Implementation of Kaizen 5S, MUDA, and PDCA for Productivity Improvement of Manufacturing Firms in Ethiopia: The Mediating Role of PDCA and Waste (Muda) Elimination between 5S and Productivity Improvement

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Abstract

This study primarily aimed at investigating empirically the relationship between Kaizen 5S (housekeeping), waste (Muda) elimination, PDCA analysis and productivity improvements among manufacturing firms in Ethiopia using the Structural Equation Model (SEM). The study targeted 30 export-oriented manufacturing firms. However, in order to overcome the problem of common method biases, the data were collected from multiple respondents in each firm. The questionnaire was distributed to 313 respondents that were selected proportionally from 30 industries. The data for the study were collected through a five-point Likert type questionnaire. Kaizen implementation practice was examined through housekeeping (5S), Work standardization (PDCA), and Waste (Muda) elimination, and productivity through the cost of production, labor and capital utilization. The Structural Equation Model (SEM) was employed to investigate the direct and indirect relationship between the variables. The SEM direct effect result indicated that the firm's 5S implementation practice was directly related to the elimination of the seven deadly wastes and continuously improved the manufacturing process through solving problems in the best scientific way. Furthermore, the 5S, waste elimination, and PDCA Analysis of Kaizen continuous improvement methodologies were perceived as methods for adding to productivity and efficiency in the production process. Moreover, the SEM bootstrapping result indicated the fact that PDCA analysis partially mediated the causal relationship between kaizen 5S (housekeeping) and productivity.

Keywords: Kaizen, 5S, PDCA, MUDA, Productivity, Manufacturing, Firm.

1. Introduction

In the globalized economy, manufacturing has three major objectives: fulfilling customers' needs and wants, improving value addition in the production process, and eventually simplifying the wellbeing of human beings by providing desirable, visually pleasing, environmentally safe, economically affordable, and high-quality products. In the manufacturing process, any kind of inefficiency is not welcomed by both companies and customers (Gidey and Kitaw, 2014). The recent global market competition has forced organizations to examine their operation for the purpose of making process improvements (Mandwe, 2013). The major determinants of the ability to sell products and services in highly competitive markets are no longer relative cost advantages. More and more, competitiveness is based on quality, speed, and service and product differentiation (Monga, 2000). Essentially, the center is on enhancing productivity through efficiency and effectiveness to meet or win the competition on cost, quality, time and flexibility. Manufacturing firms have to make their processes more efficient and effective to meet the growing need of their customers (Gidey and Kitaw, 2014).

Productivity improvements require designing and a successfully sustained implementation of comprehensive plans (Mandwe, 2013). Over the years, many methods of improving manufacturing operations' efficiency and effectiveness have been developed which range from work-study, operations research, lean manufacturing, kaizen, Total Quality Management (TQM), Just-In-Time (JIT), Visual Mapping, Statistical Quality Control (SQC), Six-Sigma, and Business Process Reengineering (BPR). These methods differ from each other in how they are implemented, how the improvement should be achieved and what is to be improved. Continuous improvement is one of the core strategies for excellence in production and is considered vital in today's competitive environment. It calls for endless effort for improvement involving everyone in the organization.

Kaizen is a continuous improvement (CI) process involving everyone, managers and workers alike. Broadly defined, Kaizen is a strategy to include concepts, systems, and tools within the bigger picture of leadership involving and people's culture, all driven by the customer (Imai, 1986). The term comes from 'Gemba Kaizen' meaning 'continuous improvement' (Robinson, 1991). Others, such as Womack and Jones (1996) described kaizen as lean thinking and lay out a systematic approach to help organizations systematically reduce waste.

The manufacturing industry in Ethiopia started in the 1920s with a simple processing technology that produced agriculture-based products. However, the sector has neither transformed itself into high tech processing nor is competitive in the international market. The sector has persistently faced high production cost, severely constrained supply and poor-quality raw materials and technology, both mainly imported, witnessing little improvements in the main areas of challenges over the years. Ethiopia places abundant resources each year in the manufacturing sector to realizing the national vision of becoming a lower-middle-income country by 2025 through developing the domestic engineering and fabrication capacity and by improving productivity, quality and competitiveness of the domestic productive sectors manufacturing industries (GTP II, 2016). Beyond the massive expansion to increase the productivity of the industrial sector, Ethiopia has started implementing the Kaizen philosophy since 2011/12 with the assistance of Japan International Corporation Agency (ENPC GTP II, 2016). To support its successful implementation, Ethiopian Kaizen Institute was established by the Council of Ministers Proclamation No.256/11 as an autonomous federal government office having its own legal entity under the then Ethiopian Ministry of Industry.

The pilot implementation of the kaizen philosophy in export-oriented manufacturing firms proved that it is possible to enable the products of these firms to meet international standards and be competitive in the global market by promptly eliminating their cumbersome and backward industrial culture (ENA, 2016). The degree of emphasis given by the government can be understood by the establishment of the Ethiopian Kaizen Institute in 2011 to name September as a month of Kaizen at the national level by the Ethiopian Kaizen Institute. The main premise behind this is that September is the first month in the Ethiopian calendar and people plan in all walks of life and keep hopes in their hearts for many things in a new year. The philosophical interpretation of the term has something to do with success in both personal and organizational lives (EH, 2016). Therefore, this study, as the first of its kind ,(as far as the knowledge of the researcher goes) intends to investigate the causal association between kaizen 5S (housekeeping), MUDA (waste elimination), PDCA analysis and productivity improvements in Ethiopian manufacturing firms using the Structural Equation Model (SEM) and Bootstrapping method.

2. Literature Review and Hypothesis Development

2.1.Kaizen Continuous Improvements

Among many contributions of Japan in the world of management of product and service quality, Kaizen has had a very high impact on boosting organizational productivity and efficiency (Mishra and Gupta, 2010). In the decade of 1980, management techniques focusing on employee involvement and empowerment through teamwork approach and interactive communications and on improving job design were not new, but Japanese companies seemed to implement such techniques much more effectively than others. The business lesson of the 1980s was that Japanese manufacturing organizations, in their quest for global competitiveness, demonstrated a greater commitment to the philosophy of continuous improvement than western companies did (Bowles and Hammond, 1991). For such a philosophy, the Japanese used the term Kaizen. Kaizen which is defined as continuous improvement in the organizational workplace and a view based on common sense in modern management.

2.2. Kaizen 5S (Housekeeping)

According to Imai (1986), a process of managing the workplace for improvement purposes, is known in Japanese as ‘’Gemba’’ (workplace). Imai introduced the word ’’Gemba‘’, which means ‘’real place’’, where the value is added to the products or services before passing them to the next process where they are formed. For proper housekeeping, a valuable tool or methodology is used as the 5S methodology. The English words equivalent to the 5S's are sort, straighten, sweep, sanitize, and sustain. Genobz (2010) describes the Kaizen 5S as a planned program to achieve total organization, cleanliness, and standardization in the workplace. Imai (1986) said that 5S evaluations provide measurable insight into the orderliness of a work area. A number of authors attested the significance of the 5S kaizen approach for the overall improvement of operational processes (Osada, 1991; Chapman, 2005; Rivera and Cox, 2008). The objectives of each of the 5S’s are given below:

- Sort (S1) - eliminate unneeded items and reduce item searching time.
- Set in Order (S2) - easy items storage and retrieval
- Shine (S3) - clean and safe working environment
- Standardize (S4) - existence of better workplace standards and visual control systems
- Sustain (5S) - development and improvement of positive team discipline and spirit for long period of time

Okpala (2014), Kaizen 5S (housekeeping) practice is aimed at improving productivity by clean, neat, and well-arranged shop floor through the use of visual signs to ensure.

