EVOLUTION OF LEAN PRODUCTION AND HIGH INVOLVEMENT WORK PRACTICES IN AUTOMOTIVE SUPPLIERS

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Abstract

Currently, 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 their plants, but it seems important that their suppliers should also modify their production systems in line with the lean production philosophy. The effects of this wave will probably result that one integrated supply chain can be built. It seems to be enough empirical evidence that practices of human resource management (High Involvement Work Practices, HIWP) play an important role in the successful implementation of lean production and especially in its maintenance, by creating a culture of continuous improvement that supports the rest of lean practices. The purpose of this paper is to present an architecture of lean manufacturing practices, indicating the recommended implementation sequence and the needs that can solve each of these practices for suppliers companies in the automotive industry. Also be described as lean production practices have evolved over the past 10 years, in a Spanish automotive sample. Finally, we discuss in detail the evolution of continuous improvement programs in 11 first tier suppliers in the automotive industry which had implemented the program since 2000

Keywords: Lean production; High Involvement Work Practices; Automobile Supply Chain

1. Lean manufacturing

The environment in which most industrial companies find themselves is characterized by the rivalry with competitors, the speed of change and the instability of demand. The majority of their markets are mature and their customers demand quality products that fit their specifics needs, one of which is the demand for quicker and more regular deliveries (Marin-Garcia, Pardo del Val, & Bonavía Martín, 2009; Peng, Schroeder, & Shah, 2008; Devaraj, Hollingworth, & Schroeder, 2004; Ketokivi & Schroeder, 2004). Everything seems to indicate that this tendency will only increase in the future. With this in mind, it is advisable that companies position themselves and decide their strategic operation priorities (Urgal González & García Vázquez, 2005; Ketokivi & Schroeder, 2004; Martín Peña & Díaz Garrido, 2007). Currently a consensus exists regarding two large blocks of strategic priorities in the area of production. Companies whose principal corporate strategy is the emphasis on costs will see as priority the efficient management of operations (reduce costs, investments and inventory) (González Benito & Suárez González, 2007; Avella, Fernandez, & Vazquez, 2001; Ketokivi & Schroeder, 2004; Hayes & Wheelwright, 1984). Those companies that emphasise differentiation will see the quality operations area as priority (error free products and quality as perceived by the customer); or flexibility (range of the product line, modification of production volume and design modifications) or delivery (production cycle time, delivery speed and on time delivery) (Lewis & Boyer, 2002; González Benito & Suárez González, 2007; Avella, Fernandez, & Vazquez, 2001; Devaraj, Hollingworth, & Schroeder, 2004; Ketokivi & Schroeder, 2004; Hayes & Wheelwright, 1984; Lewis & Boyer, 2002).

According to some authors it is difficult for a given company to satisfy all these priorities at the same time, given that there exists a certain incompatibility (trade off) between them (Avella, Fernandez, & Vazquez, 2001; Devaraj, Hollingworth, & Schroeder, 2004; Skinner, 1969). However, there are also investigations where a sequential or accumulative model is proposed, contrary to that of incompatibilities (González Benito & Suárez González, 2007). According to this model the companies focus on a few priorities at any given moment, but once they are satisfied they move onto others without losing the developed abilities. In this way they accumulate abilities that allow them, over time, to simultaneously satisfy a wide range of priorities. It is likely that the practices that encourage differentiation suffer less incompatibility and that the orientation promoting flexibility is

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compatible with an orientation towards an above average quality of product/service. However they can show incompatibility with practices of cost leadership.

To put lean manufacturing systems into place, it is common for a group of practices related to operations management to be proposed (production planning and control, materials flow, maintenance system, quality system...), the relationships with clients and suppliers, product design or human resource management (participative management, worker involvement...) (Shah & Ward, 2007; Dabhilkar & Ahlstrom, 2007; Jorgensen, Laugen, & Vujovic, 2008; Gurumurthy & Kodali, 2008; Carrasqueira & Machado, 2008; Marin-Garcia, Pardo del Val, & Bonavía Martín, 2006; Marin-Garcia & Carneiro, 2010; Treville & Antonakis, 2006; Doolen & Hacker, 2005; Marin-Garcia & Conci, 2009; White & Prybutok, 2001; Prado Prado, 2002).

