. Many organizations in Zimbabwe have implemented a diverse number of LM practices. The use of

Value Stream Map (VSM) in a bakery manufacturing company resulted in the reduction of waste by 25% and a 16% increase in throughput (Goriwondo et al., 2011). In an aluminium foundry company, implementation of Just In Time (JIT) resulted in lower production costs and throughput time (Madanhire et al., 2013). In another study, the implementation of VSM in a margarine manufacturing company led to an improvement in cycle time by 86% (Goriwondo and Maunga, 2012). Goriwondo et al. (2013) also reported that the use of VSM resulted in the reduction of cycle time and lead time for tabletting and liquid creams and ointments for a pharmaceutical company. In another study by Muvunzi et al. (2013), implementation of VSM in a tile manufacturing company led to an improvement in processing times, lead time, cycle time and raw material costs. In a different study by Nyemba and Mbohwa (2017), transportation costs were reduced by 43% in a furniture manufacturing company due to the implementation of process maps. Furthermore, implementation of VSM in a glide manufacturing company led to an improvement in lead time, processing time and manpower utilisation (Dzanya and Mukada, 2015).

Literature review, however, shows that there are few documented researches on the evaluation of LM practices on industry wide performance in Zimbabwean manufacturing industries. To the best of the author's knowledge, this is the first study showing how IC acts as a moderating variable for the relationship between LM practices and operational performance in Zimbabwean companies. Pareto analysis was used to rank LM practices mostly used by companies in Zimbabwe. Figure 1 shows that four LM practices frequently used in LM implementation were JIT, Jidoka, Stability and standardization and People integration. Practices such as Kaizen, poka-yoke, visual control, Cellular Manufacturing (CM) and Total Preventive Maintenance (TPM) were not frequently used by companies. In addition, practices such as one-piece flow, quick changeover, Statistical Process Control (SPC), setup reduction and line balancing were used even less frequently. As a result, JIT, Jidoka, Stability and standardization and People integration were used for developing the model that measured the effect of LM practices on operational performance in Zimbabwean firms.

