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University of Ghana
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University of Ghana
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The Effect of Kaizen on Performance: Evidence from Manufacturing Enterprises in Ghana

Richmond Atta-Ankomah[1] · **Johnson Appiah Kubi**[2] · **Charles Godfred Ackah**[1]

Abstract

Between 2012 and 2017, a number of manufacturing enterprises of varying sizes in Ghana participated in a programme that trained and guided them to implement Kaizen practices with an objective of improving their productivity and performance. This study sought to evaluate the impact of the programme by mainly using the difference-in-difference method. The results show that the programme led to a positive and significant impact on firm performance, particularly with respect to sales and profits, and for some of the firms, an improvement in labour productivity as well. We found further that whether a firm experienced this impact appears to depend on the size of the firm and the calibre of the consultant who delivered the training. The findings generally suggest that an extensive promotion of Kaizen as a management technique among a broad spectrum of manufacturing enterprises could yield substantial benefits for the enterprises and the national economy.

Keywords Kaizen · Manufacturing enterprises · Firm performance · Firm size · Caliber of kaizen trainer

Résumé

Entre 2012 et 2017, un certain nombre d'entreprises manufacturières de tailles différentes au Ghana ont participé à un programme qui les a formées et guidées pour mettre en œuvre la méthode Kaizen dans le but d'améliorer leur productivité et leur performance. Cette étude visait à évaluer l'impact du programme en utilisant prin-

✉ Richmond Atta-Ankomah
attasnr@gmail.com

Johnson Appiah Kubi
appiahkubijw@yahoo.com

Charles Godfred Ackah
akaobo@yahoo.com

1 Institute of Statistical, Social and Economic Research, University of Ghana, Legon, P. O. Box LG 74, Accra, Ghana

2 Centre for Migration Studies, University of Ghana, Legon, Accra, Ghana

cipalement la méthode des différences de différences. Les résultats montrent que le programme a eu un impact positif et significatif sur la performance de l'entreprise, en particulier en matière de ventes et de bénéfices, et certaines enterprises ont également vu une amélioration de la productivité du travail. Nous avons en outre constaté que le fait qu'une entreprise ait bénéficié de cet impact semble dépendre de la taille des entreprises et du niveau de la personne qui a dispensé la formation. De façon générale, les résultats suggèrent qu'une promotion à grande échelle de la méthode Kaizen en tant que technique de gestion au sein d'un large éventail d'entreprises manufacturières pourrait générer d'importants avantages pour les entreprises et pour l'économie nationale.

Introduction

Various attempts by the government of Ghana at industrialisation, since political independence over 60 years ago, have not yielded any significant results (Osei et al. 2020). This is reflected in the fact that the level of labor productivity in Ghana's manufacturing sector has remained stymied and lowest after agriculture (Atta-Ankomah and Osei, 2021). Consequently, the country continues to substantially depend on importation for manufactures with major implications for balance of payments, exchange rate stability as well as the nature and pattern of structural change (Osei and Jedwab 2016; Ackah et al. 2014). Often, the search for solutions and the prescribed solutions to this industrial development quagmire tend to focus more on economywide challenges that affect productivity and firm performance. However, internal constraints particularly those bothering on organisational and managerial capacity and firm-level innovation are also important (Nemlioglu and Mallick 2017; Manley and Mcfallan 2006). Indeed, the literature shows that these internal management and organisational constraints including those relating to the social structure within which production occurs are key to explaining productivity differentials across firms (even among those in narrowly defined sectors), industries and countries (Caselli and Gennaioli 2013; Bloom and Van Reenen 2007; Schmenner and Swink 1998; Kaplinsky 1995).

The answer to Ghana's struggling manufacturing sector may, therefore, partly lie in solutions that address within-firm constraints to firm productivity and performance in addition to efforts at addressing economywide challenges to productivity growth and structural transformation. In line with this view, the Japanese International Development Cooperation Agency (JICA) collaborated with Ghana's National Board for Small Scale Industries (NBSSI) on a programme which trained and guided a number of manufacturing firms in Ghana to adopt Kaizen practices between 2012 and 2017. The main aim of the programme was to help the firms address internal managerial and operational issues that stifle productivity and performance.

This article investigates the impact of the programme on the performance and productivity indicators of the manufacturing enterprises that received the training on Kaizen and implemented the Kaizen practices. More crucially, we test two additional hypotheses, namely: (1) the effect of the programme on performance and productivity depends on the size of the firm and (2) the effect of the programme depends on

the calibre of the consultants/trainers who delivered the training to the firms and guided them to adopt the practices. Mainly applying difference-in-difference (DID) method on 184 manufacturing firms, this article shows that the programme led to a significant and positive impact on firm performance, particularly on their sales and profits, and for some of the firms, an improvement in labor productivity as well. Also, the results show that whether a firm experienced this impact may depend on the size of the firm and the calibre of the trainer.

This article contributes to the literature on the impact of Kaizen on manufacturing enterprises in Ghana and generally in Africa, where research on Kaizen is still at the early stages. In Ghana, there appears to be only a few existing studies (e.g. Ackah et al. 2020; Mano et al. 2012) on Kaizen and none of them explores how firm size and the calibre of the Kaizen trainer matters to the impact of adoption. Moreover, unlike Mano et al. (2012) which focuses on micro-size fabricators in a single cluster in one administrative regional capital in Ghana, this article provides broader insights into the likely effect of Kaizen on firm performance because it covers firms from several manufacturing industries of varied sizes and from several locations. While there is a growing body of literature (such as Marín-García et al. 2018; Suárez-Barraza and Ramis-Pujol 2010; Withanachchi et al. 2007) on Kaizen in other developing and emerging economies, particularly in Asia, many of these studies used case study, qualitative, or operations research methodologies, usually involving either a single firm or only a few firms. These studies also do not clearly offer empirical insight into the importance of firm size and the calibre of the Kaizen trainer to the impact on the adopter's productivity and performance.

The remainder of the article is organised as follows: Section Two presents a literature review, while Section Three provides information about the nature of the Kaizen programme in Ghana. Section Four discusses the data and analytical method used. Section Five presents the results and discussions, while Section Six provides a conclusion.

Literature Review: Kaizen and Firm Performance

Kaizen has been variously defined in the literature.[1] An extensive review of the existing definitions by Suárez-Barraza et al. (2011) shows that the definitions vary depending on the emphasis placed on the nature of improvement that can be achieved under Kaizen (that is, from incremental to radical), whether Kaizen could be seen as an element in other operational management systems such as Total Quality Management (TQM) as well as whether it could be viewed as a management philosophy or even as a philosophy of life. Unsurprisingly, the definition and the

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[1] Examples of Kaizen definitions include: (1) Kaizen is "a means of continuing improvement in personal life, home life, social life, and working life. At the workplace, Kaizen means continuing improvement involving everyone – managers and workers alike" (Imai, 1989, cited in Suárez-Barraza et al., 2011, p. 289); (2) Kaizen is "A host of continuous activities in which those involved play specific roles for identifying and ensuring improvements that contribute to corporate goals" (Brunet and New 2003, p. 1428).

practice of Kaizen usually tend to be context specific but often with a high degree of similarities (Brunet and New 2003).