In diverse papers it has been stated that the application of these practices has beneficial effects for the given company. These effects are greater if large groups of practices are implanted, and not in an isolated way, taking advantage of a synergetic effect between them. (White & Prybutok, 2001). Thanks to lean manufacturing companies can improve their productivity as much in terms of workforce as machinery, and can reduce time between receipt of order and completion of production, can improve internal and external quality and reduce inventory levels and unit costs (Callen, Fader, & Kirnksky, 2000; White & Prybutok, 2001; Marin-Garcia, Garcia-Sabater, & Bonavia, 2009).All of this allows an improvement in competitivity.

Taking into account the fact that the implantation of these practices is a gradual process, it is vital to reflect if it is possible to find the most appropriate order in which the practices should be put into action in the auxiliary automobile industry (Marin-Garcia, Perello-Marin, & Garcia-Sabater, 2010). A general proposal by Monden exists (1998) and, in this paper, we will present an adaption to the particular necessities of the sector upon which we are focusing. We will begin with describing how, over the last decade, the necessities as much as the practices of lean manufacturing have evolved. We will also analyse the evolution over these 10 years of those continuous improvement programmes implanted to give support to lean manufacturing in 11 companies within the sector. From these experiments a proposal for a lean manufacturing practice architecture will be proposed, indicating the implantation procedure most appropriate for automobile supplier companies.

2. Evolution of the use of practices and necessities

The grade of deployment of lean manufacturing practices has been analysed via a survey taken by Spanish companies belonging to the cluster of Spanish suppliers to the automotive industry. The majority of these companies are small and medium sized (table 1) and there is no significant difference seen between the samples from the years 2000 and 2010, although over this decade there had been a process of concentration that gave origin to mergers, acquisitions, and closures, generating an increase in the number of large companies in the sector.

Table 1. Distribution of companies by size**.**

Workers	2000	2010
less than 50	39%	24%
between 50 and 249	48%	56%
250 or more	13%	21%
N	31	33

The data that we are going to present in this section were obtained via a questionnaire within which companies were asked about the level of deployment of the different practices with a range of answers between 0, nothing, up to 5, very much (Marin-Garcia & Carneiro, 2010).

In figure 1 we show the evolution of strategic practices in the area of production. Over these 10 years the relative importance of priorities has changed. Although the principal priorities in 2010 continue to be leadtimes and the reduction of defects. However, in these 10 years, the necessity to fight competitors on the basis of cost has moved from third to eighth place, and to achieve an increased workforce productivity has changed from penultimate to fourth place. We can appreciate how the sensation of having to attend to all competitive fronts has increased over the decade, and that current companies score the 11 dimensions with a grade of importance greater than 4, while in the year 2000 there were 6 dimensions with an importance of below 4. Without a doubt this has increased the complexity of operations management in having to try to simultaneously improve diverse indicators that, in some cases, can have some grade of incompatibility. Lastly, to highlight that the increment of strategic priorities is statistically significant in 5 of these (to increase the flexibility to modify products, attend to variable demand, reduce leadtimes, to integrate production decisions with the company strategy and to increase workforce productivity).

