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Impacts of *Kaizen* Management on Workers: Evidence from Central America and the Caribbean Region

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Abstract

In recent years, there has been renewed interest in the productivity movement, and in particular the diffusion of *Kaizen* management as an approach to industrial development in developing countries. While a number of previous studies have evaluated the impact of the introduction of *Kaizen* on management practices and business performance, few studies have assessed its impacts on working conditions, wages, and employment, especially in the long term. By collecting firm-level data, we were able to conduct a retrospective study on the impacts of the *Kaizen* project - a project implemented in eight countries in the Central America and the Caribbean Region by the Japan International Cooperation Agency. Ninety-four firms were selected to take part in the project based on their willingness to adopt *Kaizen* management practices. Using the same criteria, we selected 182 comparable firms in the same industries and countries to make up the comparison group. Employing propensity score matching methods, this study found that the introduction of *Kaizen* improved working conditions and strengthened the social capital of workers. The willingness of managers to pay for *Kaizen* training increased after the training was completed, which suggests that it had a positive effect´ on the firm's performance. We also found that managers and workers perceive the usefulness of *Kaizen* differently, which may lead to suggestions on ways to improve the design of future training programs.

Keywords: Management training, Impact evaluation, Willingness to pay, Small and medium enterprises, Central America and the Caribbean Region

JEL Classification: L2, M1, O1

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Introduction

There has been an increasing interest among development economists in managerial capital as "a key missing form of capital in developing countries" (Bruhn, Karlan, and Schoar 2010, 629). Several randomized control trials on management training have been conducted in recent years. Most of them have found that even a short-term program of basic business training or coaching can significantly improve management practices (e.g., Karlan and Valdivia 2011; Field et al. 2010; Berge et al. 2012; Mano et al. 2011; Drexler et al. 2014; Berge et al.´ 2014; Bruhn and Zia 2013). Moreover, Bloom et al. (2013) found that management training improves a firm's performance as well as its management practices.

These studies focus on the impact of management training and coaching on management practices and business performance. Although they do not pay much attention to other impacts, it seems natural to ask whether management training also improves working conditions, increases employment and wages, and improves the attitude of employees toward work and toward the acquisition of advanced skills.

This paper attempts to assess the impact of management training on workers, rather than the impact on sales revenues. This is because although *Kaizen* has a positive impact on a firm's gross profit and value added (Mano et al. 2014), it takes time for *Kaizen* to have a positive impact on sales revenue (Higuchi et al. forthcoming; Higuchi et al. 2015; Mano et al. 2012). The paper uses survey data collected from firms in eight Central American and Caribbean countries, where the Japan International Cooperation Agency (JICA) implemented a technological cooperation project from 2009 to early 2012. The main purpose of JICA's project was to train business development service providers to teach *Kaizen*, a Japanese approach to production management and quality control, to firms in their own countries (see Figure 1 for the project timeline). As an integral part of the training, each of the aspiring trainers introduced *Kaizen* management practices into several firms under the guidance of Japanese experts. These firms

were not randomly selected but were chosen because they showed a strong interest in learning and adopting *Kaizen* management; this group of firms constitutes the treatment group in the present study. Due to budgetary constraints within the project, not all firms in the eight countries were invited to participate in this first phase of the project.

Two and a half years later, the same group of JICA divisions and government bodies planned a further phase of *Kaizen* training and extended invitations to other small and medium-sized firms in the eight countries. The same criteria was used to select firms for participation so as to ensure the comparability of the new firms with the original ones, and the selection process minimized self-selection bias in the two groups. Between late 2014 and early 2015, we conducted a survey of all participating firms, defining the treatment group as the original group of firms and the comparison group as the firms chosen in the second phase. Thus, the treatment and comparison groups in this study are appropriate for comparison. Moreover, the study applies propensity score matching methods that impose the condition of common support; these empirical strategies allow for a reasonably solid impact evaluation.

Our survey was designed to elicit information from both managers and workers about working conditions, management practices, and business performance. It also inquired about relationships between employees, and between managers and employees as well as the attitudes of employees toward their work. The purpose of the questionnaire was to assess the impact of *Kaizen* on these variables. Our attention was mostly focused on the impact that the introduction of *Kaizen* has on the improvement of management practices, working conditions, and social capital within firms.[1]

We obtained the following major findings: First, the introduction of *Kaizen* significantly improved both management practices and working conditions. Moreover, it considerably strengthened social capital within firms, especially the relationships between employees in the

[1] Many of the firms in the sample were reluctant to disclose actual figures on business performance; as a result, we were only able to obtain percentage increases relative to base year values.

treatment group firms. Interestingly, both managers and employees discovered that employees' attitudes toward work improved with the introduction of *Kaizen*. Among the treatment group firms, employee wage growth was closely correlated with improvements in attitudes toward work.

Secondly, during the recession the treatment group firms did not lower wages as much as the comparison group firms. These results allow for various interpretations, which we will discuss in detail below. Thirdly, managers and employees perceived the usefulness of *Kaizen* differently. For example, managers needed some time to fully embrace the *Kaizen* management practices. Interestingly, however, employees required even more time to accept the practices, even in cases in which the introduction of *Kaizen* was followed by better working conditions. These findings have some implications for the design of future training programs, which we will explore later in the paper.

The rest of the paper is organized as follows. The next section describes the design of the study, followed by a descriptive analysis of the survey data. Sections 3 and 4 present the estimation methods and the estimation results, respectively. Section 5 concludes the paper and discusses the implications the survey may have for policy and future research.

1. Empirical Setting and Data

1.1 Timeline

A JICA-sponsored project titled "Project for Capacity Building of Facilitators on Improving Productivity and Quality for Small and Medium Enterprise in the Central America and Caribbean Region" was implemented between July 2009 and March 2012 by JICA and UTN-CECAPRO (the Productivity and Quality Center of the National Technical University) of

Costa Rica (see Figure 1 for a timeline of this project).[2] The project was a South-South cooperation project between eight countries in the region: Belize, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. Prior to this project, CECAPRO had sent consultants to Japan to receive intensive training from the Japan Productivity Center on how to teach *Kaizen* in private firms. The CECAPRO consultants then visited each of the eight countries to train staff members from SME support agencies and private consultants.[3] At that point, the aspiring trainers were referred to (and will be referred to in this paper) as "facilitators."

The SME support agencies in each country invited firms to apply for the *Kaizen* training. Subsequently, JICA and the governments of the eight countries involved in the project selected a total of 135 target firms from the firms in the eight countries that had applied for the training. The selection was not random but was based on the following conditions: (1) the firm was eager to adopt *Kaizen* practices; (2) it was a small- or medium-sized enterprise with 10 to 100 employees, including family members; (3) it had been in operation for more than three years since it was established; (4) it had official corporate status; and (5) it had not yet adopted *Kaizen* practices.

