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Impact of Kaizen Events on improving the performance of automotive components first tier suppliers.

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Abstract

Purpose of this paper: The aim of this paper is to explore the possibility of improving production indicators by implementing Kaizen Events. The teams are composed of both managers and operators with the aim of developing and/or implementing improvements in a period of from 3 to 5 days.

Methodology: The empirical research will consist of the description of the results obtained in 11 industrial companies from the automotive components industry In each of the companies, we have followed up different interventions over a 9-12 month period

Findings: We shall present the initial situation; the activities carried out by the company and the evolution of the manufacturing performance approximately three months after the activities are finished, as well as qualitative conclusions on the carrying out of the Kaizen Event.

What is original/value of paper: There has been little empirical research to establish the degree of the improvement of productive indicators in companies advancing towards lean production. The paper tries to fill this gap

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Keywords: Human resources, Productivity and competitiveness, continuous improvement, teams.

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1 INTRODUCTION

Currently, most automobile manufacturers have transformed their philosophy of production in favour of the lean production paradigm. By doing so, they hope to improve efficiency and to obtain better results in the markets in which they operate. This transformation must occur not only in the plants, but it seems important that first tier suppliers should also modify their production systems in line with the lean production philosophy (Liker & Wu 2000). In the future, the effects of this wave will probably also reach second level suppliers, with the result that one integrated supply chain can be built.

Nevertheless, in the interventions that we have carried out in recent years in the automobile auxiliary industry, we have been able to observe that the suppliers companies are still not convinced of the profitability of lean systems, in spite of the favourable opinions expressed in scientific publications. One of the main reasons is that they lack information and clear examples related to their activities. For the supplier company managers, the fact that lean production is a success in automobile manufacturers does not guarantee, from the outset, that they too will have this success.

Moreover, for the supplier companies there is no question that the advance towards lean production requires investments, not just in facilities but also in worker training and time to develop the improvements. They are also aware that the way is not free of risks, such as the loss of the buffer provided by stocks or the greater pressure on workers, among others. Some of these risks have been discussed in recent research (Cooney 2002;Fairris 2002).

With the aim of solving this problem, one of Spain's largest car manufacturers carried out a suppliers' development program between 1999 and 2001. This consisted of a team of consultants who visited the plants under study and provided them with support in the form of a Kaizen Event.

On the other hand, in the academic world it is considered that certain management actions in human resources, such as training, teamwork and continuous improvement are undoubtedly important factors, particularly when organisations face a change in how they operate (Power & Sohal 2000;Taira 1996).

In this paper we are interested in showing the possibilities for enhancement of industrial processes offered by the implementation of Kaizen Event in companies supplying the automobile manufacturers. The success of the improvement proposals shall be measured on the basis of the variation of specific production indicators. With the aim of isolating the effects that could be produced by the type of process followed to put lean production into action, all the companies were submitted to the same treatment, consisting of the creation of task forces made up of managers and workers, who developed the improvement proposals after receiving specific training.

As proposed by Shah and Ward (Shah & Ward 2003), there has been little empirical research to establish the degree of the improvement of productive indicators in companies advancing towards lean production.

In this paper, we aim to fill part of this gap in the empirical research, with special attention to the evolution and development of these indicators after the implementation of Kaizer Event work teams. Qualitative conclusions will also be presented on the implementation process in the different supply companies.

The following section of the paper deals with an analysis of the existing literature on Kaizen Events, their definition and impact. This will be followed by a description of the methodology applied on carrying out the research and also of the measurements used. The results obtained are then presented, both quantitative and qualitative, followed by a discussion of their repercussions, both at a practical level and in terms of research.

2 REVIEW OF THE LITERATURE

Kaizen is a Japanese term invented by (Imai 1986) to describe a continuous improvement (Cuscela 1998). The aim is to achieve continuous improvement in costs, quality and flexibility (Bessant et al. 1993) and productivity (Choi, Rungtusanatham, & Kim 1997). One of the characteristics of *kaizen* is that the improvements result in lower costs (Choi, Rungtusanatham, & Kim 1997), certainly much lower than other techniques such as process re-engineering or similar methods (de Lange-Ros & Boer 2001;Rijnders & Boer 2004).

The words *Kaizen* and *Event* were joined to give the term the connotation of a pre-determined duration, in which the advantages of a continuous improvement could be obtained in a limited period of time.