Suárez-Barraza et al. (2011) show that two broad variants of Kaizen as a concept can be found in the literature, namely; the Japanese Kaizen, and the Western Kaizen (also referred to as 'continuous improvement'). The Japanese variant largely emphasises Kaizen as a management philosophy, while the Western variant tends to project Kaizen more as an element in other management approaches and a theoretical principle for improvement technologies to eliminate waste (Suárez-Barraza et al. 2011). As a management philosophy, Kaizens entail three key principles, proposed by Berger (1997) based on his insights from an earlier work by Imai (1986), the coiner of the term. These principles include: (1) Kaizen is process oriented, requiring that processes must be improved before results can be improved; (2) Kaizen should emphasise continuous maintenance and improvement in work standards, which with innovation, can lead to lasting improvements; (3) Kaizen is people oriented, and hence, should involve everyone in the organisation.

While Kaizen is generally transferable to any context (Yokozawa and Steenhuis 2013; Aoki 2008; Kaplinsky 1995), the literature reiterates several conditions for effective adoption. Adoption can be moderated by constraints around the quality of social and economic infrastructure as well as the level of human capital development (Kaplinsky 1995). At the micro level, the commitment of the top management of the adopting firm, good communication among workers, the presence of a 'Kaizen Champion', continuous training of workers are among the crucial factors (Ishigame 2020; Maarof and Mahmud 2016; Recht and Wilderom 1998). Several other studies such as Suárez-Barraza and Miguel-Davila (2020), Vento et al (2016), García et al (2014) and Doolen et al (2008) stress the importance of management commitment and communication for a fruitful adoption of Kaizen. Also, the level of adoption of Kaizen and related practices can vary by firm size (see Sugimoto 2018; Kumar and Antony 2008; Powell 1995; Fisher 1993).

Whether based on the Japanese or the Western variant, the empirical literature show that Kaizen can substantially improve firm performance and many aspects of business operations, particularly if it is effectively adopted (see Ishigame 2020; Katai 2020, Yadav et al. 2019; Marín-García et al. 2018; Kumar et al. 2018; Jiménez et al. 2015; Arya and Jain 2014; Panizzolo et al. 2012; Suárez-Barraza and Ramis-Pujol 2010; Puvanasvaran et al. 2010; Withanachchi et al. 2007; Bassant 2000; Brunet and New 2003; Cheser 1998). Cheser's (1998) study, for example, found the adoption of the Japanese variant of Kaizen to be associated with a significant rise in motivation among staff in US manufacturing companies. Similarly, Suárez-Barraza and Ramis-Pujol (2010) in a case study of a Mexican public organisation found that the use of Lean-Kaizen helped the organisation to improve cycle times in human resource selection and hiring process. A more recent study by Kumar et al. (2018) also showed that Kaizen led to improvement in productivity and other performance indicators in a case study of selected small and medium size enterprises in India. In another case study, involving seven suppliers in South Africa's automotive industry, Ishigame (2020) also found that Kaizen led to improvement in quality and the enterprises' productivity.

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Although the empirical literature on Kaizen continues to expand (see Álvarez-García et al. 2018), many of the existing studies including those cited above used case study or operations research methodologies and are predominantly based on developed and emerging economies of Asia and Southern America. Empirical research on Kaizen using impact evaluation methods are less common. However, the few existing ones (such as Ackah et al. 2020; Higuchi et al. 2015; Mano et al. 2014, 2012) show a positive impact of Kaizen on firm performance and productivity. For instance, Mano et al (2014) found a positive effect of Kaizen on profits of firms in a metalworking cluster in Nairobi, Kenya, arguing that Kaizen led to reductions in waste and production costs. Higuchi et al. (2015) used a randomised control trial (RCT) approach to evaluate the impact of Kaizen training on small manufacturers in two study sites in Vietnam. Their findings show that the training increased the value added of participants in one of the sites where the participants managed to learn how to significantly reduce waste in production. Similarly, Ackah et al. (2020) found a positive impact of Kaizen on the performance of manufacturing enterprises in Ghana using a propensity score matching method.

With the same data used in Ackah et al. (2020) which involves a wide array of manufacturing enterprises in Ghana, this article builds on the literature by first examining the impact of Kaizen on firm performance in Ghana using the DID method. Second and more distinctively, we show empirically whether the impact of Kaizen may depend on the size of an enterprise as well as the calibre of the training consultant who guided the firm to adopt Kaizen. It appears the existing empirical literature has not clearly explored the moderating effect of firm size on the effect of Kaizen on performance, although (as noted earlier) there are indications that the level of adoption of Kaizen can vary by firm size. The empirical literature also appears silent on the effect of the calibre of personnel/consultant who delivers the training and guides the adopters to implement the practices.

The Kaizen Programme in Ghana

The Ghana office of the Japanese International Cooperation Agency (JICA) in collaboration with Ghana's National Board for Small Scale Industries (NBSSI) implemented a programme which trained and helped some manufacturing enterprises in Ghana to adopt Kaizen management practices. This programme was carried out in four of the then 10 administrative regions of Ghana (Ashanti, Northern, Brong Ahafo and Central regions). The participants were taken through Basic Kaizen practices such as 5S (sorting, setting, shining, standardising and sustaining), waste reduction techniques, visualisation, stock control, petty cash book keeping, recording of sales and accounts receivable and payables, among many others. The intervention was piloted in the Ashanti region between 2012 and 2014, after which it was expanded with more firms in Ashanti region being trained in 2015 and those in

Northern, Brong Ahafo and Central regions receiving the training in 2016, 2017 and 2018, respectively.[2] Thus, a key feature of the programme is that the participants did not enrol in the programme at the same time or in the same year.

There are also several additional features of the programme that are worth mentioning because they have implications on how the impact of the programme on the performance indicators should be modelled. In particular, they may emphasise the need to account for unit-specific unobserved heterogeneity in addition to the unobserved heterogeneity across treated and untreated firms. First, the programme initially involved Japanese experts on Kaizen who were engaged to deliver the training and practical guidance to the firms to implement the Kaizen practices. NBSSI officials were attached to the Japanese experts to learn about how to independently deliver Kaizen training to clients in the absence of the Japanese experts (that is, *self-implementation* by NBSSI). This was done largely to ensure that there was continuity or sustainability of the programme after the Japanese experts have left. In fact, between 2015 and 2017, the NBSSI independently trained many enterprises with no direct involvement of the Japanese experts.

Second, the firms that participated in the programme were of varied sizes which allows us to examine whether the impact varies by firm size. The motivation for this analysis is underpinned by the fact that the level of adoption of Kaizen practices can vary by firm size, as noted in Section Two. A potential reason for this is that the application of some elements of Kaizen may not be supported by the capability of every firm, which tend to vary by firm size (Sugimoto 2018; Kumar and Antony 2008). Indeed, our interactions with NBSSI officials showed that the implementation of some of the Kaizen practices required investments or expenses that the status quo mode of operation did not call for. Hence, the implementation of those practices would depend on whether the firm is able to bear the expenses and/or the commitment of management. It is therefore reasonable to think that not all the elements of the Kaizen introduced to the manufacturing firms would be applied by each one of them during implementation. Consequently, the size of the firm (defined with respect to the number of people employed by the firm) could be correlated with the treatment variable.