In 2015, JICA and the governments of the eight countries agreed to implement a new round of *Kaizen* management training that would be rolled out by the SMEs. Each government extended invitations to firms that had not been included in the original group, and a large number of SMEs in each country applied for the training. The 182 target firms were chosen by the SME support agencies and JICA using the same criteria as in the original round of training. We obtained approval from all relevant organizations to do an impact evaluation of the SME training

[2] In Spanish, the center is called *El Centro de Calidad y Productividad*. During the project period the center was called CEFOF (*Centro de Formación de Formadores y de Personal Técnico para el Desarrollo industrial de Centro América, Universidad Técnica Nacional*). The center was recently renamed CECAPRO.

[3] In this project, consultants are referred to as "facilitators." The data was collected by enumerators in each country under the supervision of Ms. Satomi Wakamatsu and Ms. Tamayo Ito.

portion of the facilitator capacity building project and, in particular, to conduct a survey of target firms from both the first and second rounds of the training program.

It was intended that the 135 target firms from the first round of training program implementation would be used as the treatment group and the 182 target firms from the second round would make up the comparison group. Both groups were selected using the same criteria, and therefore, both groups were equally eager to introduce *Kaizen*. In this manner, self-selection bias was minimized, and there was no systematic bias toward overestimation of results in one group compared to the other.

During the preparation phase, we began conducting the surveys for the second round of the training program. The survey process was completed as the second round of training began. Two questionnaires were used: one for general managers and the other for employees. The description of the basic statistics and the features of the collected data will be presented toward the end of this section.

1.2 The content of the training

The most important role of the facilitators in the training program was to introduce *Kaizen* to target firms in their own countries under the guidance of the CECAPRO consultants. The cycle of the following project activities was carried out twice during the project.

Phase 1: Training at CECAPRO (40 hours)

Phase 2: Seminar in each country (2 days)

Phase 3: OJT training (to introduce *Kaizen* to target firms in countries under the guidance of the CECAPRO consultants) (24 weeks)

Phase 4: Training at CECAPRO (40 hours)

Phase 5: OJT training (to introduce *Kaizen* to target firms in countries under the guidance of the CECAPRO consultants) (24 weeks)

Phase 6: Final examination at CECAPRO (1 day)

Phase 7: Final seminar in each country (1 day)

Phase 8: Evaluation and systematization of the activity

The CECAPRO consultants overseeing the trainings in each country, provided classroom training sessions for owners and managers within the target group firms. They then sent the facilitators to the firms to benchmark the facilities, practices, and the attitudes of the managers and employees, and to provide on-site coaching services. A facilitator was responsible for several firms in his or her jurisdiction and would regularly visit these firms. In order to provide training support and guidance to both the facilitators and the firms, a CECAPRO consultant would also visit the firms that were assigned to the facilitators under his or her supervision.

1.3 Data

The data collected within this survey related to working conditions, employment, and sales revenue. During preparation of the survey, we found that some firms were quite open to sharing business data, while others were not. Therefore, rather than requesting actual figures for some variables, we asked for the rate of change compared with the previous year. In this way, it was easier for firms to share information and afterwards it was easier for us to compare data between firms.[4]

In order to dig more deeply into the mechanisms behind *Kaizen's* impact, we moved beyond business performance and collected detailed data on processes taking place on the factory floor. This is because several of the social impacts of *Kaizen* encourage changes by employees, including: (1) participation, which includes the strengthening of social capital among personnel; (2) improvement in working practices (logistics); and (3) visualization. In

[4] We chose sales revenue rather than profit rate because in many cases it takes time for firms to calculate these figures. Since most managers are quite busy, our interviews usually lasted less than one hour.

business administration, these factors make up the "QC (Quality Control) circle" and are the actual drivers of *Kaizen's* results (Shimada 2017a; 2015a; 2015b).

There are three reasons for focusing on the above-mentioned factors. Firstly, participation is the most important element of *Kaizen*, which employs a bottom-up approach to operations through the formation of a committee or group of workers often referred to as a *Kaizen* committee (or QC circle). This committee is a forum for promoting improvement in business practices and gathering suggestions from workers based on their own on-the-job knowledge. In this way, workers can become active participants in the operation of their firm rather than passive recipients simply receiving instructions from managers. For example, firms promote employee participation by engaging them in the prevention of hazards in the work place. The objective is not only to encourage worker participation in improving the conditions in the workplace but also to improve service to the customers.[5] It was expected that the training would increase these kinds of participation, and as a result, employees would become more proactive in their work. Secondly, "visualization" aims to identify problems in the firm and to promote sharing of problems among staff members, who can then work together to solve them. This is an essential foundation for promoting the participation of workers. Thirdly, the "improvement of logistical working practices" and the social capital in the firm accumulate and lead to significant changes in a firm's performance. These are the drivers of *Kaizen*.

The impacts on business performance do not come directly from these three factors. Instead, as shown in Figure 2, there is an impact ladder for business performance. After the *Kaizen* training, the behavior of managers is expected to change, and they become *Kaizen* leaders who can promote participation, visualization, and improvements in working practices. Social capital is then strengthened through the active participation of employees. This leads to

[5] For instance, in the health sector *Kaizen* is introduced not only to prevent nurses from possible infection by diseases but also to improve the service nurses provide to their patients through improved working conditions.

the next stage, which is a change in employee behavior. When this happens, the full impact of *Kaizen* can finally emerge. It is important to keep this ladder in mind during the analysis of *Kaizen*'s impact.

Table 1 shows the sample sizes of the treatment and comparison groups as well as the descriptive statistics. In the treatment group, 135 firms initially signed up to participate in the *Kaizen* project. From the original 135, eight firms went only as far as the initial meeting; these eight firms are not included in the treatment group as they did not implement any training. Among the remaining 127 firms, 94 managers accepted our survey; we were unable to obtain consent from 33 firms because they could not find the time to participate in the interviews (one hour for managers and one hour for employees). In the comparison group, 182 firms agreed to complete the survey.

Data relating to educational and occupational backgrounds was collected from the general managers along with a brief history of their business that includes the following: growth in sales revenue; employment; marketing activities; transactions with financial institutions; public relations; manager/employee communication; employee attitudes; and employees' general perceptions of *Kaizen* and the firm's efforts to adopt Kaizen practices. From employees we elicited information on attitudes toward work, relationships with colleagues, relationships and communication with management, as well as their general perceptions of *Kaizen* and the firm's efforts to adopt *Kaizen* practices. Since several general managers refused outright or were reluctant to share business data, we could not obtain precise data on sales revenue. We were, however, able to obtain data on the annual growth rate of sales revenue.

Managers tended to be in their mid 40s, while employees were in their mid 30s. Managers were highly educated - 65.6% of them had completed university. The sample firms employed 33.6 workers on average but only 7.85 workers were employed on a full-time basis. These firms catered largely to domestic markets rather than to international export markets. In

2009 (i.e., before the training project), only 9% of the sample firms exported their products. On average, the firms had more than 10 years of operation experience.