The Kaizen Event teams as task forces are teams that do not form a permanent part of the organisational structure and are involved in a secondary task for their members (Bradford and Bradford, 1981; (Lawler III 1996)). This task is superimposed upon the habitual obligations of the group members within the company (Lawler III, Mohrman, & Benson 2001).

The main difference with other group suggestion systems, such as quality circles, is the time needed. Kaizen Events normally last from 4 to 5 days, while quality circles and similar systems can be active for months or years.

Moreover Kaizen Event teams are externally managed groups: they only have the responsibility of achieving specific improvements in specific areas, and the management designs the group task, selects the components, sets out the basic rules to achieve the objectives, etc. The management also guides the group task and supervises the group results, as well as designing the organisational context the group is to work in and setting up the reward system and training or information the group is to receive (Hackman 1990;Montabon 2005;Rees 1997).

Kaizen Events are also known in the literature as Accelerated Improvement Workshops (Alexander & Williams 2005), Kaizen Project (Bradley & Willett 2004), Process Improvement or Industry Forum Master Class (Bateman & Brander 2000), Kaizen Blitz (Cuscela 1998;Gray et al. 2005;Minton 1998), continuous process improvements (Componation & Farrington 2000). The term *Kaizen Event* was coined by (Vasilash 2000). (8 and 9B)

2.1 Repercussions of Kaizen Event practices on business performance in lean production environments

In the bibliographical revision carried out, we found several papers on the effect of the use of Kaizen Event on the company's results. Many of these make reference to productive indicators and consider that kaizen contributes to improving physical productivity (measured as pieces per worker or reduction of cycle time), the quality of products made or the amount of stock necessary in the company.

The following is a list of authors who have published articles on Kaizen Events, together with the type of industry/service and the areas in which improvements were achieved:

- (Alexander & Williams 2005): *Library*. Flow, Work in Process, Dock to Dock, Cycle Time
- (Bradley & Willett 2004): *Transportation products industry*. Cost, Inventory Level, Dock to Dock, Setup times
- (Bateman & Brander 2000): *Automotive Industry*. Cost, Dock to Dock, Quality, Productivity.
- (Cuscela 1998). *Automotive Industry*. Flow, Quality, Productivity and Security
- (Gray, Mann, Saddler, Casey, Green, Kistner, Daley, & Ambrose 2005): *Laboratory*. Work in Process, Moral and Less Documentation
- (Componation & Farrington 2000). *Automotive industry*. Cycle Time
- (Bateman & David 2002): *Automotive industry*. Cycle Time, Productivity
- (Sheridan 1997): *Jet engines industry*. Dock to Dock, Quality, Productivity and improvement of cashflow
- (Minton 1998): *Electronic assembly industry*. Flow, Cost, Work in Process, Cycle time

It can be seen from the list that not a great deal has been written about the impact of Kaizen Events on production indicators. Also, most cases dealing with the automotive industry include few of these indicators, and, except for a limited number of studies (Bateman & David 2002; Bateman & Brander 2000), focus on a single company. The aim of the present study is therefore to evaluate the impact on a greater number of indicators as well as on a group of suppliers with varying characteristics. In the sample there are multinational companies with strong global presence in the automotive industry, as well as national companies with plants in different provinces. Also, not all companies have the same production systems: there are manufacturers of plastic parts for injection, metal parts and assemblies. The authors studied some companies with highly automated production processes and others with manual processes. Additionally in some cases, companies had complex logistic schemes such as the delivery in sequence to the customer. It should also be pointed out that the improvements obtained include not only those mentioned above, but also all those associated with any improvement team involved in continuous improvement.

Finally, there are some publications where the joint application of lean production and work teams was evaluated. In these, it was considered that the use of techniques associated with the lean production system (just in time, total productive maintenance or total quality management) substantially enhanced operational performance, while the effects deriving from the participation of the workers in the deployment of that system, rather than following more directly managerial procedures (by unilateral decisions of managers or consultants) are much less pronounced (Lowe, Delbridge, & Oliver 1997;Shah & Ward 2003). Nevertheless, the aim of our research is not so ambitious as those researches. We do not attempt to isolate the effect produced by the application of certain lean production techniques from the effect due to the use of ad-hoc groups, but we do aim to quantify the joint effect of developing the implementation of a lean system through groups that allow workers involvement.

3 RESEARCH METHOD

3.1 Sample procedures

For the empirical research, data was compiled from 11 first tier suppliers of one automobile manufacturer located in Spain. These companies were selected either for their importance by volume of purchase, having achieved cost reductions in recent years, or because they had recently encountered problems relating to the quality of deliveries.