Third, our interactions with the NBSSI indicated that the enterprises were recruited into the programme mainly through invitation from the NBSSI although a few others approached the NBSSI on their own. Following the invitation or the initial contact, each enterprise had to meet a set of assessment criteria, of which the details can be found in the assessment sheet provided in Table 4 in the "Appendix" section, before they were admitted into the programme.

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[2] Note that no firm in the Central Region was included in the survey because the data collection was done at end of 2017 before the programme started in the Central Region in 2018.

Data and Analytical Approach

Data

The data for this study were collected between October 2017 and December 2017. We sought to interview all the firms that had received the training and were already implementing the practices at the time of the data collection. This list of enterprises was obtained from the NBSSI. Let us note, however, that because these firms were admitted into the programme in different years, most of them actually served as control or comparison firms until the year in which they were admitted into the programme.

The NBSSI also provided us with a list of enterprises that had been pre-qualified for training in Ashanti Region, Brong Ahafo Region and Northern Region but had not yet received the training or had just received training but were yet to start actual implementation of the practices. We made an effort to interview these firms in order to include them in the control or comparison group—these firms are considered as never treated in relation to the period of time used for the evaluation. We adopted this approach mainly because the programme was not originally designed to allow an impact assessment through the RCT method. However, because all the firms had to meet a set of assessment criteria for admission into the programme, both treated and untreated firms may share some common characteristics, particularly with respect to the issues considered in the assessment criteria. This, however, may not adequately address the implications of the non-random enrolment into the programme on estimating the casual effect of the programme.

Although, the survey was conducted in a one-time period, we collected information on performance and input variables such as annual sales, annual value of production, number of employees per year as well as annual input indicators from 2011 (that is, a year before the programme started) to 2017. A total of 184 enterprises were interviewed from the three administrative regions—Ashanti Region, Northern Region and Brong Ahafo Region – where Kaizen had been introduced. This number consist of 98 firms that had been treated at the time of the survey and 86 firms that had not been treated. In terms of regional breakdown, there were 110 enterprises in the Ashanti Region (with 64 treated firms), 45 in the Northern Region (of which 22 were treated) and 29 in the Brong Ahafo. All the enterprises in Brong Ahafo were considered as not treated—14 of these enterprises had just received the training at the time of the survey and were yet to start implementation of the practices, while the remaining 15 had only been pre-qualified to receive the training. All the respondents held top managerial positions: A closed ended question about the position of the respondents showed that 65% were the president or chief executive officers of their firm, 17% held the position of general managers, 9% were production managers and the remaining 9% held other top managerial positions.

Econometric Model and Estimation Method

Because we collected information on the outcome variables from 2011 to 2017, we are able to model the effect of the training on the outcome variables using a panel data

framework; specifically, the DID method which may also help to deal with issues with the non-random assignment into the programme. Following this approach, we test the hypothesis that participation in the programme had no statistically significant effect on three key performance indicators; namely, labour productivity measured by output per worker, sales and profit. To do this, we consider the following model:

$$y_{it} = c_g + \delta_i + \lambda_t + \tau w_{it} + X_{it}\gamma + u_{it}, t = 1, \ldots, T \tag{1}$$

where y_{it} represents the performance indicator, λ_t captures time effect, c_g is unobserved group effect, w_{it} is the impact variable which equals 1 from the year the firm received the training and started implementing the practices and all the years that follow but zero for all the years before the training and implementation. τ measures the impact of the programme on the outcome variables; specifically, it is the average treatment effect on the treated (ATT). $\boldsymbol{x_{it}}$ is a vector of control variables and u_{it} are the idiosyncratic errors. δ_i is for unit-specific trends and is included to capture the effect of unit-specific unobserved heterogeneity which may be correlated with the treatment variable w_{it}. As explained in Section Three, unit-specific unobserved heterogeneity are likely to be relevant in the model; hence, the inclusion of δ_i.

In addition to the key hypothesis discussed above, we also examine whether the impact of the programme varies by the size of the firm. This is informed by the notion that the treatment or the extent of exposure to the treatment, particularly in terms of the implementation and applicability of the practices, could depend on the size of the firm, as discussed in Sections Two and Three. We therefore use the number of people employed by the firm in the year just preceding the year in which the firm was admitted into the programme to break w_{it} into four distinct impact variables, respectively, for micro-enterprises, small enterprises, medium enterprises, and large enterprises (the definitions of these variables have been provided in Table 1). A similar approach is also used to explore whether being trained by the Japanese experts or by NBSSI personnel made any difference. With information from the NBSSI, we were able to differentiate the firms that were trained by the Japanese from those that were not. The effect by the type of trainer and firm size are modelled separately but the two models generally follow Eq. 2, which is similar to Eq. 1 except that Eq. 2 has more than one impact variable.

$$y_{it} = c_g + \delta_i + \lambda_t + \sum \tau_g w_{git} + X_{it}\gamma + u_{it}, t = 1, \ldots, T \tag{2}$$

Due to the potential effects of unit-specific unobserved heterogeneity,[3] we apply both the Fixed Effects (FE) and the Random Effects (RE) estimators to derive the parameter estimates for Eqs. 1 and 2. The estimation of the models used the cluster-robust variance at the firm level to ensure that the standard errors are robust to heteroscedasticity and serial correlation. This was done because our preliminary

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[3] Our preliminary analysis showed that the unit level unobserved heterogeneity should not be constrained to zero in both the FE and RE models – the results of the Breuch-Pagan LM test for RE models are shown in Table 4 in the "Appendix" section. Hence, regression analysis by ordinary least squares may be inappropriate.

Table 1 Description of variables used in the panel regression models

Variable	Variable name	Description of variables
Outcome variables	Loutputpworker	log of annual output per worker. It was derived by first dividing total value of output by the number of employees and taking the log of this value
	Lsales	log of the value of annual sales
	Lprofit	Log of annual profit
Impact variable, represented as w_{it} in Eq. 1	trt	This variable takes a value of zero for all the years before participating in the programme but one for the remaining years (that is, from the year in which the firm was enrolled in the programme up to 2017). The coefficient of this variable measure the impact of the programme on the performance indicators
Impact variable by type of trainer, represented as w_{git} in Eq. 2	trt_ojt2	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for remaining years and if the firm was trained by the Japanese experts
	trt_ojt3	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for remaining years and if the firm was trained through NBSSI self-implementation
Impact variables by firm size[a]	trt_size2	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for remaining years (that is, from the year in which the firm was enrolled in the programme up to 2017) and if the firm was a micro enterprise in the year immediately preceding the year of enrolment
	trt_size3	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for the remaining years and if the firm was a small size enterprise in the year immediately preceding the year of enrolment
	trt_size4	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for the remaining years and if the firm was a medium size enterprise in the year immediately preceding the year of enrolment
	trt_size5	This variable takes a value of zero for all the years preceding the year of the firm's enrolment into the programme but one for the remaining years and if the firm was a large enterprise in the year immediately preceding the year of enrolment

Table 1 (continued)

