Australian Journal of Basic and Applied Sciences, 9(2) February 2015, Pages: 100-107

AENSI Journals

Australian Journal of Basic and Applied Sciences

ISSN:1991-8178

Journal home page: www.ajbasweb.com

Innovation and Production Management through a just in Sequence Strategy in a Multinational Brazilian Metal-Mechanic Industry

[1]Dorion, E.C.H., [2]Guimarães, J.C.F., [3]Severo, E.A., [4]Reis, Z.C., [5]Prodanov, C.C., [6]Olea, P.M., [7]Nodari, C.H.

[1]University of Caxias do Sul, Departament of Master in Business Administration from the University of Caxias do Sul (PPGA-UCS), Francisco Getúlio Vargas, 1130 – Petrópolis 95070-560, Caxias do Sul, Brazil
[2]University Potiguar, Departament of Master Program of Administration, Engenheiro Roberto Freire, 1684, Capim Macio – Ponta Negra 59080-40, Natal, Brazil
[3]Federal Center of Technological Education Celso Suckow da Fonseca, Department of Production Engineering, Maracanã, 229 – Maracanã 20271-110, Rio de Janeiro, Brazil
[4]University of Caxias do Sul, Departament of Master in Business Administration from the University of Caxias do Sul (PPGA-UCS), Francisco Getúlio Vargas, 1130 – Petrópolis 95070-560, Caxias do Sul, Brazil
[5]University Feevale, Departament of Administration, ERS 239, 2755 – Vila Nova 93352-000, Novo Hamburgo, Brazil
[6]University of Caxias do Sul, Departament of Master in Business Administration from the University of Caxias do Sul (PPGA-UCS), Francisco Getúlio Vargas, 1130 – Petrópolis 95070-560, Caxias do Sul, Brazil
[7]University of Caxias do Sul, Departament of Master in Business Administration from the University of Caxias do Sul (PPGA-UCS), Francisco Getúlio Vargas, 1130 – Petrópolis 95070-560, Caxias do Sul, Brazil

ARTICLE INFO

Article history:
Received 25 October 2014
Received in revised form
26 November 2014
Accepted 29 December 2014
Available online 15 January 2015

Keywords:
Innovation, Production Management, Industry

ABSTRACT

This study aims to describe the implementation of a project supply strategy, based on the Just in Sequence concepts; highlighting its difficulties and benefits. The case is described as a Brazilian metal-mechanic company that operates in the assembly of road transport and freight vehicles, being one of the market leaders in Brazil and around the world. The results show clear evidence that the new method presented difficulties related to the discipline of the employees in effectively using the JIS tool, however, it presents concrete innovations related to communication processes between the areas of production and stocks scheduling, as well as the reduction in inventories components within the production process, increasing the efficiency of the assembly line.

To Cite This Article: Dorion, E.C.H., Guimarães, J.C.F., Severo, E.A., Reis, Z.C., Prodanov, C.C., Olea, P.M., Nodari, C.H., Innovation and Production Management through a just in Sequence Strategy in a Multinational Brazilian Metal-Mechanic Industry. ***Aust. J. Basic & Appl. Sci.,*** *9(2): 100-107, 2015*

INTRODUCTION

In a context of competitiveness, companies seek alternatives to reduce costs and meeting deadlines established by their clients, with reduced inventories. Such context has pushed organisations to develop technology strategies in production management systems, from the perspective of allocating resources and advertising them only on demand, avoiding losses on inventory and material handling. In this sense, firms transcend the concepts of individual competitiveness and seek partnerships within the production chain (Lambert and Cooper, 2000), improving in materials supply, more specifically in this case of the automotive industry and road equipment.

The Just in Time (JIT) strategy presents itself as an innovative control system in production management. However, it presents some implementation difficulties, mainly because of cultural and contextual perspectives (Hines *et al*., 2004; Sohal and Eggleston, 1994). Companies that have implemented JIT have done it to maintain and grow in a competitive market, expanding their global production while maintaining high levels of quality and developing new products (Sakai and Amasaka, 2008; Amasaka and Sakai, 2010). However it is crucial that any efficient production management system relies on robust but innovative control methods of management materials; where for example, the Just-in-Sequence (JIS) strategy contributes to the synchronization of JIT production environments.