2.3. PDCA Analysis

Edwards Deming, a pioneer of the field, popularized a tool called the plan-do-check-act (PDCA) cycle, also known as Deming Cycle for continuous improvement (Saleem et al, 2012). As stated by Thessaloniki (2006), in the PDCA methodology, the management plans, each employee follows the planned activities, the supervisors check, and the management correct or secures every step, systematically. Thus, PDCA methodology is a system that can be applied to make the diagnosis, plan, train, implement, evaluate, and then standardize the process (Imai, 1986; Muhammad, 2015).

- Plan - Involves analyzing the current situation, identifying an opportunity and planning for change;
- Do - Stands for implementing the plan;
- Check - Refers to determining whether the implementation remains on track and has brought about the planned improvement; and
- Act - Refers to performing and standardizing the new procedures to prevent the recurrence of the original problem or to set goals for the new improvements.

2.4. Waste (MUDA) Elimination

According to Thessaloniki, (2006), MUDA in Japanese means waste. The resources at each process-people and machines either add value or do not add value and therefore, any non-value adding activity is classified as MUDA in Japan. Work is a series of value-adding activities, from raw materials, ending with a final product. MUDA is any non-value-added task. As describes by Okpala (2014), manufacturing waste is refers to the application of resources like raw materials, labor, equipment, or machines over and above what is needed to produce the product or service defined by the customer. Or manufacturing waste is any activity or process which the customer is not willing to pay for. There are seven wastes or Muda's in the production process (Ohno, 1988):

1. Muda of transportation: moving products that are not actually required to perform the processing;
2. Muda of inventory: all components, work in process and finished product not being processed;
3. Muda of motion: people or equipment moving or walking more than is required to perform the processing;

4. Muda of waiting: periods of inactivity for people, information or goods;
5. Muda of overproduction: producing too much or too soon;
6. Muda of processing: resulting from poor tool or wrong set of procedures or systems; and
7. Muda of defects: the effort involved in inspecting for and fixing defects.

2.5 Hypothesis Development

It is generally agreed that Kaizen implementation as a corporate culture increases overall organizational productivity through continuous improvement and all employees' active involvement (Lidia, 2011; Venkataiah and Sagi, 2012; Sidhu et al, 2013; Jadhav et al., 2014; Bhoi et al, 2014; Desta, et al., 2014; Zailani, Shaharudin, and Saw, 2015; Bhaskaran, 2015; Seblewongel, 2015; Erez, 2016; Rewers et al, 2016; Tajubu, 2016; Kholif et al., 2018; Nguyen, 2019).

2.5.1 Kaizen 5S, PDCA, and Productivity

Lidia (2011), indicated the existence of a positive correlation between kaizen continuous improvement practices and organizational productivity. This was evidently based on wastage reduction in production, lower product and service costs during production and distribution, increase operational efficiencies in their value chain and increase innovations (new ideas, products, and services). Kaizen implementation increased operational readiness, efficiency, productivity, and processes capability in the manufacturing sector in Kenya. Venkataiah and Sagi (2012),confirmed that the implemented kaizen event variables are found to be positive and significantly correlated with the perceived quality performance factors in surveyed automobile industries in the Chennai area, India. Desta, et al (2014), conducted an empirical survey study to analyze Kaizen 5S implementation in manufacturing industries in northern Ethiopia. The result related toKkaizen outcomes revealed that 56% of the respondents believed that the implemented kaizen techniques to some extent improved quality, customer satisfaction, reduction of production cost and lead time. Specifically, companies with Kaizen practice on average reduced lead time by 15%, cost of production by 14%, workforce size by 12%, increased staff involvement and innovation by 23%, staff motivation by 16%, customer satisfaction by 14% and quality improved by 13%. According to Erez (2016), the five kaizen implementation tools (quality circle, TQM, six sigma, control charts, and PDCA) have a direct relationship with company's' overall financial performance. More specifically, the company's Kaizen implementation outcome significantly reduced waste, improved productivity and satisfaction of employees and customers. Kocik (2017), assessed the practical use of the PDCA Deming cycle in one of the small and medium-sized enterprises in the plastic processing industrial sector. The result of the assessment indicates the implementation of PDCA cycle has reduced the number of variances in the production process by more than 60%.

Prasha (2017) said implementation of two PDCA cycle reduced energy consumption, wastes, and increased productivity. As per Dasig Jr. (2017), Define, Measure, Analyze, Improve and Control (DMAIC) methodology which is the previous version of Pan, Do, Check, and Act (PDCA) implementation project positively impacts productivity, efficiency, and process innovation. According to Amin et al. (2018), the application of the PDCA continuous improvement applied between the elimination of waste, safety of employees and increased productivity. Vargas et al. (2018) attested that when the PDCA) cycle is applied with other supportive tools such as Pareto and flowchart, it reduced defects and dramatically improved the quality of the manufactured products. Furthermore, the joint approach implementation results in significant productivity improvement, increased customer satisfaction, and a cleaner and comfortable working condition for the employees. For Bhardwaj et al. (2018), the adoption of PDCA tool of lean manufacturing in the service sector reduced service delivering time, rejections, improved productivity, quality, employee morale, and customer satisfaction. According to Adriana et al. (2017), implementing the PDCA analysis leads to improvements in quality, productivity, and results in a significant reduction of waste in the manufacturing process. Nabiilah et al. (2016) declared that PDCA cycle application enables to reduce defects, operational costs, improve production, labor utilization, and quality of the products manufactured. Therefore, based on review of relevant literature the following five hypotheses were developed to examine the causal association between the implementation of Kaizen 5S (Housekeeping), waste (Muda) elimination, PDCA analysis, and productivity improvement of manufacturing firms.

H_1:5S implementation practice has a direct and positive significant effect on the waste elimination in manufacturing firms.
H_2:5S implementation practice directly and positively influences the effectiveness of PDCA cycle implementation in manufacturing firms.
H_3:5S implementation practice has a direct and positive significant effect on the productivity of manufacturing firms.

H_4: Waste elimination practice has a direct and positive significant effect on the productivity of manufacturing firms.
H_5: PDCA analysis practice has a direct and positive significant effect on the productivity of manufacturing firms.