Although the treatment and comparison groups of firms were similar, having been selected as target firms based on the same criteria, we used the propensity score matching method to identify firms with an even higher level of comparability (Rosenbaum and Rubin 1983; Heckman et al. 1997, 1998; Smith and Todd 2005). Figures 3 and 4 show the density of propensity scores for managers and employees, respectively, applying the propensity score matching method. The propensity score distributions of the treatment and comparison groups largely overlap. Hence, the condition of common support is fulfilled.

Next, we performed balancing tests, which rely on the t-test of equality in the mean of each covariate between the treatment and comparison groups, after matching to ensure the balance of all covariates. The matching of managers and employees was implemented separately because the questions asked were different. The validity of matching is shown in appendices A and B. After the matching, no significant differences in the variables remained. This confirms that the matching was successful. In other words, at that point it was possible to estimate the counterfactual performance based on the performance of the matched comparison firms.

2. Empirical Results

Based on the matching discussed above, we were able to calculate the ATT (average treatment-on-the-treated). As our prime concern was the impact of management training on workers, we first analyzed the social impacts, in particular on the working conditions of employees. As participation is the most important among the three drivers of *Kaizen* (discussed above), we analyzed the ways in which *Kaizen* promoted the participation of workers. Additionally, we looked at the performance of each firm and the willingness of managers to pay for *Kaizen* training (hereafter "WTP"). Third, we analyzed the remaining two drivers of *Kaizen*,

namely visualizations and daily work practices, pertaining not only to logistics but also to social capital and networks.

(1) Social impacts

This section mainly focuses on the social impact of *Kaizen* training on the participation of employees in operations within a firm and the measures taken to prevent accidents. Table 2 shows the PSM estimation of the impact of *Kaizen* on these dimensions. In order to make an accurate estimate, we used the kernel matching and nearest-neighbor bias corrected estimators. Kernel matching is a nonparametric matching estimator that uses the weighted averages of all comparison group firms to construct the counterfactual match for each firm (Heckman, Ichimura, and Todd 1988).[6] To check the robustness of the results, we employed nearest neighbor matching and compared the results of the two matching methods used. This estimator matched each treatment firm to the comparison firm with the closest propensity score.[7]

Columns (1) to (4) present the results from the manager data, and columns (5) to (8) present the results from the employee data. Columns (3), (4), (7), and (8) show the mean values of each variable for the treatment and comparison groups. Columns (1) and (5) adopt Kernel matching results, and columns (2) and (6) use the nearest matching.

As columns (1) and (2) show, for three out of four items, the managers in the treatment group firms rated the impacts of *Kaizen* positively. Those three items were as follows: employees' attitude toward work, suggestions from employees, and more measures to prevent accidents. Managers and employees were asked questions relating to their subjective assessment of each of the items. The scale of rating differed depending on the nature of the question. For

[6] For the Kernel matching, we used bootstrap. Bootstrap refers to a method whereby repeated samples are drawn from the original sample, and where we can estimate standard errors and other (Khandker et al. 2010). We used a bandwidth of 0.06.

[7] We used the STATA command *nnmatch*, which corrected the bias of the treatment effect and estimated either the sample or population variance, with or without assuming a constant treatment effect (homoskedasticity).

instance, for the attitude question, a five-point scale was used: “5” Very Good; “4” Good; “3” Moderate; “2” Bad; “1” Very Bad. In contrast, the question on accident prevention measures used a three-point scale: “3” Yes, perfectly; “2” Yes, moderately; “1” No.

In both cases where Kernel matching and nearest-neighbor matching were used, the estimates were significant at the 1% level. The contribution that suggestions from employees made to profits became positive at the 5% significance level for Kernel matching but was not significant even at the 10% level for nearest-neighbor matching. These differences are evident simply by looking at the mean value, or columns (3) and (4). The mean values of the treatment group firms were higher than those of the comparison group firms. Therefore, managers recognized the influence of *Kaizen* in initiating workers’ participation in the business.

As columns (5) and (6) indicate, employees found their attitude toward work was more positive after the introduction of Kaizen than it was before. However, they did not find themselves more willing to suggest improvements to their managers after *Kaizen*, nor did they perceive their firm as taking improved measures to prevent accidents. Thus, the managers and employees perceived the effects of the introduction of *Kaizen* differently. This difference in perception may be due to the fact that the relationship between employers and workers in the target countries is top-down rather than bottom-up or equal; as a consequence, *Kaizen* was introduced by management. As described by Shimada (2016; 2015), the situation in Japan was similar in the mid-1950s during the early stages of *Kaizen*. Japanese firms were very hierarchical before Kaizen, and it took a long time to bring about a shift in manager-worker relations. When Japan introduced *Kaizen*, the Labor side (*Sohyo*, or the General Council of Trade Unions of Japan) strongly objected to it and considered it a tool for labor subjugation. After many years of implementation, both management and labor reached a state of compromise and cooperation. In other words, it takes a significant amount of time to introduce and implement *Kaizen*.

Judging from the results after the project, *Kaizen* had already changed workers’ attitudes, and both managers and workers recognized this change. Our study was conducted soon after the

project, therefore, the long-term impacts of the program are not clear. This could be an interesting subject for future research.

(2) Impacts on firms' performance and WTP

The results of matching for the effects of training on growth in sales revenue, wages, and employment are shown in Table 3. The numbers in columns (1) and (2) are revenue indexes, with 100 representing the level of annual sales revenue in 2009; the numbers in columns (4) and (5) are the wage indexes. The existing literature on the impact of business management does not contain any previous analyses of the impact of training on wages. Nonetheless, we chose to focus on wages because *Kaizen* practices may result in an increase in a firm's efficiency and thus, increased profits. The sharing of the increased profits between the firm and its employees, in the form of increased wages, is thought to increase the receptiveness of employees to the further apply *Kaizen*.[8] Table 3 shows the mean of these indexes in each year from 2010 to 2013. It also shows the *t*-values for the nearest neighbors matched DID between the treatment and comparison groups, and between each of these years and the base year, 2009.

Columns (1) to (3) indicate that the treatment group did not experience an increase (or decrease) in sales revenue relative to the comparison group during the period under study. This result is consistent with the findings of Higuchi et al. (2015), Higuchi et al.(forthcoming), Mano et al. (2012) and Mano et al. (2014). The result is also in line with our *Kaizen* impact ladder framework. It may be, that at the beginning the treatment group was mainly focused on the assimilation of the *Kaizen* practices in terms of increased productivity, safety, and comfort in the workplace.

[8] The three guiding principles were announced in 1955 by the Japan Productivity Center. They were: expansion of employment, cooperation between labor and management, and fair distribution of the fruit of productivity. The principles were announced after a long negotiation between management and labor. The labor union was quite against the introduction of *Kaizen* as they regarded it as a tool to intensify labor. After this announcement, the labor union agreed to participate in *Kaizen* (Shimada 2017; 2015).

