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THE EFFECT OF LEAN OPERATIONS IN MANUFACTURING ON FIRM PERFORMANCE: THE CASE OF MANUFACTURING FIRMS IN ACCRA

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Abstract: **This study examined the influence of lean operations on firm performance, considering some business characteristics controlled variables. A correlational design was employed, and a sample of 162 participants were drawn from a targeted research population of beverage manufacturing firms in Accra. Pearson's correlation test and structural equation modelling (SEM) were used to test hypotheses. The study found that lean operations had a positive effect on operational and financial performance but not marketing performance. None of the controlled variables or firm characteristics (i.e. firm size, firm age, operational capital, total asset) had a significant effect on firm performance. The study concluded that firm performance in terms of operational and financial performance improves as lean management enhances in practice. It was recommended that firms should invest more in lean management and train employees to more effectively handle its planning and execution.**

Keywords: **Lean Operations, Lean Management, Firm Performance, Firm Size, Firm Age, Operational Capital, Total Asset.**

I. INTRODUCTION

It is in the interest of all businesses to maximize revenue and profitability over time, but achieving sustained growth in any business is not without effort, especially in competitive markets. Manufacturing companies in particular face numerous challenges and would have to be successful in overcoming these challenges to achieve short- and long-term goals. Supply chain and operations management experts see continuous waste creation as one of these challenges ([1]; [2]). The creation of waste should be a problem to any manufacturing business because waste increases operational cost through its production, elimination, and management [3]. Yet, some commentators [4] have argued that waste is unavoidable in manufacturing and can only be minimized through lean thinking and strategies. Lean operations, in the context of manufacturing, is also termed lean manufacturing [2] and is focused on continuous quality improvement and reduction in waste. Lean management strategies therefore do not eliminate waste in production or operations but also aim at enhancing the quality of products and services in the passing of time. Quality improvement and waste reduction are interrelated processes because the later can facilitate the former leading to business agility. For example, if waste is reduced or avoided in manufacturing company, management would spend little or no time dealing with waste and would focus more attention on quality assurance. This illustration more strongly applies to beverage manufacturing firms that need to avoid or reduce waste to eschew contamination of their products. Clearly, lean operations or management plays a critical role in the successful management of beverage manufacturing firms. Ideally, manufacturing firms gear lean operations towards improving firm performance. This means that lean operations are always expected to improve operational, marketing, and financial performance. Over the years, lean thinking and management in manufacturing firms have been based on common strategies and principles such as the precept of optimizing cost through waste management

and increasing quality through quality assurance procedures [5]. A literature review by [6] has revealed that this and other principles have enabled businesses to enhance performance. Invariably, the majority of studies have confirmed a positive association between lean operations and firm performance ([4]; [6]; [7]). It has however been reported in some studies [7] that manufacturing firms in developing African countries such as Ghana do not consider their characteristics to developing lean management plans and strategies. These characteristics, which include business age, size, capital, and asset size, are said to make a major influence on the effectiveness of lean management planning and execution. If a company has adequate funds, for instance, it can finance an ingenious lean management process and achieve desirable results.

It is argued in this study that one of the best ways to empower beverage manufacturers to take the said characteristics into account in lean management is to provide evidence on how these characteristics influence the relationship between lean management and firm performance. Thus, treating these factors as potential confounders of the relationship between lean management and firm performance in line with [8] is a good way to tell managers how to adapt lean operations (for higher efficiency and performance) based on business conditions. In this study therefore, a unique theoretical stance is applied to control for relevant firm characteristics in testing the influence of lean management on firm performance in Ghana's key beverage firms.