First, we examine the causal relationship between the implementation of Kaizen 5S (Housekeeping), waste (Muda) elimination, PDCA analysis, and productivity improvement of manufacturing firms. Then, we investigate to what extent PDCA analysis and Waste (Muda) eliminations mediate the causal association between 5S implementation practices and productivity improvements. Previous literature and studies of Kaizen implementation practice and productivity improvement treated all tools as independent variables and tried to establish direct relationship between them (Imai, 1986; Skinner, 2003; Jadhav et al., 2014; Gordian, 2014; Okpala, 2014; Kucerova et al., 2015; Choomlucksanaa et al., 2015; Deming Institute, 2016; Agmoni, 2016; Kocik, 2017, Prasha, 2017; Amin et al., 2018; Bhardwaj et al., 2018).

The joint approach implementation of Kaizen tools and methodologies may result in significant productivity improvement and customer satisfaction ((Nabiilah et al., 2016; Vargas et al., 2018). In this study three Kaizen implementation tools i.e. 5S, Waste (Muda) elimination, and PDCA analysis were included to examine the causal association between them. However, the successful implementation of the first tool i.e. 5S (housekeeping) leads to a reduction of wastes; and increases productivity, employee satisfaction, morale, and helps the creation of safe and accident free work environment (Imai, 1982, Skinner; 2003; Okpala, 2014). Therefore, waste (Muda) elimination and PDCA analysisKkaizen implementation tools, in addition to direct effect, they may intermediate the relationship between 5S (housekeeping) and productivity improvements. This theoretical relationship between the independent variables leads to the development of two additional hypothesis that aimed to examine the indirect effect of waste elimination and PDCA analysis on the causal relationship between 5S and productivity improvements.

H_6. Kaizen 5S implementation practices have a direct and positive significant effect on productivity improvement with a mediating effect of waste elimination.
H_7. Kaizen 5S implementation practices have a direct and positive significant effect on productivity improvement with a mediating effect of PDCA analysis.

The Research model

The above theoretical and empirical discussions and proposed hypothesized relationships among the variables are outlined in the following research model.

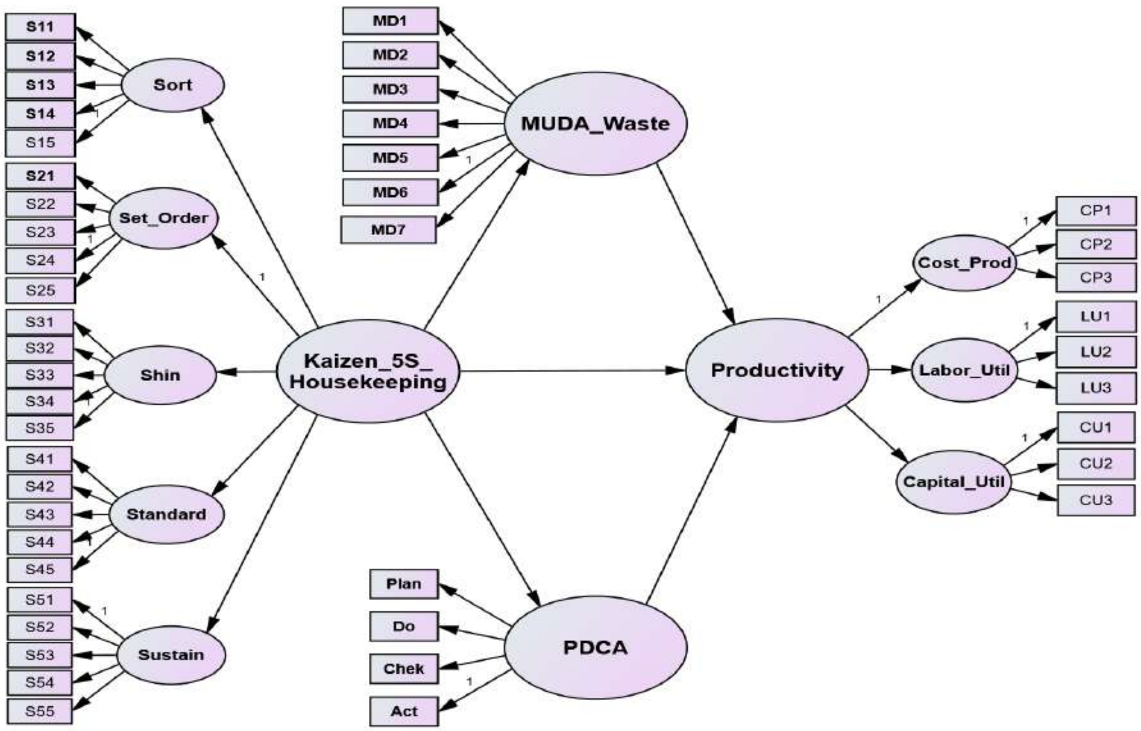

Figure 1: the conceptual model of the study.

3. Research Methods

3.1 Sampling Design

The study targeted 30 export-oriented manufacturing firms which are selected for Kaizen project pilot implementation at national level. The data were collected from multiple respondents in each firm because collecting data from a single respondent to make statistical inferences about firms may result in the problem of common method biases (Miller, & Roth, 1994; Kathuria, Partovi, & Greenhaus (2010). The total number of employees working in the selected 30 industries was 10, 187 (ten thousand and one hundred eight seven). Zikmund et al (2013) provided a simplified table for determining the sample size for a given population in research. Accordingly, based on the sample determination table for a population between 10,000 and 20,000, the appropriate sample size is 313. Hence, a sample of 313 respondents was selected proportionally from the selected 30 industries.

3.2 Validity and Reliability Analysis

The significance of assuring the reliability and validity of the measurement was attested by a number of researchers in the field (Altheide & Johnson, 1994; Roberts et al., 2006; Kimberlin & Winterstein, 2008). The measurement instruments - reliability and validity tests - are the ways of demonstrating and communicating the quality of the research processes and the trustworthiness of research findings.

3.2.1 Reliability Analysis

In this study, the reliability of the developed instrument was assured by two methods, i.e., by Cronbach's alpha coefficient and Composite Reliability (CR). Reliability coefficients alpha range from 0.00 to 1.00, where the values of the coefficients closer to 1 indicate higher levels of reliability (Cronbach, 1984; Kimberlin & Winterstein (2008). The acceptable values of coefficients alpha to ensure the reliability of the instrument in question in social science can be 0.7 or greater. The common threshold for CR is greater than 0.7 similar to that of the Cronbach alpha coefficient value (Puala et al., 2006; Hair et al, 2010). The results in Table 1 below indicate that the value of Cronbach's alpha for all of the latent variables were found above 0.7, which is above the required value of 0.7 (Roberts et al., 2006; Chauhan, 2016). In addition, the composite reliability values of each latent variable were calculated. The CR value of all ten variables in the four constructs was found between 0.90 – 0.98, which is quite greater than the required value 0.7 (Roberts et al., 2006; Hair et al, 2010).