In columns (4) to (6), we do not see any evidence that the treatment group firms shared profits with their employees. The DID for the wage index indicates that while wages increased significantly more for the treatment group than the comparison group between 2009 and 2012, in the next year the comparison group raised wages substantially and caught up with those of the treatment group. Columns (7) to (9) present the data on the number of employees in both groups during the period under study and the matched DIDs. Again, we do not find evidence that the treatment group increased (or decreased) its number of employees more significantly than the comparison group.

Next, we analyzed the factors that correlate with wage growth. Table 4 shows the regression results of the treatment and comparison group firms. The difference between the two groups is that in the comparison group firms, sales revenue growth is significantly correlated with wage growth, whereas in the treatment group, the improvement in work attitudes is significantly correlated with wage growth. These results reaffirm the fact that the managers in *Kaizen* firms started to evaluate workers differently. As we have seen before, *Kaizen* has a positive effect on employees' attitudes toward work. At this point, it has been confirmed that for managers, this change is important.

Table 5 examines whether the *Kaizen* training raised the WTP for the treatment group firms. Columns (1) and (2) show the results of Kernel matching and nearest-neighbor matching, respectively. The upper row shows the WTP; the lower row shows the WTP under the condition of "definitely sure" (explained below). As the table shows, the WTP did not become significant. This is a puzzling result. We adopted the certainty approach advanced by Blumenshein et al. (2008), and asked: "How sure are you about the answer? Are you definitely sure or probably sure?" This approach was found to reduce bias to a negligible level.[9] The lower row of Table 5 represents the results based on this approach; it is at this point that the WTP became statistically

[9] Suzuki et al. (2014) and Higuchi et al. (2015) also employed this approach.

significant. Therefore, it is safe to say that the *Kaizen* training does indeed raise managers' WTP, which suggests that *Kaizen* has a positive effect on a firm's performance. Furthermore, the difference in the results between the upper and lower rows suggests that managers tend to answer questions by anticipating the intention of the interviewer, and they try to satisfy their interviewer with the "correct answer." Although this is a simple method, the certainty approach reduces bias and is useful for collecting a higher quality of data.

(3) The adoption of *Kaizen* practices and the impact on social capital

The last aspect of the study relates to daily working practices; this section encompasses not only logistics (business practices on the factory floor) but also social capital and networks. These are the remaining two drivers of *Kaizen* that were mentioned earlier, namely: "visualization" and "work practices."

First, we analyzed the ways in which *Kaizen* has been implemented on the factory floor in relation to the "visualize" driver (Table 6). As we discussed earlier, one of the essential parts of the *Kaizen* activities is "visualization," which is to "see" more than simply the situation of the firm. Rather, to visualize is to identify and promote the sharing of problems within the firm, so that employees can work together to solve them. The first step is to encourage managers to share their basic thoughts about the firm: (a) sharing the mission of the firm essential for participation. Next, managers must: (b) set the sales target and share it with workers. Finally, they need to: (c) explain management policy, planning, and results periodically to employees. We analyzed the impact of each of these.

For each item, questions were asked of both managers and employees to gauge their subjective assessment of them. The scale of rating differed depending on the nature of the question. Three-point scales ("3" Yes, perfectly; "2" Yes, moderately; "1" No) were used on "the sharing mission" and "accident prevention" questions. The management policy question also

used the same rating scale but with different catchwords: (“3” Yes; “2” Yes, but not periodically; “1” No).

Table 6 shows a stark difference in viewpoints between managers and employees. It was observed that managers in the treatment group firms understood the importance of sharing basic information with workers. The results were robust for the categories of “periodic explanation to workers” (at the 1% significance level for Kernel matching) and “record of attendance of workers” at the 5% significance level. The results were mixed for “share the mission and vision” and “set the sales targets.”

As shown in columns (5) and (6), the employees of the treatment and comparison group firms did not diff in any of these variables after matching In other words, from the perspective of the employees, and in contrast to that of the managers, the introduction of *Kaizen* had not yet produced noticeable changes to these aspects. Managers perceiving themselves as implementing what they had learned was important after the *Kaizen* training; however, the perception of employees was slightly different. These results indicate that there is room for future improvement and that it takes time for *Kaizen* to have any visible effects on the ground. In any organization, surface change may occur after the leader realizes what he or she needs to do and then does it. However, institutional change does not happen as easily and takes more time.

Second, we scrutinized whether *Kaizen* promoted visualization and participation of the workers on the ground in more detail (Table 7). Questions on *Kaizen* practices listed in Table 7 were asked using a three-point scale (“3” Yes; “2” Yes, moderately; “1” No). The results were mixed. For some aspects, both managers and employees recognized the impacts, but for others, perceptions differed between managers and employees. Managers recognized the positive influence of all variables (the existence of the *Kaizen* committee; a floor plan; putting tools in the designated place; cleaning the work space; maintenance; and a sense of participation) except the last one (keeping the material record every day), although the estimation results for some variables were mixed.

Employees perceived things slightly differently. For instance, they recognized the existence of the committee at the 1% significance level for Kernel matching. Managers also recognized it but the coefficient was small. This indicates a result that is not particularly robust (Kernel matching only became significant at the 10% level). These results show that actual operation is ahead of the managers' perceptions. The workers do these tasks of their own volition; within *Kaizen* practice, this is called "participation in the operation" even in the absence of explicit instructions. In effect, workers in the treatment group had become active players rather than passive laborers.

The recognition of a floor plan and maintenance completely differed between managers and employees. Managers displayed the floor plan with the intention of giving workers a clear idea of the factory floor and of initiating gradual changes; however, this was not recognized by employees, indicating room for improvement in the future. It seems both managers and employees shared a sense of participation.

As we have already seen, the attitudes of employees towards their work changed after the introduction of *Kaizen*. However, even when managers tried to lead changes in many parts of the operation, we found that the workers could not recognize the changes on the factory floor. This is a puzzling result. If what was happening on the factory floor was not the incentive behind employees changing their attitudes toward work, then what was?

The answer to this question could be the relationships between employees and other people in the firm. With this in mind, we then analyzed the firm's social capital. Up until this point, our study had determined that employees do not recognize changes as much as managers do. Yet in spite of this, we found that employee attitudes have changed perceptibly. One possible reason for this finding is that *Kaizen* may have promoted social capital or employee participation in the operations of the firm, and that is what affected the attitudes of employees toward work.

Table 8 shows the results of this analysis. Again there is a stark difference between the attitudes of managers and employees. This time, though, there does not appear to be any positive

effect on the managers' social capital. The first variable questions their trust toward the general public.[10] The second question asked specifically about social capital, the trust managers show toward the employees (question to managers) and the level of trust between colleagues (question to employees). In both variables, the results did not become statistically significant for managers but they did for employees at the 5% significance level. The results are robust, as confirmed by both estimators. This indicates that *Kaizen* strengthened the social capital of employees and that there was indeed a difference between what was truly happening on the ground and the impacts perceived by managers.