II. LITERATURE

Empirical Review

As indicated earlier, lean operations are based on two purposes, namely to reduce waste and increase quality of products and services. The lean strategy therefore comprises business activities aimed at eliminating waste, at best, and maximising the value of products or services for final consumers. Beverage manufacturing companies are product-oriented and have little to do with services; hence their involvement in lean processes is motivated by their continuous waste creation (which can increase operational cost and mar quality) and customers' continuous demand for quality [9]. Because customer demands are ever-changing, a lean strategy is necessary for a manufacturing business to stick to its promise for customers by maintaining or enhancing customer value in the face of the risks of waste production and high operational cost. In the beverage manufacturing sector, continuous quality improvement is ensured through a resilient Total Quality Management (TQM) process in which departments are synergised to continuously eliminates threats to poor quality delivery. TQM in a typical beverage manufacturing company entails training employees in line with quality standards set, developing a profile of continuous machine and equipment maintenance, adhering to regulatory quality standards, and monitoring production to ensure that quality levels are maintained and if possible augmented ([10]; [1]). The second aspect of lean management, waste elimination, is strongly required in beverage manufacturing as raw materials like barley, wheat, oat, and sugars are highly wasteful. When a business is unable to control wastage of these materials, it incurs high operational cost and thus minimizes profitability. [10] has observed that waste generation can lead to poor quality of products and/or services and consequently does not only increase cost. For instance, improper management of inventory may result in a situation where expired or spoilt raw materials (e.g. wheat, maize, rice) are used in production, thereby set the foundation for poor quality. Waste elimination is the priority of every business and is aimed at avoiding waste of raw materials and existing finished goods [3], [4]). It is rationale for every business to prefer waste elimination to waste reduction as the former is the only way to achieve maximum quality. However, since waste reduction produces better outcomes than failure to control and reduce waste at all, businesses that are financially weak may consider it an applicable option. The logistics management and production teams of a firm have the responsibility to eliminate or reduce waste. In their effort to eliminate waste, they avoid spoilage and expiry of raw materials and finished goods and recycle waste directly generated to earn additional income [11]. In waste reduction, logistics management is intensified or advanced to reduce the amount of raw materials and finished goods that go bad (when spoilage cannot be completely avoided) and the cost incurred in waste disposal is reduced through basic or high-tech recycling [10]. A business, regardless of where it is found, operates to serve customers with some products and services and in this process makes some financial returns. Businesses operate under the principle that customers deserve the best possible quality [4], which offers the highest customer value. As a result, a beverage producing company employs the best possible human resources, technologies, and raw materials to produce and deliver the highest possible quality of products. In deploying the foregoing resources, adequate funds must be spent. That is, lean operations associated with a business requires adequate expenditures and funding. Resources in this regard are spent by the business in the expectation that products will be purchased, leading to profitability. Customers also spend money to consume beer owing to the value they know the product offers them.

Apparently, the firm and customer spend something to gain something in return, a scenario that explains the social exchange theory (SET) formulated by George Homans in 1961.

Because customers are willing to pay for the best quality products, the effectiveness of lean operations would affect the quality of products produced, the level of sales made, and consequently profitability. As mentioned earlier, lean operations directly impact product quality through its quality improvement and waste reduction programs provided it employs the right amount of resources. From this perspective, lean operations (whose outcomes depend on resources deployed in the form of money, technologies, people, and innovation) can make a positive influence on firm performance. This idea is rooted in the Resource-Based View (RBV) of the firm, which contends that the effectiveness of business operations depends on availability of requisite resources. With the above thinking having empirical backing from other studies ([9]; [1]; [2]), though in different sectors and jurisdictions, the current study tests the following principal hypotheses:

H1a *- Lean operations are significantly associated with firm performance in terms of operational performance*.

H1b *- Lean operations significantly influence firm performance measured in terms of marketing performance.*

H1c *- Lean operations significantly influence firm performance measured in terms of financial performance.*

Theoretical Review

As cited by [12], good research should be grounded in theory [13]. The Resource-Based View (RBV) of the firm is a theory that contends that availability of relevant resources and their judicious use influence the firm's ability to meet its goals, which include the delivery of the best possible quality products. The Dynamic Capabilities Approach (DCA) is also a theory used to explain the need for a business to have the ability to creatively blend resources in a manner that engenders the highest possible outcomes. The DCA, which is sometimes seen as a variant or complement to the RBV, also argues that business activities are more likely to result in productivity when the firm has the capacity to blend its resources (money, personnel, and other asserts) to meet goals in response to competition in the market. Waste management and reduction requires the deployment of resources in the form of funds and personnel, which means that the effectiveness of lean operations in manufacturing firms is more likely to increase with increasing access to relevant resources. If so, operational capital and total asset available to the business can predict lean operations and therefore firm performance. This thinking is backed by some studies ([11]; [2]), as a result of which the following hypotheses are verified in the current study:

$\boldsymbol{H_2}$ *– operational capital makes a significant influence on lean operations so that the later improves as operational capital increases*.