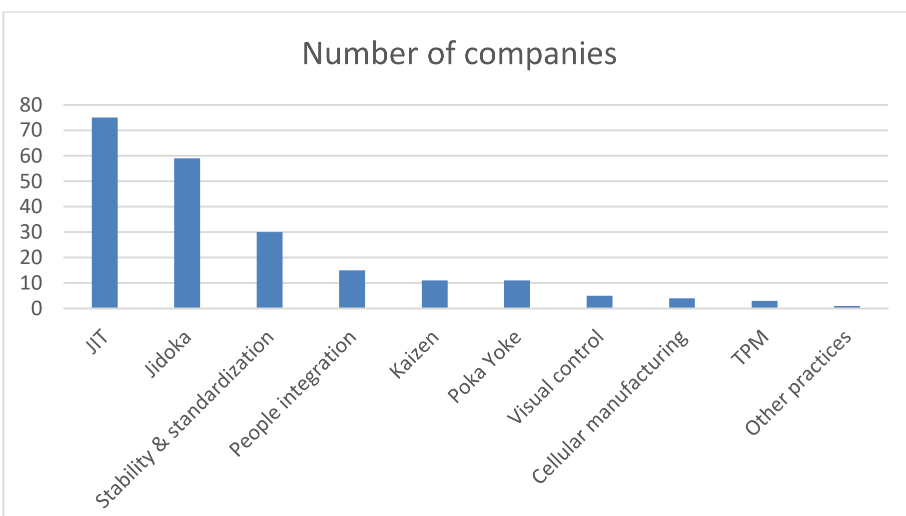

Figure 1: Pareto analysis of LM practices

2.2 Relationship between LM practices and operational performance

The application of LM practices is not considered just as an operations management technique but a philosophy that has helped organizations to improve efficiency, effectiveness and cost of their operations (Barnabè and Giorgino, 2017, Spasojevic Brkic and Tomic, 2016, Dubey and Singh, 2015). Shrafat and Ismail (2018) developed a model to assess the impact of LM practices on business performance with operational performance acting as a mediating variable in Jordanian companies. The results revealed that LM practices have a strong and direct relationship with business performance and operational performance. Additionally, operational performance has a strong mediating effect on the link between LM and business performance. Panwar et al. (2018) investigated the effect of implementing LM practices in Indian process industries. The results showed that the adoption of LM practices increased operational and quality performance. In another study of Jordanian companies, Al-Tahat and Jalham (2013) found that implementation of eight lean practices had a positive effect on the Quality Performance Indicator (QPI). Similarly, Belekoukias et al. (2014) examined the impact of five lean practices which were VSM, autonomation, Just In Time (JIT), Kaizen and Total Preventive Maintenance (TPM) on operational performance. The results showed that the implementation of these practices had a significant and positive relationship with flexibility, cost, speed, dependability and quality. Several other studies such as Fullerton et al. (2003), Hofer et al. (2012), Wickramasinghe and Wickramasinghe (2017) and Dal Pont et al. (2008) have also found a positive relationship between LM practices on operational performance.

2.3 Institutional theory, contingency theory and Industry clockspeed (IC)

Institutional theory suggests that organizations may adopt performance improvement techniques such as LM in their operations due to mimetic, coercive and normative pressures. Organizations are open systems that are influenced by external environments to comply with certain standards and exhibit organizational legitimacy. As a result, organizations implement LM to increase customer value, reduce manufacturing costs and increase market share. Mimetic pressures describe how organizations copy their competitors in order to outperform them (Gupta et al., 2019, Cavusoglu et al., 2015). Organizations may copy the structures of the competitors in order to improve their performance (Fang et al., 2019). The coercive pressures can be defined as pressures that are exerted by other bodies in order for organizations to satisfy regulations (Fang et al., 2019). Organizations are forced to comply with regulations for them to continue operating and these regulations may act as a basis for formation of associations with other organizations (Iyer, 2019). Normative pressures occur as organizations transform in order to suit the respective industry standards (Iyer, 2019, Cao et al., 2014, Liao, 2018). A study by Dubey et al. (2018) investigated how institutional pressures influenced the diffusion of TQM in the Indian automotive industry. The study highlighted that the TQM philosophy had no laid down procedures to use during its implementation. As a result, organizations imitated successful companies that implemented it. LM also contains no laid down procedures, hence organizations worldwide imitate companies that have been successful in adopting the philosophy.

The contingency theory states that best practices may be applied depending on the contingencies of the situation. These contingencies may be the external environment, culture or firm size. This theory analyzes the organizational issues based on the contextual situation. IC is also one of the external factors that organizations should consider before implementing LM. IC is defined as the pace/rate of change of an industry caused by factors such as changes in technology and competition (Metanantakul et al., 2018, Wiengarten et al., 2012). Carter and Jackson (2019) also defined it as the degree of change of forces that affect an organization's competitive edge. The concept of IC was first introduced by Fine (1996) and has three components which are the change in processes, products and organizational structure. Process technology measures the rate at which production equipment depreciates in value; product technology measures the rate at which new products are introduced into the market and organizational clockspeed incorporates the rate of change of structures by organizations (Fine, 1999).

Lucianetti et al. (2018) conducted a study to show the association between contingency factors and the adoption of advanced managerial practices and manufacturing tools in manufacturing organizations. They pointed out that contingency theory has been used by researchers such as Flynn et al. (2010), Wong et al. (2015) and Monday et al. (2015) to describe how organizations embrace advanced manufacturing practices. Results of the study revealed that contingency factors influenced how advanced manufacturing tools and managerial practices are embraced by manufacturing organizations in Italy. In turn, the advanced manufacturing tools and managerial practices had a positive correlation with operational performance.

This study aims to assess the moderating role of IC on the relationship between LM practices and operational performance. High IC industries are characterized by a high rate of new product conception which entails that organizational structures change frequently and the product development time is short (Mendelson and Pillai, 1999). Examples of products that fall under this category include electronics, fashion, cosmetics etc. The slow clockspeed industries have a fairly stable organizational structure with low product obsolescence and process technology replacements rates.