Next, we checked the other aspects of social capital, asking whether "crime, theft, and disorder" were obstacles to their operation. "Crime, theft, and disorder" usually reflect a negative relationship with outsiders. This relationship, however, is also internal in the case of Central America and the Caribbean islands. As reported by the World Bank (2011), the crime rate in this region is very high. During our interviews with several firms, a number of managers privately revealed that they have faced extortion from their own staff members who are connected to "*mara*s," a gang in Central America and the Caribbean Region. As the table shows, the coefficients are negative and significant at the 5% level. This means that after *Kaizen*, "crime, theft, and disorder" became less problematic; this is not surprising given that it is a known fact that high social capital is often associated with a lower crime rate (Putnam 2001).

Even if the direction of causality is unknown, these results imply that after *Kaizen*, the social capital inside the *Kaizen* firms improved. Even when the trust between managers and employees did not improve, it was generally recognized that the attitude of employees had changed. This positive change probably improved the atmosphere in the workplace, and this then spilled over into the relationship between managers and employees.

[10] The questions were asked the same way that the World Values Survey conduct their surveys, for example: "Generally speaking, would you say that…? 1. Most people can be trusted, or 2. You need to be careful dealing with people."

(4) How difficult is it for managers and workers to adopt *Kaizen*?

As we have seen, there are different perceptions on *Kaizen's* progress. Thus, we looked at whether it takes time for managers and workers to adopt *Kaizen* (Table 9). The table shows that all managers in the treatment group appreciated *Kaizen* as a management tool. Before the project, however, the same managers reacted differently to *Kaizen*. Previously, the majority of managers did not know whether *Kaizen* would be useful for their firms. We need to recall that while firms were selected into the treatment group based on their eagerness to learn *Kaizen*, the managers in these firms were still not fully convinced about the usefulness of the method.

For this reason, at the time of introducing *Kaizen*, managers faced difficulty convincing their colleagues and employees to adopt this new approach (as shown in Table 9). Employees were more skeptical about introducing *Kaizen* than management-level staff members were. They may have feared that this new management method that promised to improve "efficiency," would ultimately cause them to lose their jobs. We also need to remember that in many cases nowadays, new management methods involve BPR (Business Practice Re-engineering). These methods try to reduce costs, including staff costs, and they often end up reducing the number of jobs for workers and/or decreasing wages. Thus, when managers start to introduce new management methods, there is good reason for workers to be apprehensive. This anxiety feeds workers' skepticism about new management methods, especially when managers first try to introduce them.

This trend was evident in the answers to the following questions. We asked both managers and employees when they realized the usefulness of *Kaizen* (Figure 5). While the majority of managers (80%) found *Kaizen* useful within the first three months, 20% of the managers needed a number of additional months. A greater portion of employees (34.94%) required more time, even if *Kaizen* eventually enhanced their working conditions (including wages). Therefore, it is safe to say that it takes time to reap the benefits of *Kaizen*. It is a gradual

approach rather than a rapid one, since its foundation rests on the cooperative relationship (or trust) between managers and workers (vertical), and among workers (horizontal), which needs time to be strengthened.

3. Conclusions

Our study found that *Kaizen* improved the participation of employees in the operation of firms and strengthened social capital inside the firms, especially with respect to the relationships between workers in the treatment group. The willingness of managers to pay for *Kaizen* training became positive after the introduction of *Kaizen*, suggesting that managers realized its usefulness to the performance of their firm.

Regarding sales revenue and the number of employees, there were three encouraging signs. First, managers realized what they needed to do, and they also perceived positive changes on the factory floor after the project. Second, even when the employees did not fully recognize all the changes that managers were trying to implement in the factories, our study found that the level of employee participation and social capital in the firms were nonetheless strengthened. Third, managers appreciated worker participation and valued it highly, as suggested by the trend in wages.

Even if there were positive signs for the *Kaizen* approach, there is room for improvement, especially given the differences in perception between managers and employees. As discussed, institutionalization of *Kaizen* takes time. The managers now understand the concept of *Kaizen*, thus the next step would be to institutionalize it. At the core of *Kaizen* is a bottom-up approach, so a strengthening of institutionalization would be the way to improve its overall efficiency. This is also a classic case of asymmetry of information. Our findings suggest that it took time for private firms to understand the usefulness of *Kaizen*. In this situation, the

investment is less than the Pareto optimal level. Therefore, support from the government and international donors is essential to encourage firms to introduce *Kaizen*.

Finally, this paper has a number of limitations. First, as mentioned earlier, this paper primarily used subjective rather than objective data, because it was difficult to collect objective data from private firms. Our sample firms were all SMEs, and as the staff in these organizations have many responsibilities and are very busy, we could not get them to agree to take more time to gather objective data. Second, we collected data soon after the project ended; thus, this survey could not analyze the long-term impacts of *Kaizen*. This is largely due to the phase-in research setting. The next phase serves as a comparison group. This point can be addressed in a future survey. Furthermore, due to the limited sample size in each country, we could not analyze country and firm interaction. These are all challenges to be confronted in the future.

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Table 1 Descriptive statistics and sample size

Variable	Treatment Managers Mean (SD)	Comparison Mangers Mean (SD)	Treatment Employees Mean (SD)	Comparison Employees Mean (SD)	Total Mean (SD)
Age	47.138	45.289	35.156	35.108	40.544
	(12.539)	(10.927)	(9.955)	(10.236)	(12.106)
Years in the company	16.734	12.110	8.688	6.795	10.597
	(10.358)	(9.768)	(6.480)	(6.537)	(9.127)
Number of full-time employees	6.543	8.528	.	.	7.847
	(9.184)	(10.774)	.	.	(10.283)
Number of persons engaged including family members and excluding temporary workers	21.920	32.619	.	.	33.593
	(21.098)	(41.532)	.	.	(83.231)
Percentage of export amount in 2009	5.730	10.490	.	.	8.965
	(18.057)	(25.597)	.	.	(23.513)
No. of observation	94	182	96	176	548

Table 2 Employee's working conditions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Managers				Employees			
	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean
Employees' attitudes towards work	0.306 ***	0.388 **	3.301	3.121	0.294 ***	0.215 **	3.200	3.017
(Five-point scale)	(3.078)	[0.002]			(3.062)	[0.071]		
Employees suggest improvements	0.233 ***	0.169 **	2.404	2.253	0.125	0.301	2.458	2.347
(Three-point scale)	(2.960)	[0.075]			(1.635)	[0.781]		
Firms take measures to prevent	0.274 ***	0.233 ***	1.660	1.396	0.163	0.122	1.600	1.500
accidents? (Three-point scale)	(3.803)	[0.041]			(1.200)	[1.39]		
Suggestions contribute to increased	0.122 **	0.105	1.819	1.747	-	-	-	-
profit. (2 =yes, 1 = no)	(2.023)	[0.163]			-	-	-	-
	Treat=86, Comparisonl=140	N=231~237	94	182	Treat=83, Comparison=173	N=205~259	96	176