The Kaizen Events were led by external consultants (lean managers of the main client), whose role was to select lines of action in conjunction with engineers from the company and to collaborate in the training and implantation stages.

These companies, located in the main Spanish cities, belong to different industries and manufacture various products, among which are soundproofing, metal stamping, welded parts, nuts and bolts, plastics (injection and moulded), mechanical sets and electrical products (see table 2).

Table 2 Description of the companies studied

	Processes	Turnover (mill €)	Industry
Case 1	Injection and assembly	28	Plastics
Case 2	Pressing, mechanizing, injection and welding	29	Metal-mechanical
Case 3	Pressing and welding	80	Metal-mechanical
Case 4	Mechanizing, pressing and injection	27	Metal-mechanical
Case 5	Injection	24	Plastics
Case 6	Mechanizing and assembly	60	Assembly
Case 7	Assembly	85	Assembly
Case 8	Injection and assembly	178	Chemistry
Case 9	Injection	125	Chemistry
Case 10	Injection and assembly	166	Plastics
Case 11	Injection and assembly	85	Electronic products

Although this set of companies does not provide a representative sample of the population, the product manufactured or the process employed varies from plant to plant, providing some test of the generalization of the results.

The entire data obtaining process took place between March 1999 and July 2001. All of the companies were observed over a period of 9 to 12 months and the following activities were carried out (Montabon 2005):

Step 1: Selecting the line or process to be observed in the plant.

Step 2: Initial diagnosis of the situation of the line selected. This diagnostic period usually lasted 2 days, with the collaboration of a group of 4 or 5 managers from different departments. During the visit, the measurements of the productive indicators published in the lines and their date of publication were also noted, where present. For occasional aspects, the head of quality control or maintenance was consulted for comparison with the opinion of the head of production.

Step 3: Development of the Kaizen-Blitz activities and action. A workshop dynamic of 4-5 complete days duration was used, under the guidance of expert consultants. Groups of 5 to 14 people participated in the workshops, half of whom were workers. The contents were selected in line with the needs detected in the diagnosis. The workshops started off by explaining the theory of the tools that were going to used in the event and making sure that everybody understood them. These tools ranged from 5S tools, Visual Factory and Re-design of Layouts for the less developed plants in lean manufacturing, to Kanban or TPM techniques for those in which the technique had already been introduced. The workshop participants were in charge of taking samples of the production indicator measurements, accompanying them with photos or video recordings when it was considered necessary. These data served to set out the initial value of the indicators prior to intervention of the ad-hoc group. At the end of the week, the group had implemented the chosen improvements and had proposed an immediate action plan for further improvements that would require the approval of the management. Finally, a date was agreed for follow-up on the evolution of the indicators of productive efficiency. These data served to establish the final value of the indicators after the group's intervention.

This process was repeated two or three times in each company during a 9-month period until the objectives specified in the initial diagnosis were fulfilled. In other words, two or three Kaizen Blitzes were carried out in each company.

Step 4: Drafting a report to reflect the summary of the activities, to be added to the research database

All the companies received the same intervention, summarised in the four steps described above in the data gathering process, with allowances made for the particular circumstances of each one.

In order to create our dependent variables, we selected only production efficiency indicators gathered by objective measures. We considered that, for the research aims proposed, objective performance measures provide a more robust comparison, as they are less prone to short-term fluctuations (Lowe, Delbridge, & Oliver 1997). As our interest was centred on evaluating the impact on the production process, no financial indicators or indicators of human resources-related aspects were registered.

The five operational measures utilised to assess the efficiency of the productive process were as follows:

- Quality (Q) (de Toni & Tonchia 1996;Giffi, Roth, & Seal 1990;Gunn 1992;Maskell 1995): percentage of correct pieces, compared with the total number of pieces processed.
- Overall Equipment Efficiency (OEE): (Dal, Tugwell, & Greatbanks 2000;Giffi, Roth, & Seal 1990;Maskell 1995): time in which the machine is working according to specifications producing correct pieces, compared with the total net time available.
- Dock to Dock Time (DTD): (de Toni & Tonchia 1996;Giffi, Roth, & Seal 1990;Gunn 1992;Maskell 1995): average production time invested in raw materials, work in process and finished goods of a product.
- Workforce Productivity (de Toni & Tonchia 1996;Giffi, Roth, & Seal 1990;Lowe, Delbridge, & Oliver 1997): units produced per hour.
- Changeover Time (Giffi, Roth, & Seal 1990;Gunn 1992;Maskell 1995;Schonberger 1996): time that a machine is stopped to make the necessary adjustments so that it can manufacture a different reference.

