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ASSESS THE IMPACT OF LEAN MANAGEMENT PRACTICES ON ORGANISATIONAL PERFORMANCE

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A B S T R A C T

The purpose of this study is to investigate the impact of lean management practices in Horizon Addis Tire Manufacturing PLC. In addition, the mediating effect of operational performance is tested. This survey-based study was cross cross-sectional study. A self-administered survey five-point Likert scale questionnaire was used for primary data collection. Factor analysis, correlation, multiple regression analyses, and fuzzy set qualitative comparative analyses were used to test the study's four hypotheses. The predictive tests on fuzzy set qualitative comparative analysis for all the models indicate that the five highly coherent models for the sub-sample have high predictive ability for the holdout sample and vice versa. Finally, comparing the predictive power assessments from multiple regression model lean management practices to organizational performance measure, and fuzzy set qualitative comparative analysis also suggests that the five predictive power assessments are consistent, thereby confirming that the models have high predictive power. This study contributes to the lean management body of knowledge by identifying the relationships between lean management practices, operational performance, and organizational performance. The present study provides the notion of the integral and holistic practices of lean practices, operational performance, and organizational performance. The study adds to the knowledge and theories on how lean management practices can affect organizational performance, at the operations level. This study provides the notion of integral and holistic practices of lean management and a comprehensive approach to performance measurement. Understanding these relationships will help practitioners make better decisions in manufacturing organizations as well as enable the application of the concepts in this study to other contexts such as service organizations.

1. INTRODUCTION

Reducing waste and eliminating non value-added work from processes has become increasingly important in an organisation to succeed in a competitive business environment. Womack et al. (1990) defined the term "lean" as that system that utilizes less in term of all inputs, to create the same outputs as those created by traditional mass production system, which contribute increased varieties for end customer. Lean focuses on removing wastes and ads value from customer perspectives, it is necessary to identify the non-value added activity and value added activity in the manufacturing system, which creates wastes (Xiong et al., 2019). Quality management is important pillar of

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Lean concept (Joosten et al., 2009; Arsovski, 2023; Mekuria 2023).

In manufacturing sectors with multi-stage and high-speed production procedures, unforeseen breakdown of production machines can be expensive. The inability of the machine component(s) to work as designed is a prevalent justification for machine failure. It will immediately add to the manufacturing of waste, e.g., the item being rejected or waiting for unplanned downtime etc. (Tsarouhas 2021).

Lean manufacturing (LM) is a systematic production method that is used to minimize waste within the production system focusing on productivity and quality. LM practices for the manufacturing companies are the elimination of wastes, continuous improvements, respect for the human and its elements; production on time, following standard procedure, mistake proofing, and detection of defects. Lean manufacturing has been used to improve the competitiveness and performance of the companies in the last few decades. Many previous studies have shown that companies integrate the LM approach in their manufacturing operations with efforts to improve productivity and efficiency. LM has been used successfully to improve company effectiveness and efficiency. Diverse studies, however, have revealed that many businesses who try to integrate LM into their production operations fall short of their goals (Panigrahi et al., 2023).

Operational performance is the performance of the company measured with respect to indicators related to effectiveness, efficiency, productivity, waste reduction and quality. Based on a review of the literature it was found that the major four components of operational performance are the quality, the cost, the delivery time of the product (Chavez et al., 2013; Nawanir et al., 2013; Rasi et al., 2015; Panigrahi et al., 2023), and flexibility (Inman et al., 2011; Leite & Braz, 2016; Panigrahi et al., 2023a).

Although the relationship between lean practices and different dimensions of operational performance has been assessed by several studies, those that are assessing relationships proposed in this study, are still limited (Hong et al., 2014). The links between lean and operational measures have been deeply studied since it is obvious that the direct impact of lean practices is reflected in production processes‟ performance metrics or operational performance metrics (Negrao et al., 2017; Panigrahi et al., 2023).

Organizational performance is confounded with notions such as: productivity, efficiency, effectiveness, economy, earning capacity, profitability, competitiveness etc. For this reason it is increasingly insisted on a clear and unambiguous definition of the concept of performance and usefulness of the study for the practical interpretation organizational performance is a difficult, complex, hard to achieve process (Elena-Iuliana & Maria, 2016).

As the lean management practices LMP are associated with bringing improvement in the processes, they facilitate achieving sustainable on organisational performance. The impact of lean management practices can be best measured on customer satisfaction, financial and marketing measure of organizational performance (Kamble et al., 2020).

1.1.Problem Statement

Among the most important elements of Horizon Tire Manufacturing PLC (Addis Ababa) economic reforms are the intensification of foreign trade and the privatization of public-sector companies to attract foreign investment. Ethiopia has well-established bilateral relationships with all neighboring African countries, South Africa, Algeria, Egypt, India, Nigeria, the European Union, and Japan. This has enhanced its regional and global trade and enabled local industry and foreign investors to compete in bigger markets. However, the manufacturing sector in developing countries in the case of Horizon Addis Tire Manufacturing PLC experience diverse challenges and opportunities, some of which are common to all countries, while other challenges apply only to developing countries and require greater efforts by manufacturers to address.

there are few problems like low production volume, demand oriented productions, productivity is getting less than 50 per cent, variation in product quality, less customer involvement, less supplier involvement and raw materials not arriving just in time as planned. Due to this reasons, the company made a report that states production is 80 per cent from 100 per cent. These problems are leading the company to a lower production rate, lower productivity, lower profit margins,

1.2. General Objective

The general objective of the study is to assess the impact of lean management practices on the organizational performance of Horizon Addis Tire Manufacturing PLC, Addis Ababa.

The following are the specific objectives (SO) that are carried out to achieve the general objective of the study.

SO1: To explore the extent lean management practices relates to organisational performance.

SO2: To analyze the relationship between lean management practices and operational practices.

SO3: To explore the extent operational practices relate to organisational performance.

SO4: To investigate the impact of the operational practices mediate the relationship between lean management practices and organisational performance

SO5: To validate regression analysis result by using fsQCA software.

2. LITERATURE REVIEW

2.1. Toyota Production System

During the Second World War, the economy of Japan collapsed and Japanese manufacturers had to device new methods to reduce costs and remain in the market. They developed some concepts focusing on waste minimization (Levinson & Rerick, 2002) so that unnecessary costs were to be reduced. The philosophy of

the Toyota Production System consists of continuous improvement of products, processes or activities in the manufacturing system according to set standards for minimizing the waste together with the participation of all employees. Therefore this philosophy gives the responsibility to all in the work place for each and every aspect inside the organizational boundary.

In the Toyota Production System house, Just in Time is one pillar which is a famous concept. It emphasizes the delivery of right product, at the right time in the right quantity to the customers using minimum necessary resources. This approach therefore creates a minimum level of inventory leading to a minimum level of inventory handling cost. But in most cases, the organizations are facing problems and creating disruptions in the work floor by keeping additional amounts of inventory.

The other pillar is called Jidoka which means that the machines work automatically with human touch according to the Toyota Production System principles. Improvements of the quality should be done with this approach while minimizing human touch. The Toyota Production System suggests in advance that whenever there is an error, the machine should identify any error itself and stop further processing without noticing by any worker. In continuous run of such machines, the quality of the output will be enhanced with minimized waste.

Apart from minimizing the waste, Japan made efforts to improve the quality of their products by using statistical quality control methods. The foundation of the JIT house therefore is composed with production leveling, continuous improvement and standardized work. By smoothing production, customers can be delighted with better quality products as they require.

Lean is "an integrated sociotechnical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability" (Rotter et al., 2019).

Lean management is a method of managing companies that assumes adaptation to the actual market conditions via organizational and functional alternations. The heart of lean management is the act of "polishing up" the company thanks to changes in its policy, particularly in the company's assets and its management styles. Additionally lean management concentrates on professional training and shaping the staff"s attitudes as well as maintaining positive public relation (Dekier, 2012).

2.2. Lean Management/Manufacturing

Lean management/ manufacturing was conceptualized as a tool to help automotive manufacturers improve operational performance and has been widely used in manufacturing industries. Today, however, lean management/manufacturing is viewed as a socio-technical approach to management aimed at improving operational performance in various aspects of production (Joosten et al., 2009). Many researchers claim that lean investments return multiple times in reduced costs, a more productive workforce, shorter lead times and better quality (Shah & Ward, 2007; Al-Smadi, 2009). Engelund et al. (2009) state that the change from traditional to lean management / manufacturing depends on the comprehensive understanding of lean management / manufacturing, its potential development and the influence of current conditions. In other words, they highlight the importance of understanding lean management/ manufacturing before going on to adopt this approach. Jasti et al. (2020), urge organizations, before even thinking of adopting lean management/manufacturing, to answer the question "Why lean manufacturing?" Leaders should work on the basis for making their organization a good candidate for adopting lean thinking, which is more of an approach than a tool; more a way of thinking than a software package; not a tool that an organization can buy or a simple system for it to follow, but an ideology, a way of thinking and a belief that lean is the right choice.