* p<0.10 ** p<0.05 *** p<0.01

Notes: Standard errors of Kernal matchig are obtained from Bootstrapping. Numbers in parentheses are z-statistics in columns (1) and (5). Numbers in brackets are p-value in columns (2) and (6). Five-point scale: 5.Very good, 4. Good, 3. Moderate, 2. Bad, 1. Very bad. Three-point scale: 3 Yes, 2 Yes, moderately, 1. No

Table 3 Sales revenue, wages, and employment

	Sales Revenue				Wages				Employment			
	(1)	(2)	(3)		(4)	(5)	(6)		(7)	(8)	(9)	
	Treatment firms	Comparison firms	Nearest-Neighbor Matching		Treatment firms	Comparison firms	Nearest-Neighbor Matching		Treatment firms	Comparison firms	Nearest-Neighbor Matching	
	mean	mean	*t*-value		mean	mean	*t*-value		mean	mean	*t*-value	
in 2010	111.0	111.6	-0.892	in 2010	104.4	107.4	-0.877	in 2010	21.9	32.6	0.185	
	[24.3]	[22.2]			[6.6]	[13.2]			[21.1]	[41.5]		
in 2011	115.0	114.5	-0.615	in 2011	107.0	105.6	1.189	in 2011	26.0	34.9	0.196	
	[29.5]	[24.2]			[6.8]	[4.7]			[24.9]	[45.7]		
in 2012	111.8	116.5	-1.267	in 2012	106.1	104.9	2.487 ***	in 2012	27.3	36.9	0.044	
	[27.7]	[37.4]			[5.9]	[6.9]			[24.8]	[49.8]		
in 2013	116.3	122.4	1.332	in 2013	107.0	107.7	0.533	in 2013	29.4	36.6	0.083	
	[31.7]	[44.3]			[6.1]	[14.4]			[28.4]	[49.2]		

Notes: Numbers in brackets are the standard diviation.

Table 4 Factors correlating with wage growth

	(1)	(2)
Dependent variable	Treatment firm Wage growth	Comparison firm Wage growth
	coefficient	coefficient
Sales revenue growth	0.314	0.07 ***
	(1.30)	(5.20)
Work attitude of employees improved	1.922 *	0.530
	(1.73)	(0.79)
University degree	2.308 *	2.141 **
	(1.69)	(1.92)
Cons	-1.950	0.631
	(-0.50)	(0.27)
N	75	163
R-squared	0.085	0.168

Numbers in parentheses are t-statistics.

Table 5 Willingness to pay for *Kaizen* training

	(1)	(2)	(3)	(4)
	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean
WTP	0.031	0.041	0.819	0.813
	(0.530)	(0.520)	(0.387)	(0.391)
WTP + Definitely sure	0.203 ***	0.180 **	0.521	0.373
	(3.122)	(0.039)	(0.502)	(0.485)
	Treat=86, Comparison=140	N=231~237		

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

Notes: Standard errors for Kernal matching are obtained from Bootstrapping. Numbers in parentheses are *t*-statistics in column (1). Numbers in parentheses are *p*-value in column (2). Numbers in parentheses in columns (3) and (4) are medians.

Table 6 Leadership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Managers				Employees			
	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean
Share the mission and vision? (five-point scale)	0.232 **	0.12	3.269	3.110	0.095	0.064	3.406	3.364
	-(2.045)	[0.284]			-(1.125)	[0.598]		
Set sales targets? (2 =yes, 1 = no)	0.093	0.128 *	1.745	1.698	-0.091	0.203	1.526	1.597
	-(1.046)	[0.086]			(-1.199)	[0.838]		
Explain management policy, planning and results periodically to employees? (three-point scale)	0.265 ***	0.233 *	2.213	1.973	0.049	0.074	2.198	2.207
	-(2.549)	[0.050]			-(0.397)	[0.594]		
Record the attendance of each employee? (2 = Yes, 1 = No))	0.081 **	0.134 **	1.926	1.824	-	-	-	-
	-(1.961)	[0.021]			-	-	-	-
	Treat=86, Comparison=140	N=231~237	94	182	Treat=83, Comparison=173	N=205~259	96	176

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

Notes: Standard errors for Kernal matching are obtained from Bootstrapping. Numbers in parentheses are *z*-statistics in columns (1) and (5). Numbers in parentheses are *p*-value in columns (2) and (6). Five-point scale: 5.Very good, 4. Good, 3. Moderate, 2. Bad, 1. Very bad. Three-point scale: 3 Yes, 2 Yes, moderately, 1. No

Table 7 *Kaizen* practices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Managers				Employees			
	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean
Is there a committee or group organized by the employees in search of solutions to the problems of the workplace? (three-point scale)	0.228 *	0.192	1.851	1.637	0.470 ***	0.500 **	2.073	1.697
	(1.852)	(0.193)	[0.892]	[0.821]	(4.271)	(0.002)	[0.874]	[0.806]
Have a floor plan displayed on the wall of the workplace? (three-point scale)	0.268 ***	0.203	1.511	1.287	0.088	0.072	2.292	2.176
	(2.579)	(0.141)	[0.839]	[0.654]	(1.334)	(0.367)	[0.457]	[0.425]
Employees put tools and equipment in the designated place? (three-point scale)	0.511 ***	0.435 ***	2.109	1.768	-	-	-	-
	(5.832)	(0.001)	[0.791]	[0.739]	-	-	-	-
Employees clean their workspace at the end of every workday? (three-point scale)	0.509 ***	0.547 ***	2.606	2.155	0.262 ***	0.189 *	2.583	2.420
	(5.008)	(0.000)	[0.609]	[0.759]	(3.414)	(0.089)	[0.574]	[0.713]
Employees clean and do maintenance using the manual? (three-point scale)	0.265 ***	0.233 ***	2.176	1.955	-0.124	-0.025	2.021	2.119
	(2.549)	(0.050)	[0.760]	[0.810]	(-1.041)	(0.127)	[0.763]	[0.723]
All managers and employees share the sense of participation in reducing defect rate or number of customer complaints? (three-point scale)	0.283 ***	0.151	2.543	2.368	0.135 *	0.662	2.542	2.494
	(2.710)	(0.171)	[0.667]	[0.674]	(1.706)	(0.555)	[0.648]	[0.668]
Keep the material record every day (or at every transaction) with dates, material name, amount used and amount purchased? (three-point scale)	0.005	0.233	2.787	2.797	-	-	-	-
	(0.091)	(0.764)	[0.411]	[0.404]	-	-	-	-
	Treat=86, Comparison=140	N=231~237			Treat=83, comparison=173	N=205~259		

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

Notes: Standard errors for Kernal matching are obtained from Bootstrapping. Numbers in parentheses are *t*-statistics in columns (1) and (5). Numbers in parentheses are *p*-values in columns (2) and (6). Three-point scale: 3 Yes, 2 Yes, moderately, 1. No