2.4 Operational performance

In the last two decades, many journals have published papers that focus on the effect of LM on operational performance. A literature review indicated that a diverse number of variables that measure operational performance have been used by researchers. Santos Bento and Tontini (2018) state that flexibility, quality, delivery and cost are the frequently used items for quantifying operational performance. Table 1 gives an overview of the operational performance measurement variables identified by researchers with their references. The table shows that the frequency of use of each variable differs significantly. The variables used frequently were cost, quality and delivery time while demand, defect rate, lot size, cycle time, first yield pass, efficiency, processing time and return on assets were the least referenced variables.

Table 1: Operational performance variables and their references

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Inventory	*	*	*	*													
2. Cost	*			*	*	*	*					*	*			*	*
3. Productivity	*			*			*				*		*				
4.Waste reduction	*			*			*			*							
5. Demand	*																
6. Delivery	*		*	*		*		*			*		*				*
7. Quality		*	*		*	*		*			*	*				*	*
8. Lead time			*				*					*					*
9. Turnover			*							*							
10.Space utilisation				*				*									
11. Defect rate				*													
12. Lot size				*													
13. Dependability					*											*	
14. Speed					*											*	
15. Flexibility						*						*				*	*
16. Cycle time							*										
17.First pass yield							*										
18. Efficiency								*									
19. Profit									*	*				*			
20.Customer satisfaction										*			*				
21. Processing time										*							
22. Setup time																	*
23. Sales growth											*				*		
24. Market share											*			*	*		
25.Return on sales														*	*		
26. Return on assets														*	*		

(1) (Panwar et al., 2018) (2) (Marodin et al., 2018) (3) (Marodin et al., 2017) (4) (Panwar et al., 2017a) (5) (Dal Pont et al., 2008) (6) (Furlan et al., 2011) (7) (Shah and Ward, 2003) (8) (Wickramasinghe and Wickramasinghe, 2017) (9) (Fullerton and Wempe, 2009) (10) (Hadid et al., 2016) (11) (Hong et al., 2014) (12) (Khanchanapong et al., 2014) (13) (Rahman et al., 2010) (14) (Agus et al., 2012) (15) (Yang et al., 2011) (16) (Belekoukias et al., 2014) (17) (Santos Bento and Tontini, 2018)

There seems to be an impression that variables such as quality, cost, speed, flexibility and dependability are popular measures of operational performance. (Knudtzon, 2018, Pozo et al., 2018, Khanchanapong et al., 2014, Belekoukias et al., 2014, Birkie and Trucco, 2016, Dal Pont et al., 2008, Furlan et al., 2011, Taj and Morosan, 2011, Hallgren and Olhager, 2009, Shah et al., 2017, Chavez et al., 2013).

2.5 Model development and hypothesis

A second-order structural model for assessing the effect of LM on operational performance is presented in Figure 2. The model consists of one endogenous variable, operational performance and two exogenous variables, LM and IC. A second order construct, LM, was formed from four first-order constructs (JIT, Jidoka, Stability and standardization and People integration). The major aim was to understand how the LM practices affect operational performance with IC as a moderating variable.