2.3 Lean Management/ Manufacturing Practices

The most often revealed practices commonly associated with lean production are: bottleneck removal (production smoothing), cellular manufacturing, competitive benchmarking, continuous improvement programs, cross-functional work force, cycle time reductions, focused factory production, just-in-time/continuous flow production, lot size reductions, maintenance optimization, new process equipment/technologies, planning and scheduling strategies, preventive maintenance, process capability measurements, pull system/ Kanban, quality management programs, quick changeover techniques, reengineered production process, safety improvement programs, self-directed work teams, total quality management (Mrugalska & Wyrwicka, 2017). Behrouzi and Wong (2011), suggested that the implementation of lean practices often fails because of the lack of a clear understanding and of an effective approach to lean management/manufacturing and its performance measurement. Current procedures for choosing an appropriate lean strategy depend on the decision makers" intuitive judgement, rather than any kind of rational validation. Although their paper does not address some of the lean management/manufacturing principles that were mentioned as distinct components in previous studies, many are linked to related practices.

According to Sundar et al. (2014), a company must take many basics steps in order to transform a standard manufacturing setup into a lean one. Certain components are indicated by analysts and are embraced by manufacturing companies to enhance competitiveness by reducing costs and lead time and by improving quality and work flow.

Talib et al. (2020) state that the basic purpose of lean management/manufacturing is to manufacture a product with minimum waste and continuous improvement of all activities and processes involved in any form of work.

The key practices used to achieve this purpose are: kaizen, housekeeping 5S (H5S), just-in-time (JIT), visual management, value stream mapping (VSM), and on, gemba, total productive maintenance (TPM), and single

minute exchange of dies (SMED) (Al-Smadi, 2009). Shrafat and Ismail (2019) propose a model for manufacturing cells to evaluate the use of lean management/manufacturing practices (Kasemsap, 2018; Yadav et al. 2020).

2.4.Total Productive Maintenance

Total productive maintenance is an innovative and leading lean technique and product- driven improvement methodology which focuses on improving the integrity of production, safety and quality systems by optimizing equipment reliability, eliminating breakdown and establishing efficient and effective management of plant assets Total productive maintenance (TPM). TPM is an innovative and leading lean technique and product-driven improvement methodology which focuses on improving the integrity of production, safety and quality systems by optimizing equipment reliability, eliminating breakdown and establishing efficient and effective management of plant assets (Ahmad et al., 2020).

2.5. Organizational Performance

Organizational performance is a subjective perception of reality, which explains the multitude of critical reflection on the concept and its measuring instruments. At present, there are a variety of definitions attributed to the concept of organizational performance due to its subjective nature. Thus, the concept of organizational performance has gained increasing attention in recent decades, is pervasive in almost all spheres of human activity. Performance although prescriptions for improving and managing organizational performance are widely available, the issues of terminology, levels of analysis (e.g., individual, work unit, or organization as a whole), and conceptual bases for assessment of performance preoccupied the academic community (Demeke & Tao, 2020). Organizational performance is confounded with notions such as: productivity, efficiency, effectiveness, economy, earning capacity, profitability, competitiveness etc (Elena-Iuliana & Maria, 2016).

2.6. Effect of Lean Management Practices on Operational Performance

Lean manufacturing should be applied at all organizational levels especially in higher ones in order to enhance operational performance (Chavez et al., 2013; Belekoukias et al., 2014; Rasi et al., 2015; Abdallah et al., 2021). Some studies found that lean production has a positive relation with operational performance in industrialized companies (Friedli, 2018; Arabi et al., 2021). Shrafat and Ismail (2019) found that TPM coupled with SPC and with a focus on H5S will have a significant impact on OP. And concluded that lean practices such as TPM make strong positive structural contributions to OP. Belekoukiasa et al. (2014) found that TPM does not have an impact on quality. Phan et al. (2019) study establish that there is a significant influence of HRM, TPM, JIT and TQM on the four variables, namely, quality, cost and safety, delivery and flexibility.

Panwar et al. (2018), this study found that pull production provide weak evidence of impacting both operational performance and quality improvement. Yadav et al. (2019), found that that the implementation of lean practices like pull system are positively associated with the operational performance of SMEs. Agus and Hajinoor (2012), conclude that lean practices such as pull production system have strong positive structural contributions toward product quality performance (PQP). Susanty et al. (2021), finding suggests that a pull system coupled with total productive maintenance can have a significant impact on OP.

Ahmad et al. (2020), stated that SMEs have been found to primarily use 5S resulting in a positive impact on the operational performance. Naslund (2008), stated that the 5S‟s technique has benefits for both the employee and the organization. Organizational benefits include higher quality, reduced costs, improved safety, more reliable deliveries, and improved availability of plant and equipment.

Belekoukiasa et al. (2014), paper fills a research gap by investigating the relationship and impact that some of the most essential and commonly implemented lean methods (i.e., JIT) have on important contemporary measures of operational performance (i.e., cost, speed, dependability, quality and flexibility). Gonçalves et al. (2019), found that in the JIT bundle, Pull system, Jidoka and Heijunka are the practices that have a positive correlation with operational performance. Silva and Warnapura (2021) study indicate that lean manufacturing practices contribute significantly to all the dimensions of operational performance, namely, quality inventory minimization, delivery, productivity, and cost reduction. Hibadullah et al. (2014), stated that focusing on customer need and satisfaction should be the most important practice for implementing quality initiatives. Primo and Amundson (2002), found that supplier involvement helps improve product quality. McIvor et al. (2006) found that purchasing managers believe supplier involvement resulted in better perceived quality of new products, in addition to improvements in time and reduction in costs.

Yadav et al. (2019), the results on this study stated that the SMEs have been found to primarily use lean practices, like statistical process control resulting in a positive impact on the operational performance. Valente et al. (2020) results of this study show that the impact of Lean practices such as statistical process control implementation on companies‟, lead to substantial improvements on operational performance measures.

Yadav et al. (2019) findings state that the SMEs have been found to primarily use employee involvement resulting in a positive impact on the operational performance. According to Leksono et al. (2020) top management commitment directly influences the company's operational performance. Hadikusuma & Siagiana (2022) study revealed that top management's commitment has no direct effect on improving operational performance.

2.7. Effect of Lean Management Practices on Organsational Performance

A number of authors Shrafat and Ismail (2019) have hypothetically proposed and observationally confirmed a positive relationship between lean management/ manufacturing adoption and changes in organzational performance. Shrafat and Ismail (2019) examined the effects of lean management/manufacturing practices on the manufacturing companies that had adopted them. They found that companies which had embraced lean strategies underwent changes in approach and in the level of their performance. The authors suggest that the application of lean management/manufacturing practices had helped to shape relations among the workers themselves and established a framework within which the workforce was expected to perform. They contend that lean management/ manufacturing made these organizations more adaptable and faster, thus improving their performance.

Such findings lend support to the contention of Abdallah et al. (2020) that companies should recognize that lean management/manufacturing is likely to enhance their performance and market value. A summary of relevant literature reveals that applying a lean management/manufacturing system will enhance organsational performance. It is increasingly accepted that lean management/ manufacturing is capable of providing all firms with various benefits which will in turn improve operational performance and ultimately organsational performance.

Shrafat and Ismail (2019), found that TPM coupled with SPC and with a focus on H5S will have a significant impact on organizational performance. Saini and Singh (2020), found that organizational performance has a strong correlation with total productive maintenance (TPM) practices. Belekoukiasa et al. (2014), on their paper stated that surprising results were obtained in relation to the no impact of TPM and negative effect of VSM on the performance of organisations.

Susanty et al. (2021) finding suggests that a pull system coupled with total productive maintenance can have a significant impact on organizational performance. Saini and Singh (2020) descriptive analysis findings of the paper, lean practices such as JIT is significantly contributing for enhancing organizational performance. Belekoukiasa et al. (2014) results of this study indicate that out of the five lean methods studied, JIT contributes to the highest impact on improvement in all five individual measures and the overall organizational performance. Gonçalves et al. (2019) results of this study revealed that In the JIT bundle, Pull system, Jidoka and Heijunka are the practices that have a positive correlation with, Financial and/or Market performance.

Naslund (2008) stated that the 5S‟s technique has benefits for both the employee and the organization. Saini and Singh (2020), lean practices such as 5S is significantly contributing for enhancing organizational performance. Shrafat and Ismail (2019) findings suggests that focus on H5S will have a significant impact on organizational performance.

Berraies and Hamouda (2018) found that deeper customer involvement leads to higher market share and shareholder profitability. Zhang and Huo (2013), collected 617 usable samples and inferred that customer involvement significantly improves financial performance. Moreover, customers provide information related to product demand patterns and enable firms to achieve higher performance (Li et al. 2020).

Butali and Njoroge (2018) result showed a positive impact of employee participation and involvement on organizational performance according to participation of employees in decision making process and involving them in organization plans and goal setting has a positive impact on employees commitment toward organizational performance. Naidu (2016), study found that employee involvement is having a positive, significant impact on organizational performance of Visakhapatnam Steel Plant.

According to Gachanja and Kinyua (2021), top management commitment has significant effect on organizational performance. Kaaria et al. (2018), result revealed that top management commitment significantly influences organizational performance in commercial state corporations in Kenya. Valente, Sousa and Moreira (2020), results of this study show that assessing the impact of Lean practices such as statistical process control implementation lead to substantial improvements on market (e.g. market share and sales growth), and financial performances.