Table 1: Reliability Analysis

Construct/Latent Variable	Factors	Cronbach's alpha (α)	Composite Reliability	Final Number of Indicators

Kaizen 5S (Housekeeping)	Sort	0.879	0.90	4
	Set in order	0.880	0.91	4
	Shine	0.908	0.90	5
	Standardize	0.815	0.98	4
	Sustain	0.875	0.94	4
MUDA	MUDA	0.874	0.95	7
PDCA	PDCA	0.918	0.97	4
Productivity	Cost of production	0.930	0.94	3
	Labor utilization	0.882	0.91	3
	Capital utilization	0.881	0.94	3

3.2.2 Validity Analysis

To assure the content validity, the researcher conducted a pre-pilot study and the items of the instrument were reviewed by a supervisor, academicians, and experts with research interests in this area, and re-evaluated through structured interviews with practitioners. The construct validity was tested using a confirmatory factor analysis (CFA) with the help of AMOS 23 software. According to Cooper & Schindler (2001), construct validity involves two elements, namely, discriminant validity and convergent validity. In this study discriminant validity was checked for nine extracted variables. It can be confirmed when the variables are measured by referring average variance explained (AVE), maximum shared variance (MSV) and Composite Reliability (CR). To test for discriminant validity, the criteria described by Hair et al, (2010), and Chauhan, (2016) were used. Accordingly, the discriminant validity of the factor is assured when the maximum shared variance (MSV) < Average Variance Extracted (AVE), and Average Variance Extracted (AVE) < Composite Reliability (CR). The result in Table 2 shows that for all latent variables MSV < AVE and AVE < CR, implying that each factor was different from the other.

Table 2: Validity

LV	CR	AVE	MSV	ASV	1	2	3	4	5	6	7	8	9	10
1.	0.90	0.69	0.07	0.03	0.83									
2.	0.95	0.72	0.07	0.01	-0.12	0.85								
3.	0.97	0.88	0.19	0.05	0.06	0.15	0.94							
4.	0.90	0.70	0.14	0.04	0.26	-0.26	-0.04	0.84						
5.	0.94	0.80	0.05	0.02	0.05	0.07	-0.02	0.20	0.89					
6.	0.91	0.67	0.14	0.03	0.20	0.10	-0.07	0.37	0.23	0.82				
7.	0.94	0.81	0.19	0.06	-0.02	0.08	0.43	0.07	-0.02	0.14	0.90			
8.	0.98	0.92	0.05	0.01	0.21	0.03	0.06	0.22	0.13	0.06	-0.02	0.96		
9.	0.91	0.71	0.41	0.07	0.19	-0.09	0.16	-0.01	-0.16	-0.13	0.31	-0.08	0.84	
10.	0.94	0.80	0-+ ``.41	0.09	0.16	0.02	0.42	-0.07	-0.17	-0.02	0.44	-0.07	0.64	0.89

Where: LV=Latent Variable, 1=Sort, 2 = MUDA, 3=PDCA 4= Shine, 5= Sustain, 6= Set in Order, 7=Capital Utilization, 8= Standardization, 9 =Labor Utilization, 10 = Cost of Production.

4. Data Analysis

A total of 313 questionnaires were distributed to employees working in the 30 target manufacturing firms. Out of the 313 questionnaires distributed, 216 were filled in and returned by respondents from 23 firms, amounting to about 69.81 percent of the total sample size. According to Saunders et al. (2009), a response rate above 60% is considered as a quite respectable result, and explains that the sample was representative to make statistical analysis, and inferences for the population in question**.** The data collected through the questionnaire were analyzed through the statistical package for social science (SPSS) 23 and AMOS 23 software.

5. Results

5.1. Descriptive Statistics Result

Table 3 presents the demographic characteristics of the respondents. Gender representation respondents shows that 164(75.9%) were male and 52(24.1%) were female. In terms of age, out of the 216 respondents, 143 (66.2%) were between 18–34 years range, 44(20.4%) were under the age range of 35–50 years, and the remaining 29(13.4%) of the respondents were above 50 years. With regard to the level of education, a significant number of respondents had a university or college degree, TVET Diploma, and college diploma which account for 71(32.9%), 65(30.1%) and 41(19%), respectively. The remaining 26(12%), 10(4.6%), and 3(1.4%) had certificate, second degree, and grade 12 complete or below, respectively. Therefore, from the above analysis we can easily conclude that the manufacturing sector employment was dominated by male which takes the lion share i.e. 76% among sample organizations and the participation of females in the productive sector was significantly low in sampled manufacturing organizations. In addition, the majority of 143 of employees (66.2%) and 136 (63%) were under the productive age group of between 18-34 years range and had first degree or TVET diploma respectively. This implies that the participation of educated youths in the manufacturing sector was relatively high in the sampled companies.

Table 3: Respondents' Demographic Profile

Item	Description	Frequency	Percentage
Gender	Male	164	75.9
	Female	52	24.1
	Total	**216**	**100**

Age	Between 18-34 Years	143	66.2
	Between 35-50 Years	44	20.4
	Above 50 Years	29	13.4
	Total	**216**	**100**
Level of Education	12 Complete and Below	3	1.4
	Certificate	26	12.0
	TVET Diploma	65	30.1
	College Diploma	41	19.0
	First Degree	71	32.9
	Second Degree and Above	10	4.6
	Total	**216**	**100**

5.2. Exploratory Factor Analysis (EFA)

The main purpose of this section is to test the suitability of the items developed to measure the variables and the internal structure of the constructs that the instrument intended to measure. In order to examine the suitability of the instrument developed to measure the variables for factor analysis, EFA using maximum likelihood extraction with Promax rotation was performed. The maximum likelihood extraction method allows computation of wide range goodness of fit indexes of the model ; it also allows the statistical significance test of factor loadings, correlations among factors, and the calculation of confidence intervals for these factors (Cudeck and O'Dell, 1994; Chauhan, 2016). EFA conducted for four constructs i.e., kaizen 5S, PDCA analysis, waste (Muda) elimination, and productivity to determine the structural pattern of the developed dimensions with the help of factor loading, TVE, KMO, eigenvalues, and Bartlett's test of Sphericity. From 45 items developed and subjected to explanatory factor analysis, only 41 were retained and 4 items were eliminated because of low factor loadings i.e. < 0.6 (Cooper and Bhattacherejee, (2001); Hair et al.,(2014). The three items discarded during EFA were, S15 (unnecessary items are sorted and disposed) from factor 9 with factor loading of 0.345, S25 (Irrelevant items are eliminated) from factor 5 with factor loading of 0.457, S45 (The first 3Ss are maintained in their fully implemented state) from factor 7 with factor loading of 0.587, and S55 (good practices and performances are recognized) from factor 4 with factor loading of 0.433. The 41 variables that were retained after EFA yielded ten factors explaining 73.319 per cent of the cumulative variance. Table 4 summarizes the factor loadings of the 41 items retained under the ten extracted factors.