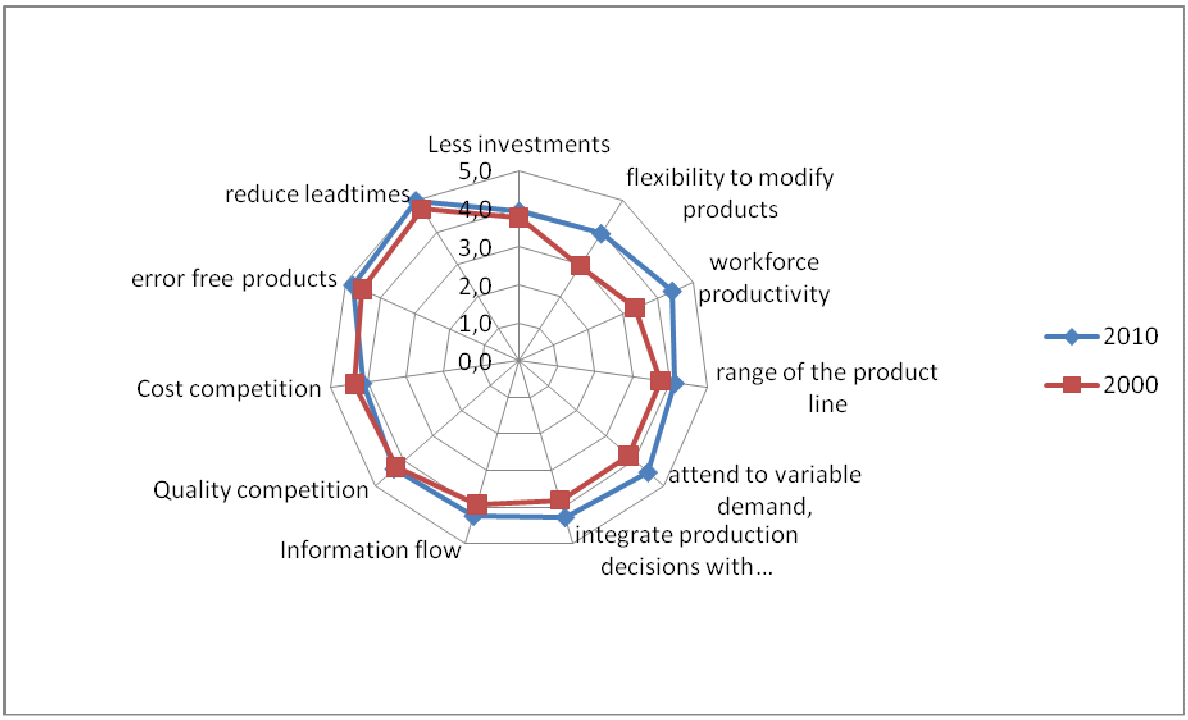

Figure 1. Evolution of competitive priorities**.**

In figure 2 we show the evolution of the grade of practices in lean manufacturing. Practically all the practices have seen increases in the grade of deployment in the sector. The differences are statistically significant in all except Preventive Maintenance, supplier relationship and JIT with suppliers. The first two were at a high level of deployment in 2000 and have remained amongst the most developed in 2010. The third was one of the less used in 2000 and continues to be one of the most complicated to implant in 2010. In part because it requires the prior deployment of other tools than still have not achieved an adequate level of development in the sector, and in part because second level suppliers are smaller companies with fewer resources that encounter many difficulties when implanting and maintaining lean manufacturing in their companies. However, over these 10 years the grade of implantation of practices such as SOP, SMED, customer relationship, internal JIT and empowerment has increased greatly, allowing that the sector has passed from an initial stage to a stage of moderate deployment of lean manufacturing practices.

The only practice that has fallen back in its grade of use is visual management. Perhaps this is due, as we will see in the next section, to the fact that in the year 2000 companies had just launched these practices (those which all companies began with) and, with time, the practice has diminished in use for a lack of discipline in maintenance. It could also be due the ever more frequent use of computers in the collection and analysis of data; while the use of informative screens (touch screen or not) has not been popularized in production lines; which means that the information that previously was distributed on paper (and even hand written) is now transmitted in electronic format, without having achieved the visual impact of traditional procedures.