$\boldsymbol{H_3}$ *– total asset makes a significant influence on lean operations so that the later improves as total asset increases.*

Firm size is defined as the size of the firm's asset and personnel [4]. Usually, the firm size is positively associated with total asset and operational capital because the number of employees and level of assets a firm has is an indicator of business worth. Large businesses are more capable of securing assets and paying a relatively large number of employees. Since personnel and assets are directly used by the firm to facilitate lean operations, firm size can also be significantly associated with lean operations. Firm age is also an indicator of business experience because businesses only succeed and survive in the market for a long time when they have both the relevant resources as well as dynamic capabilities to utilise the resources available to achieve business goals, which include the delivery of quality services and the reduction of waste [5]. This reasoning connotes that the firm is more likely to champion a productive lean strategy and process when it is characterised by significant experience, which is a function of business age. This study therefore tests the following final sets of hypotheses:

$\boldsymbol{H_4}$ *– firm size makes a significant influence on lean operations so that the later improves as firm size increases*.

$\boldsymbol{H_5}$ *– firm age makes a significant influence on lean operations so that the later improves as firm age increases.*

III. METHODOLOGY

This study employed a cross-sectional correlational design, which is the most suitable for testing non-causal relationships or hypotheses. The population of the study was employees of some manufacturing firms in Accra, namely Accra Brewery Limited (ABL), Guinness Ghana Breweries Limited (GGBL), Coca Cola Bottling Company Ghana Limited (CCBCGL), and Kasapreko Ghana Company Limited (KPCL). Based on [8], the following selection criteria were applied to select

members of the target population: being a permanent worker who had worked in the companies for at least a year; (b) being a manager who was involved in the lean activities of the company for at least a year; and (c) having the ability to write and read in English, which was the medium in which questionnaires were administered. Having a basic education was the yardstick for selecting those with the ability to write and speak English. The numbers of employees who met these criteria at the various firms are as follows: ABL – 47; GGBL – 51; CCBCGL – 45; and KPCL – 36. The theory of [8] was further considered to select members of the accessible population. In this vein, members of the target population who were not willing to participate or will not be available to participate were excluded, which led to the accessible population comprising: ABL – 43; GGBL – 47; CCBCGL – 40; and KPCL – 32. The total accessible population of the study was therefore 162. All members of the accessible population were made to participate in the study to maximize statistical power. The main variables of this study were lean operations and business performance. Lean operations (in manufacturing) was measured using a 9-domain scale borrowed from [1], whereas business performance was measured in terms of operational, financial, and marketing performance in accordance with [3]. These scales were chosen because they are referred to as the standard measures of lean operations and business performance. Moreover, they have produced satisfactory psychometric properties in previous studies ([1]; [3]). Even so, both scales were validated based on a procedure demonstrated elsewhere [14]. Tables 1 and 2 show results of this validation. Other variables measured were the control variables, which are firm size, operational capital, asset size, and firm age. Firm size was the number of employees of the company, and operational capital was measured in terms of the total amount disclosed by the companies as operational capital. Asset size was the active asset of the business, whereas firm age was the number of years the company had been in business.

Table 1: Reliability and validity statistics of the measurement scales

Construct	Domain	Cronbach alpha	Average variance estimate	Mean shared squared variance	Average shared variance
Firm performance	Factor 1	0.911	0.741	0.111	0.056
	Factor 2	0.903	0.734	0.110	0.056
	Factor 3	0.900	0.732	0.109	0.055
Lean operations	Factor 1	0.892	0.725	0.109	0.055
	Factor 2	0.910	0.740	0.111	0.056

Table 2: Model fit indices

Model	$\chi 2$	p	RMSEA	TLI	GFI	AGFI
1 (Measurement model for firm performance)	132.11	0.211	0.022	0.978	0.955	0.962
2 (Measurement model for lean operations)	162.09	0.301	0.019	0.981	0.969	0.977
3 (Structural model)	109.01	0.192	0.031	0.967	0.921	0.938

Note: RMSEA = Random Mean Square Error of Approximation; TLI = Tucker-Lewis Index; GFI = Goodness-of-Fit Index; AGFI = Adjusted Goodness-of-Fit Index

In Table 1, the Average Variance Estimate (AVE), Maximum Shared Squared Variance (MSV), and Average Shared Squared Variance (AVS) were estimated and used as indicators of scale validity, whereas Cronbach's alpha (CA) measures scale reliability. It can be seen from Table 1 that each domain of had a CA greater than or equal to 0.7. Based on popular studies [15], this result confirmed reliability of the measurement scales. Moreover, the AVE≥0.5, MSV<AVE, and ASV<AVE criteria recommended and applied by researchers [14] were met. Validity of the measurement scales was therefore confirmed. All items were parcelled or added up to generate the variables lean operations and firm performance. Based on previous studies ([16]; [14]), the three models in Table 3 yielded a good fit because they met the following criteria with respect to the absolute fit indices: p >0.05; RMSEA <.08; TLI >.90; GFI >.80; and AGFI >.90. This outcome provides a good basis for testing the study's hypotheses.