Table 4: Explanatory Factor Analysis of Kaizen 5S Practice, PDCA Analysis, and Productivity

Pattern Matrix[a]											
		Factor									
Code		1	2	3	4	5	6	7	8	9	10
MD1	Production of finished goods above the market demand is kept small.	.830									
MD2	No operator stays idle due to unbalanced production line or machine breakdown.	.926									
MD3	Needless movement of materials/work in process is maintained minimum.	.903									
MD4	Movement of people that do not add value maintained low.	.892									
MD5	The company actively identifies and eliminates unnecessary steps in production.	.856									
MD6	There is no excess stock of finished/semi-finished goods that go beyond supporting the immediate	.754									

	need.										
MD7	Early identification and correction of errors in the production process is critically valued.	.763									
Plan	The root cause of any problem is identified and an improvement plan to address it is generated.		.988								
Do	Improvement plans are implemented often on a small scale.		.908								
Act	The results of the changes are reviewed to determine if the problem has been resolved.		.943								
Chek	Successful change improvement plans are incorporated into standard work documents and communicated to all stake holders.		.846								
S31	Workplace floors are kept clean.			.801							
S32	Machines/tools are kept neat and clean.			.807							

S33	Work place safety is maintained.			.811							
S34	Equipment inspection is conducted regularly.			.853							
S35	Employees regularly clean floor and equipment without being told.			.827							
S51	Everyone has been trained adequately in standard procedures.				.871						
S52	Reasonable rules of work behaviors are created in the workplace.				.938						
S53	Before and after 5S photos are exhibited where everyone can see them.				.890						
S54	Standard working procedures are regularly reviewed and up-to-date.				.881						
S21	Storage facilities are marked with clear location indicators.					.810					
S22	Paintings are used to indicate walkways and locations on floors.					.871					

S23	Items are arranged in a way easy to use.					.827					
S24	Items are labeled in the a easy to find and put away.					.759					
S25	Irrelevant items are eliminated.					.784					
CU1	Work processes have improved through appropriate use of technology.						.936				
CU2	Effectiveness of machines and equipment are regularly reviewed.						.879				
CU3	Targets are set for machine and equipment utilization.						.826				
S41	Continuous improvement memos are regularly generated.							.825			
S42	Continuous improvement is employed to bring about work standardization.							.956			
S43	Standard operating procedures are established and documented.							.779			
S44	Regular workplace cleaning is maintained using							.745			

	schedules.										
LU1	Employees' perform their work efficiently.								.731		
LU2	Manpower deployed effectively.								.931		
LU3	Flexible work arrangements are made to meet demand fluctuations.								.864		
S11	Unneeded equipment and tools are separated.									.887	
S12	Unwanted inventories, materials or parts are not around.									.859	
S13	There is no any an unused job or tool around.									.756	
S14	Red tagging is done to the things not required.									.794	
CP1	On-time deliveries of materials have been ensured.										.707
CP2	Minimum inventory carrying cost is maintained.										.907
CP3	Cost of re-work/scrap is reduced in the operations.										.965
	Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization.										

	a. Rotation converged in 7 iterations.
Total Variance Explained = 73.319, KMO = .839, Bartlett's test of Sphericity = .000	

5.3. The Confirmatory Factor Analysis

The output of the CFA has shown a good fit. The structural equation model fit was checked based on CMIN/*df*, Goodness of Fit (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Normed fit index (NFI), Incremental Fit Index (IFI), and Root Mean Square Error Approximation (RMSEA). The obtained CFA output reveals that CMIM/df value was 1.620, which is below the suggested value < 3 and; the Goodness of Fit (GFI) of 0.894, which is well above the recommended value for a satisfactory model fit of the data 0.5. The obtained Tucker-Lewis Index (TLI), Incremental Fit Index (IFI), and Comparative Fit Index (CFI) values were above 0.9, which is above the recommended value for a satisfactory model fit of the data 0.9. Finally, the Root Mean Square Error Approximation (RMSEA) value was 0.054, which is less than the recommended value of 0.08. Therefore, we can find the overall structural model fit indices within the acceptable recommended values.

Table 5: The Structural Model Goodness of Fit Indices

Structural Model Fit		
The Goodness of Fit Indices	**Model Fit Index**	**Recommended Value**
$\chi 2$ (Sig.) (CMIN)	1229.295	
Degree of freedom (*df*)	759	
CMIN/*df*	1.620	< 3[a]
Goodness of Fit Index (GFI)	0.894	> 0.5[b]
Tucker-Lewis Index (TLI)	0.930	> 0.9[b]
Incremental Fit Index (IFI)	0.935	> 0.9[a]
Comparative Fit Index (CFI)	0.935	>0.9[a]
Root Mean Square Error Approximation (RMSEA)	0.054	> 0.08[a]
[a] Hair et al. (2010), Chauhan (2016).		
[b] Byrne (1998).		

6. Discussions

The purpose of the study was to examine the causal relationship between kaizen implementation practices and productivity improvement of manufacturing firms in Ethiopia using 5S (Housekeeping), PDCA analysis, and Waste (Muda) elimination. A total of seven hypothesis were proposed to investigate the causal association among 5S (Housekeeping), PDCA analysis, Waste (Muda) elimination, and productivity improvement. Hypothesis H1, H2, H3, H4, and H5 were tested with SEM to find out direct effect between the variables, and H6 and H7 were tested employing SEM bootstrapping method to investigate the indirect effect of waste (Muda) elimination and PDCA analysis on the causal relationship between kaizen 5S and productivity of manufacturing firms.