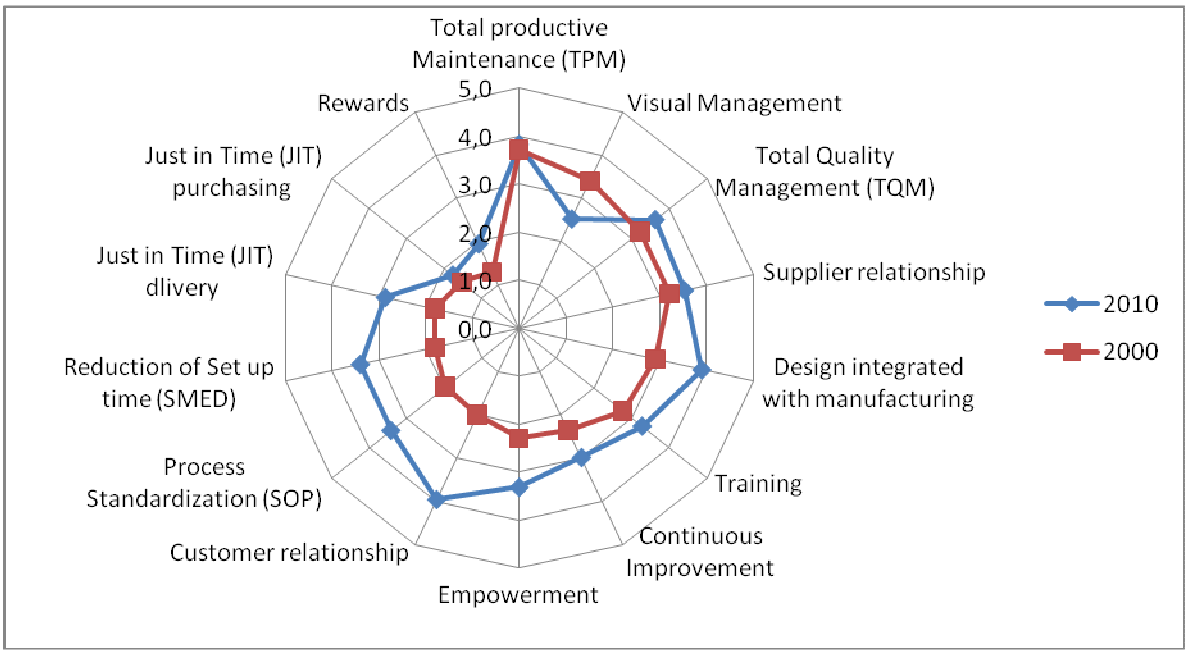

Figure 2. Grade of use of lean manufacturing practices**.**

To complete the analysis of the evolution of the last decade, in the next section we are going to comment upon how the process of deployment has been in 11 companies from the sector that have in common having taken part in a development programme for suppliers around the year 2000 (Marin-Garcia, Garcia-Sabater, & Bonavia, 2009).

3. Evolution of continuous improvement programmes to support the implantation of lean production

In this section we resume the qualitative investigation undertaken in 11 companies from the previous sample. These 11 companies participated during 2000-2001 in a series of Kaizen events led by external consultants (lean managers of the main client) with the objective of deploying lean manufacturing in the company. 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.

All the companies received the same intervention, summarised in the four steps described below:

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.

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. 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 some others tools had already been introduced. At the end of the week, the group had developed 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. 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 events 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

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%; 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 (Marin-Garcia, Garcia-Sabater, & Bonavia, 2009).

We interviewed the production directors of these companies with the objective of learning how they valued respectively the workshops undertaken ten years ago, what was the deployment process of lean manufacturing

after that experiment, what difficulties they found and how they overcame them (Fendt & Sachs, 2008; Charmaz, 2006).

The majority of the interviewees do not doubt that the experiment was a success. To value it in this way is not only based on the positive evolution of the KPIs (FTT, OEE, DTD or productivity), they also take into account the impulse needed for the deployment of lean manufacturing, or the knowledge that it allowed them to attain. In this sense, the involvement of the consultants was valued, the practical experience they had, and the transfer of real solutions that had been tried in similar situation (in the premises of the customer). For many of the interviewees, these workshops from 10 years ago showed them "all I know about lean manufacturing". However, not all the opinions are favourable. In a few companies it is considered that "it isn't worth anything", "the customer came to sniff around our processes and to impose a cost reduction, with hardly any help in achieving this end". It is interesting to observe that the assessment of success or failure of the workshops did not depend on whether the company had begun or not the path towards lean manufacturing before the arrival of the external consultants. Although it is possible that the action of the consultants was not exactly equal in all the companies, it appears to be more probable to imagine that the reaction from the companies can be seen as culturally conditioned - there are companies where they do not like it when outsiders come to tell them how to do things, or that try to introduce methodologies that clash with company or holding group politics, or for reasons of commercial friction far from the Kaizen events, or for objective differences in the consultants' way of acting during the events.

With respect to when the companies began the deployment of lean manufacturing, the majority undertook it around 2000. One company had started with lean manufacturing implantations around 1995. Another example, which began in 1999 with 5S, SMED and TPM. Amongst the others, some had undertaken Kaizen Events after the continuous improvement approach, but without a methodology or lean manufacturing deployment perspective. Other had not undertaken anything more than have started up a suggestions system. Therefore, for the majority, the first real contact with a lean manufacturing deployment was the Kaizen events.