To improve inventory management, without compromising delivery, companies started to apply the concepts and use of JIT logistics resources. The JIS is a logistics method that works in depth in the supply chain, in order to serve the production line to the extent of the demand pace. The JIS is understood as a supply system where providers are close to the company, or within it, in which the main feature of the system is to meet so

Corresponding Author: Dorion, E.C.H., University of Caxias do Sul Department of Business Administration at the University of Caxias do Sul (PPGA-UCS) Francisco Getúlio Vargas, 1130 – Petrópolis 95070-560, Caxias do Sul, Brazil
Tel: +55 51 32182100 E-mail: echdorion@gmail.com

sequenced directly from the production line (Werner *et al*, 2003; Matson and Matson, 2007; Wagner and Silveira-Camargos, 2011; Hüttmeir *et al*., 2009).

This study aims to describe the implementation of a project supply as an innovative strategy, based on the JIS concepts; highlighting its difficulties and benefits. The case is described as a Brazilian multi-national metal-mechanic company that operates in the assembly of road transport and freight vehicles and equipments for over 60 years, being one of the market leaders in Brazil and around the world.

Production management and process control:

The Just in Time (JIT) is denominated as the Toyota Production System (TPS), although it was developed both by Toyota Mitsubishi companies, which contributed significantly to the spread of this philosophy, increasing the number of new techniques to the production system. In the evolutionary process of the JIT were aggregated and developed other tools like Kanban, Kaizen and Just in Sequence (JIS), transcending what is now called Lean Manufacturing, and creating a competitive advantage over the automaker industry (Sakai and Amasaka, 2008).

But the implementation of such systems generates various types of difficulties within the companies, provoking some cases of lack of success, either for cultural or practices changes (Sakai and Amasaka, 2008; Monden, 1983; Yingling *et al*., 2000; Conboy, 2009). One of the key factors for a successful implementation of JIT lies in the use of methodologies that make up the design of the system which directly affects the reliability of deliveries; which is necessary for both the development of mathematical and statistical models that consider the factors of the process (Deleryd and Vannman, 1998; Khoo *et al*., 2005). The JIT production system is based on the delivery of small orders in a short period of time, which constantly demand methods to assess a current productive capacity and it requires a flexible production system, allowing the rapid exchange of the models on the production line.

In a flexible production process, its quality guarantee augments its importance, since producing small batches generates a continuous flow of value added (Seth *et al*., 2008; Singh *et al*., 2010). Such complexity has given the opportunity to design new tools such as production management software that meet specific characteristics of each business, according to the application required (Sloan and Khoshgoftaar, 2009). The automaker industry is struggling to survive in a competitive market. To expand its global production and to achieve consistent levels of quality, it has to simultaneously release new production models that will increase their value and competitiveness (Sakai and Amasaka, 2008; Amasaka and Sakai, 2010). In that context, one of the urgent tasks of the industry is to re-think the current Japanese production innovation system, without being imprisoned by the past successes or the conventional production systems (Amasaka and Sakai, 2010). In the case of the JIT evolution context, the first step was to admit that the competitive landscape had changed, and that production efficiency methods such as the JIS have not yet been sufficiently explored.

This competitive environment demands innovative decisions, grounded by highly accurate information, derived from a knowledge management processes suitable for JIT environments, and with the use of appropriate tools and methods for the solution of each specific situation (Conteh *et al*., 2006; Alstete and Meyery, 2010; Tan and Platts, 2002). Obtaining information in a short steps production environment makes it difficult or perhaps impossible to establish a trustable historical database, which can determine valid control limits (Khoo *et al*., 2005). Another aspect to consider is the costs and difficulties of implementing modern management systems of production and new technologies, especially in small and medium enterprises, although this has implications on a large scale in the large automaker plants.

The attention to study and improve the JIT is justified by the fact that this system has the underlying goal of eliminating waste, which can be achieved through various efforts, such as reducing the length of lead time and by improving quality (Ouyang *et al*., 2006). However, this is still influenced by the ability of the service and the synchronization of the production line. Such synchronization process requires a specified amount of supply of materials needed for the assembly line and is determined the JIS method.

Within the perception of Just in Time (JIT), introduced by (Matson and Matson, 2004), the ideal state for the implementation of lean manufacturing processes is a vision without inventory management. However, analyzing a complex product such as an automobile, which is formed by a large number of components, the number of processes involved becomes greater. In this context, the difficulty of applying a JIT production plan of all processes in an orderly fashion is understandable. The materials which supply the production lines must be free of defects and available at the time of assembly, so that the production sequence and flow of components should be synchronized with the assembly process.