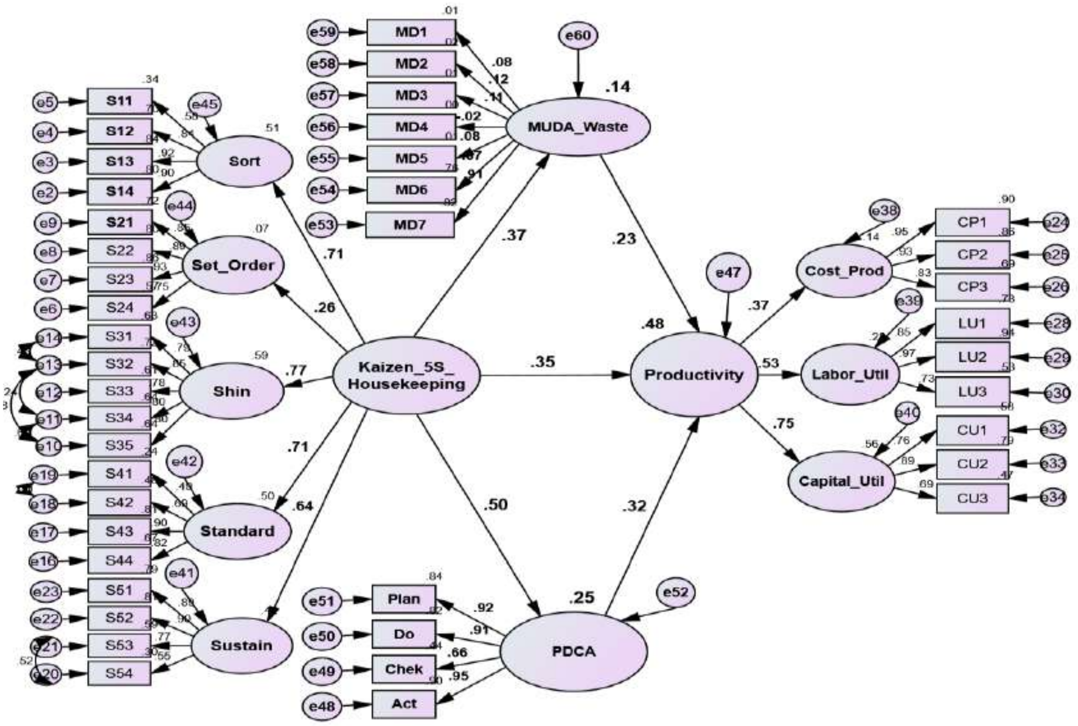

Figure 2:Structural Model

Direct Effects

As the significance level presented in Table 6 and the standardized regression output in the SEM presented in Figure 2 show, first, it is evident that kaizen 5S (Housekeeping) implementation practice positively and significantly reduces manufacturing waste's (Muda); i.e., any non-value adding activity with a standardize estimate (β) = 0.37 at p<0.01. This positively and significantly enhances the successful implementation of PDCA cycle which enables finding root causes of the problems by scientifically testing potential solutions, evaluating outcomes, and implementing the one that best works with a standardize estimate (β) = 0.50 at p<0.01, respectively. This result indicates that Kaizen 5S (Housekeeping), usually the first step in continuous improvement project, successfully leads to elimination of the seven deadly wastes that are caused by overproduction, waiting, transportation, unnecessary inventory, over-processing, unneeded worker movement, and a defective part; and enables continually improving the manufacturing process through solving problems in the best scientific way. Therefore, hypotheses (H_1 and H_2) were accepted. Second, kaizen 5S (Housekeeping) implementation practice is positively and significantly related to productivity with a standardize estimate (β) = 0.352 at p<0.05, and there is a positive and significant relationship between waste (Muda) elimination, PDCA analysis practices, and productivity of manufacturing firms at p<0.01 with a standardize estimate (β) = 0.23 and 0.32, respectively. Therefore, continuous improvement of methodologies for the implementation of 5S (housekeeping), waste elimination tools, and PDCA Analysis of Kaizen was perceived as one method for adding to productivity and efficiency in the production process. This can be evident through waste reduction in the production process, lower product costs, increased operational efficiencies, and innovative capability of workers. The result of the SEM analysis in this study also leads to the conclusion that the company culture of adopting Kaizen philosophy as a continuous improvement program is positively and significantly related to the productivity of manufacturing firms. Therefore, hypotheses (H_3, H_4, and H_5) were accepted.

Table 6: The SEM Direct Effect between 5S, Waste (Muda), PDCA and Productivity

Hypothesis	Path Direction	Estimate	S.E.	C.R.	P	Decision

H_1	MUDA	<---	5S	2.583	0.858	3.012	0.003	Accept
H_2	PDCA	<---	5S	1.498	0.558	2.685	0.007	Accept
H_3	Productivity	<---	5S	0.63	0.308	2.044	0.041	Accept
H_4	Productivity	<---	MUDA	0.112	0.041	2.724	0.006	Accept
H_5	Productivity	<---	PDCA	0.102	0.046	2.237	0.025	Accept

Indirect Effects

This discussion aims at examining two hypotheses of the study. First, it will examine whether waste (Muda) elimination practice intermediates the causal relationship between kaizen 5S (housekeeping) implementation practice and productivity. Secondly, it aspires to prove whether PDCA analysis has any significant mediating role between organizations' Kaizen 5S (housekeeping) implementation practice and productivity improvement of manufacturing firms.

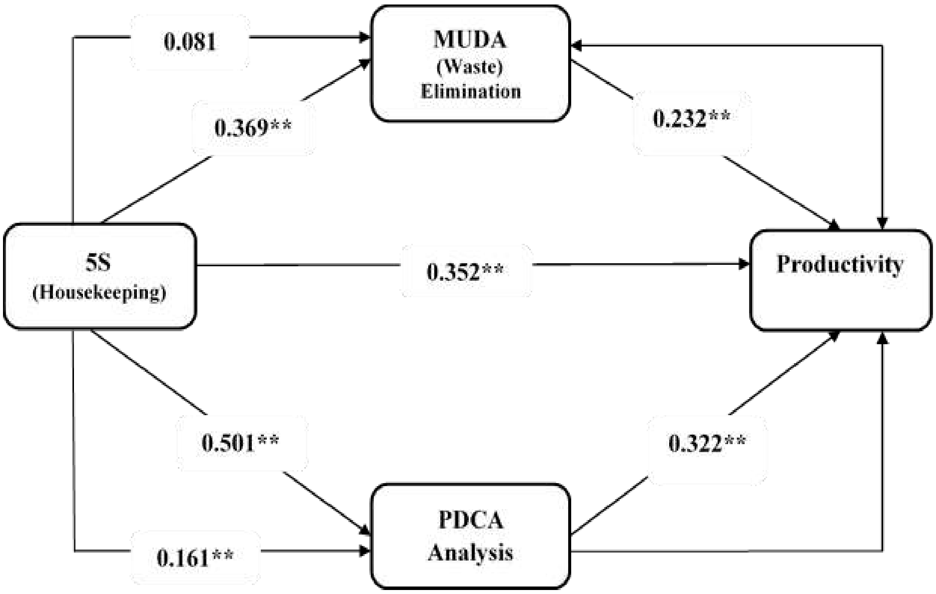

Figure 3: The Indirect Effect

As indicated in Table 7 below, the indirect effect of Kaizen 5S (housekeeping) implementation practice on productivity through waste (Muda) elimination was found to be insignificant with a standardize estimate (β) = 0.081 and p=0.102. This leads to the conclusion that Muda (waste) elimination, except the direct effect, does not intermediate the relationship between Kaizen 5S (housekeeping) and productivity. Therefore, H_6 was rejected. This is due to the fact that waste (Muda) elimination is a direct outcome of Kaizen 5S (housekeeping) implementation practice. However, the indirect effect of Kaizen 5S (housekeeping) implementation practice on productivity through PDCA analysis was found to be significant with a standardized estimate (β) = 0.161 and p=0.005. This indicates that a good deal of support has been found for H_7 that Kaizen 5S (housekeeping) implementation practices have a positive impact on productivity improvement with a mediating effect of PDCA analysis as shown in Figure 3. Furthermore, both direct effects of mediation with a standardized estimate (β) = 0.352 at p=0.041, and indirect effects with a standardized estimate (β) = 0.161 at p=0.005 was found to be partially significant to the type of mediation (Zainudin, (2012), MacKinnon et al., (2004); Valente et al., (2015). This underscores the fact that PDCA analysis partially mediates the causal relationship between Kaizen 5S (housekeeping) and productivity. Therefore, H_7 is accepted. In addition to implementing kaizen 5S (Housekeeping) methodology as a corporate culture, PDCA analysis plays a significant role in the productivity improvement of manufacturing firms. This is due to the fact that in addition to effectively managing to maintain and achieve a clean workplace through Kaizen 5S, it is also important to solve problems of the manufacturing system in a scientific way through PDCA approach for better productivity improvement.