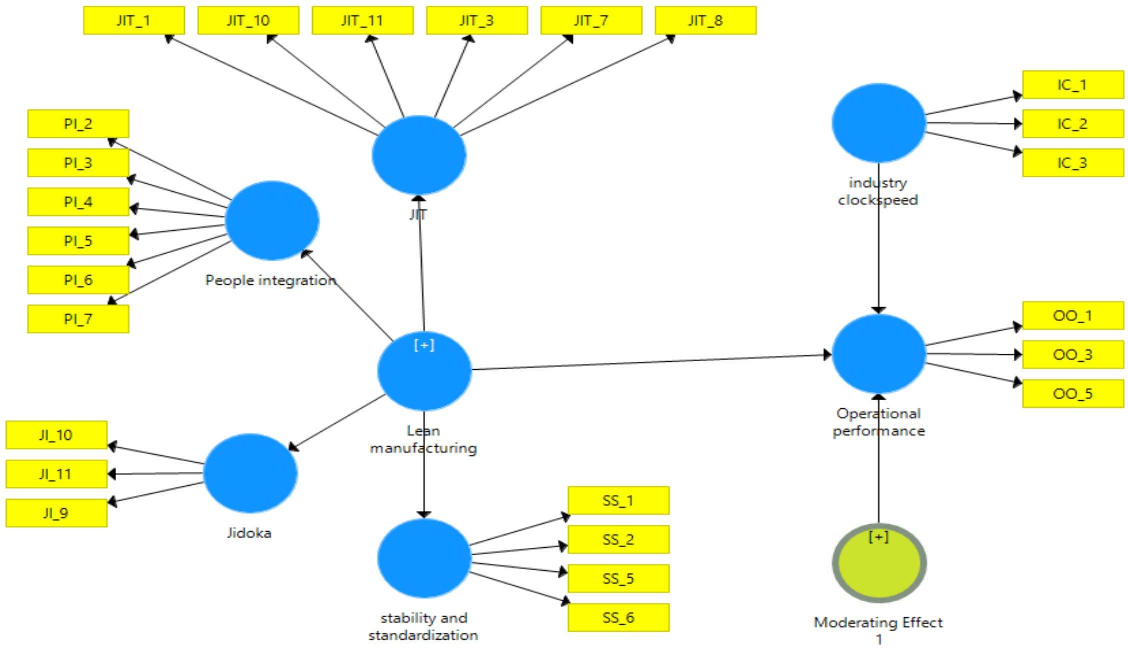

Figure 2: Lean measurement structural model

2.5.1 Effect of LM practices on operational performance

Many researchers have shown that application of LM practices has a direct and significant relationship on operational performance. This is because implementation of LM results in decreased customer lead time, manpower requirement, process waste, inventory level, improved understanding of the process and stability of the process (Abdulmalek and Rajgopal, 2007, Liker and Meier, 2005, Melton, 2005) which improve operational performance. A study by Rahman et al. (2010) showed that the application of flow management, JIT and waste management practices resulted in improvement in operational performance. Demeter and Matyusz (2011) revealed that there was improvement in inventory turnover for companies that implemented LM than in traditional companies. Hofer et al. (2012) averred that LM practices had a direct and significant correlation with financial performance. Additionally, Inman and Green (2018) claimed that LM had a direct and positive relationship with operational performance. Other studies that have found a significant and direct relationship between LM practices and operational performance are (Fullerton et al., 2003, Yang et al., 2011, Panwar et al., 2017b, Wickramasinghe and Wickramasinghe, 2017). Therefore, it is hypothesised that;

H_1: LM practices have a direct relationship with operational performance.

2.5.2 The moderating role of IC

For a successful implementation of LM practices, managers should also consider the contingent effect of IC upon their organizations. IC considers the rate of change of products, processes and organizational structure within an industry. This paper suggests that an environment under which an organization operates will affect the results of the LM implementation process. In a low IC industry, change occurs at a slow rate and is predictable (Masini et al., 2004). This enables industry structures to be stable, which makes the application of LM practices to be easy since industry practitioners rely on previous knowledge about their firms. In a high IC environment, the pace of change is high and organizational structures are continuously changing. Competition is also high as new organizations emerge, hence companies constantly optimize their processes, products and structures. Organizations in high IC environment need to lower their order processing times in order to deliver products on a just-in-time basis to customers. Organizations that survive in a high IC industry are able to transform from one temporary benefit to another as they partner with suppliers and customers so as to respond quickly to the ever-changing environment. A study by Chavez et al. (2013) revealed that in low IC industries, LM practices have a direct and positive relationship with operational performance than in high IC industries. This study argues that IC will have an effect on operational performance in both low IC and high IC. The following hypothesis was derived for the study;

H_2: There is a significant moderating effect of IC on both fast and slow IC industries.