Variable	Variable name	Description of variables
Control variables	Lworkers	The log of the number of people employed by the firms in each year and it is the only time varying variable among the control variables used in the regressions
	Male	This takes the value of one if manager of the firm is a male; otherwise zero
	Age	Age of the manager in years
	proficient_eng	It equals to one if the manager reported he is proficient but zero otherwise
	ashantiBA	It equals to one if the firm is located in Ashanti or Brong Ahafo; otherwise zero
	Registered	It takes a value of one if the firm is registered but zero otherwise
	sole_pro	It equals one if the firm is a sole proprietorship but zero otherwise
	Foodind	This equals to one if firm is in food or water industry; otherwise zero
	Metalwork	This equals to one if firm is in fabrication of metals, machine installation industry but zero otherwise
	Riskaverse	This equals one if the manager chooses option 1 but zero if he chooses option 2 from the following: Receive GH¢ 100 for sure (option 1) or flip a coin and receive 0 if it's tail or GH¢ 300 if it's head (option 2)
	Preferstoday	This equals one if the manager chooses option 1 but zero if he chooses option 2 from the following: Receive GH¢1000 today (option 1) or receive GH¢ 1500 for sure one year from now (option 2)

[a]Based on NBSSI's official definition, firms in Ghana are categorised using number of workers as follows: micro (1–5); small (6–29); medium (30–99); and large (100 and above)

analysis showed that u_{it} were both heteroscedastic and serially correlated. We then use the robust version of Sargan-Hansen test of overidentifying restrictions to choose between FE and RE estimators.

We acknowledge here that we are unable to verify whether our empirical strategy fully addresses the potential implication of the non-random selection into the programme. However, we believe that we have adopted one of the 'state of the art' quasi experimental techniques for programme evaluation that can deal with the design limitations of the Kaizen programme in Ghana. Another potential problem was respondents' recall bias regarding the provision of data on activities that had taken place in the past, especially for those who may not have good record keeping practices. Field monitoring by the principal investigators during the data collection, however, showed that record keeping was not a major issue for the majority of the firms involved in the study. Table 1 provides a list of variables and *variable names* used in the analysis and how they were constructed.

Results and Discussion

Descriptive Analysis

The fact that the firms did not enrol in the programme in the same year means that a firm should be considered as part of the untreated group until it is enrolled into the programme. In other words, some of the treated firms also served as control firms for those that had already been enrolled in the programme before they were enrolled. For those that had not been enrolled in the programme by 2017, they remained in the untreated group for the entire period, that is, from 2011 to 2017. Table 2, therefore, compares the treated cases with untreated cases on the outcome variables and the characteristics of the firms/managers, instead of a comparison between those that were treated and those that were never treated. By and large, the treated and untreated cases do not statistically differ on the outcome variables before their enrolment into the programme—the difference in both output per worker and profit is statistically insignificant, while the difference in sales is statistically significant only at 10% level of significance (Table 2). The mean of the outcome variables presented in the table are computed based on the average values for each firm for all the years it was not in the programme. This means that, for the firms that had not been enrolled in the programme by 2017, their average values came from all the years from 2011 to 2017.

For the control variables, which are largely time invariant variables (except in the case of the number of workers), we observe a statistically significant difference between the treated cases and untreated cases with regards to age of the manager, gender of managers, region of location and the registration status of the firms. Also, the treated and untreated cases do not seem to have equal distributions with regards to the specific industries they operate in (Table 2). However, the statistical test of significance shows no difference between the treated and untreated cases on the remaining time invariant variables in Table 2. With respect to the size of

Table 2 Firm/manager's characteristics by whether the firm was treated

Variable type	Variable/description	Untreated cases	Treated cases	t/z statistic	P value
Outcome variables	Average output per worker for the years before treated (in Ghana Cedis)	19,718.52	18,459.62	0.394	0.694
	Average sales for the years before treated	430,105.5	566,664	− 1.807	0.071
	Average profit for the years before treated	230,372.6	232,135.2	− 0.036	0.971
Control variables and others	Mean age of managers	43.4	46.0	− 3.342	0.001
	Proportion (%) for male managers	70.1	80.6	− 3.417	0.001
	English proficiency of managers	43.4	48.9	− 1.597	0.110
	Located in Ashanti/BA region	73.5	83.2	− 3.281	0.001
	Proportion (%) of firms registered	78.3	93.7	− 5.752	0.000
	Proportion of firms with a sole proprietor	77.1	72.4	1.595	0.111
	Average number of workers for the years before treated	19.4	22.3	− 1.423	0.155
	Proportion (%) by size of firm a year before treated				
	Micro	18.8	22.4	− 1.309	0.191
	Small	63.7	55.2	2.551	0.011
	Medium	15.6	19.0	− 1.357	0.175
	Large	1.9	3.4	− 1.494	0.135
	Proportion (%) of firms by industry				
	Food/water industry	40.5	34.0	1.951	0.051
	Wearing apparel industry	21.2	8.2	4.867	0.000
	Wood products	12.8	24.6	− 4.819	0.000
	Metalwork industry	8.1	13.4	− 2.664	0.008
	Chemicals	7.2	6.7	0.250	0.802
	Paper, plastics and textiles	3.8	6.3	− 1.800	0.072
	Other industries	6.5	6.7	− 0.145	0.885
	Proportion (%) of managers risk averse	68.8	69.8	− 0.300	0.764
	Proportion (%) of managers present bias	82.1	79.5	0.969	0.333

the firm prior to enrolment, Table 2 largely shows no statistically significant difference between the treated and untreated cases except for cases in the small enterprise category. This is confirmed by the comparison with regards to the average number of workers before enrolment, which shows a statistically insignificant difference between the two cases.

The descriptive analyses particularly on the time varying variables largely show no significant difference between the treated and untreated cases, giving some level of confidence that the crucial common trends assumption needed for identification under the DID method is less likely to be violated.

Regression Results and Discussion

The FE regression results on the impact of the programme on the three outcome variables are presented in Table 3, while Table 5 in the "Appendix" section presents the results from the RE regression. A comparison between the FE and RE results largely shows only a marginal difference in the coefficients. However, the robust Sargan-Hansen test results in Table 5 in the "Appendix" section indicate that for all the estimated models, the FE estimator is preferred to the RE estimator. Hence, our discussion of the results focuses on the results of Table 3.

The regression results in Columns 1, 2 and 3 of Table 3 are based on Eq. 1 (in which we measure the ATT for all the firms) and are, respectively, for the outcome variables: output per worker, sales and profit. Based on Eq. 2, Columns 4, 5 and 6 of Table 3 show the ATT by the size of firm, respectively, for the output per worker, sales and profit. Columns 7, 8 and 9 are also based on Eq. 2 but they show the effects by whether the firm was trained by Japanese Kaizen experts or through NBSSI's self-implementation.

The results in Column 1 of Table 3 show that the programme did not have any effect on the output per worker for all the treated firms as indicated by the statistically insignificant coefficient for *trt*, even at 10% level of significance. The no effect of the programme on output per worker is true irrespective of the size of the firm— Column 4 of Table 3 show statistically insignificant coefficients for all size-specific impact variables (that is, *trt_size2, trt_size3, trt_size4* and *trt_size5*). Column 7 of Table 3, however, show a significant ATT of 10.8% increase in output per worker for firms that were trained by the Japanese Kaizen experts (at 10% level of significance) but insignificant effect on output per worker for firms that were trained through NBSSI's self-implementation.