Kosgei and Gitau (2016) study established that understanding and practicing of supply chain management with key focus on supplier relationships is an essential prerequisite for staying competitive in the global race and enhancing profitably in the market. The study also found out that there was a great opportunity for organizations to improve its performances through proper use of SRM strategies and therefore recommended that organizations should show more commitment in SRM by having systems to monitor, appraise and evaluate performance at a strategic level.

2.8. Effects of Operational Performance on Organizational Performance

Preko et al. (2014) study revealed that service delivery is significant to customer satisfaction customer delight. Further findings in the study also revealed that there is a positive correlation between service delivery and satisfaction, and satisfaction and customer delight. Lakhal (2014) findings of this research indicate that the presence of an intermediate measure of competitive advantage between quality and organizational performance. Al-Mamary et al. (2014), concluded that the quality of the system and quality of the information are considered as a key factors affecting information system acceptance and improve the organizational performance.

Singh and Tandon (2019) result of this paper shows that there is a positive association between the investigated organizational norms and employee productivity. The study has clearly explained how beliefs, gestures, norms

and other relative features of organizational culture affect organizational performance. There is a significant impact of positive and negative culture on the employees and organizational performance.

Musau et al. (2017) the regression finding of this study shows that inventory level impacts positively on organizational performance explains the descriptive and thematic findings which showed awareness among procurement employees and heads on the need to manage inventory. Moreover, it justifies the need to have in place various strategies and practices for inventory level and why it is necessary to consider modern inventory Management systems. Oladipo et al. (2020), results of this study show ineffective inventory management can lead to stock out which will definitely lead to loss of customer and goodwill in organizational performance, which will make the profit of the business decrease and result in ultimate collapse of the organization. Effect of inventory management practices has a positive impact on organizational performance, profitability increases with availability of product varieties increases; Effective use of inventory management brings about cost reduction.

Akeem (2017) finding of the research, it was evident that cost control has a positive impact on organizational performance. In order to make it a success, there is a need for organization to apply cost control and cost reduction scheme in their operation and worker should be carried along and they must be motivated to achieve the desired goals and objectives. Dodokh and Al-Maaitah (2019) the findings suggested that there is a positive relationship between social media for marketing, for customer relations and services, and for information accessibility and organizational performance in terms of rapid adaptation, cost reduction, and innovation.

Based on the literature reviewed and discussion with advisor, following hypotheses were developed:

H1: Lean management practices have statistical impact on organizational performance.

H01: Lean management practices have no statistical impact on organizational performance.

H2: Lean management practices have statistical impact on operational performance.

H02: Lean management practices have no statistical impact on operational performance.

H2a: Lean management practices have statistical impact on quality.

H02a: Lean management practices have no statistical impact on quality.

H2b: Lean management practices have statistical impact on inventory level. H02b: Lean management practices have no statistical impact on inventory level. H2c: Lean management practices have statistical impact on productivity.

H02c: Lean management practices have no statistical impact on productivity.

H2d: Lean management practices have statistical impact on cost reduction.

H02d: Lean management practices have no statistical impact on cost reduction.

H2e: Lean management practices have statistical impact on delivery.

H02e: Lean management practices have no statistical impact on delivery.

H3: Operational performance measures have statistical impact on organizational performance.

H03: Operational performance measures have no statistical impact on organizational performance.

H4: Operational performance measures have statistical mediating effect on the impact of lean management practices on organizational performance.

H04: Operational performance measures have no statistical mediating effect on the impact of lean management practices on organizational performance.

2.9. Conceptual Research Framework

Based on the research questions, objectives of the study, literature reviewed, and research gap conceptual research framework is defined (Figure 1).

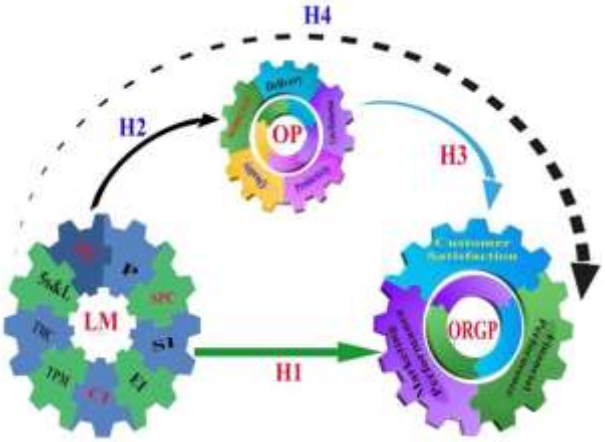

Figure 1. Concept of research

Source: *Based on literature review conducted framework for this study*

2.9. Fuzzy Set Qualitative Comparative Analysis

Fuzzy set qualitative comparative analysis (FsQCA) is a theoretical approach to invest Ting the relationship between potential causal condition variables and outcome variables (Ragin et al. 2008). It refers to researchers‟ evaluation of the outcome that an unobserved configuration would generate were it present in the data set (Soda & Furnari, 2012). To aid in this process, fsQCA uses a Boolean chart-referred to as a “truth table”-to capture and examine all logically possible combination of attributes.

FsQCA is a useful tool to study configurations and interdependence of factors leading to isolating mechanisms and accounts for contingency and complex antecedent conditions (Woodside, 2013). Woodside (2013), FsQCA has recently gained popularity in entrepreneurship research, because it offers a method to investigate causal asymmetry relying on different configurations of multiple interrelated variables. Fiss et al. (2013) suggest that integrating fsQCA findings into a regression framework allow for added insights regarding result robustness, complementarity and substitutability relationships between causal conditions.

The primary objective of fsQCA is to identify a set of configurations and pathways that are sufficient to explain a given outcome (Woodside, 2013). As per Woodside (2013), fsQCA seeks to identify conditions that are sufficient but not necessary to cause an outcome. Rather than estimating the net effects of independent variables on the outcome, fsQCA explores the relationships between a given construct and all binary combinations.

The fsQCA analytical procedure can be conducted with the aid of the fs/QCA 3.0 software package (Meuer & Fiss, 2020). fsQCA enables researchers to uncover "different recipes for success" through a configurational logic (Salonen et al., 2021) fsQCA‟s set-theoretic approach enables researchers to also consider configurations that do not exist in the data through "counterfactual analysis".

This methodological approach provides an opportunity to identify relevant configurations that yield high performance in the outcome condition (Kraus et al., 2018). fsQCA builds on the assumption of causal complexity and provides a systematic template for analyzing how configurations of conditions relevant to the studied topic interact to explain an outcome of interest (Furnari et al., 2021) .

The function of FsQCA is to capture highly complex theoretical interrelations based on conditions including different contexts, making it the most appropriate methodological strategy (Kollmann et al., 2021). Lou (2022) fsQCA has emerged as a useful approach in recent years for solving complex causal relationships. It combines the advantages of case analysis and quantitative analysis; it can fully examine the influence of multiple factors on results when they interact with one another.

3. RESEARCH METHODOLOGY

3.1. Sample Size: Sample size refers to the number of elements to be included in the study.For this study, based on the formula provided by Lamola and Yemane (1967) the minimum sample size (n) was calculated. In this study 263 questionnaire correctly filled questionnaire (162 Amharic and 101 English languages) were collected (285 distributed).

$$n = N \div 1 + N (e)^2$$

Where, n=Sample size required, N=Population size=711, e=Margin of error=5%, Confidence level=95%, n= 711 ÷ [1 + 711 (0.0025)]= 255.985≈256 samples

In this study, for analyzing the mean value of lean management practices, operational performance and organizational performance parts is designed on five-point Likert scale arrangement containing multiple questions / items for each variable which ranges from 1 representing a "strongly disagree" response through 5 indicating "strongly agree".

3.2. Mediation Analysis by Baron and Kenny Method

A mediator is a variable that is in a causal sequence between two variables. Mediation analysis is a method to increase information obtained from a research study when measures of the mediating process are available (MacKinnon et al., 2012). A mediation analysis is conducted by applying Baron and Kenny (1986) method. Four steps involved in the Barron and Kenny (1986) (Zhao et al., 2010) approach (Figure 2) to establishing mediation are as follows:

Step1. Shows that the initial value is correlated with the outcome. Y is used as the criterion variable in a regression equation and X a predictor. This step establishes that there is an effect that may be mediated.

Step 2. Shows that the initial variable is correlated with the mediator. M is used as the criterion variable in a regression equation and X a predictor. This step essentially involves treating the mediator as if it were outcome variable.

Step 3. Shows that the mediator affects the outcome variable in a regression equation and X and M as predictors it is not sufficient just to correlate the mediator with the outcome, the mediator and the outcome may be correlated because they are both caused by the initial variable X. Thus the initial variable must be controlled in establishing the effect of the mediator on the outcome.

Step 4. To establish that M completely mediates the X-Y relationship, the effects of X on Y controlling for M should be Zero. This means that after the mediator is entered in the regression model, the relationship between the independent and dependent variables should either disappear (full mediation) or significantly diminish (partial mediation) Barron and Kenny (1986).