3. Research methodology

3.1 Questionnaire design

A questionnaire was developed in order to evaluate the effect of implementing LM in Zimbabwean industries. The questionnaire had three sections. Section A had questions on the number of employees, process type and the number of years that the company had implemented LM. Section B contained questions relating to the degree of adoption of LM practices while Section C had items on the measure of performance of the organization. The respondents were asked to select the LM practices they had implemented in their organization. A seven-point Likert scale with 1- strongly disagree, 2- disagree, 3- disagree somewhat, 4- undecided, 5 – agree somewhat, 6 – agree and 7- strongly agree was used to assess the level of adoption of LM practices. The selection of LM practices was based on the study conducted by Maware and Adetunji (2018). The scales used for IC was based on Chavez et al. (2013) and included items on product optional features, models and design changes.

The operational performance variables used for the study were quality, speed, cost, flexibility and dependability. These were identified from studies by (Shah and Ward, 2003, Belekoukias et al., 2014). A five-point scale varying from 1 - declined more than 20%; 2-declined 1-20%; 3-stayed the same; 4-increased 1-20% and 5-increased more than 20% was used. The control variables used in the study were industry type and company size. Only manufacturing companies with more than 50 employees were considered in the study. Four industry practitioners and two academics evaluated the questionnaire to check for relevance, logic, presentation and spellings.

3.2 Data collection

Data collection was done by emailing the Google form link and hand delivery of hard (printed) copies to 600 companies listed in the CZI. It was assumed that organizations with more than 50 employees were more likely to implement LM and have a deeper understanding of the philosophy than smaller organizations. The sample involved organizations from the pharmaceuticals, agrochemicals, motor, steel, timber, battery, plastics, food, beverages, electronics and clothing industries. The rate of new product introduction, process technology replacements and product development time were used to categorise the companies into low IC and high IC. Exploratory factor analysis (EFA) was conducted in SPSS to group the LM practices into a higher level LM construct. This procedure is performed by reducing high dimensional information of observed items into a lower number of constructs (Guo et al., 2019). A guideline given by Peng and Lai (2012) was used to conduct the PLS multi-group analysis.

A Multi-group analysis approach in Partial Least Squares was used to evaluate the moderating effect of IC on the association between LM practices and operational performance. A multi-group analysis is a method that is used to compare parameters across groups. It also allows to test if the path coefficients for the two subpopulations are significant (Henseler, 2007). This method allows different groups within a sample to be treated separately. The hypothesis proposed for the study is that by comparing the two sectors with different ICs using Partial Least Squares-Multi- Group Analysis (PLS-MGA), there are no significant differences between the path weights for slow and fast ICs.

Table 2 gives the list of companies that responded to the survey questionnaires. The respondents were selected from leaders and managers from the departments of operations, quality management and continuous improvement. The authors believed that these managers have knowledge of both LM implementation and their organizational processes.

Table 2: Industry characteristics

Low industry clockspeed	Number of companies	Sample %	High industry clockspeed	Number of companies	Sample %
Pharmaceutical	20	9.3	Food	42	19.6
Agrochemicals	15	7.0	Beverage	15	7.0
Motor	23	10.7	Electronics	14	6.5
Steel	19	8.9	Garment	12	5.1
Timber production	15	7.0			
Battery	20	9.3			
Chemical and plastics	19	8.9			

3.3 Non-response bias

Non-response bias was examined in order to compare the early and late responses. The extrapolation method by (Armstrong and Overton, 1977) was used to compare the early and late responses. Five items were chosen randomly from the survey questionnaires to compare responses of the first 20 and last 20 respondents using the Chi-square test. The results revealed that the non-response bias for the early responses and late responses had no significant effect with $p < 0.05$.

4. Results

4.1 Measurement model: Construct reliability and validity

Exploratory Factor Analysis was conducted using SPSS version 25. The results revealed that Bartlett's test of sphericity was significant $\chi^2(214) = 2058.55$ with a p-value of less than 0.001. The total variance of 51.67% was obtained for the six constructs (JIT, Jidoka, People integration, stability and standardization, industry clockspeed and operational performance). The construct reliability of each of the factors was above 0.65 indicating that each of the items of each construct retained were measuring the same construct. The values for Average Variance Extracted were greater than 0.5 indicating a strong convergent validity for the model (Moshtari, 2016). Table 3 summarises the results of convergent validity and internal consistency or reliability. The confidence intervals for the Heterotrait-monotrait ratio (HTMT) did not include 1, thus all the constructs exhibited discriminant validity (Hair Jr et al., 2016).