The absolute values of these operational measures can depend, among other factors, on the volume of production of the company, the capacity used, the type of process, or differences due to the complexity of products or time required to make them (Banker et al. 1996;Cua, McKone, & Schroeder 2001;Ichniowski & Shaw 1999;Lowe, Delbridge, & Oliver 1997). We should stress that none of these factors changed substantially in any of the companies during the observation period. To be able to compare the degree of improvement between the different companies we selected as dependent variables of our research the percentage that represented the improvement of the value of an indicator over the initial situation.

4 RESULTS

Before discussing the overall results of the companies analysed, we shall describe the state of the companies at the outset. We will begin by relating the production system in the different companies, in order to subsequently show the value of the operational measures in each of the companies before initiating the intervention of Kaizen-Blitz teams.

The production system in each plant was established on the basis of the data compiled during the interview and visit to the production facilities. We considered that most of the companies would either be at an initial early stage, which could be associated to a traditional point of view of mass production (cases 3 and 6), or else an initial stage in the development process towards lean production (cases 2, 4, 5, 7, 8, 9 and 11). Company number 1 was at an intermediate stage of development and only company 10 seemed to have advanced to any degree in the lean production implementation process.

Regarding the initial situation of the productive indicators of each of the companies (Table 3), in the quality indicator most of the companies were below the recommended standards for world class manufacturing (Dal, Tugwell, & Greatbanks 2000). The lowest were cases 9 and 10, due to the complexity of their processes.

As for OEE, only company 10 had a level close to 80%, which may be considered a benchmark of world class manufacturing (Dal, Tugwell, & Greatbanks 2000), whereas the other companies were below the threshold that would be considered acceptable (60%-75%).

Table 3 Operational performance at start-up

Indicator	Quality (Q)	Overall Equipment Efficiency (OEE)	Dock to Dock Time (DTD)	Workforce Productivity	Batch Changeover Time
Measure	%	%	days	Units/ WF hrs worked	minutes
Case 1	91.2	53	6.9	6.4	18
Case 2	82	67	13	19.6	35.5
Case 3	78.3	66	8.2	69	
Case 4	93.2	59	23	4166	357
Case 5	97	70	14.5	43.7	89
Case 6			9	29.0	40
Case 7				3.5	
Case 8	76	61	17.8	16.7	
Case 9	55	77.2	10.6		75
Case 10	71	79	39	4.3	17
Case 11	90	60	37.6	13	180
Mean	81.5	65.8	19.2	437.0	101.0

More than half of the companies have a dock to dock of more than 10 manufacturing days, thanks to which they are able to offset possible inefficiencies of their production lines. Companies 10, 11 and 4 had the highest dock to dock rate.

The workforce productivity is, apparently, acceptable and the variations are due to the different complexity of the products they manufacture (from screws or trims to complete car cop-pick).

As for changeover time, only two companies (10 and 1) achieved reduced values. In the first case, the values reached are very close to the technological limit, as they were obtained after several SMED (single minute exchange of die) interventions. The remaining companies have a lot of room for improvement, particularly when we consider the high figures of companies 4 and 11.

The empty boxes correspond to the indicators that were calculated in the companies in a way different to ours and we were unable to reconstruct the data in a reliable manner. Also, in certain cases, these data correspond to indicators, which, due to the particular characteristics of the company, were not considered to be important and were therefore not taken into account (e.g. OEE of over-sized machinery or FTT of cheap products also in over-sized machinery).

The table 4 shows how production indicators have improved in the cases studied.

Table 4.- Improvement in operational performance

Indicator	Quality (Q)	Overall Equipment Efficiency (OEE)	Dock to Dock Time (DTD)	Workforce Productivity	Batch Changeover Time
Case 1	8%	36%		11%	-33%
Case 2	5%	13%	-41%	14%+	-72%
Case 3	11%	30%	-48%	17%+	-75%*
Case 4	6%	6%	-22%	8%	-40%
Case 5	1%	11%	-7%		-71%
Case 6			-64%	34%	
Case 7				60%	
Case 8	1%	4%	-21%	23%	-54%*
Case 9				9%+	-48%
Case 10				21%	
Case 11	5,60%	25%	-60%	14%+	-87%
Mean	5%	18%	-38%	22%	-60%