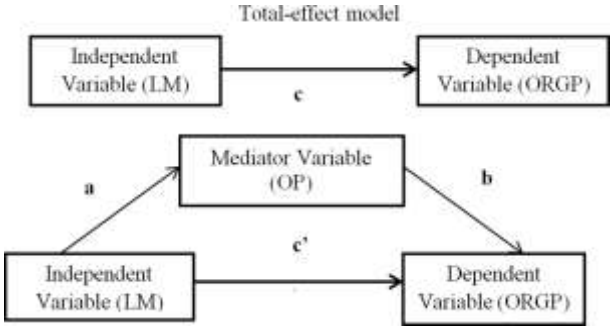

Figure 2. Barron and Kenny steps

Total effect model and mediation model. A mediator model decomposes the total effect, c, into the indirect effect, ab (product of the indirect paths a and b) and the direct effect, c‟ (with the effect of the mediator removed). The total effect can be describes as c=c‟+ab, and hence the indirect effect as ab=c-c‟.

In this study Baron and Kenny mediation method (four steps) was used to answer whether or not operational performance measure as mediator of the relationship between lean management practice and organizational performance.

3.3. Analysis Software Packages

In this study commonly used SPSS software (version 21) was used for frequency, percent, mean, standard deviation, correlation analysis, regression analysis to identify the relationship and effect of lean management practices (independent factors) on organization performance (i.e., dependent factor). Validation of regression results were computed by using fsQCA software 3.0.

3.4. Fuzzy-Set Qualitative Comparative Analysis

In this study Figure 3 explained the basic steps in fsQCA followed to conduct for validation of regression results obtained.

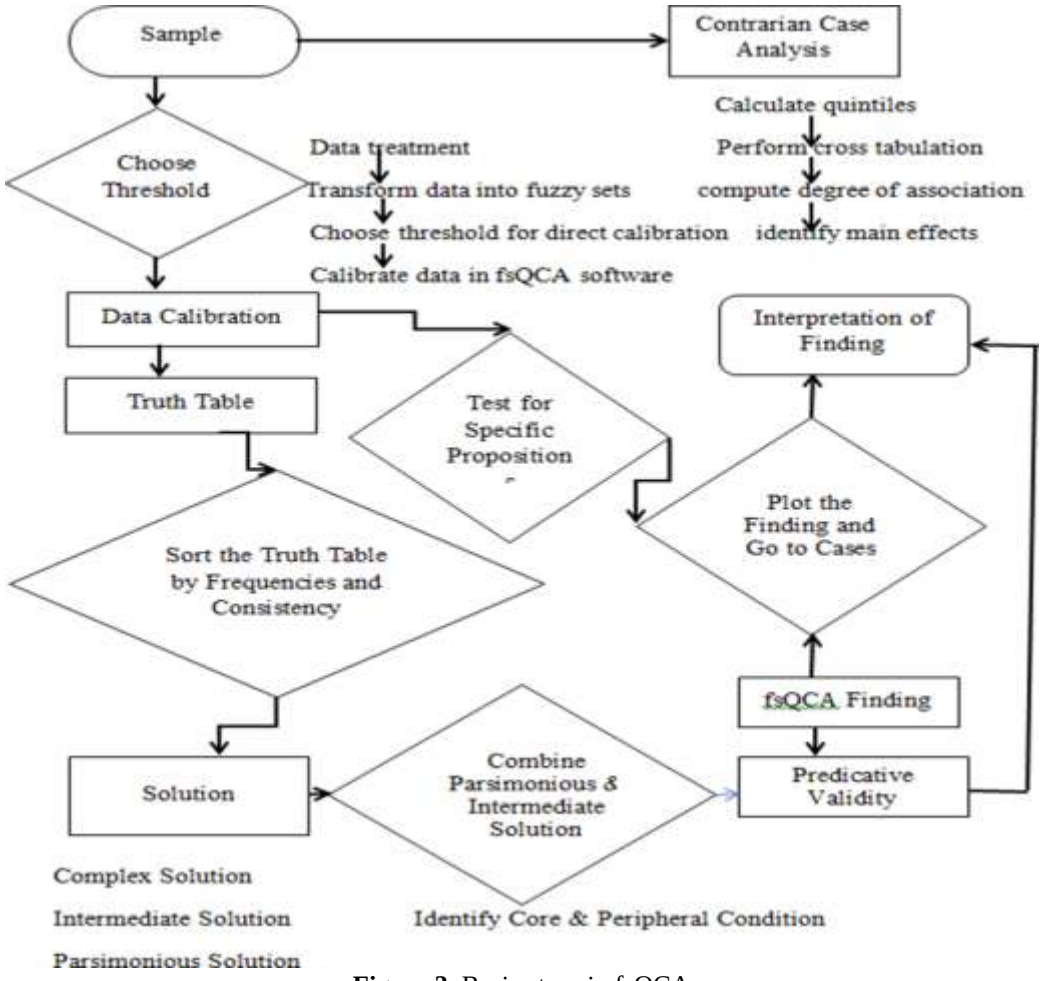

Figure 3. Basic steps in fsQCA
Source: *Pappas and Woodside (2021)*

4. DATA COLLECTION AND ANALYSIS

4.1. Factor Analysis of Lean Management Practices

A total of 44 items (initially 50 items) were loaded under LM practices. In relation to the LM practices, 9 factors were formed, explaining 68.890% of the variance which is above the threshold value of 60% (Hair et al., 2021) with acceptable scale reliability coefficient (Cronbach"s alpha ≥.6) i.e., from .664 to .905 and with an eigenvalue of 1.055 to 15.404 were greater than 1 and the values in the main diagonal of the anti-image matrix (.819 to .948) were greater than .6 (Hair et al., 2012). The KMO criterion was .917 which is greater than .5 and the significance of Bartlett"s test of sphericity was Chi-square=7660.529, degree of freedom (df)=946, p=.000<.05, which suggested the general appropriateness of the correlation matrix or factor analysis application. The communalities analysis range between .598 to .789 and factor loading range from .518 to .813 (Table 1). Here, it is relevant to indicate that communality ≥.5 and factor loadings values more than .50 are sufficient for justification of constructs (Hair et al., 2013; Hair et al., 2021).

During factor analysis six items i.e., 5S&L1, 5S&L3, P6, EI5, TPM1, and TPM5 were dropped out from LM practices. All of the LM variables presented satisfactory values (Table 1).

Table 1. Factor analysis for LM practices (independent variables)

Factor (Code)	Loadings	Eigen values	% Variance	Cumu-lative	Comm-unalities	CITC
	>.5	**>1**		**>60%**	**>.5**	**>5**
5S and Layout (Alpha=.891)						
5S&L2, 4-9-5S&L9	.523-.743	15.404	35.008	35.008	.598-.726	.584-.733
Top Management Commitment (Alpha=.887)						
TMC1-TMC5	.733-.813	3.828	8.701	43.709	.649-.742	.694-.760
Statistical Process control (Alpha=.881)						
SPC1-SPC6	.584-.718	2.360	5.364	49.073	.635-.727	.656-.736
Just In Time (Alpha=.873)						
JIT1- JIT6	.638-.805	2.092	4.775	53.828	.620-.738	.617-.717
Customer Involvement (Alpha=.905)						
CI1- CI5	.641-.759	1.698	3.858	57.686	.733-.797	.733-.812
Pull (Alpha=.809)						
P1- P5	.598-.735	1.514	3.440	61.127	.595-.659	.540-.662
Supplier Involvement (Alpha=.843)						
SI1- SI5	.632-.794	1.236	2.809	63.936	.693-.707	.614-.700
Employee Involvement (Alpha=.836)						
EI2- EI4	.518-.653	1.125	2.556	66.492	.664-.726	.686-.705
Total Productive Maintenance (Alpha=.664)						
TPM2- TPM3	.634-.711	1.055	2.398	68.890	.680-.725	.505-.505

Source: Computation using SPSS-21 based on data from author's field work, 2024

4.2 Factor Analysis of Operational Performance Measure

A total of 23 items (initially 25 items) were loaded under OP measures. In relation to the OP measures, 5 factors were formed, explaining 70.391% of the variance which is above the threshold value of 60% (Hair et al., 2021) with acceptable scale reliability coefficient (Cronbach‟s alpha ≥.6) i.e., from .842 to .904 and with an eigenvalue of 1.251 to 9.566 and the values in the main diagonal of the anti-image matrix (.853 to .957) were greater than .6 (Hair et al., 2012). The KMO criterion was .911 which is greater than .5 and the significance of Bartlett‟s test of sphericity was Chi-square=3844.665, degree of freedom (df)=253, p=.000<.05, which suggested the general appropriateness of the correlation matrix or factor analysis application. The communalities analysis ranges from .613 to .802 and factor loading range from .573 to .867 (Table 2). Here, it is relevant to indicate that communality ≥.5 and factor loadings values more than .50 are sufficient for justification of constructs (Hair et al., 2013; Hair et al., 2021). During factor analysis two items i.e., Q1 and Q2 were dropped out from OP measures. All of the OP measures presented satisfactory values (Table 2).