The adherence to a planned sequence is critical in JIT environments such as the automotive industry. The production efficiencies that JIT provides are maximized when the delivery of components and assemblies for production is accompanied by assembling these components in finished products and in a planned order (Sackett and Williams, 2003).

It becomes clear that the lack of synchronization of production reduces both productivity and profitability. From that perspective, (Wagner and Silveira-Camargos, 2011) emphasize that the JIS is a delivery system in which suppliers are installed within the enterprises, in this case a condominium industry, by supplying them directly on the production line, in sequence and at certain times defined by the customer.

A JIS is characterized by the enhancement of the JIT work philosophy. As a result of movements of customization, companies that operate with JIT promoted an evolution of the supply system, capable of providing not only the necessary items, the amount requested and the time required, but also put them in the right sequence. What was initially called Just in Time Sequenced later became Just in Sequence, or Project Supply.

Practically, the JIS process means that the parts are delivered daily or several times a day, in order and when it is directly required from the assembly line. The sequencing strategy allows a company to eliminate the "buffer supply" which is costly, while the amount of necessary components is reduced to a minimum. Without a relevant sequencing adapted to a programmed production, all necessary components have to be stored in buffers. In flexible production lines, exemplifying through an automotive assembly line, variety becomes a strategic option to produce for personalized customers. In that case, when the next order arrives at the work center, the scheduler distributes the orders in line with the supply sequence of the final production (Wagner and Silveira-Camargos, 2011).

References (Werner *et al*., 2003; Hüttmeir *et al*, 2009) postulate that the JIS, applied to a supply of materials, is being accomplished by a set of organizational means. It is known that the use of software solutions for an integrated system helps improve production in different areas. The Enterprise Resource Planning (ERP), for logistics, planning and manufacturing interaction simulation, in some way, reaches those intended goals. A decentralized approach for each manufacturing unit offers advantages for many purposes, but the main focus is still in production planning and simulation.

For Meissner (2010), the JIS control of production processes and logistics can support a simultaneous achievement of these goals; where it tends to offer an opportunity to minimize the uncertainty in the short-term planning of the supply chain partners, by conducting a sequence of order replacement parts from the suppliers. Most notably, for the successful stabilization of this scheme, it is necessary to focus on reducing buffers and eliminating instabilities in the process, which can be achieved by carrying out a stable production flow system based on a number of principles and methods. The conceptual study of authors presents the principle of production control JIS approach, which is to synchronize and harmonize the flow of material within the supply chain, thereby reducing safety stocks and materials handling. Through innovative strategies and methods, it is observed that organisations that seek their application can make improvements in productivity, rationalization of both workflows and business processes in the supply network.

Hüttmeir *et al*. (2009) note that eliminating the variability is not always a desirable strategy because a supplier can increase its competitiveness by being able to respond to changes in customer needs, thus becoming generating competitive advantage. Therefore, one option may be the use of JIS programming, which currently has played a significant role in the processes of lean manufacturing, even considering that the JIS production lines are less lean than those who operate under the JIT philosophy.

In this sense, Browning and Heath (2009) discuss the extent to which a company should be willing to compromise its lean processes and strategic deal with such variability. The JIS program illustrates and seeks a balance of tension between lean and agility to keep the organisation competitive before his client. Within this perspective, Hüttmeir *et al*. (2009) conclude that the essential capabilities for dynamic competitive operations will not come from routines settings developed by lean processes but from innovative practices that allow flexibility, even with lean methods.

Finally, it is important to mention that the combination of lean and innovation can develop new incentives to improve the reliability of the process, since there is no tolerance for re-work in JIS production.

RESULTS AND DISCUSSIONS

This article is characterized as an exploratory qualitative research of a Brazilian metal-mechanic industry, which aims at the practical implementation of JIS. The case study covers an empirical inquiry that investigates a contemporary phenomenon with its real life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used (Yin, 2009). The analysis and the interpretation of data occurred through the use of a content analysis method, with the transcription of the interviews, the preparation of the data, and a subsequent categorization; identifying the key elements of the reports of respondents (Weber, 1990). Data analysis was complemented with the assessments of the company documents and participative observation. Data were collected to further describe the process of implementation of JIS in the company (Malhotra, 2006). The respondents are part of the workforce of the metal-mechanic industry, consisting of two auxiliary production scheduling assistants, one logistics assistant, two logistics analysts and the logistics coordinator.