Table 8 Social capital and network

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Managers				Employees			
	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean	Kernel matching coefficient	Nearest-neighbor bias-corrected coefficient	Treatment firm mean	Comparison firm mean
Most people can be trusted? (2 = Yes, 1 = No)	-0.061	-0.105	1.355	1.456	0.103 **	0.178 **	1.375	1.318
	(-0.849)	(0.203)	[0.481]	[0.499]	(1.805)	(0.036)	[0.487]	[0.467]
Trust employees (Manager)? or Trust Colleagues (Employee) ? (Five-point scale)	0.074	-0.012	3.624	3.632	0.226 **	0.331 **	3.698	3.585
	(0.594)	(0.937)	[0.806]	[0.905]	(1.915)	(0.052)	[0.964]	[1.010]
Are crime, theft, and disorder obstacles? (5: Very serious - 1: No)	-0.477 **	-0.517 **	1.903	2.104	-	-	-	-
	(-2.214)	(0.380)	[1.554]	[1.503]	-	-	-	-
	Treat=86, Comparison=40	N=231~237			Treat=83, Comparison=173	N=205~259		

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

Notes: Standard errors of Kernal matching are obtained from Bootstrapping. Numbers in parentheses are *t*-statistics in columns (1) and (5). Numbers in parentheses are *p*-values in columns (2) and (6). Numbers in brackets in columns 3, 4, 7 and 8 are medians. Five-point scale rating: 5.Very good, 4. Good, 3. Moderate, 2. Bad, 1. Very bad. Three-point scale: 3 Yes, 2 Yes, moderately, 1. No

Table 9 Managers' perception of *Kaizen*

		Before	After
Is 5S/*Kaizen* useful?	Very useful	27 (35.0%)	77 (100%)
	Useful	16 (20.8%)	0
	Useful but others are more useful	2 (2.6%)	0
	Not useful	1 (1.3%)	0
	Don't know	31 (40.3%)	0
Did you have any trouble convincing your management-level colleague or employees to introduce 5S/*Kaizen*?		To colleagues	To employees
	It was difficult	18 (19.4%)	43 (46.2%)
	No difficulty	75 (80.6%)	50 (53.8%)

Figure 1

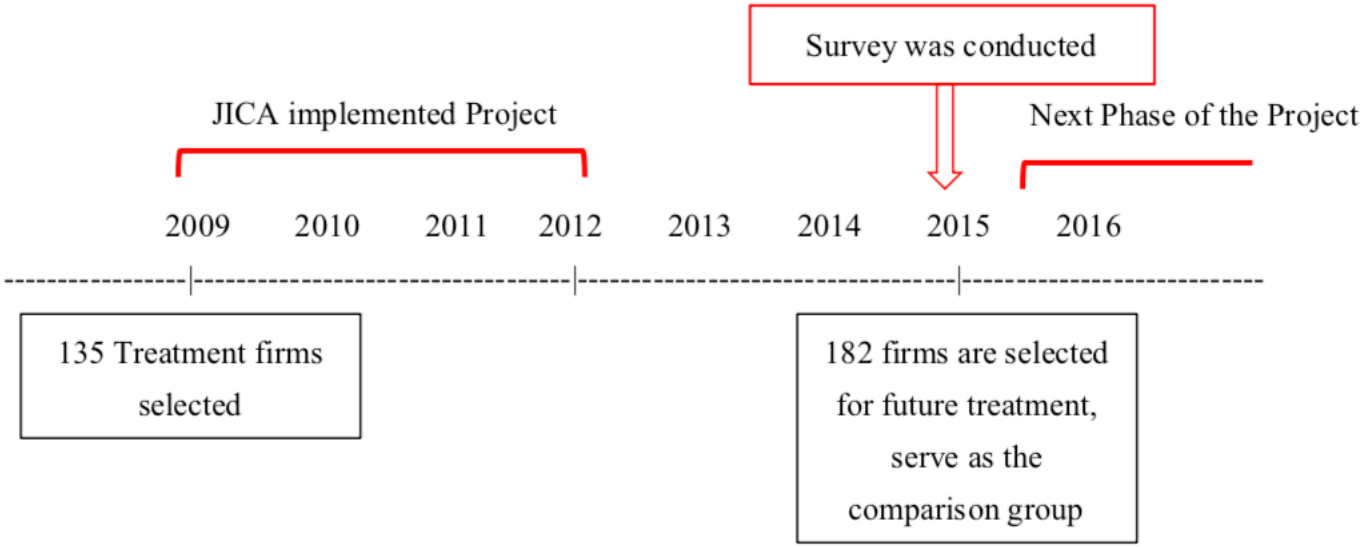
Survey was conducted
JICA implemented Project
Next Phase of the Project
2009
2010
2011
2012
2013
2014
2015
2016
135 Treatment firms selected
182 firms are selected for future treatment, serve as the comparison group

Figure 2 Impact ladder

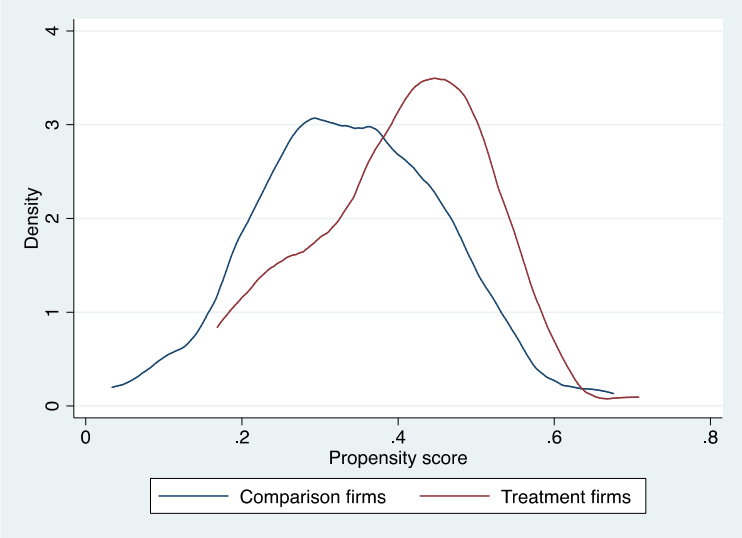

Figure 3 Propensity score distribution (Managers)

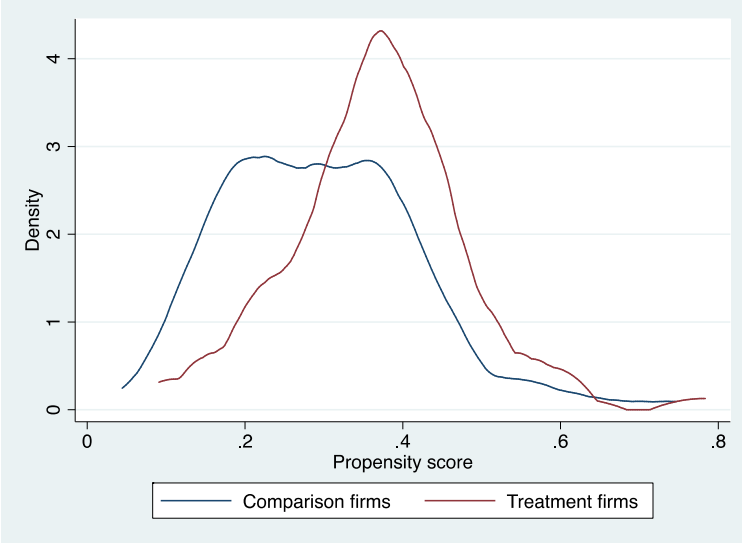

Figure 4 Propensity score distribution (Employees)