With respect to sales, we observe from Column 2 of Table 3 a statistically significant ATT of 14.1% increase in sales for all the firms (at 5% level of significance). However, Column 5 shows a statistically significant and positive effects on sales for small and medium size enterprises (that is, coefficients for *trt_size3* and *trt_size4,* respectively), but no effect for micro (*trt_size2*) and large enterprises (*trt_size5*). These findings suggests that the effect of the programme on sales may vary by the size of the firm: while some firms realised a positive effect on sales, others did not realise any impact on sales. Column 8 shows that the firms that were trained by the

Table 3 Effect on Kaizen on performance indicators – Fixed Effects estimates

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Effect for all			Effect by size of firm			Effect by type of trainer		
	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit
y2012	0.115***	0.076	0.015	0.118***	0.076	0.021	0.115***	0.075	0.014
	(0.036)	(0.057)	(0.081)	(0.036)	(0.057)	(0.079)	(0.036)	(0.057)	(0.081)
y2013	0.264***	0.186***	0.106	0.266***	0.186***	0.109	0.263***	0.184***	0.104
	(0.042)	(0.063)	(0.084)	(0.042)	(0.063)	(0.084)	(0.041)	(0.063)	(0.085)
y2014	0.356***	0.275***	0.091	0.357***	0.276***	0.098	0.353***	0.272***	0.087
	(0.042)	(0.063)	(0.100)	(0.042)	(0.063)	(0.100)	(0.042)	(0.064)	(0.101)
y2015	0.462***	0.388***	0.276**	0.461***	0.388***	0.279**	0.460***	0.385***	0.273**
	(0.049)	(0.073)	(0.109)	(0.049)	(0.073)	(0.109)	(0.049)	(0.073)	(0.110)
y2016	0.570***	0.474***	0.286**	0.570***	0.475***	0.287**	0.569***	0.472***	0.285**
	(0.057)	(0.077)	(0.119)	(0.056)	(0.077)	(0.119)	(0.057)	(0.077)	(0.119)
y2017	0.578***	0.447***	0.279**	0.581***	0.447***	0.284**	0.577***	0.446***	0.278**
	(0.062)	(0.084)	(0.125)	(0.062)	(0.084)	(0.125)	(0.062)	(0.084)	(0.125)
trt	0.085	0.141**	0.181*						
	(0.056)	(0.058)	(0.101)						
trt_size2				0.147	0.019	0.090			
				(0.259)	(0.146)	(0.206)			
trt_size3				0.093	0.158**	0.192			
				(0.060)	(0.076)	(0.121)			
trt_size4				0.087	0.173**	0.271*			
				(0.106)	(0.081)	(0.147)			
trt_size5				− 0.296	0.128	− 0.621**			
				(0.305)	(0.390)	(0.293)			
trt_ojt2							0.108*	0.174***	0.213*

Table 3 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Effect for all			Effect by size of firm			Effect by type of trainer		
	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit
							(0.061)	(0.067)	(0.122)
trt_ojt3							0.045	0.089	0.125
							(0.106)	(0.095)	(0.129)
ln_workers	− 0.772***	0.368***	0.474***	− 0.771***	0.369***	0.477***	− 0.765***	0.375***	0.481***
	(0.088)	(0.107)	(0.127)	(0.089)	(0.107)	(0.127)	(0.090)	(0.109)	(0.129)
Constant	10.571***	10.414***	9.106***	10.570***	10.414***	9.098***	10.555***	10.396***	9.088***
	(0.239)	(0.282)	(0.333)	(0.242)	(0.282)	(0.333)	(0.245)	(0.287)	(0.337)
Observations	1,094	1,126	1,005	1,094	1,126	1,005	1,094	1,126	1,005
Number of firms	172	176	166	172	176	166	172	176	166
R-squared (within)	0.377	0.272	0.064	0.380	0.274	0.068	0.378	0.273	0.065
R-squared (overall)	0.00649	0.333	0.225	0.00630	0.337	0.225	0.00688	0.340	0.227
F Statistics	32.21	16.81	7.474	26.16	12.80	6.403	29.36	15.48	6.682
p value for F Stat	0	0	1.74e−08	0	0	8.53e−09	0	0	3.91e−08

Note: (1) Robust standard errors in parentheses; (2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Japanese experts had a statistically significant and positive effect on sales, while those enrolled in the NBSSI's self-implementation had no effect on sales.

Column 3 of Table 3 indicates that the programme had a positive and statistically significant effect on profit with ATT of 18.1% for all the firms. The effect by size of the firms, rather, shows no significant effect on profit for both micro and small enterprises, while the effect for large enterprises was negative and statistically significant (Column 6). The effect on profit for medium size enterprise was positive and statistically significant. Again, the firms that were trained through NBSSI's self-implementation had no significant effect on profits, while those trained by the Japanese expert had a positive and statistically significant effect (see Column 9).

The above findings together show generally that the Kaizen programme had a positive and statistically significant impact on the performance of the manufacturing enterprises in Ghana; however, not all the firms that participated in the programme experienced this impact. Whether a firm benefited from the programme or not seem to have a relationship with the size of the firm and whether it was trained by the Japanese experts or NBSSI. Generally, the small and medium size enterprises benefitted from the programme, while their micro and large counterparts did not. This may be linked to issues regarding the differences in firms' capability to implement the Kaizen practices, particularly in the case of micro enterprises, as argued by Sugimoto (2018) as well as the level of commitment by management with regards to implementing Kaizen principles and practices in general (see García et al. 2014; Doolen et al. 2008). This finding thus resonates with earlier work (such as Powell 1995; Fisher 1993) which showed that the adoption of Kaizen practices can vary by firm size.

A likely explanation for why the firms that received the training through NBSSI self-implementation may not have realised a significant impact of the programme on performance while those trained by Japanese expert did is that the NBSSI trainers may have not been able to deliver the training as effectively as was done by the Japanese experts. This is a reasonable explanation given that the NBSSI trainers might have to go through a 'learning by doing' phase on how to deliver the training effectively. It also raises questions about the depth or extent of knowledge transfer from the Japanese experts to the NBSSI trainers. Further descriptive analysis, comparing the firms trained by the Japanese experts to those trained by NBSSI, presented in Table 6 in the "Appendix" section, show that the two groups did not differ statistically on the outcome variables and the number of employees before enrolment into the programme. Moreover, the number of employees, which is time varying, was included as a regressor in the fixed effects model to account for any cofounding effect of size. Thus, the idea that the Japanese experts may have delivered the training more effectively than the NBSSI is potentially a key reason why we observe a significant effect for those trained by the Japanese experts but no effect for those trained by the NBSSI.

It should be noted that there are many critical success factors, some of which were mentioned in Section Two, for implementing Kaizen that may also be important in explaining the above findings. However, a detailed analysis of these factors is outside of the scope of this article.

Conclusion

Between 2012 and 2017, a number of manufacturing enterprises of varying sizes in Ghana participated in a programme that trained and helped them to implement Kaizen practices. This study investigated whether participation in the programme had a significant impact on productivity and performance using DID methodology and whether the impact differs by firm size and the calibre of the Kaizen trainer. The findings generally show that the programme had a positive and significant impact on the performance and productivity of the firms that participated in the programme. The results are consistent with previous studies (such as Higuchi et al. 2015; Mano et al. 2012, 2014) which used research methodologies similar to the one used in this article. This article, thus, presents an additional empirical evidence about the impact of Kaizen in Ghana (an African context), supporting the view that Kaizen is transferable to less developed contexts.