Table 2 Factor analysis for OP measures (mediating variables)

Factor (Code)	Loadings	Eigen values	% Variance	Cumu-lative	Comm-unalities	CITC
	>.5	**>1**		**>60**	**>.5**	**>.5**
Cost Reduction (Alpha=.842)						
CR1- CR4	.744-.772	9.566	41.591	41.591	.657-.723	.638-.712
Inventory Level (Alpha=.861)						
IL1- IL4	.601-.867	2.497	10.858	52.449	.534-.798	.578-.773
Productivity (Alpha=.861)						
PRO1-PRO4	.644-.811	1.544	6.713	59.163	.642-.745	.667-.730
Quality (Alpha=.904)						
Q3- Q9	.573-.794	1.332	5.791	64.954	.587-.750	.613-.777
Delivery (Alpha=.872)						
D1- D4	.634-.815	1.251	5.438	70.391	.654-.802	.664-.795

Computation using SPSS-21 based on data from author's field work, 2024

4.3. Factor Analysis of Organizational Performance Measure

A total of 10 items (initially 10 items) were loaded under ORGP measures. In relation to the ORGP measures, 2 factors were formed, explaining 76.997% of the variance which is above the threshold value of 60% (Hair et al., 2021; Singh & Awoke, 2023) with acceptable scale Cronbach"s alpha reliability coefficient ≥.6 i.e., from .913 to .934 and with an eigenvalue of 1.713 to 5.987 and the values in the main diagonal of the anti- image matrix are between .859 to .931 were greater than .6 (Hair et al., 2012). The KMO criterion was .902 which is greater than .5 and the significance of Bartlett's test of sphericity was Chi-square=2171.443, degree of freedom (df) = 45, p=.000<.05, which suggested the general appropriateness of the correlation matrix or factor analysis application.

The communalities analysis ranges from .657 to .842 and factor loading range from .770 to .884 (Table 3). Here, it is relevant to indicate that communality ≥.5 and factor loadings values more than .50 are sufficient for justification of constructs (Hair et al., 2013; Hair et al., 2021). During factor analysis, no items were dropped out from ORGP measures. All of the ORGP variables presented satisfactory values (Table 3).

Table 3. Factor analysis for ORGP measure (dependent variables).

Factor (Code)	Loadings	Eigen values	% Variance	Cumu-lative	Comm-unalities	CITC
	>.5	>1		>60	>.5	>.5
Customer Satisfaction (Alpha=.913)						
CS1-CS5	.770-.877	5.987	59.867	59.867	.657-.821	.715-.839
Financial & Marketing Performance (Alpha=.934)						
FMP1-FMP5	.822-.884	1.713	17.130	76.997	.736-.842	.779-.864

Computation using SPSS-21 based on data from author's field work, 2024

4.6 Pearson's Correlation Analysis of LM Practices, OP Measure, and ORGP Measure

Out of 136 correlations, all correlation coefficients are larger than .20. The highest coefficient of correlation in this study however, is .879 which is below the cut-off of .90 for the collinearity problem. Further, the correlation coefficient between the independent variables and dependent variable were less than .90, indicating that the data was not affected by a collinearity problem (Hair et al., 2012).

Table 4. Correlation between LM practices, OP measures and ORGP measures, N=263

Source: Computation using SPSS-21 based on data from author's field work, 2024

Variables	TMC	TPM	SI	EI	CI	SPC	P	5S&L	JIT	LMPI	CR	IL	PRO	Q	D	OPI	CS	FMP	ORGPI
TMC	1																		
TPM	.555**	1																	
SI	.439**	.564**	1																
EI	.443**	.622**	.622**	1															
CI	.510**	.557**	.535**	.690**	1														
SPC	.439**	.572**	.467**	.642**	.654**	1													
P	.206**	.367**	.350**	.490**	.400**	.580**	1												
5S&L	.334**	.530**	.387**	.566**	.525**	.678**	.591**	1											
JIT	.278**	.357**	.379**	.398**	.369**	.474**	.456**	.543**	1										
LMPI	.640**	.769**	.721**	.828**	.798**	.826**	.661**	.766**	.634**	1									
CR	.160**	.265**	.276**	.304**	.385**	.408**	.445**	.401**	.510**	.472**	1								
IL	.048	.158*	.301**	.291**	.250**	.271**	.395**	.338**	.443**	.373**	.478**	1							
PRO	.258**	.421**	.386**	.443**	.419**	.484**	.453**	.600**	.601**	.607**	.442**	.452**	1						
Q	.277**	.405**	.360**	.441**	.460**	.548**	.496**	.626**	.580**	.626**	.469**	.405**	.681**	1					
D	.201**	.339**	.285**	.326**	.357**	.488**	.410**	.554**	.485**	.512**	.445**	.365**	.525**	.640**	1				
OPI	.243**	.410**	.418**	.468**	.485**	.568**	.571**	.651**	.681**	.671**	.746**	.709**	.807**	.820**	.765**	1			
CS	.279**	.387**	.358**	.389**	.401**	.469**	.441**	.603**	.612**	.588**	.486**	.355**	.564**	.677**	.631**	.701**	1		
FMP	.177**	.317**	.308**	.403**	.420**	.427**	.381**	.462**	.466**	.504**	.442**	.358**	.526**	.608**	.519**	.635**	.556**	1	
ORGPI	.259**	.400**	.378**	.449**	.465**	.508**	.467**	.605**	.612**	.619**	.527**	.404**	.618**	.729**	.653**	.757**	.885**	.879**	1
Mean	3.971	3.879	3.630	3.865	3.803	3.837	3.730	4.015	3.725	3.828	3.673	3.617	3.863	3.875	3.871	3.780	3.872	3.992	3.932
SD	.797	.701	.805	.793	.841	.736	.735	.693	.736	.561	.821	.795	.804	.713	.745	.596	.790	.770	.688

Hence, collinearity and multi-collinearity do not represent data problems in this study.

The results further indicated that the most important LM practice affecting ORGP was JIT with correlation coefficient .612 (i.e., with the highest score of correlation), which goes to prove that where JIT was perceived as a dominant LM practice, improvements in ORGP levels are significant. Similarly, SPC and 5S&L were also found affecting ORGP as their scores were also high.

All regression models are significant (p<.01) and LM practices are significantly and positively related to OP measures and ORGP measures. It is standard practice to use the coefficient p-values to decide whether to include variables in the final model. According to Cohen (1988), R2<.02: very weak;.02<=R2<.13: weak; .13<=R2<.26: moderate; and R2>=.26: substantial. R2 values of all regression models are between .289 to .613 that can be interpreted as substantial effect, respectively.

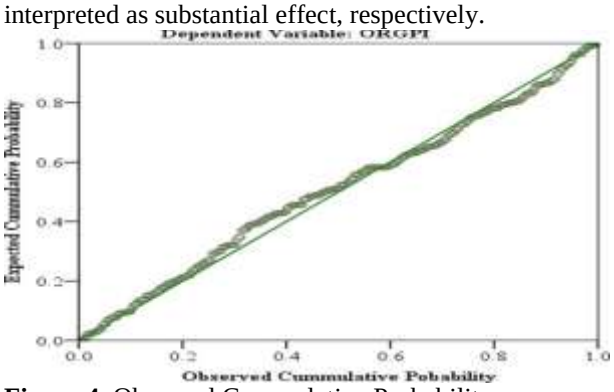

Figure 4. Observed Cummulative Probability
Source: *Computation using SPSS-21 based on data from author's field work, 2024*

The Durbin-Watson statistic assesses the covariance of the residues, that is, their autocorrelation. From Tables 4-13, the Durbin-Watson index lies within the range of 1.50-2.50, i.e., 1.912 to 2.158, suggesting that there was no autocorrelation problem in the data (Durbin, 1951).

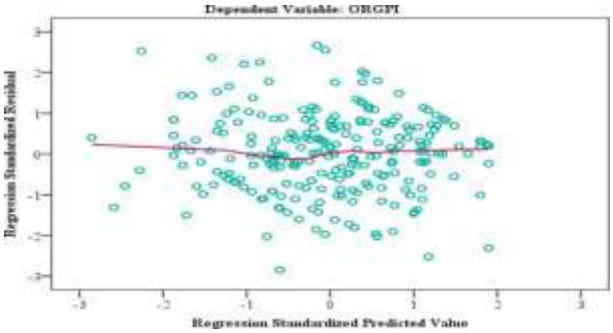

Figure 5. Normal P-P plot of regression standardized residual
Source: *Computation using SPSS-21 based on data from author's field work, 2024*

In order to test the first hypothesis, multiple regression analysis was used (Figure 4 and 5). Table 5 shows that three LM practices (5S&L, JIT, and CI) had a positive significant effect on ORGP at p<.05. Table 5 also indicates that the items of the listed practices together explained about 44.1 per cent of the variance in ORGP on the basis of the adjusted R2 value. The F-statistics is equal to F (9, 253)=23.985 and significant at p<.05. Therefore, the null hypothesis H01 was rejected and the alternative, H1, accepted.