The percentage of improvement was calculated as: (value at end–value at start)/value at start
+: measured as direct workforce variation for a specific production instead of units per hour worked
*: Estimated as machine stop time reduction

All the productive indicators, on which interventions were made, were favoured by the use of lean production techniques derived from the activities developed by the ad-hoc groups

The main results obtained in the eleven cases analysed are summarised by a notable improvement in the efficiency of the machines (approximately 18%), mainly obtained due to a radical improvement in the changeover time (reductions of almost 60% of the original time); improvement in the quality rate of nearly 5% (setting out from levels over 90%); reduction of inventory levels by almost 40% and an increase in productivity between 9% and 60%. Along with this, we also detected important improvements in the use of the space in the plant, a reduction in the number of containers and the distance travelled by products.

The quality indicator showed less gains, although it must be noted that almost all of the companies had already engaged in some sort of action to enhance their processes in order to assure acceptable quality levels. In fact, all of them were holders of the ISO-9000 certificate and moreover had a certification from the customer, with annual audits and even in some cases with more demanding criteria than ISO-9000.

If we compare the quality levels of companies studied with those of the companies supplying American automobile plants it may be seen that, initially, the quality rating of almost all the observed companies was below 98%, which is the average for North American companies (Liker & Wu 2000). However, after the interventions, half of the companies studied reached a quality level of over 98%. In addition, compared with the data of Lowe et al. (1997), the difference between the quality of the high performance companies and low performers is very small. In view of all the above, we considered that 5% of improvement obtained on average in the observed companies is a significant figure.

Regarding the productivity indicator, the measurement used by Lowe et al. (1997) is not the same as ours, which is why we cannot directly compare their data with ours. Nevertheless, it is highly illustrative to verify the broad margin of variation in productivity values between companies making different products, a factor that may also be observed in our cases.

Unfortunately, we were unable to find any published material with data that would allow us to compare the values obtained for the rest of the indicators studied in our research.

Finally, we must take into account that the presented measures are not independent. For example, an improvement of quality in automated processes will affect the efficiency of the machines. Efficiency is also affected by the reduction in changeover time, because depending on the extent of the reduction, more machine manufacturing time can be obtained. Nevertheless, this is not a direct relationship, because the company can take advantage of the fact that changeover is faster to make more changes. In this case, machine use will not be improved, but the indicator that would be enhanced is dock to dock, since the work in progress would be less when working with smaller batches. As an example, we can see that in the case of company 4 (Table) the improvement of 6% in OEE is due to the improved quality of the products, while the 40% reduction in changeover time did not improve efficiency, as the company policy was to cut the size of the batches. What did improve in this case was the dock to dock indicator (22%), which meant that, on average, the products were in the plant for one week less (falling from 23 days to 18 days).

5 DISCUSSION AND CONCLUSIONS

Our work aims to identify the possibilities for improvement of the productive indicators when a company puts in action Kaizen Event activities. The companies studied belonging to different sectors and production processes, were medium to large sized and their main clients are automobile assembly plants.

All the companies studied have initiated measures to improve performance and, in the light of the results obtained, they appear to have fulfilled this objective, at least as far as production indicators are concerned.

One important aspect for the smooth running of the interventions was the support shown by the managers in the ad-hoc group meetings and the presence of the CEO at the closing session of each workshop. In addition, the workshops gave rise to a structure that facilitates communication between the group and management, while the training acts as a means to reduce resistance to change (Power & Sohal 2000)

On the other hand, cooperation between external and internal teams was considered to be highly satisfactory by both sides. One of the fundamental reasons for this good working relationship was the use of standard lean production tools (5S, SMED, TPM, Balance Worklines, etc.), whose existence and utility were already known to all the directors involved, including the least experienced.

Here it should be mentioned that the client was able to benefit from the results obtained by lowering the prices of the products that had benefited from improvements. This was one of the primary aims of the external consultants, although it met with some resistance on the part of the companies, even if they benefited from the rest of the improvement. This resistance was basically due to the existence of other clients' products that would be negatively affected by the improvements, but the client insisted on partially improving his component and then reducing the price of the part.

In some cases, operations were extended to other departments after the initial operation was over. This happened mostly in the case of multi-nationals who had already had experience of this type of practice. Other companies confined themselves to maintaining the improvements implemented and showed limited interest in extending them to other areas, in spite of being aware of the benefits involved. The reasons given in the interviews were the classical "resistance to change" and/or "right now we haven't time", or that they were more interested in growing than improving, even though they admitted that this attitude was an error.