More importantly, this article provides two additional insights into the impact of Kaizen on firm performance which we have not come cross in the existing literature. That is, whether a firm experienced the impact on performance depends on the size of the firm and the calibre of the training consultant used. The reasons for this results could be many as suggested by many studies which explored the conditions and critical success factors for effective adoption of Kaizen (Maarof and Mahmud 2016; Yokozawa and Steenhuis 2013; Aoki 2008; Doolen et al. 2008). However, this area is not within the scope of this article and may require further research. In particular, further research on Ghana may explore the key factors driving the differences in the impact across firms of different sizes and why the impact varies by the type of training consultant.

With respect to policy, our findings suggest that an extensive promotion of Kaizen among a broad spectrum of manufacturing enterprises in Ghana could yield substantial benefits and contribute to achieving Ghana's industrial development goals. However, the training may have to be very tailored for firms of different sizes. The findings also flag the level of knowledge transfer from the Japanese trainers to the NBSSI and how effectively the NBSSI is able to independently support more firms to adopt Kaizen. This issue is crucial in terms of broadening adoption and realising the expected impact.

Appendix

See Tables 4, 5, and 6.

Table 4 Enterprise selection assessment sheet

Overall Score	Score
1. Company assessment (Point 1: Not, 2: Fair 3: Good)	
(1) Active client of BAC	1 2 3
(2) Registration with Register General Department	1 2 3
(3) Number of emloyees (both fully employed and part-time) (Score: 1. 1–3, 2. 4–6, 3. 7–10, 4. 11–15, 5: 16+)	1 2 3 4 5
(4) Gender balance of the organisation	1 2 3
(5) Willingness to implement KAIZEN	1 3 6
(6) Growth stage of the Organisation based on NBSSI ranking system	1 2 3
(7) Book and record keeping	1 2 3
(8) English literacy rate of management	1 2 3
(9) Willingness to disclose or share business information	1 2 3
(10) Activeness	1 2 3
Sub total	
2. Applicable Basic KAIZEN Menu (Point 1: not sure 2: Applicable)	1 2
(1) 5S including Seiton board	1 2
(2) 7Wastes	1 2
(3) Factory layout change (Minor)	1 2
(4) Reduction of defects	1 2
(5) Inventory Control	1 2
(6) Code of Conduct	1 2
(7) Organisation chart	1 2
(8) Line balancing (Minor)	1 2
(9) Skill map	1 2
(10) Work standard	1 2
Sub total	
3. Expectation of KAIZEN achievement (Point 1: Not sure 2: Achievable)	1 2
(1) 5S including Seiton board	1 2
(2) 7Wastes (shortening of transport)	1 2
(3) Factory layout change (Minor), shortening of transport	1 2
(4) Reduction of defects	1 2
(5) Inventory Control	1 2
(6) Code of Conduct (Absenteeism)	1 2
(7) Organisation chart	1 2
(8) Line balancing (Minor)	1 2
(9) Skill map (Multi-skilled worker)	1 2
(10) Work standard	1 2
Sub total	
4. Recommendation products by GoG (Point 0: Not recommended 10: Recommended)	0 5
5. Local industry development (Applicability to many other enterprises in the same industry) (Point 3: Somehow, 5: Fair, 8: Above average 10: Fully)	3 5 8 10
6. Access to the company (Point 1: within 30 min from BAC) (Point 3: between 30 and 60 min from BAC) (Point 5: 60 min+ from BAC)	1 3 5

Table 4 (continued)

Overall Score	Score
7. Export potential or import substitute (Point 0: No potential Point 5: Potential)	0 5
G. Total (100 points)	

Source: Project implementers—National Board for Small Scale Industries (NSSI) and JICA Ghana office

Table 5 Effect of Kaizen on performance indicators—Random Effects estimates

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Effect for all			Effect by size of firm			Effect by type of trainer		
	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit
tyear2012	0.613	0.743	0.412	0.568	0.703	0.471	4.615***	0.216	0.103
	(0.840)	(0.768)	(0.770)	(0.805)	(0.727)	(0.779)	(0.930)	(0.751)	(0.808)
tyear2013	0.502	0.343	0.331	0.455	0.378	0.348	4.557***	− 0.204	0.025
	(0.531)	(0.353)	(0.501)	(0.452)	(0.319)	(0.483)	(0.925)	(0.495)	(0.631)
tyear2014	0.027	0.107	0.170	0.274	0.403	0.396	4.064***	− 0.362	− 0.094
	(0.720)	(0.620)	(0.444)	(0.744)	(0.659)	(0.468)	(0.812)	(0.616)	(0.485)
tyear2015	0.185	0.256	0.691**	− 0.094	0.070	0.604*	4.383***	− 0.066	0.513
	(0.303)	(0.281)	(0.333)	(0.260)	(0.252)	(0.348)	(0.521)	(0.342)	(0.403)
tyear2016	1.022**	0.640**	0.559*	0.820**	0.522	0.496	5.182***	0.317	0.374
	(0.434)	(0.324)	(0.335)	(0.417)	(0.323)	(0.344)	(0.628)	(0.363)	(0.382)
tyear2017	1.364***	1.295***	1.537***	0.795*	0.872**	1.308***	5.430***	0.904***	1.325***
	(0.373)	(0.337)	(0.362)	(0.435)	(0.361)	(0.377)	(0.552)	(0.350)	(0.410)
y2012	0.116***	0.074	0.013	0.117***	0.075	0.019	0.115***	0.074	0.011
	(0.036)	(0.057)	(0.082)	(0.036)	(0.058)	(0.080)	(0.036)	(0.058)	(0.082)
y2013	0.264***	0.184***	0.099	0.266***	0.185***	0.102	0.262***	0.181***	0.097
	(0.042)	(0.063)	(0.085)	(0.042)	(0.064)	(0.085)	(0.042)	(0.064)	(0.085)
y2014	0.352***	0.268***	0.083	0.355***	0.272***	0.094	0.348***	0.264***	0.080
	(0.042)	(0.063)	(0.100)	(0.043)	(0.064)	(0.100)	(0.042)	(0.064)	(0.101)
y2015	0.456***	0.377***	0.270**	0.459***	0.384***	0.279**	0.453***	0.374***	0.267**
	(0.049)	(0.073)	(0.109)	(0.049)	(0.074)	(0.110)	(0.049)	(0.074)	(0.110)
y2016	0.563***	0.460***	0.277**	0.568***	0.469***	0.286**	0.560***	0.460***	0.277**
	(0.057)	(0.077)	(0.119)	(0.057)	(0.078)	(0.120)	(0.057)	(0.078)	(0.120)
y2017	0.573***	0.435***	0.271**	0.578***	0.442***	0.283**	0.569***	0.435***	0.271**
	(0.057)	(0.077)	(0.119)	(0.057)	(0.078)	(0.120)	(0.057)	(0.078)	(0.120)

Table 5 (continued)