Table 7: the bootstrapping indirect effect

Hypothesis	**Direct w/o Med**		**Direct w/Med**		**Indirect**		**Type of Mediation**
	β	**p-value**	**β**	**p-value**	**β**	**p-value**	
H_6 Productivity <---5S *(Through MUDA)*	0.538	0.007	0.210	0.039	0.081	0.102	No Mediation
H_7 Productivity <---5S *(Through PDCA)*	0.538	0.007	0.352	0.041	0.161	0.005	Partial Mediation

7. Conclusions

Ethiopia allocates abundant resources each year to the manufacturing sector to realize the national vision of becoming a lower-middle-income country by 2025 through improving productivity, quality, and competitiveness of the domestic export-oriented manufacturing firms. In the last eight years, the movement for productivity and efficiency has spread in Ethiopian manufacturing firms. Kaizen is viewed as a means that can empower productivity improvement as a distinct advantage for socio-economic transformation by reforming the industry scene and helping in the realization of a productivity-driven plan to comprehensive development and improvement. Kaizen is a continuous improvement program that has been perceived as one method for augmenting productivity and efficiency in the production process. In line with this assumption, the results of the SEM analysis in this study also leads to the conclusion that the company culture of adopting Kaizen 5S (housekeeping), waste (Muda) eliminations, and PDCA cycle philosophy as a continuous improvement program are positively and significantly related to the productivity improvements. Moreover, in addition to the usual step-by-step approach, the joint implementation of Kaizen methodologies may result in a more significant productivity improvement. The SEM bootstrapping result explains that the great deal of support Kaizen 5S (housekeeping) implementation practices render, have a positive impact on productivity improvement with a mediating effect of PDCA analysis. This clearly indicates that continuous improvement of the manufacturing process through solving problems in a scientific way through PDCA implementation significantly mediates the relationship between 5S (housekeeping) and productivity improvements.

Reference

Adriana S. Silva, Carla F. Medeiros, Raimundo Kennedy Vieira. (2017). Cleaner Production and PDCA cycle: Practical application for reducing the Cans Loss Index in a beverage company. Journal of Cleaner Production, 150, 324 -338.

Altheide, D. L., & Johnson, J. M. (1994). Criteria for Assessing Interpretive Validity in Qualitative Research. American Psychological Associations.

Amin, N.A., Hasrulnizzam, W., Mahmood, W., Kamat, R.S., and Abdullah, I. (2018). Conceptual Framework of Lean Ergonomics for Assembly Process: PDCA Approach. *Journal of Engineering and Science Research*, 2(1), 51-62.

Asian Productivity Organization (2009). Productivity Data Book. Tokyo: Keio University Press Inc.

Bhardwaj, A., Nagar, J., and SMor, R. (2018). Productivity gains through PDCA approach in an Auto Service Station, Proceedings of the 2nd IEOM European Conference on Industrial Engineering and Operations Management Paris, France, July 26-27, 2018.

Bhaskaran (2015). Lean Six Sigma in Indian Automotive Clusters: International Conference of Inclusive Innovation and Innovative Management. 14-22.

Bhoi, J. A., Desai, D. A., & Patel, R. M. (2014). The Concept and Methodology of Kaizen. International Journal of Engineering Development and Research, 2(1), 2321-9939.

Bowles, J. and Hammond, J. (1991). Beyond Quality of how 50 Wining Companies Use Continuous Improvement: New York: Putnam.

Chapman, C.D. (2005). Clean House with Lean 5S. Quality Progress, 38(6), 27-32.

Chauhan, K. A. (2016). Research Analytics: A Practical Approach to Data Analysis. Dream Tech-Press, New Delhi, India.

Choomlucksanaa, J. Ongsaranakorna, M., Suksabai, P. (2015). Improving the productivity of sheet metal stamping subassembly area using the application of lean manufacturing principles. 2nd International Materials, Industrial, and Manufacturing Engineering Conference, MIMEC 2015, 4-6 February 2015, Bali Indonesia, Procedia Manufacturing 2 (2015), 102 – 107.

Cooper, D. C. & Schindler, P. S. (2001). Business Research Methods (7th ed.). New York: McGraw-Hill.

Cronbach, L.J (1984). Essentials of Psychological Testing (4th Edition). New York: Harper & Row.

Cudeck, R. and O'Dell, L. (1994). Applications of Standard Error Estimates in Unrestricted Factor Analysis: Significance Tests for Factor Loadings and Correlations. Psychological Bulletin, 115, 475-487.

Dasig, D. Jr. (2017). A frontier in organizational and business process innovation in service management through lean six sigma Kaizen project implementation. Journal of Administrative and Business Studies, 3(6), 263-283.

Desta, A., Asgedom, H. B., Gebresas, A., & Asheber, M. (2014). Analysis of Kaizen Implementation in Northern Ethiopia's Manufacturing Industries. International Journal of Business and Commerce, 3(8), 39-57.

Erez, A. (2016). The role of Kaizen in creating radical performance results in a logistics service provider. Log Forum, 12.

Ethiopian Herald (2016). Kaizen in Ethiopia. (http://www.ethpress.gov.et/herald/)

Ethiopian Kaizen Institute (2012), "Quality and Productivity Change Movement", Vol. I.

Ethiopian National Planning Commission. (2016). Growth and Transformation Plan II 2015/16-2019/20. Addis Ababa, Ethiopia.

Ethiopian News Agency (2016). Japan Brings Kaizen Philosophy to Ethiopia, Addis Ababa.

Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., and Strahan, E.J. (1999). Evaluating the Use of Exploratory Factor Analysis in Psychological Research. Psychological Methods, 4 (3), 272-299.

Gidey, E., Beshah, B., & Kitaw, D. (2014). Review on the Evolving Relationship between Quality and Productivity. *International Journal for Quality Research*, 8(1).

Gordian, S. B. (2016). Improving Public Service Delivery in Tanzania through Kaizen: A Review of Empirical Evidence. Business Education Journal. 1(2), 1-21.

Hair, J. F., Black, B., Babin, B., & Anderson, R. E. (2010). Multivariate Data Analysis. 7th edition Pearson Prentice Hall. Upper Saddle River, NJ.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). Multivariate Data Analysis. 7th Pearson New International Edition.

Imai, M. (1986), Kaizen: The Key to Japan's Competitive Success, McGraw Hill, New York, USA.

Imai, M. (2001). Gemba Kaizen: A Common Sense, Low-Cost Approach to Management. Singapore: McGraw-Hill Book Co.

Jadhav, G. S., Jamadar, V. M., Gunavant, P. S., & Gajghate, S. S. (2014). Role of Kaizens to Improve Productivity: A Case Study. In Applied Mechanics and Materials, 592, 2689-2693.

Kathuria, R., Partovi, F. Y., & Greenhaus, J. H. (2010). Leadership practices, competitive priorities, and manufacturing group performance. International Journal of Operations & Production Management, 30(10), 1080-1105.

Khan I. A. (2011), "Kaizen: The Japanese Strategy for Continuous Improvement", VSRD International Journal of Business & Management Research, 1(3), 177-184.

Kholif, A. M., Abou El Hassan, D. S., Khorshid, M. A., Elsherpieny, E. A., & Olafadehan, O. A. (2018). Implementation of Model for improvement (PDCA-cycle) in dairy laboratories. Journal of Food Safety, 38(3), 2451.