Table 5. Multiple regression for the impact of LM practices on ORGP

Model	**R**	**R^2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.679	.460	.441	23.985	.512	.000	2.076
	Unstd. Coeff.		**Std. Coeff.**	**DV: ORGP**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.986	.230		4.280	.000		
5S&L	.207	.066	.215	3.132	.002	.453	2.205
TMC	-.084	.049	-.098	-1.720	.087	.656	1.525
SPC	.031	.070	.033	.438	.662	.378	2.642
JIT	.334	.054	.359	6.239	.000	.644	1.552
CI	.119	.058	.146	2.037	.043	.418	2.395
P	.059	.053	.065	1.107	.269	.618	1.619
SI	.042	.051	.049	.818	.414	.585	1.709
EI	-.022	.055	-.028	-.399	.690	.441	2.265
TPM	.086	.048	.103	1.775	.077	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

In order to test the second hypothesis, multiple regressions were used. Table 6 shows that the items of LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 59.9 per cent of the variance in OP measure on the basis of the adjusted R2 value. The F-value is equal to F(9, 253)=44.502 and significant at p<.05. This indicates that LM practices had a significant positive impact on OP measure. Based on

the t-values, all LM practices except TMC and EI had a positive significant impact on OP measure, at p<.05. Therefore, H02 is rejected and accepted the alternative hypothesis-H2.

In order to understand how each LM practices would influence each OP measure, the sub- hypotheses were also tested (Table 7 to Table 11). Table 7 shows that the items of LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 42.6 per cent of the variance in quality on the basis of the adjusted R2 value. The F-value is equal to F(9, 252)=22.485 and significant at p<.05. This confirms that LM practices had a significant impact on Q. On the basis of t-values, only 5S&L and JIT had a positive significant impact on Q at p<.05. Therefore, H02a is rejected and accepted the alternative hypothesis-H2a.

Table 6. Multiple regression for the impact of LM practices on OP measure

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.783	.613	.599	44.502	.376	.000	1.966
	Unstd. Coeff.		**Std. Coeff.**	**DV: ORGP**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.879	.169		5.189	.000		
5S&L	.211	.049	.253	4.347	.000	.453	2.205
TMC	-.076	.036	-.101	-2.097	.037	.656	1.525
SPC	.059	.051	.072	1.140	.255	.378	2.642
JIT	.323	.039	.399	8.192	.000	.644	1.552
CI	.100	.043	.141	2.326	.021	.418	2.395
P	.114	.039	.146	2.931	.004	.618	1.619
SI	.052	.038	.070	1.371	.171	.585	1.709
EI	-.038	.040	-.056	-.945	.346	.441	2.265
TPM	.024	.036	.034	.685	.494	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

Table 7. Multiple regression for the impact of LM practices on Q

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.667	.445	.426	22.485	.550	.000	2.158
	Unstd. Coeff.		**Std. Coeff.**	**DV: Q**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.767	.248		3.097	.002		
5&L	.296	.071	.291	4.176	.000	.453	2.205
TMC	-.017	.053	-.019	-.327	.744	.656	1.525
SPC	.103	.075	.104	1.368	.173	.378	2.642
JIT	.252	.058	.256	4.379	.000	.645	1.551
CI	.103	.063	.119	1.641	.102	.416	2.403
P	.079	.057	.083	1.390	.166	.618	1.619
SI	.002	.055	.002	.033	.974	.585	1.710
EI	-.029	.059	-.035	-.487	.626	.438	2.282
TPM	.026	.052	.030	.502	.616	.628	1.592

Source: *Computation using SPSS-21 based on data from authors field*

LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 26.4 per cent of the variance in inventory level on the basis of the adjusted R2 value. The F-value is equal to F(9, 253)=11.417 and significant at p<.05. This confirms that LM practices had a significant impact on IL. Moreover, and on the basis of

t-values, only JIT, P and SI had a positive significant impact on inventory level at p<.05. Therefore, H02b is rejected and accepted the alternative hypothesis-H2b.
LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 45.8 per cent of the variance in P on the basis of the adjusted R2 value. The F-value is equal to F(9, 253)=25.587 and significant at p<.05. This confirms that LM practices had a significant impact on PRO. On the basis of t-values, only 5S&L and JIT had a positive significant impact on P at p<.05. Therefore, H02c is rejected and accepted the alternative hypothesis-H2c.

Table 8. Multiple regression for the impact of LM practices on IL

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.537	.289	.264	11.417	.68278	.000	1.912
	Unstd. Coeff.		**Std. Coeff.**	**DV: IL**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	1.492	.307		4.859	.000		
5S&L	.134	.088	.120	1.525	.128	.453	2.205
TMC	-.151	.065	-.151	-2.309	.022	.656	1.525
SPC	-.086	.093	-.080	-.928	.354	.378	2.642
JIT	.330	.071	.306	4.628	.000	.644	1.552
CI	.071	.078	.075	.920	.359	.418	2.395
P	.184	.071	.176	2.610	.010	.618	1.619
SI	.167	.068	.169	2.432	.016	.585	1.709
EI	.046	.073	.051	.638	.524	.441	2.265
TPM	-.117	.064	-.121	-1.807	.072	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

Table 9. Multiple regression for the impact of LM practices on PRO

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.690	.476	.458	25.587	.592	.000	1.871
	Unstd. Coeff.		**Std. Coeff.**	**DV: PRO**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.301	.266		1.129	.260		
5S&L	.302	.076	.267	3.957	.000	.453	2.205
TMC	-.036	.057	-.036	-.637	.525	.656	1.525
SPC	.008	.081	.007	.097	.922	.378	2.642
JIT	.399	.062	.365	6.442	.000	.644	1.552
CI	.046	.067	.048	.682	.496	.418	2.395
P	.045	.061	.042	.731	.466	.618	1.619
SI	.061	.059	.061	1.029	.304	.585	1.709
EI	.053	.063	.058	.842	.400	.441	2.265
TPM	.056	.056	.057	.994	.321	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 34 per cent of the variance in cost reduction on the basis of the adjusted R^2 value. The *F*-value is equal to *F*(9, 253)=15.997 and significant at *p*<.05. This confirms that LM practices had a significant impact on CR. On the basis of *t*-values, only JIT, CI, P, and EI had a positive significant impact on CR at *p*<.05. Therefore, H02d is rejected and accepted the alternative hypothesis-H2d.
LM practices (TMC, TPM, P, 5S&L, SI, EI, JIT, CI, and SPC) together explained about 17.682 per cent of the variance in D on the basis of the adjusted R^2 value. The *F*-value is equal to *F*(9, 253)=17.682 and significant at *p*<.05. This confirms that LM practices had a significant

impact on D. On the basis of *t*-values, only 5S&L, JIT, and SPC had a positive significant impact on D at $p<.05$. Therefore, H02e is rejected and accepted the alternative hypothesis-H2e.

Table 10. Multiple regression for the impact of LM practices on CR

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.602	.363	.340	15.997	.667	.000	2.009
	Unstd. Coeff.		**Std. Coeff.**	**DV:CR**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.822	.300		2.738	.007		
5S&L	-.006	.086	-.005	-.069	.945	.453	2.205
TMC	-.110	.064	-.107	-1.719	.087	.656	1.525
SPC	.076	.091	.068	.834	.405	.378	2.642
JIT	.396	.070	.355	5.673	.000	.644	1.552
CI	.241	.076	.246	3.169	.002	.418	2.395
P	.246	.069	.228	3.566	.000	.618	1.619
SI	.010	.067	.010	.153	.879	.585	1.709
EI	-.144	.071	-.153	-2.029	.044	.441	2.265
TPM	.064	.063	.064	1.007	.315	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

Table 11. Multiple regression for the impact of LM practices on D

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.621	.386	.364	17.682	.59464	.000	1.919
	Unstd. Coeff.		**Std. Coeff.**	**DV: D**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	1.012	.267		3.783	.000		
5S&L	.328	.077	.314	4.286	.000	.453	2.205
TMC	-.064	.057	-.068	-1.126	.261	.656	1.525
SPC	.194	.081	.191	2.386	.018	.378	2.642
JIT	.236	.062	.233	3.797	.000	.644	1.552
CI	.039	.068	.044	.575	.566	.418	2.395
P	.017	.061	.018	.283	.777	.618	1.619
SI	.020	.060	.021	.329	.743	.585	1.709
EI	-.118	.063	-.138	-1.868	.063	.441	2.265
TPM	.092	.056	.102	1.641	.102	.629	1.591

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

OP measure (Q, IL, PRO, CR, and D) together explained about 58.5 per cent of the variance in ORGP measure on the basis of the adjusted R^2 value. The *F*-value, which was used to measure the model fitness, is equal to $F(5, 256)=74.733$ and is significant at $p<.05$. This confirms that OP measure had a significant impact on ORGP measure. On the basis of *t*-values, all OP measure except IL had a positive significant impact on ORGP measure at $p<.05$. Therefore, H03 is rejected and accepted the alternative hypothesis-H3.

To investigate the mediating effect of operational performance, Baron and Kenny"s (1986) mediation regression analysis technique was conducted. Mediation is an assumed causal series in which one variable (independent) affects a second variable (mediator), which affects a third variable (dependent). The purpose of the mediator variable is to explain and govern the nature of the relationship of independent and dependent variables.

Table 12. Multiple regression for the impact of OP measure on ORGP

Model	**R**	**R2**	**Adj. R^2**	**F-value**	**SEE**	**Sig.**	**DW**
	.770	.593	.585	74.733	.442	.000	1.925
	Unstd. Coeff.		**Std. Coeff.**	**DV: ORGP**		**Coll. Stat.**	
IVs	**B**	**SE**	**Beta**	**t-value**	**Sig.**	**Tol.**	**VIF**
(Constant)	.609	.177		3.436	.001		
Q	.269	.055	.285	4.858	.000	.462	2.166
IL	.024	.041	.028	.586	.558	.693	1.442
PRO	.181	.047	.212	3.850	.000	.525	1.905
CR	.158	.041	.190	3.857	.000	.657	1.522
D	.227	.050	.247	4.583	.000	.547	1.829

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

The following Baron and Kenny"s steps were applied for mediation analysis:

Step 1: A simple regression analysis was made between each predictor and mediator (each LM practices on OPI measure). The relationship between the predictor (LM practices) and the mediator (OPI) must be significant.