Variables	(1) Effect for all	(2)	(3)	(4) Effect by size of firm	(5)	(6)	(7) Effect by type of trainer	(8)	(9)
	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit	loutputpworker	lsales	lprofit
	(0.062)	(0.085)	(0.125)	(0.062)	(0.085)	(0.126)	(0.062)	(0.085)	(0.126)
size_yearBT2				0.232	0.227	0.262			
				(0.351)	(0.294)	(0.316)			
size_yearBT3				1.500***	1.266***	0.846*			
				(0.450)	(0.418)	(0.460)			
size_yearBT4				1.765***	1.453**	1.363**			
				(0.590)	(0.625)	(0.677)			
ojt12							− 4.722***		
							(0.462)		
ojt11							− 3.888***	0.645**	0.365
							(0.655)	(0.319)	(0.355)
trt	0.088	0.149**	0.187*						
	(0.056)	(0.058)	(0.102)						
trt_size2				0.136	0.028	0.086			
				(0.260)	(0.147)	(0.208)			
trt_size3				0.094	0.159**	0.193			
				(0.061)	(0.076)	(0.123)			
trt_size4				0.091	0.179**	0.276*			
				(0.107)	(0.080)	(0.150)			
trt_size5				− 0.284	0.133	− 0.592**			
				(0.299)	(0.386)	(0.263)			
trt_ojt2							0.119*	0.188***	0.222*

Table 5 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Effect for all			Effect by size of firm			Effect by type of trainer		
	loutputworker	lsales	lprofit	loutputworker	lsales	lprofit	loutputworker	lsales	lprofit
trt_ojt3							(0.061)	(0.067)	(0.124)
							0.038	0.086	0.125
							(0.107)	(0.095)	(0.131)
ln_workers	− 0.713***	0.461***	0.592***	− 0.764***	0.406***	0.497***	− 0.691***	0.460***	0.585***
	(0.082)	(0.101)	(0.094)	(0.086)	(0.103)	(0.107)	(0.084)	(0.103)	(0.096)
Time invariant control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.465***	7.672***	6.387***	8.120***	7.441***	6.273***	8.518***	7.672***	6.387***
	(0.754)	(0.662)	(0.865)	(0.786)	(0.674)	(0.903)	(0.714)	(0.647)	(0.862)
Observations	1,094	1,126	1,005	1,094	1,126	1,005	1,094	1,126	1,005
Number of firms	172	176	166	172	176	166	172	176	166
R square (within)	0.377	0.270	0.0637	0.380	0.273	0.0676	0.377	0.271	0.0642
R square (overall)	0.189	0.513	0.388	0.251	0.546	0.398	0.271	0.525	0.390
chi2 for model	316	351.1	368.0	401.6	897.6	426.0	6436	435.4	408.6
p value	0	0	0	0	0	0	0	0	0
Breuch-Pagan LM (Chi2 bar)	2536.61	2441.43	1736.77	2520.16	2462.66	1719.46	2526.3	2441.84	1729.33
p value	0	0	0	0	0	0	0	0	0
Sargan-Hansen statistic (Chi2)	25.199	34.937	25.207	17.773	26.751	29.029	36.1	31.698	26.06
p value	0.0014	0	0.0014	0.087	0.005	0.0022	0	0.0002	0.002

(1) Robust standard errors in parentheses; (2) *** $p<0.01$, ** $p<0.05$, * $p<0.1$; (3) The dummy for self-implementation firms was omitted from Eq. 8 and 9 because of collinearity

Table 6 Firm/manager's characteristics by whether the firm was trained by Japanese expert or NBSSI

Variable type	Variable/description	Self – implementation (NBSSI trained)	OJT (Japanese) trained	t/z statistic	P value
Outcome variables	Output per worker	19,471.69	20,440.37	− 0.239	0.811
	Sales	596,258.50	677,756.80	− 0.769	0.442
	Profits	281,521.70	242,518.60	0.836	0.403
Control variables and others	Mean age of managers	44.2	45.5	− 1.292	0.197
	Proportion (%) for male managers	63.6	81.1	− 4.784	0.000
	Proportion (%) of manager English proficient	54.5	58.5	− 0.951	0.342
	Located in Ashanti/BA region	51.5	88.7	− 10.163	0.000
	Proportion of firms registered	84.8	98.1	− 6.213	0.000
	Proportion (%) of firms with a sole proprietor	69.7	67.9	0.456	0.649
	Average number of workers for the years before treated	28.1	25.6	0.720	0.472
	Proportion (%) by size of firm a year before treated				
	Micro	23.7	3.3	7.223	0.000
	Small	52.5	60.9	− 1.821	0.069
	Medium	23.7	29.6	− 1.403	0.161
	Large	0.0	6.3	− 3.402	0.001
	Proportion (%) of firms by industry				
	Food/water industry	45.5	34.0	2.820	0.005
	Wearing apparel industry	12.1	7.5	1.879	0.060
	Wood products	18.2	18.9	− 0.210	0.833
	Metalwork industry	9.1	13.2	− 1.532	0.126
	Chemicals	3.0	11.3	− 3.618	0.000
	Paper, plastics and textiles	6.1	7.5	− 0.696	0.486
	Other industries	6.1	7.5	− 0.696	0.486
	Proportion (%) of risk averse managers	72.7	62.3	2.641	0.008
	Proportion (%) of present bias managers	84.8	75.5	2.750	0.006

Declarations

References

Ackah, C.G., R. Atta-Ankomah, and J.A. Kubi. 2020. Management Practices and Performance Improvement in Manufacturing Enterprises: The Case of Kaizen Adoption in Ghana. In *Workers, Managers, Productivity*, ed. A. Hosono, J. Page, and G. Shimada, 269–292. Singapore: Palgrave Macmillan.

Ackah, C., C. Adjasi and F. Turkson. 2014. Scoping Study on the Evolution of Industry in Ghana'. WIDER Working Paper 2014/075. Helsinki: UNU-WIDER.

Álvarez-García, J., A. Durán-Sánchez, and M.D.L.C. del Río. 2018. Systematic bibliometric analysis on Kaizen in scientific journals. *The TQM Journal* 30 (4): 356–370.

Aoki, K. 2008. Transferring Japanese kaizen activities to overseas plants in China. *International Journal of Operations & Production Management* 28 (6): 518–539.

Arya, A.K., and S.K. Jain. 2014. Impacts of Kaizen in a small-scale industry of India: A case study. *International Journal of Lean Six Sigma* 5 (1): 22–44.

Atta-Ankomah, R. and R. D. Osei. 2021. Structural change and welfare: A micro panel evidence from Ghana. *Journal of Development Studies*. https://doi.org/10.1080/00220388.2021.1939864.

Bassant, J. 2000. Developing and Sustaining Employee Involving in Continuous Improvement. IEE Seminar, Kaizen: From Understanding to Action (Ref. No. 2000/035) 2: 1–18, London, UK.

Berger, A. 1997. Continuous improvement and kaizen: Standardization and organizational designs. *Integrated Manufacturing Systems* 8 (2): 110–117.

Bloom, N., and J. Van Reenen. 2007. Measuring and Explaining Management Practices Across Firms and Countries. *The Quarterly Journal of Economics* 122 (4): 1351–1408.

Brunet, A.P., and S. New. 2003. Kaizen in Japan: An empirical study. *International Journal of Operations & Production Management* 23 (12): 1426–1446.

Caselli, F., and N. Gennaioli. 2013. Dynastic Management. *Economic Inquiry* 51 (1): 971–996.