The evolution over the ten previous years differed in each of the companies. However, two behaviour forms can be seen. The first of these, the most general, is the gradual loss of impulse once the Kaizen events are over. The attained achievements and the initiated dynamics gradually degraded and, after 12-24 months, the situation with respect to Lean Manufacturing was very similar to that of the year 2000. Perhaps not all of the tools lost their effect. For example, it has been stated that some maintenance of 5S and SMed has been seen. But in general terms the system remains at 15-12% of what it could have achieved had the implantation been continued. The motives for this were principally the lack of management support. In some cases because " they didn't believe in the system" or "the management support was like a theatre, the client wanted us to do it so we did". In others, due to the fact that the growth in business overwhelmed capacity and "to attend to urgent matters robbed us of time we were able to dedicate to important matters". Another common cause for the fall off in the system was due to the companies not being able to give the necessary resources for the system to work. One of the resources was money for small investments. But the principle resources lacking , in the opinion of the managers interviewed, was the ability to dedicate the time of someone who took command of following the deployment of Lean Manufacturing or the ability to free up workers from the production line so they could dedicate some time to working on the pilot production line towards the deployment of a Lean Manufacturing tool or tools. This difficulty is still current in the year 2010 in some companies. Lastly, another cause for the interruption in Lean Manufacturing deployment was the wear and tear that it generates in those who keep the systems moving. These people have to be convincing management and workers alike, training, following, paying attention to possible improvement methods... and the job is never done. Something which can begin as an interesting challenge ends up becoming "a pain when the necessary support and resources are not available".

The second form of behaviour is characterized by companies who continue with Lean Manufacturing system deployment, and some of the first groups that one, two or three years after they stop it (which is to say 4-5 years after the first implantation) decide to look again at, and restart, the implantation of Lean Manufacturing. In these cases, the principal driver of the new initiative was management. This change in level of involvement comes from changes in management personnel or changes in the political of the parent group in the case where the company has several installations. All the companies in this group coincide in that the success of the continued implantation is based in various things. Perhaps the principal thing is the explicit support of management. Another, very important, is to achieve a change in culture. Above all, to instill a philosophy of continuous improvement where the maintenance of improvements is seen as important as putting them into place is key. In this sense, standardization is a key part in sustaining the system. This cultural change has been brought about by training and "preaching the example" by management. The third of the key things seems to be "most focused" which is to say all possible is done to achieve something, and a system of indicators that is available to confirm, in time, whether everything is going to plan, and in the case of problems that can guide as to which corrective actions are necessary. Lastly, those polled agreed that the existence of a "lean champion", with either full time or part time commitment to the role, is crucial to make sure all functions as it should.

4. Conclusion

In this paper we have analysed the different practices of Lean Production, the evolution of its grade of use in the auxiliary automotive industry between 2000 and 2010 and how this evolution has been experienced in some companies. Starting from the experience of a group of companies, a success lean manufacturing implantation process should have the following steps:

1. Explicit support from upper management: implantation requires continuous effort from the whole company. Much can be gained from implantation, but it is necessary to maintain constant striving towards continuous improvement. Towards this end it is advisable that all personnel are clear that the upper management unconditionally support the project and provide the necessary resources.

2. The establishment of a project team to lead the implantation. Heading this group it is advisable to have a continuous improvement "champion" or leader. The objectives of this team are usually, amongst others: spread good practice throughout the company, provide training on tools and techniques, and to establish implantation objectives and to supervise the advancement. In small companies the team might have to be small and perhaps comprised of people with a part time commitment to the project. Probably the support of the sector organization would be key in giving support to these mini teams.

3. Choosing a methodology that guides and structures the implantation project.

4. Selection of pilot projects and the progressive unfurling of the implantation.

The order in which practices are implanted suggested by us in the implantation process section allows a progressive construction of a solid base for Lean Manufacturing. First phase practices tend to be easier to implant, but we must advise that even the simplest practice is complicated to maintain, thus meaning a change in attitudes and collective conduct is necessary. Thus support, supervision and constant reminder from upper management is required so that the gains obtained from the implantation are maintained over time, and so that we do not return, bit by bit, to where we were at the beginning.