Step 2: A simple regression analysis was made between each predictor and criterion variable (each LM practice on ORGPI). The relationship between the predictor (LM practices) and the criterion (ORGPI) must be significant.

Step 3: A simple regression analysis was made between mediator and criterion variables (each OPI on ORGPI). The relationship between the mediator (OPI) and the criterion (ORGPI) must be significant.

Step 4: The predictor effect on the criterion must be reduced in Step 3 rather than Step 2. If the effect on the criterion variable is reduced and turns non-significant in Step 3 compared with Step 2, then full mediation occurs. However, if this effect is reduced in Step 3 compared with Step 2, but is still significant, then partial mediation occurs.

The mediating regression results in Table 13 show that all LM practices impacted ORGP measure. OP fully mediated the impact of TMC, P, SI, and SPC on ORGP measure, except for TPM, EI, CI, JIT, and 5S&L which had a partial mediating effect. When ORGP measure was regressed at the same time on each LM practice and OPI measure (see each Step 3 in Table 13) the relationship between these LM practices and ORGPI was reduced from standardized β=.224 to β=.046 for TMC; from β=.368 to β=.070 for SI, from β=.423 to β=.028 for P, and from β=.486 to β=.090 for SPC. Because these coefficients transformed from being statistically significant to being insignificant, full mediation occurred.

Table 13. Results

Step	DVs	IV(s)	Adj. R^2	β	t-value	Sig.	Results
1	OP	TMC	.055	.242	4.021	.000	
2	ORGP	TMC	.047	.224	3.721	.000	
3	ORGP	TMC	.561	.046	1.092	.276	Full
		OPI		.739	17.509	.000	Mediation
1	OP	TPM	.122	.354	6.120	.000	
2	ORGP	TPM	.130	.365	6.341	.000	
3	ORGP	TPM	.570	.114	2.633	.009	Partial
		OPI		.709	16.381	.000	Mediation
1	OP	SI	.168	.414	7.352	.000	
2	ORGP	SI	.132	.368	6.401	.000	
3	ORGP	SI	.563	.070	1.555	.121	Full
		OPI		.721	16.065	.000	Mediation
1	OP	CI	.231	.484	8.938	.000	
2	ORGP	CI	.192	.442	7.957	.000	
3	ORGP	CI	.567	.103	2.216	.028	Partial
		OPI		.700	15.066	.000	Mediation
1	OP	EI	.189	.438	7.866	.000	
2	ORGP	EI	.158	.401	7.076	.000	
3	ORGP	EI	.565	.090	1.992	.047	Partial
		OPI		.710	15.682	.000	Mediation
1	OP	P	.287	.538	10.317	.000	
2	ORGP	P	.176	.423	7.550	.000	
3	ORGP	P	.559	.028	.574	.566	Full
		OPI		.735	15.102	.000	Mediation
1	OP	SPC	.317	.566	11.083	.000	
2	ORGP	SPC	.233	.486	8.975	.000	
3	ORGP	SPC	.564	.090	1.828	.069	Full
		OPI		.699	14.130	.000	Mediation
1	OP	JIT	.452	.674	14.726	.000	
2	ORGP	JIT	.339	.584	11.631	.000	
3	ORGP	JIT	.570	.145	2.645	.009	Partial
		OPI		.652	11.903	.000	Mediation
1	OP	5S&L	.420	.649	13.796	.000	
2	ORGP	5S&L	.309	.559	10.882	.000	
3	ORGP	5S&L	.568	.124	2.322	.021	Partial
		OPI		.669	12.531	.000	Mediation

Source: *Computation using SPSS-21 based on data from authors field work, 2024*

In addition, the β coefficient for TPM decreased from β=.365 to β=.114, for EI decreased from β=.401 to β=.090, for JIT decreased from β=.584 to β=.145, for 5S&L decreased from β=.559 to β=.124, and for CI decreased from β=.442 to β=.103. However, they were still significant, which means there is a partial mediating effect regarding TPM, EI, JIT, CI, and 5S&L.

It is concluded that OP measures fully mediate the impact of LM practices on ORGP, apart from TPM, CI, EI, JIT, and 5S&L, which has a partial mediating effect. Therefore, H04 is rejected and accepted the alternative hypothesis-H4.

Mediating effect of OP measures on the impact of LM practices on ORGP measure.

The study present sufficient recipes for high and low levels of ORGP that met the thresholds of >.8 and >.2 for consistency and coverage, respectively. The results show that for high levels of ORGP, 9 recipes are sufficient. The results of the recipes of LM practices accounting for low and high scores of ORGP are presented in Table 14, where 9 sufficient causal recipes for high scores of ORGP and 5 sufficient casual recipes for low scores of ORGP, hereinafter describe the configurations of LM practices that lead to higher ORGP (consistency: .9722; coverage: 7837). Analysis of necessary conditions.

Table 14. Factors

Factors	**ORGPI**		**~ORGPI**	
	Consistency	**Coverage**	**Consistency**	**Coverage**
Factors Accounting for High ORGP				
5S&L	.9355	.9096	.9367	.2934
TMC	.8949	.8828	.9583	.3045
SPC	.9011	.9233	.9225	.3045
JIT	.8787	.9415	.9244	.3190
CI	.8812	.9193	.9122	.3065
P	.8509	.9263	.9208	.3229
SI	.8431	.9318	.9199	.3275
EI	.8872	.9096	.9112	.3009
TPM	.8746	.9070	.9402	.3140
Factors Accounting for Low ORGP				
~5S&L	.2733	.9306	.7114	.7803
~TMC	.2949	.9564	.6313	.6594
~SPC	.3212	.9279	.7676	.7143
~JIT	.3644	.9374	.8305	.6882
~CI	.3353	.9222	.7599	.6733
~P	.3779	.9368	.7899	.6307
~SI	.3915	.9382	.8085	.6241
~EI	.3181	.9175	.7262	.6747
~TPM	.3385	.9461	.7215	.6497

Source: *Computation using fsQCA 3.0 based on data from authors field work, 2024*

5. RESULT AND CONCLUSION

The study proposes that LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, P, SI, EI, TPM) will have both symmetric and asymmetric paths to ORGP. Accordingly, research questions were posed and answered by formulating and testing first, a symmetric model that assesses the effect of LM practices on ORGP and second, an asymmetric model to determine configurations of LM practices are sufficient for high levels of ORGP. Accordingly, while multiple regression was employed to ascertain the potential of the causal paths between LM and ORGP, fsQCA was used to provide an understanding of the complex, nonlinear and synergistic effects of LM practices on ORGP by determining the complex configurations of LM that are sufficient for ORGP. The findings highlight the statistically significant effect of both symmetric and asymmetric relationships between LM practices and ORGP.

Results and Discussion for Multiple Regression Analysis

LM practices, such as 5S&L, JIT and CI, had a positive impact on organizational performance. Although 5S&L, CI, and JIT had a positive significant impact on organizational performance, TMC, TPM, SI, EI, P, and SPC did not. This was because the effect of TMC, TPM, SI, EI, P, and SPC on organizational performance often does not appear in the short term, indicating that not all LM practices can create a significant positive impact on organizational performance. The results also showed that LM practices such as 5S&L, JIT, P, CI, SI, TPM, and SPC had a positive significant impact on OP measures except TMC and EI. This indicated that for successful LM practice applications, the appropriate OP measures should take place, and others who suggested that LM practices have a positive significant impact on OP measures. Moreover, the only LM practices that had a significant impact on Q are 5S&L and JIT.

Furthermore, the LM practices of JIT, P and SI had a positive significant impact on IL. The rest of the LM practices do not have a significant impact on IL. Moreover, JIT had the most impact on IL, from the three factors that have significant impact on IL. In addition, the LM practices of 5S&L and JIT had a positive significant impact on PRO.

Lean manufacturing practices contribute significantly to all the dimensions of operational performance, namely, quality inventory minimization, delivery, productivity, and cost reduction. Among LM practices, JIT had the most impact on PRO.

Moreover, the LM practices of JIT, CI, P and EI had a positive significant impact on CR. The rest of the LM practices do not have a significant impact on CR. In addition to this, JIT had the most impact on CR. In addition, the LM practices of 5S&L, JIT and SPC had a positive significant impact on D. who showed that lean manufacturing practices contribute significantly to all the dimensions of operational performance, namely, quality inventory minimization, delivery, productivity, and cost reduction. Among LM practices, 5S&L had the most impact on D.

The results also showed that OP measures had a positive significant impact on ORGP. Who suggested that OP measures influence ORGP positively. This same result also revealed that OP measures fully mediated the impact of LM practices of P, SI, TMC and SPC on ORGP, while 5S&L, JIT, CI, EI and TPM had a partial mediating effect.