This case study took place in a metal-mechanic company which has its headquarters in the Serra Gaúcha region, in the southern part of Brazil. For confidentiality matters, the company is denominated as the Alpha

Company. The company has operated mainly in the assembly of vehicles carrying cargo and road transport parts since the early 1950's. It is one of the market leaders in Brazil and currently works in twelve countries distributed across the Americas, Africa, Europe and Asia, which gives it the status of multinational. It hires approximately 8,000 employees in three manufacturing plants, two in Brazil and one in Argentina.

In 2011, the Alpha Company initiated a JIS implementation process in its final assembly of road equipment, denominated as the Supply Project. To implement the JIS, it was necessary to train a group of logistics professionals responsible for mapping the process and the execution of the technical studies that resulted in a Just in Sequence process.

During the training, the group of logistics professionals conducted a survey of the situation prior to the implementation of JIS. By mapping the supply processes, and by identifying improvement opportunities and difficulties in the flow of information, materials and people, the group established a diagnosis of the final assembly sector, enhancing innovative actions in the processes related to the supply of materials.

The situation previous to the implementation of JIS was presenting losses and wastes, due to a non-sequential supply scheme and where the warehouses of materials were informed that certain models of trucks would be produced on the day and the items needed were separated for the final assembly. However, the schedule was usually changed to the benefit of certain customers or timeliness of production, which generated in plenty of material on site, or even the use of available items from another road implement model; creatting constant urgent material requirement to stockrooms, resulting in production line stops, due to lack of components.

To alleviate the problem, the warehouses had created intermediate stocks spaces, near the production line, to respond quickly to the production demand, leading to an increase in inventories. The company implemented the Kanban tool as another effort to minimize the negative effects of the constant changes in the scheduling of production. The initiative, which technically had the objective to upgrade the component management on the production line, appeared to be ineffective against the demand volume and especially the variety of models.

In order to find an effective solution for supplying the material requirements of the final assembly line of road equipment, the Supply Project was developed (Figure 1), which involved the following steps: i) planning, ii) mapping, iii) proposal iv) implementation v) control.

Each stage of implementation of the Supply Project presents a technical and financial analysis, because the company considered them essential to the effective conduct of the project. The level of technical and financial safety established for the success of the operation at the planning stage was of 30%, while at the proposal stage; it should maintain an assertiveness of 80% with respect to the need for resources used, where the company may admit error estimates throughout the project, but within established parameters. The process scheme included the amount of resources used throughout the project, showing that the greatest need of technical and financial resources occurs at the implementation stage.

Another key factor is the need for approval of the Gates along the project execution. At Gate 1, the logistics and production coordinators were responsible for such task with the participation of the manufacturing manager; assessing the initial concept design with its potential benefits, costs, resources provided and implications on the production system. The responsibility of Gate 2 was with the logistics coordinators, who assessed the implications for the flow of materials, information and people. The proposed new method of supply was approved at Gate 3 by the coordinators of logistics and production. With the implementation of the project, the process completes itself with the control stage at Gate 4, where the coordinators of logistics and production, as well as the manufacturing manager do their final evaluation.

Planning:

The planning began with the training and the involvement of the team responsible for logistics solutions related to the final assembly line of the road equipment. At this stage, were identified the scope of the project, the definition of objectives, constraints, constraints, assumptions and the unfolding of the stages and phases in the Work Breakdown Structure (WBS) (Fig. 1) which served as a guide in its development, execution and control.

Still in the planning stage took place the definition of the pilot project, which consisted in choosing a production line from the final assembly area, which would host the intervention as a trial of the new method of supply for materials. The pilot received a technical study, resulting in a project plan with the required activities described in a schedule. In this context, the pilot was also used to perform the layout and flow tests, as well as the introduction of new Kanban system. It was determined that the pilot would be applied on the assembly line that had the least variation schemes to facilitate the first actions of the mapping step. The planning required the work of five analysts for a one month period, totaling about 50 hours of study and preparation of plans.

Mapping:

The mapping is organized in five phases: i) supply ii) the product structure, iii) mix of the production line, iv) layout and v) flow. This step describes the process used in their supply line. The Supply phase presents the supply method to be used, as well as the alternative supply line for production. The Product Structure phase evaluates the record of the architecture of the product, checking what was noted in the information system and what was actually in the technical drawings; to analyze the impact of the distortions found in stocks and the availability of materials for the assembly line. The study of the structures and settings of the product consumed around 150 hours, over a period of two months.