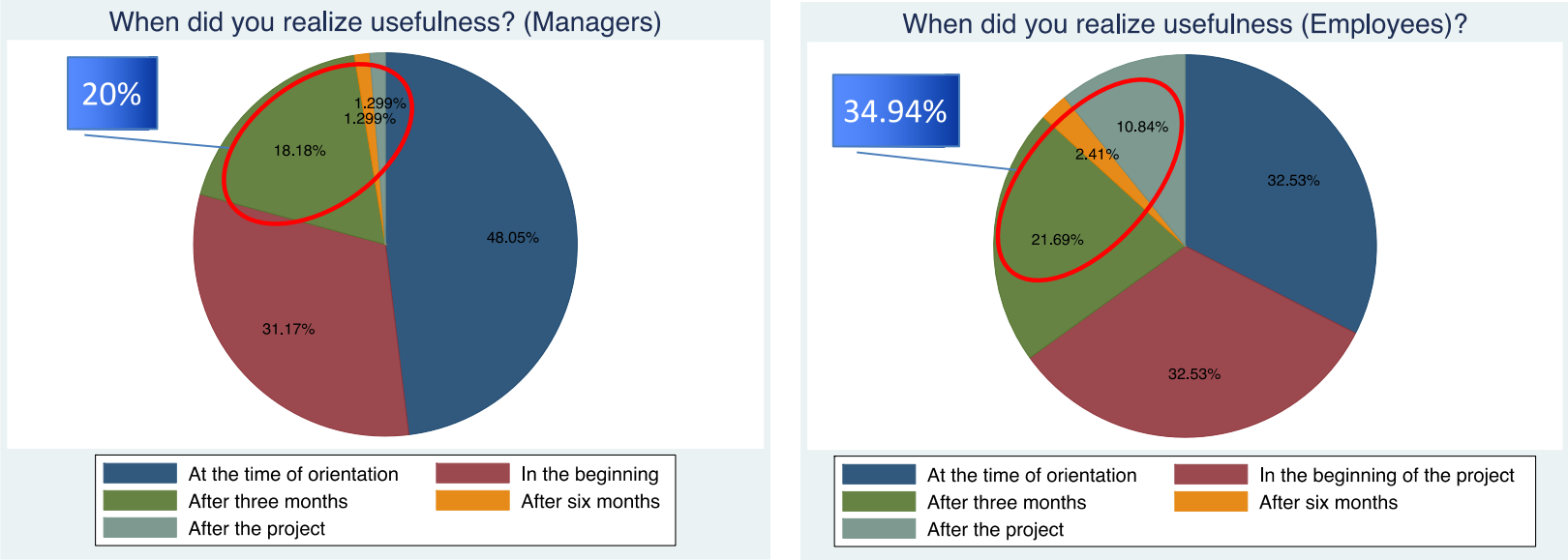

Figure 5 Timing of realizing usefulness (Managers and Employees)

Table A Balancing test results (Managers)

Variable	Mean		t-test	
	Treated	Comparison	t	p>t
	(Upper row: before matching, Lower row: After Matching)			
Number of persons engaged	21.920	32.619	-2.24 **	0.026
	23.072	23.449	-0.09	0.928
Enterprises' year of operation	23.849	20.890	1.49	0.137
	24.406	23.580	0.4	0.692
Tendency of business (three scale rating)	0.755	0.720	0.46	0.647
	1.529	1.435	0.85	0.399
Perspective of business (three scale rating)	0.540	0.531	0.17	0.867
	1.073	1.029	0.92	0.381
Education (1 = University graduate, 0 = Non university graduate)	0.268	0.363	-2.25 **	0.025
	0.565	0.594	-0.34	0.732
English proficiency (six scale rating)	1.953	1.662	1.56	0.12
	3.870	3.826	0.17	0.868

* p<0.10 ** p<0.05 *** p<0.01

Note: Number of persons engaged include family members and exclude temporary workers in 2009. Three scale rating for tendency of business: 1 = Growing, 2 = Stable, 3 = Declining. Three scale rating for perspective of business: 1 = Optimistic, 2 = Pessimistic, 3 = Critical. Six scale rating for English proficiency: 1=Advanced proficiecy, 2=Proficient, 3=High intermediate, 4=Low Intermediate, 5=Basic, 6=Not at all.

Table B Balancing test results (Employees)

Variable	Mean		t-test	
	Treated	Comparison	t	p>t
	(Upper row: before matching, Lower row: After Matching)			
Age	41.084	40.256	0.76	0.447
	34.819	33.639	0.82	0.414
Sex	1.4	1.3911	0.2	0.839
	1.4819	1.5301	-0.62	0.537
Relation to founder	2.2447	2.322	-1.02	0.31
	2.9157	2.9277	-0.27	0.791
Work years	12.668	9.4972	3.92***	0
	9.4578	8.2289	1.16	0.25
Know 5S/Kaizen	1.7437	1.514	5.01***	0
(before the peoject)	1.7952	1.8193	-0.39	0.696

* p<0.10 ** p<0.05 *** p<0.01

Note: Sex: 1. male, 2 female, Relation to founder: 1. Yourself, 2. Famlily/ relative, 3. Employer. Know 5S/Kaizen: 1. Yes, 2. No.

Abstract (in Japanese)

要約

近年、開発途上国の産業発展へのアプローチとしてのカイゼンの役割に新たな関心が向けられている。これまでのいくつかの研究では、カイゼン導入が経営のあり方やビジネス・パフォーマンスに与える影響を評価されてきたが、労働条件、賃金、雇用などへのインパクトを評価する研究はほとんど行われていない。本研究は JICA の「中小企業の品質・生産性向上に係るファシリテーター能力向上プロジェクト（中米・カリブ広域）」（2009 年～2013 年）にかかわった企業（94 社）を対象に経営陣と従業員双方から聞き取り調査を行い、比較群の企業（182 社）と比較を行いプロジェクトの効果を傾向スコアマッチング手法によって分析したものである。分析の結果、カイゼンの導入が労働条件を改善し、労働者の間の信頼（社会関係資本）を強化することが確認された。また、カイゼンの研修の後、経営者の研修に対する支払い意思額（WTP）が高まったことも確認されたが、一方、経営者と労働者ではカイゼンの効果について異なった見方がされていることも分かった。これらの結果は、今後のカイゼン協力のあり方をさらに効果的にすることにつながると思われる。

キーワード：マネジメント研修、インパクト評価、支払い意思額、中小企業、中米・カリブ地域