Data was gathered using a self-reported questionnaire delivered in hand at the premises of the chosen firms. Before administering questionnaires, management of the firms had to approve the study and made way for data collection. The date for administering questionnaires was determined by management. Four field assistants were hired to support the researcher in the distribution and retrieval of questionnaires. It took about 30 working days to complete data collection. Out of 162 questionnaires administered, 156 were returned but 4 were discarded because they contained major response

errors. Thus, 152 questionnaires were analysed. Data analysis started with coding. Data (indicators) on the control variables was provided by appropriate offices in the four companies. Since data on the control variables should remain the same across respondents in the same company, the indicator taken from the company was assigned (in coding) to all participants from that company. IBM SPSS 24 and AMOS 8 were used to present findings. Descriptive statistics were used to summarize the data. The z-score procedure was used to look for outliers, but no outlier was found in the process. Normality of data was assumed, and the Shapiro-Wilk's test was conducted to confirm normality of the data. Pearson's correlation test, confirmatory factor analysis, and multiple linear regression analysis were used to present findings. Values at p <.05 were considered statistically significant.

IV. FINDINGS

Findings

This section presents findings of the study. In this vein, Table 3 shows the correlation matrix of all variables, while Table 4 exhibits the regression and SEM coefficients, which represent the relevant effect sizes.

Table 3: Correlation Matrix

Variable	No.	1	2	3	4	5	6	7	8
Lean operations	1	1	.353**	0.128	.334**	.183*	.179*	0.098	.209**
Operational performance	2		1	.558**	.620**	.323**	.188*	0.052	0.044
Marketing performance	3			1	.641**	0.075	0.076	.210**	0.062
Financial performance	4				1	.195*	-0.022	-0.002	-0.04
Firm size	5					1	.259**	.298**	.185*
Firm age	6						1	.325**	.324**
Operational capital	7							1	.338**
Asset size	8								1

**p<.0001; *p<.05.

Table 3 shows the correlation between relevant variables. In the table, lean operations is positively correlated at 1% significance level to operational performance (r = 0.353, p = 0.000, two-tailed) and financial performance (r = 0.334, p = 0.000, two-tailed) but not marketing performance (r = 0.128, p >0.05, two-tailed). That is, operational and financial performance, but not marketing performance, increase when lean operations improve. Asset size is also positively correlated with lean operations at 1% significance level (r = 0.209, p = 0.000, two-tailed), and lean operations is positively correlated with firm size (r = 0.183, p < 0.05, two-tailed) and age (r = 0.179, p < 0.05, two-tailed) at 5% significance level. Lean operations do not correlate significantly with operational capital (r = 0.098, p >0.05, two-tailed). Based on these correlations, the hypotheses are tested as follows.

Table 4: SEM coefficients

DV	Path	Predictor	Unstandardized B	Standardised β	S.E.	t	p
LO	<---	Firm size	0.646	0.137	0.398	1.623	0.105
LO	<---	OC	-0.230	-0.030	0.678	-0.339	0.735
LO	<---	Firm age	0.882	0.102	0.754	1.171	0.242
LO	<---	Asset size	0.743	0.163	0.396	1.877	0.061
OP	<---	LO	0.196	0.351	0.042	4.643	***
MP	<---	LO	0.069	0.127	0.044	1.587	0.112
FP	<---	LO	0.242	0.331	0.055	4.355	***

***p<.0001. Note: LO = lean operations; OP = operational performance; MP = marketing performance; FP = financial performance; OC = operational capital DV = dependent variable

In Table 3, lean operations make a positive influence on operational performance at 1% significance level (β = 0.351; t = 4.643; p = .000). Lean operations also make a positive influence on financial performance (β = 0.331; t = 4.355; p = .000) but not marketing performance (β = 0.127; t = 1.587; p = .112) at 1% significance level. These findings confirm that

operational and financial performance increases when lean operations improve. Interestingly, none of the firm characteristics makes a significant influence on lean operations. So, hypothesis 1a and 1c are supported by the data.