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and Reliability of Measurement Instruments Used in Research. American journal of health-system pharmacy, 65(23), 2276-2284.

Kucerova1, M., Mikva, M., and Gejgus, J. (2015). Eliminating Waste in the Production Process Using Tools and Methods of Industrial Engineering. Production Engineering Archives, 9(4), 30-34.

Lidia, W. (2011). Kaizen and Organizational Culture in Manufacturing Firms in Kenya. Nairobi University (Unpublished Master's Thesis). Accessed in February 2017.

Lina, L. R., and Ullah, H. (2019). The Concept and Implementation of Kaizen in an Organization. Global Journal of Management and Business Research, 19 (1), 9-17.

Mandwe, P. (2013). Productivity Improvement of the Crankshaft. Scientific & Technology Research, 2(7), 207-209.

Miller, J. G., & Roth, A. V. (1994). A Taxonomy of Manufacturing Strategies. Management Science, 40(3), 285-304.

Mishra, S., & Gupta, A. (2010). Kaizen Culture: Enabling Organizational Change Management for Sustainable Competitive Advantage. Global Journal of Enterprise Information System, 2(2), 58-67.

Mohamad, M. M., Sulaiman, N. L., Sern, L. C., & Salleh, K. M. (2015). Measuring the validity and reliability of research instruments. Procedia-Social and Behavioral Sciences, 204, 164-171.

Monga, R. C. (2000). Managing Enterprise Productivity and Competitiveness. ILO Working Paper PMD-3.

Nabiilah, A.R., Hamedon, Z., and Faiz, M.T. (2016). Improving Quality of Light Commercial Vehicle Using PDCA Approach. Journal of Advanced Manufacturing Technology, Special Issue, 525-533.

Nguyen, T. L. (2019). STEAM-ME: A Novel Model for Successful Kaizen Implementation and Sustainable Performance of SMEs in Vietnam. Complexity, 2019, 1-23.

Ohno, T. (1988). The Toyota Production System: Beyond Large-Scale Production. Productivity Press, Portland.

Okpala, C. O. R. (2014). Investigation of Quality Attributes of Ice-Stored Pacific White Shrimp (Litopenaeus Vannamei) As Affected by Sequential Minimal Ozone Treatment. LWT-Food Science and Technology, 57(2), 538-547.

Osada, T. (1991). The five S's: Five Keys to A Total Quality Environment (agris.fao.org).

Patel, P.M dan Deshpande, V.A., (2017). Application of Plan-Do - Check - Act Cycle for Quality and Productivity Improvement - A Review. International Journal of Research in Applied Science and Engineering Technology, 5(1), 197 – 201.

Prasha, A. (2017). Adopting PDCA (Plan-Do-Check-Act) cycle for energy optimization in energy-intensive SMEs. Journal of Cleaner Production, 145, 277 – 293.

Rahmanian, F., & Rahmatinejad, Z. (2014). Impact of Kaizen Implementation on Performance of Manufacturing Companies' Staff. European Online Journal of Natural and Social Sciences, 2(3 (s), 1082-1094.

Rewers, P., Trojanowska, J., Chabowski, P., & Żywicki, K. (2016). Impact of Kaizen Solutions on Production Efficiency. Modern Management Review, 21(23 (4)), 177-192.

Rivera, B. R. G., & Cox, J. L. (2008). Job Satisfaction and 5 S KAIZEN–A Good Way to Get Better Productivity, Efficiency, and Uniformity in the Manufacturing and Industrial Sectors. Investigación Administrativa, (101), 7-15.

Roberts, P., Priest, H., and Traynor, M. (2006). Reliability and Validity in Research. Journal of Nursing Standard. 20(44), 41-45.

Robinson, A., (1991). Continuous Improvements Operations: A Systematic Approach to Waste Reduction. Productivity Press, Portland.

Saleem, M., Khan, N., Hameed, S., & Abbas, M. (2012). An Analysis of the Relationship between Total Quality Management and Kaizen. Life Science Journal, 9(3), 31-40.

Seblewongel, H 2015, 'Impact of Kaizen Implementation on productivity and quality improvement: A case study of Almeda Textile P.L.C' Ethiopian Kaizen Institute 2016/2017: Proceedings of Research, Companies' Best Practices

Sharing and Panel Discussions on Kaizen Implementations and Dissemination, Addis Ababa, Ethiopia, May.

Sidhu, B. S., Kumar, V., & Bajaj, A. (2013). The" 5S" Strategy by Using the PDCA Cycle for Continuous Improvement of the Manufacturing Processes in Agriculture Industry. International Journal of Research in Industrial Engineering, 2(3), 10-23.

Singh, J., and Singh, H. (2009). Kaizen Philosophy: A Review of Literature, ICFAI Journal of operations management. 8(2), 51-72.

Skinner, D. (2003). Lean and Clean. A Better Way to Run Sheet Metal Shops, Books Say Snips. Troy, 72(7), 48-56.

Tabachnick, B. G., & Fidell, L. S. (2001). Using Multivariate Statistics, 4th (ed.), Needham Heights. MA: Allyn & Bacon.

Thessaloniki (2006) Kaizen Definition and Principles in Brief: A Concept and Tool for Employees Involvement (www.michailolidis.gr)

Titu, M.A., Oprean, C. and Grecu, D. (2010). Applying the KAIZEN Method and the 5S Technique in the Activity of Post-Sale Services in the Knowledge-Based Organization. Proceedings of the International Multi-Conference of Engineers and Computer Scientists, III. Hong Kong.

Tujuba, R 2016, 'Achievements and Challenges of Kaizen Implementation in Ethiopian Metal Manufacturing Firms: Case Study of Kalit Metal Products Factory' Ethiopian Kaizen Institute 2016/2017: Proceedings of Research, Companies' Best Practices Sharing and Panel Discussions on Kaizen Implementations and Dissemination, Addis Ababa, Ethiopia, May.

Vargas, R.A., Soto, A.C., Gutierrez, C.T., and Ravelo, G. (2018). Applying the Plan-Do-Check-Act (PDCA) Cycle to Reduce the Defects in the Manufacturing Industry. A Case Study. Journal of Applied Science, 8, 1-17.

Venkataiah, C. and Sagi, S. (2012) 'Relationship between kaizen event and perceived quality performance in Indian automobile industry', International Journal of Management and Business Studies, 2(1), 231–463.

Womack, J. P., & Jones, D. T. (1996). Lean Thinking, Simon and Schuster. New York.

Yong, A.G., and Pearce, S. (2013). A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. Tutorials in Quantitative Methods for Psychology, 9(2), 79-94.

Zailani, S., Shaharudin, M. R., & Saw, B. (2015). Impact of Kaizen on Firm's Competitive Advantage In A Japanese Owned Company in Malaysia. International Journal of Productivity and Quality Management, 16(2), 183-210.

Zainudin, A. (2012). Structural Equation Modeling Using Amos Graphic. Shah Alam: Universiti Teknologi Mara Publication Centre (UPENA).

Zikmund, W. G., Carr, J. C., Babin, B., & Griffin, M. (2013). Business Research Methods. 9th edition, Nelson Education, Canada.