The Layout phase began with the study, the registration of the designs of the area, the distribution of machinery and equipment used, as well as the provision of materials stored on the production line. Another factor was the space intended for the supply, which was insufficient for the volume of stored materials. In this phase were identified the need to reduce the volume of material in process and it was found that operators were losing about 15% of their working hours in search of assembly parts.

To better understand the flow of the assembly line, it was divided into: i) material handling ii) information flow, iii) resources used. For the analysis of the material handling, production line drawings were realized, including the routes traveled by the materials, the distances and periods (expectation and movement). Thus it was identified that there were significant losses in materials, wait in processing and long distances traveled by materials of low value and high volume. Regarding the flow of information, the results demonstrated that the constant exchange of programming was not showing any agile way to inform warehouses, causing delay in the supply line. The study of the resources was limited to the evaluation of the materials needed in the production line (product structure), devices and information system, identifying flaws in the method that were fixed in the proposal stage.

Proposal:

The proposal for an innovative method of supplying the assembly line consisted of a detailed plan, containing the implementation schedule, financial resources and human resources. This plan still contained the proposed changes of responsibilities of those involved in planning and supply line because, in the previous system, the responsibility of scheduling productions was in charge of the production management and, in the new method, it would be under the responsibility of logistics, facilitating communication with the warehouses of materials and with external suppliers.

One thing to remember is that the proposal contained the detailed method developed by external suppliers, which in some cases would meet through the Kanban system (components of high volume, low cost), directly at the assembly line and, in other cases, would be provided by some kits, deposited in the warehouses and to be delivered later in the line when the product would be installed. This action had the function of significantly reducing in-process inventories, developing an active partnership with component suppliers, and committing them to production. They interacted with the production schedule, showing greater flexibility in meeting the needs, avoiding delays and leftovers.

In the next step, the project went through for the approval (Gate 3) of the logistics and production coordinators. This Gate had a higher relative importance from the others since the following stage would consume 60% of the funding of the project. Therefore, it required special care in evaluating the managers. The proposal consumed about 60 hours of the work of the logistics team and was initiated during the execution of the mapping phase, in a two months period.

Implementation:

Upon approval of the proposal, the detailed plan was implemented, through major innovation in the process of material supply, by changing the responsibilities of those involved and eliminating inventory losses. The most significant changes with the new method consisted in the: i) establishment of new responsibilities for individuals, resulting in information assurance programming and restricted consumption of the components that are in the product structure, ii) the implementation of Kanban products at low cost and high consumption volume, replacing the ones that did not revolve the Kanban inventory (low volume consumed), and iii) the establishment of an assembly kit to supply the product as it would be mounted in the way each road transport implement receives its specific components.

For the people who worked on the assembly line were held training sessions about the new system. In this exercise, were involved the operators of the specific phases, based on the needs and adequacy of the method of delivery, seeking a stakeholder participation, as they would benefit from the new method, since it was intended to reduce the burden of searching components in the production line

The implementation of the supply project involved the makeup of assembly and Kanban kits, with the necessary financial investment for the components used in the assembly. In the financial phase were identified the need for equipment, machinery and transport devices, acquired after approval of budgets as procurement policy of the company. The detailed plan had already included budget for the necessary acquisitions, leaving at this stage only the adaptation actions, the planning and the proper realization of the project.

The implementation stage occurred in a period of three months, ending with Gate 4, which was the responsibility of the logistics and production coordinators and the manufacturing manager, by evaluating the operation and the robustness of the new supply system; since the importance of the reliability of the new process was expressed in securing technical and financial feasibility.