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6. References

Avella, L., Fernandez, E., & Vazquez, C. J. 2001. Analysis of manufacturing strategy as an explanatory factor of competitiveness in the large Spanish industrial firm. *International Journal of Production Economics,* 72(2)*:* 139-157.

Callen, J., Fader, C., & Kirnksky, I. 2000. Just-in-time: A cross-sectional plant analysis. *International Journal o Production Economics,*63)*:* 277-301.

Carrasqueira, M. & Machado, V. C. 2008. Strategic logistics: Re-designing companies in accordance with Lean Principles. *International Journal of Management Scienceand Engineering Management,* 3(4)*:* 294-302.

Charmaz, K. 2006. *Constructing grounded theory. A practical guide through qualitative analysis.* London: SAGE.

Dabhilkar, M. & Ahlstrom, P. (2007). The Impact of Lean Production Practices and Continuous Improvement Behavior on Plant Operating Perfomance. In *8th International CINet Conference*.

Dal, B., Tugwell, P., & Greatbanks, R. 2000. Overall equipment effectiveness as a measure of operational improvement - A practical analysis. *International Journal of Operations & Production Management,* 20(12)*:* 1488.

Devaraj, S., Hollingworth, D. G., & Schroeder, R. G. 2004. Generic manufacturing strategies and plant performance. *Journal of Operations Management,* 22(3)*:* 313-333.

Doolen, T. L. & Hacker, M. E. 2005. A Review of Lean Assessment in Organizations: An Exploratory Study of Lean Practices by Electronics Manufacturers. *International Journal of Manufacturing Systems,* 24(1)*:* 55-67.

Fendt, J. & Sachs, W. 2008. Grounded Theory Method in Management Research: Users' Perspectives. *Organizational Research Methods,* 11(3)*:* 430-455.

Garcia-Sabater, J. J. & Marin-Garcia, J. A. 2010. Can we still talk about continuous improvement? Rethinking enablers and inhibitors for successful implementation. *International Journal of Technology Management,* In Press(.

Giffi, C., Roth, A., & Seal, G. 1990. *Competing in worl-class manufacturing*. Homewood: Irwin.

González Benito, J. & Suárez González, I. (2007). El alineamiento de la estrategia competitiva, la estrategia de producción, las capacidades productivas y los resultados empresariales. In (pp. 325-334). Madrid: International Conference on Industrial Engineering & Industrial Management - CIO.

Gurumurthy, A. & Kodali, R. 2008. A multi-criteria decision-making model for the justification of lean manufacturing systems. *International Journal of Management Scienceand Engineering Management,* 3(4)*:* 100-118.

Hayes, R. H. & Wheelwright, S. C. 1984. *Restoring Our Competitive Edge: Competing Through Manufacturing.* New York: John Wiley & Sons.

Jorgensen, F., Laugen, B., & Vujovic, S. (2008). Organizing for Continuous Improvement. In *9th International CINet Conference*.

Ketokivi, M. A. & Schroeder, R. G. 2004. Strategic, structural contingency and institutional explanations in the adoption of innovative manufacturing practices. *Journal of Operations Management,* 22(1)*:* 63-89.

Lawler III, E. E., Mohrman, S., & Benson, G. 2001. *Organizing for high performance: employee involvement, TQM, reengineering, and knowledge management in the fortune 1000. The CEO report.* San Francisco: Jossey-Bass.

Lee, C. Y. 1996. The applicability of just-in-time manufacturing to small manufacturing firms: An analysis. *International Journal of Management,* 13(2)*:* 249-259.

Lewis, M. W. & Boyer, K. K. 2002. Factors impacting AMT implementation: an integrative and controlled study. *Journal of Engineering and Technology Management,* 19(2)*:* 111-130.

Liker, J. K. & Wu, Y.-C. 2000. Japanese automakers, U.S. Suppliers and supply-chain superiority. *MIT Sloan Management Review,* 42(1)*:* 81.

Marin-Garcia, J. A. & Carneiro, P. 2010. Questionnaire validation to measure the application degree of alternative tools to mass production. *International Journal of Management Science and Engineering Management,* 5(In press).