Another interesting result was the weak relationship between LM practices and ORGP. This is probably due to several factors. First, it may be because of the mediating effects of OP measures. Second, ORGP is a macro-measure that reflects overall organizational performance, which is normally affected by internal and external factors, such as signing a new contract with partners, entering new markets, recruiting a new manager with unique expertise, or using a new type of technology that competitors do not have. Third, it takes time for LM practices to influence ORGP.

Results and Discussions for fsQCA Analysis

Regarding the fsQCA findings, multiple configurations of LM practices accounting for both high and not high levels of ORGP and underscored the significance of 5S&L, SPC, JIT, P, SI, EI, TPM for high levels of ORGP were identified. The first configurations for high levels of ORGP confirm that besides TMC and CI, the remaining LM practices (i.e., 5S&L, SPC, JIT, P, SI, EI, TPM) that were examined are important for a firm‟s ORGP, even though their presence does not guarantee high levels of ORGP. Hence besides the first configuration, which required the presence of seven out of the nine LM practices to produce high levels of ORGP, the second configuration require eight LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, P, SI, EI), the third configuration require eight LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, P, SI, TPM), the fourth configuration require eight LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, P, EI, TPM), the fifth configuration requires eight LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, SI, EI, TPM), the sixth configuration requires eight LM practices (i.e., 5S&L, TMC, SPC, CI, P, SI, EI, TPM), the seventh, eighth and ninety configuration requires nine LM practices (i.e., 5S&L, TMC, SPC, JIT, CI, P, SI, EI, TPM) to guarantee high ORGP. This suggests that LM requires the presence of seven practices at low or high levels (Model 1), the presence of eight practices at low or high levels (Model 2, 3, 4, 5, and 6) and the presence of all LM practices at low or high levels (Models 7, 8, ad 9) to be able to lead to high levels of ORGP. This highlights the importance of all the practices, such that the absence of any one of the practices must be compensated for with the presence of the remaining practices.

The findings also revealed configurations that account for low levels of ORGP, demonstrating that the recipes for low levels of ORGP are not the mirror opposites for configurations that lead to high ORGP. For predicting low ORGP the presence of all LM practices is required in all the five configurations for low levels of ORGP. To conclude, the necessity analysis results revealed that 5S&L and SPC are found to be necessary for predicting high ORGP and all positive (present) factors are found to be necessary for predicting low ORGP. This confirms that ORGP is achievable with both high and low levels of LM practices, hence validating the need to assess the combinatorial effects of the examined LM practices for ORGP.

To meet the objective(s) of the study data were analyzed in detail. Horizon Addis Tire Manufacturing PLC, Addis Ababa employees took part in this study; 84.8% male employee, 36.1% 18-30 age range, employee with first degree take 48.7%, 36.5% employee with experience of 5-9 years, Production Department and Plant Engineering Department with 35.7% and 26.6% of the employees respectively and Operator position cover a of 27%. Reliability analysis is evaluated by CITC ranging from .501 to .864 which is greater than threshold value of .50. The homogeneity of the scale items is examined using Cronbach‟s alpha statistics. Cronbach‟s alpha statistics range from .664 to .934 which is also greater than threshold value of .60.

The result reveals that three LM practices 5S&L, JIT, and CI had a positive significant effect on ORGP. The individual model variable reveal that 5S&L (β=215), JIT (β=0.359), and CI (β=0.58) are directly involved in the improvement of ORGP. Meanwhile, EI, SI, TMC, TPM, P, and SPC had no significant effect on ORGP and it may be due to the fact that the industries have not implemented LM practices effectively. Therefore, H01 is rejected and accepted the alternative hypothesis-H1.

LM practices has a significant positive impact on OP measure ($F(9, 253)=44.502$, $p<.05$). Based on the t-values, JIT (t-value=8.192, $p<.05$), 5S&L (t-value=4.347, $p<.05$), TPM (t-value=0.685, $p<.05$), P (t-value=2.931, $p<.05$), SI (t-value=1.371), CI (t-value= 2.326, $p<.05$) and SPC (t-value=1.140, $p<.05$) had a positive significant impact on OP measure. Therefore, H02 is rejected and accepted the alternative hypothesis-H2.

LM practices has and significant impact on Q, PRO, IL, CR and D. On the basis of t- values, only 5S&L (t-value=4.176, $p<.05$) and JIT (t-value=4.739, $p<.05$) had a positive significant impact on Q. Moreover, only JIT (t-value=4.628, $p<.05$), P (t-value=2.432, $p<.05$) and SI (t-value=2.610, $p<.05$) had a positive significant impact on IL. 5S&L (t- value=3.957, $p<.05$) and JIT (t-value=6.442, $p<.05$) had a positive significant impact on PRO. JIT (t-value=5.673, $p<.05$), CI (t-value=3.169, $p<.05$), P (t-value=0.153, $p<.05$),

and EI (t-value=4.739, $p<.05$), had a positive significant impact on CR. In addition, 5S&L (t-value=4.286, $p<.05$), JIT (t-value=2.386, $p<.05$), and SPC (t-value=3.797, $p<.05$) had a positive significant impact on D. OP measure ($F(5, 256)=74.733$ and is significant at $p<.05$) has a significant impact on ORGP measure. Therefore, H03 is rejected and accepted the alternative hypothesis-H3.

ORGP measure was regressed at the same time on each LM practice and OPI measure the relationship between these LM practices and ORGPI was reduced from standardized to β=.046 for TMC, β=.070 for SI, β=.028

for P, and β=.090 for SPC. Because these coefficients transformed from being statistically significant to being insignificant, full mediation occurred. In addition, the β coefficient for TPM decreased to β=.114, for EI decreased β=.090, for JIT decreased to β=.145, for 5S&L decreased to β=.124, and for CI to β=.103. However, they were still significant, which means there is a partial mediating effect regarding TPM, EI, JIT, CI, and 5S&L. Therefore, H04 is rejected and accepted the alternative hypothesis-H4.

As per correlation between LM practices, OP measures and ORGP measures, there was a significant positive relationship between "LM practices" and "ORGP" (r=.619, p<0.01). It was followed by "TMC" (r=.259, p<0.01); "TPM" (r=.400, p<0.01); "SI" (r=.378, p<0.01); "EI" (r=.449, p<0.01); "CI" (r=.465, p<0.01); "SPC" (r=.508, p<0.01); "P" (r=.467, p<0.01); "5S&L" (r=.605, p<0.01); and "JIT" (r=.612, p<0.01). The weakest

Correlation was for "TMC" and "ORGP" (r=.259, p<0.01). It was found that all the LM practices had significant positive correlation (p<0.01) with ORGP. There was a significant positive relationship between "LM practices" and "OP" (r=.671, p<0.01). It was followed by "TMC" (r=.243, p<0.01); "TPM" (r=.410, p<0.01); "SI" (r=.418, p<0.01); "EI" (r=.468, p<0.01); "CI" (r=.485, p<0.01); "SPC" (r=.568, p<0.01); "P" (r=.571, p<0.01); "5S&L" (r=.651, p<0.01); "JIT" (r=.681, p<0.01). The weakest

Correlation was for "TMC" and "OP" (r=.243, p<0.01). It was found that all the LM practices had significant positive correlation (p<0.01) with OP.

In addition there was a significant positive relationship between "OP measures" and "ORGP" (r=.757, p<0.01). It was followed by "CR" (r=.527, p<0.01); "IL" (r=.404, p<0.01); "PRO" (r=.618, p<0.01); "Q" (r=.729, p<0.01); and "D" (r=.653, p<0.01). It was found that all the OP measures had significant positive correlation (p<0.01) with ORGP. For the fsQCA analysis, the results of the recipes of LM practices accounting for low and high scores of ORGP are presented in, where 9 sufficient causal recipes for high scores of ORGP and 5 sufficient casual recipes for low scores of ORGP. In addition, after assessing predictive validity, the predictive tests for all the models indicate that the five (5) highly coherent models for the sub-sample have high predictive ability for the holdout sample and vice versa. Finally, comparing the predictive power assessments from multiple regression model (LM practices to ORGP measure, i.e., 5S&L, JIT, and CI are significant) and fsQCA (also suggests that the five predictive power assessments are consistent, thereby confirming that the models have high predictive power.

In this study nine LM practices were considered i.e., 5S&L, SPC, SI, CI, TPM, TMC, EI, P, JIT. Among nine LM practices three LM practices, 5S&L, JIT, and CI had a positive significant effect on ORGP in the case of Horizon Addis Tyre Manufacturing PLC, Addis Ababa.

This study indicates that LM practices had an impact on OP measure, i.e., IL, D, Q, PRO and CR. Among the nine LM practices all except TMC and EI had a significant impact on OP measure in the case of Horizon Addis Tyre Manufacturing PLC, Addis Ababa.

5S&L and JIT had a positive significant impact on Q and PRO while JIT, P and SI had a positive significant impact on IL. For CR, JIT, CI, P and EI had a positive significant impact. Finally, 5S&L, JIT, and SPC had a positive significant impact on D.

The study confirms that OP measure had a significant impact on ORGP measure. All OP measure except IL had a positive significant impact on ORGP measure effect in the case of Horizon Addis Tyre Manufacturing PLC, Addis Ababa.

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