V. DISCUSSION

After controlling for the relevant confounding variables, this study found that lean operations make a positive effect on firm performance in terms of operational performance in the manufacturing firms. This means that operational efficiency and effectiveness increases when lean operations management improves in practice. This outcome supports the study's theoretical position, which suggests that lean strategies and activities aim to reduce waste and increase quality, a goal that basically contributes to the firm's ability to meet customer needs and therefore operational goals. This result is also in line with some previous studies ([9]; [1]; [4]; [11]), through these studies were conducted outside Ghana. The implication of this result is that the process of waste removal or reduction and quality improvement in beverage manufacturing does not only affect product quality but also operational efficiency. This is the case because product quality can maximise sales and revenues, part of which can support operational activities. Moreover, waste reduction saves cost and labour and therefore adds to operational efficiency. Interestingly, lean operations do not make any significant effect on marketing performance, which means that hypothesis 1b is not supported by the data. The researcher believes strongly that this outcome may be due to the relatively small sample size used as most previous studies ([3]; [1]) reached findings that disagree with the current evidence. Even so, a way to argue this current result is that lean operations management in the firms do not predict marketing performance because it is not properly designed and aligned with marketing goals such as the delivery of quality brands. It could be that the manufacturing firms focus more on waste reduction and fails to provide the necessary quality that drives revenue, market performance, and growth. This reasoning is supported by [6] who observed that lean operations in Ghana are focused on waste reduction. Given this result, the firms would have to strike a balance between quality improvement and waste reduction in their lean operation practices. Furthermore, future researchers would have to consider applying larger samples to reach the ultimate effect of lean operations on marketing performance. Lean operational activities in the beverage manufacturing firms were also confirmed to make a positive effect on financial performance. To explain this, financial performance of the firms increases as lean operations improve in practice. This result is supported by most studies ([6]; [1]) in the literature and affirms the argument that the study's small sample size must have led to failure of lean operations to predict marketing performance. The import of this reasoning is that financial performance is unlikely to improve if lean operations do not lead to higher revenue and market performance. In any case, the current study indicates that lean operations can enable the firm to augment its financial position owing to the fact that its activities save cost through waste reduction and increases revenues by producing quality products. The beverage firms can thus improve their competitiveness and financial advantage if they invest more resources in line with the RNV and DCA in lean operations management. Yet, resources must be spent in moderation as excessive spending can reduce net profit and financial returns.

It is also interesting to have found that none of the firm characteristics influenced lean operations are theorised earlier in this paper. This outcome can be blamed largely on the small sample size applied in this study, but of course, not all previous studies that used large sample sizes confirmed their influence on lean operations ([3]; [5]) In the study of [1], for example, business age and size did not make any influence on lean operations through a larger sample size was used. More recently, a systematic review [2] also suggested that operational capital and asset size do not predict lean operations in studies that used large samples. For this reasons, failure of the firm characteristics to predict lean operations cannot be necessarily attributed to the relatively small sample size used. Moreover, this result does not discredit the RBV and DCA and this study's adaptation of these theories. If so, beverage manufacturers can certainly benefit higher agility and performance if they have access to requisite resources and sieve the ability to blend the resources in an innovative and cost-effective fashion.

VI. CONCLUSION

The study found that lean operations have a positive influence on operational performance, which means that operational performance in the beverage companies would improve when lean operations are enhanced in practice. It is therefore concluded that improving lean management by investing more in it and training employees to more effectively handle its planning and execution can engender operational efficiency in the beverage firms. The study also found that lean management makes a positive influence on financial performance. That is, increasing lean management can cause an increase in financial performance. If so, increasing the effectiveness of lean operations as suggested above can offer the companies higher profitability. This study however did not confirm the relationship between lean operations and

marketing performance. Moreover, none of the covariates or confounding variables influences lean operations, but these outcomes could be attributed to the use of a relatively small sample. Given the findings reached, this study concludes that lean management best predicts operational and financial performance of the firm in the beverage manufacturing industry.

Limitation and Future Research

This study controlled for firm characteristics that underpin the study population, which is to say that the current study does not necessarily control for lurking variables relevant to all populations. For this reason, the effects estimated in this study do not represent causation but the influence of the independent variable on the dependent variable. Future researchers are as a consequence required to capture all confounding variables relevant to their populations. Another limitation of this study was the fact that not many employees participated in this study, which led to the use of a small sample. The relatively small sample used could affect the significance of effects. Future researchers are therefore encouraged to apply larger samples.

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