Marin-Garcia, J. A. & Conci, G. 2009. Exploratory study of high involvement work practices: Identification of the dimensions and proposal of questionnaire to measure the degree of use in the company. *Intangible Capital,* 5(3)*:* 278-300.

Marin-Garcia, J. A., Garcia-Sabater, J. J., & Bonavia, T. 2009. The impact of Kaizen Events on improving the performance of automotive components' first-tier suppliers. *International Journal of Automotive Technology and Management,* 9(4)*:* 362-376.

Marin-Garcia, J. A., Pardo del Val, M., & Bonavía Martín, T. 2006. The Impact of Training and *ad hoc* Teams in Industrial Settings. *International Journal of Management Science and Engineering Management,* 1(2)*:* 137-147.

Marin-Garcia, J. A., Pardo del Val, M., & Bonavía Martín, T. 2009. Los sistemas productivos, el aprendizaje interno y los resultados del área de producción baldosas cerámicas. *CIT- Revista de Información Tecnológica,* 20(1)*:* 39-52.

Marin-Garcia, J. A., Perello-Marin, M. R., & Garcia-Sabater, J. J. 2010. Desarrollo de una metodología para identificar dependencia de camino en gestión de operaciones. *Working Papers on Operations Management,* 1(1)*:* 37-40.

Martín Peña, M. L. & Díaz Garrido, E. (2007). Impacto de la estrategia de producción en la ventaja competitiva y en los resultados operativos. In (pp. 367-377). Madrid: International Conference on Industrial Engineering & Industrial Management - CIO.

Martínez Sánchez, A., Pérez Pérez, M., & Urbina Pérez, O. 2001. Flexibilidad organizativa y relación entre JIT y calidad total. *Alta Dirección*, 35(210)*:* 74-84.

Maskell, B. H. 1995. *Sistemas de datos de industrias de primer nivel mundial*. Madrid: TGP-Hoshin.

Monden, Y. 1998. *Toyota Production System: An integrated approach to Just in Time*. Engineering and Management Press.

Morris, M., Bessant, J., & Barnes, J. 2006. Using learning networks to enable industrial development - Case studies from South Africa. *International Journal of Operations & Production Management*, 26(5-6)*:* 532-557.

Oliver, N. & Delbridge, R. 2002. The characteristics of high performing supply chains. *International Journal of Technology Management*, 23(1-3)*:* 60-73.

Peng, D., Schroeder, R. G., & Shah, R. 2008. Linking routines to operations capabilities: A new perspective. *Journal of Operations Management*, 26(730-748.

Prado Prado, J. C. 2002. JIT (justo a tiempo), TQM (calidad total), BPR (reingeniería),...¿Distintos enfoques para incrementar la competitividad? *Esic Market*,112)*:* 141-151.

Rother, M. & Shook, J. 1998. *Learning to see. Value stream mapping to create value and eliminate muda.* Massachusetts: Lean Enterprise Institute.

Shah, R. & Ward, P. T. 2007. Defining and developing measures of lean production. *Journal of Operations Management*, 25(4)*:* 785-805.

Skinner, W. 1969. Manufacturing. Missing link in corporate strategy. *Harvard Business Review*,May-June)*:* 136-145.

Suzaki, K. 1993. *The new Shop floor management: empoweing people for continuous improvement*. New York: Free Press.

Tapping, D., Luyster, T., & Shuker, T. 2002. *Value Stream management eight steps to planning, mapping, and sustaining lean improvements*. (1 ed.) New York: Productivity Press.

Treville, S. d. & Antonakis, J. 2006. Could lean production job design be intrinsically motivating? Contextual, configurational, and levels-of-analysis issues. *Journal of Operations Management*, 24(2)*:* 99-123.

Urgal González, B. & García Vázquez, J. M. 2005. Análisis estratégico de las decisiones de producción estructurales desde un enfoque basado en las capacidades de producción. *Revista Europea de Dirección y Economía de la Empresa*, 14(4)*:* 101-120.

White, R. E. & Prybutok, V. 2001. The relationship between JIT practices and type of production system. *Omega*, 29(2)*:* 113-124.