Cheser, R. 1998. The effect of Japanese Kaizen on employee motivation in US manufacturing. *The International Journal of Organizational Analysis* 6 (3): 197–217.

Doolen, T.L., E.M. Van Aken, J.A. Farris, J.M. Worley, and J. Huwe. 2008. Kaizen events and organizational performance: A field study. *International Journal of Productivity and Performance Management* 57 (8): 637–658.

Fisher, T.J. 1993. The view from the top: Chief executives' perceptions of total quality management. *Australian Journal of Management* 18 (2): 181–195.

García, J.L., A.A. Maldonado, A. Alvarado, and D.G. Rivera. 2014. Human critical success factors for kaizen and its impacts in industrial performance. *The International Journal of Advanced Manufacturing Technology* 70 (9–12): 2187–2198.

Higuchi, Y., V.H. Nam, and T. Sonobe. 2015. Sustained impacts of Kaizen training. *Journal of Economic Behaviour & Organization* 120: 189–206.

Imai, M. 1986. *Kaizen: The Key to Japan's Competitive Success*. New York, NY: Random House.

Ishigame, K. 2020. Enhancing Learning Through Continuous Improvement: Case Studies of the Toyota Production System in the Automotive Industry in South Africa. In *Workers, Managers, Productivity*, ed. A. Hosono, J. Page, and G. Shimada, 197–219. Singapore: Palgrave Macmillan.

Jiménez, M., L. Romero, M. Domínguez, and M. del Mar Espinosa. 2015. 5S methodology implementation in the laboratories of an industrial engineering university school. *Safety Science* 78: 163–172.

Kaplinsky, R. 1995. Technique and system: The spread of Japanese management techniques to developing countries. *World Development* 23 (1): 57–71.

Katai, K. 2020. The role of Kaizen in participation in the global value chain: the case of the mexican automotive industry. In *Workers, managers, productivity*, ed. A. Hosono, J. Page, and G. Shimada, 171–195. Singapore: Palgrave Macmillan.

Kumar, M., and J. Antony. 2008. Comparing the quality management practices in UK SMEs. *Industrial Management & Data Systems* 108 (9): 1153–1166.

Kumar, S., A. Dhingra, and B. Singh. 2018. Lean-Kaizen implementation: A roadmap for identifying continuous improvement opportunities in Indian small and medium sized enterprise. *Journal of Engineering, Design and Technology* 16 (1): 143–160.

Maarof, M.G., and F. Mahmud. 2016. A review of contributing factors and challenges in implementing kaizen in small and medium enterprises. *Procedia Economics and Finance* 35: 522–531.

Manley, K., and S. Mcfallan. 2006. Exploring the drivers of firm-level innovation in the construction industry. *Construction Management and Economics* 24 (9): 911–920.

Mano, Y., J. Akoten, Y. Yoshino, and T. Sonobe. 2014. Teaching KAIZEN to small business owners: An experiment in a metalworking cluster in Nairobi. *Journal of the Japanese and International Economies* 33: 25–42.

Mano, Y., A. Iddrisu, Y. Yoshino, and T. Sonobe. 2012. How can micro and small enterprises in Sub-Saharan Africa become more productive? The impacts of experimental basic managerial training. *World Development* 40 (3): 458–468.

Marín-García, J., A. Juárez-Tarraga, and C. Santandreu-Mascarell. 2018. Kaizen philosophy: The keys of the permanent suggestion systems. *The TQM Journal* 30 (4): 296–320.

Nemlioglu, I., and S.K. Mallick. 2017. Do managerial practices matter in innovation and firm performance relations? New evidence from the UK. *European Financial Management* 23 (5): 1016–1061.

Osei, R. D. and R. Jedwab. 2016. Structural Change in a Poor African Country: New Historical Evidence from Ghana. In McMillan, M., D. Rodrik and C. Sepúlveda (eds.). 2016. *Structural Change, Fundamentals and Growth: A Framework and Case Studies* (pp. 161–196). Washington DC: International Food Policy Research Institute.

Osei, R. D., R. Atta-Ankomah and M. Lambon-Quayefio. 2020. *Structural transformation and inclusive growth in Ghana (WIDER Working Paper 2020/37)*. Helsinki: UNU-WIDER.

Panizzolo, R., P. Garengo, M.K. Sharma, and A. Gore. 2012. Lean manufacturing in developing countries: Evidence from Indian SMEs. *Production Planning & Control* 23 (10–11): 769–788.

Powell, T.C. 1995. Total quality management as competitive advantage: A review and empirical study. *Strategic Management Journal* 16 (1): 15–37.

Puvanasvaran, A.P., S.T. Kerk, and A.R. Ismail. 2010. A case study of Kaizen implementation in SMI. *National Conference in Mechanical Engineering Research and Postgraduate Studies (2nd NCMER 2010) 3–4 December 2010. Faculty of Mechanical Engineering. UMP Pekan, Kuantan, Pahang, Malaysia*: 374–392.

Recht, R., and C. Wilderom. 1998. Kaizen and culture: On the transferability of Japanese suggestion systems. *International Business Review* 7 (1): 7–22.

Schmenner, R.W., and M.L. Swink. 1998. On theory in operations management. *Journal of Operations Management* 17 (1): 97–113.

Suárez-Barraza, M.F., and J.A. Miguel-Davila. 2020. Kaizen-kata, a problem-solving approach to public service health care in Mexico: a multiple-case study. *International Journal of Environmental Research and Public Health* 17 (9): 3297.

Suárez-Barraza, M.F., J. Ramis-Pujol, and L. Kerbache. 2011. Thoughts on kaizen and its evolution: Three different perspectives and guiding principles. *International Journal of Lean Six Sigma* 2 (4): 288–308.

Suárez-Barraza, M.F., and J. Ramis-Pujol. 2010. Implementation of Lean-Kaizen in the human resource service process: A case study in a Mexican public service organisation. *Journal of Manufacturing Technology Management* 21 (3): 388–410.

Sugimoto, S. 2018. Kaizen in practice. In: Otsuka, K., K. Jin and T. Sonobe (eds.). *Applying the Kaizen in Africa: A new avenue for industrial development* (pp 69–110). ebook: Palgrave Mcmillan. https://doi.org/10.1007/978-3-319-91400-8_3

Vento, M.O., J.L.G. Alcaraz, A.A.M. Macías, and V.M. Loya. 2016. The impact of managerial commitment and Kaizen benefits on companies. *Journal of Manufacturing Technology Management* 27 (5): 692–712.

Withanachchi, N., Y. Handa, K.K.W. Karandagoda, P.P. Pathirage, N.C.K. Tennakoon, and D.S.P. Pulla-peruma. 2007. TQM emphasizing 5-S principles: A breakthrough for chronic managerial constraints at public hospitals in developing countries. *International Journal of Public Sector Management* 20 (3): 168–177.

Yadav, V., R. Jain, M.L. Mittal, A. Panwar, and A. Lyons. 2019. The impact of lean practices on the operational performance of SMEs in India. *Industrial Management & Data Systems* 119 (2): 317–330.

Yokozawa, K., and H.J. Steenhuis. 2013. The influence of national level factors on international kaizen transfer: An exploratory study in The Netherlands. *Journal of Manufacturing Technology Management* 24 (7): 1051–1075.

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