At the same time it must be recognised that without the presence of outside consultants, i.e. without the obligation of the client, approximately 80% of the companies would not have implemented this type of improvements for the same reason that they were not interested in later extending them to other areas. We can say that the experience is repeatable, but only with the direct support of the management for this type of improvement team. For the reasons cited above, this support is not always forthcoming.

As limitations of this work, the fact that 16 (29%) of the boxes of the Table are blank may be significant. The main cause of this was the cost to the company of providing the data that enabled us to calculate the indicators or, as in the case of company 7, policies of confidentiality that prevented our access to the data. On the other hand, in some companies inconsistent data appeared, depending on the source that had provided them (production department, quality or maintenance). For this reason, during our intervention in the initial workshop we had to trace the necessary data. This was carried out together with the components of the ad-hoc group, under the supervision of the training consultants. These data were compared with diverse sources or were directly taken in plant when divergences arose. This process took up almost two days of work in each company and required the participation of several managers, usually those occupying key positions in maintenance, quality and production. Therefore, to avoid resistance, in each factory we limited ourselves to obtaining the measures of the indicators that were of immediate practical use to them, taking into account the needs detected in the initial diagnosis, the training actions implemented and the changes introduced in the production lines.

Another limitation of this study is the issue of the generalization of the findings. In some sense we have tried to overcome this limitation by analysing a number of production lines that varied in terms of product manufactured, size, annual turnover, production process used and starting level of lean deployment. However, the study should be complemented taking other sectors into account, where the companies supply a high number of clients with fluctuating and not very predictable demands. On the other hand, since all the companies received the same intervention, consisting of lean deployment through workshops, we cannot compare the results that would be obtained with another type of interventions. The lack of such data prevents us from making a definitive causal attribution.

An important advantage of our work was obtaining data from multiple sources (interviews, observations and documentation analysis), giving a certain degree of confidence in the results (Yin 1994). The interviews were carried out formally in the diagnostic sessions and the production managers took part. The line observation was done in the initial diagnosis and during workshop development. The records of production, quality and maintenance departments were also consulted, to compare them with the line observations made during the workshops. With the data sampling methodology selected, this task was laborious and demanded great dedication by the researchers. For this reason, adapting to the resources available, in our research design we chose to observe a limited number of cases.

6 IMPLICATIONS FOR RESEARCH AND PRACTICE

The issue approached in this paper is important for company and production managers because it shows the potential gains that can be obtained by means of Kaizen Event like those described in this research.

We consider that the use of training-intervention dynamics of short duration, attended by people from different hierarchic levels and different departments, related to a production line or process, could contribute to improve the productive results. The sessions should incorporate both ice-breakers dynamics, to create an atmosphere that encourages problem-solving in groups, and the philosophy and methodology of the lean tools to be implemented. During the sessions, it is also necessary to set aside time for "capturing" the necessary data, analysing them and proposing alternatives for the improvement. It is recommended that these sessions be guided by experts in the application of the tools and that they supervise the data gathering and the activities of the group.

It is advisable that at the end of the week a plan be agreed upon and, if possible, that the participants should make a presentation of it to the company management, to corroborate their acceptance and obtain a commitment for the dates from everyone involved.

Our paper may be interesting too for the people involved in consulting tasks. These can justify the investment made by the company to start up the interventions, with the gains expected from the application of their services.

In order to continue the research, we propose the following actions that would complement our work: Increasing the number of companies receiving the treatment, in order to have several firms at every level of the control variables (sector, production process, product, lean production development stage prior to the intervention); incorporating companies that have not received treatment (Kaizen Event), both those that have never received it at all and those that have at one time, but have been some time without receiving treatment; and incorporating as variables the levels of safety and hygiene, stress or the workload of line workers, to find out if the increase in productivity is due to the worsening of these conditions, as diverse authors propose (Fairris 2002).

For future studies and to complete the work already carried out, a study should be made of whether or not Kaizen Events are an appropriate tool for introducing continuous improvement and new working methods in a sustainable form in the long term. This would involve an analysis of the participating firms to find out whether or not they had implemented new work methods and extended them to all other areas of the plant, or, on the other hand, the reasons why they had neglected to implement improvements, so as to determine whether or not sustained improvement is possible.

In conclusion, the results obtained in our research underline the effectiveness of the use of Kaizen Event in the automotive industry. We are confident that this study provides proof that may encourage other companies to start similar processes that facilitate the improvement of their results

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