Table 3: Convergent validity and internal consistency reliability

Construct	Convergent validity	Internal consistency reliability		Discriminant validity
	AVE	Composite reliability	Cronbach's alpha	
	>0.50	0.60-0.90	0.60-0.90	HTMT values
JIT	0.624	0.869	0.799	Does not include 1
Jidoka	0.731	0.916	0.877	Does not include 1
People integration	0.630	0.872	0.804	Does not include 1
Stability and standardization	0.694	0.844	0.724	Does not include 1
Operational performance	0.589	0.811	0.651	Does not include 1
IC	0.555	0.629	0.616	Does not include 1

4.2 Results for the overall model

All the VIF values were below the threshold of 5 indicating that there were no collinearity problems within the model. Table 4 gives the path coefficients for the inner model. The path coefficient from LM to Operational performance was 0.481, which was fairly high, with a p value close to zero. This indicated that LM practices had a direct and significant relationship with operational performance, supporting H_1. LM had a strong effect on Stability and standardization which showed that the prerequisite for successful implementation of LM is that the processes should be standardized and stable. This was followed by JIT with 0.93. This showed that the creation of flow within the production system was also crucial. The production system should produce products at the right time in the correct quantity. The relationship between LM and People integration and Jidoka were also high with a path coefficient of 0.91 and 0.82 respectively. IC also moderated the relationship between LM practices and operational performance.

Table 4: Path weights for the inner model

Hypothesis	Effect of	On	Path coefficient	p-value	Result
	LM	JIT	0.931	0.00	
	LM	Jidoka	0.820	0.00	
	LM	People integration	0.917	0.00	
	LM	Stability and standardization	0.970	0.00	
H_1	LM	Operational performance	0.481	0.00	Supported
H_2	IC	Operational performance	0.667	0.00	Supported

The R^2 value shows the predictive power of the model. This value indicates the quantity of variance in the dependent variable that is explained by all the independent variables that are connected to it. The R^2 values of 0.25, 0.50 and 0.75 for the dependent variables show a low, medium and high effect of the exogenous variable (Ho et al., 2019, Shariff et al., 2019, Hair Jr et al., 2016). The R^2 values for the endogenous variables were all high showing that the model had high predictive power. The R^2 value for JIT was 0.687, People integration was 0.841, Jidoka was 0.672, stability and standardization was 0.941 and Operational performance was 0.965. The results revealed that the LM construct was a good predictor of operational performance.

The effect size f^2 of each independent variable was also calculated using the Cohen f^2 formula. The effect size f^2 describes how the value of R^2 changes for the dependent variable when a certain exogenous variable is omitted (Ringle et al., 2015, Wong, 2019). The values of 0.35, 0.15 and 0.02 are considered high medium and small. The effect of excluding LM from the model for the dependent variables such as JIT, Jidoka, Stability and standardization was medium, and high for People integration whilst excluding IC from the model had a medium effect on Operational performance. The predictive relevance of the model is given by Stone-Geisser Q^2 value. All the values for Q^2 were above zero indicating that the model had good predictive relevance. Table 5 shows the R^2, f^2 and Q^2 values for the endogenous variables in the model.

Table 5: The R^2, f^2 and Q^2 values for the endogenous variables

Endogenous variable	R^2	Effect size f^2	Q^2
JIT	0.867	0.222	0.353
Jidoka	0.672	0.346	0.375
People integration	0.841	0.390	0.330
Stability and standardization	0.941	0.255	0.346
Operational performance	0.965	0.173	0.126

4.2 Multi-group analysis

The Multi-group analysis was used to test the moderating role of IC on the relationship between LM practices and operational performance across the two groups (Group 1: low IC and Group 2: High IC). Table 6 shows a multi-group analysis result for the two groups. The results indicated that there were no significant differences in the effect of industry clockspeed on the low IC and high IC groups. This showed that IC moderated the relationship between LM practices and operational performance for both low IC and high IC industries. Thus, H_2 is supported because the structural equation model of LM practices, operational performance and IC does not differ between the groups.

Table 6: Results for the multi-group analysis

	Pooled		Group 1 Low IC		Group 2 High IC		Group 1 vs Group 2
	N= 214		N= 131		N= 83		P value
	Path weight	CI	Path weight	CI	Path weight	CI	
LM→JIT	0.931	0.870- 0.979	0.806	0.697-0.873	0.856	0.749-0.906	0.432
LM→ Jidoka	0.820	0.717- 0.893	0.680	0.493-0.783	0.767	0.631-0.855	0.358
LM→ People integration	0.917	0.840- 0.974	0.782	0.616-0.843	0.836	0.632-0.902	0.456
LM→ Stability and standardization	0.970	0.907- 0.990	0.809	0.716-0.867	0.808	0.688-0.876	0.986
LM→ Operational performance	0.481	0.276- 0.617	0.296	0.118-0.480	0.420	0.194-0.606	0.388
IC→ Operational performance	0.667	0.413- 0.618	0.373	0.123-0.532	0.449	0.083-0.665	0.659

5. Discussion

This paper investigated a proposed structural relationship between LM practices, IC and operational performance in manufacturing firms in Zimbabwe. The results revealed that LM practices were significantly and positively associated with operational performance. Furthermore, IC acted as a moderating variable in the relationship. The findings provided further evidence that supports the possible effect of IC on LM. The results also showed that IC had a moderating effect in both low and high IC industries, which implies that managers should consider the effect of IC when implementing LM practices.

5.1 Theoretical implications

There are few studies that have evaluated the moderating effect of IC on the relationship between LM practices and operational performance. A study conducted by (Chavez et al., 2013) is the only known paper that assessed the moderating role of industry IC on LM implementation in Ireland. This paper expanded Chavez's work by testing how IC affect operational performance in a developing country. Specifically, the results showed that LM practices are effective for operational performance improvement in both low IC and high IC industries. The study is also supported by (Knudtzon, 2018, Pozo et al., 2018, Khanchanapong et al., 2014, Belekoukias et al., 2014, Birkie and Trucco, 2016, Dal Pont et al., 2008, Furlan et al., 2011, Taj and Morosan, 2011, Hallgren and Olhager, 2009, Shah et al., 2017, Chavez et al., 2013) that show that implementation of LM practices improve operational performance.

5.2 Managerial implications

The study indicated that LM practices are positively related to operational performance, thus further furnishing managers with proof about the benefits of implementing LM. The study, however, showed that LM practices are effective in both low and high IC environments. This is contrary to the observation of Chavez et al. (2013) that concluded that LM is more efficient in low IC environments. Furthermore, researchers have categorised industries as low and high IC and managers can benchmark their operations based on the categories and identify LM practices that suit their operations. It may be that the moderating effect of IC on LM's influence on operational performance is dependent on the economy in which it is studied. It may, hence, be useful to have a research that evaluates the moderating effect of IC on the influence of LM on operational performance of companies as a comparative study between developing and developed economies.

6. Conclusion

To the best of authors' knowledge, this is the first empirical study to analyze the moderating effect of IC on the relationship between internal and external LM practices and operational performance in a developing country. The study suggested that the implementation of LM practices such as JIT, Jidoka, People integration and Stability and standardization led to an improvement in operational performance. Furthermore, the study showed that the implementation of LM practices can lead to higher operational performance both in low IC and high IC environments. This study provides empirical evidence to managers in developing countries who are sceptical of implementing LM since some researchers have reported the negative effect of LM on operational performance (Browning and Heath-Brown, 2009, Bhasin and Burcher, 2006). The limitation of this study was that the sample comprised of companies from Zimbabwean industries only. This study can be extended by testing the model with firms from other developing countries. The study can also be extended by increasing the number of

LM practices and testing their effect on operational performance. More respondents from a single firm can also be used so as to guard against single respondent biasness.

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