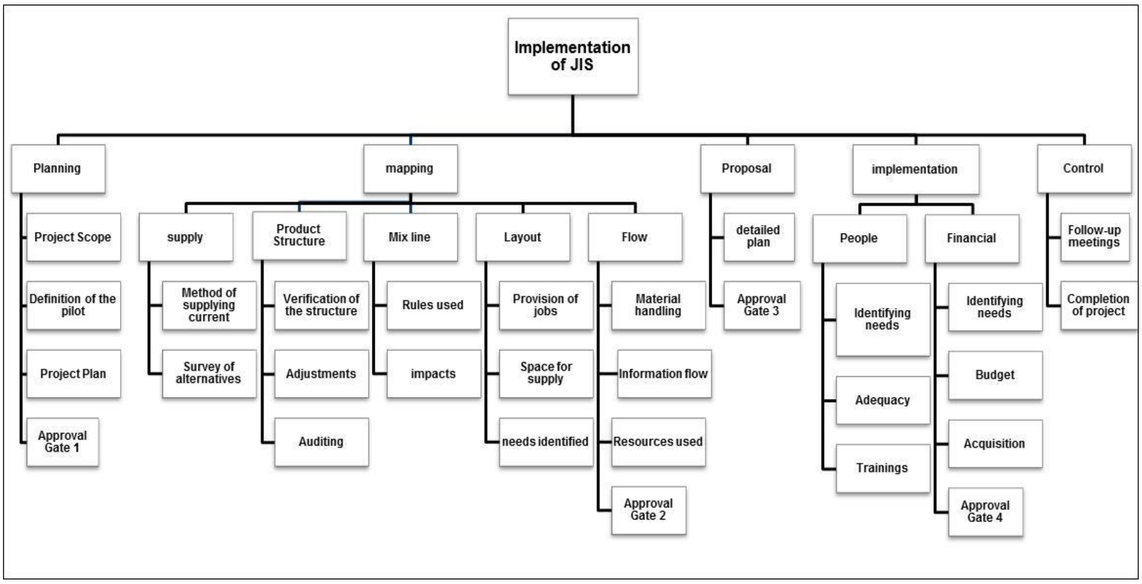

Fig. 1: Work Breakdown Structure (WBS)

Control procedures:

The control procedures occurred mainly through fortnightly meetings of the logistics team responsible for the project, which analyzed the performance of each phase, by changing and adjusting it toward its goal. Another form of control was essential to establish the Gates of approval, allowing quick adjustments in design and weighting techniques/finance at each stage.

In the final phase of the project, the logistics team and the production managers assessed whether the project complied with all its assumptions and constraints established from the initial scope of the project, quoting such assessment as an innovative experience for the company. Another innovative step that occurred in this evaluation was the analysis of the results obtained by the new method of supply project, by comparing the indicators and the objectives proposed by the project, as well as by considering the return on investment, which occurred within one and a half months.

Among the difficulties encountered with the implementation of the methodology were: i) the difficulty of maintaining enough discipline in using the specific components of each product, ii) the short period of time that the warehouses technicians had to mount the product kit, causing an excessive dependence on the programmer of the production line, iii) the constant change in schedule, causing Kit stocks on the assembly line, which could not be resolved by JIS since such alteration depended on the negotiations with the commercial department of the company.

With the implementation of the supply projects, were observed the following benefits: i) an improved communication between the areas of production scheduling and warehouses, avoiding delays in the supply of components, which were common in the previous process, ii) the new method has reduced the supply of in-process inventories, with the creation and the reformulation of Kanban Kits, iii) it has reduced losses in time for operators looking for the road transport components.

Conclusion:

The metal-mechanic sector in the Serra Gaúcha region is of great economic importance to Brazil because it is considered the second largest metal-mechanic Pole of the country, with revenues of U.S. $ 20.5 billion in 2010, and consisting of 2588 companies that generate about 62,775 jobs. The Alpha Company is one of few multinational companies from the region, which is constantly seeking to improve its processes, innovating through the implementation of JIS in all stages of the production process, and adapting its materials management techniques to its production lines all over the organisation.

From the aim of describing the implementation of the JIS strategy, were identified the difficulties related to the maintenance of the discipline of employees in using the specific components of each product and the lack of time for the warehouses to mount the kit product. The difficulty caused by the constant exchange of scheduling of the production line has interfered with the synchronization of the production line. In this perspective, (Sackett and Williams, 2003) point out that deviation in the production sequence can reduce the efficiency that affect the quality of the product, meaning that the JIS should act to eliminate losses from the lack of planning and control of the production process.

Among the benefits highlighted, an improvement in communication between the areas of production scheduling and warehouses, a reduction in inventories of components in process and a decrease in time spend to find the missing components, create more efficiency on the assembly line. The results corroborate with the assertions of)Werner *et al*., 2003; Hüttmeir *et al*, 2009; Wagner and Silveira-Camargos, 2011) as they show that the JIS is, in fact, a supply and delivery system which can be achieved by carrying out a stable production flow system, reducing safety stocks and material handling.

The implementation of the method of Project Supply method grounded in the concepts of JIS, allowed the final assembly line of the company to identify the losses in the process related to inventory and material handling line, negotiating with external suppliers and internal supply through Kanban and specific kits for each road implement produced.

The results show that the main factors contributing to the successful implementation of JIS consisted in the synchronization of the production line, through process planning and control, with the expansion of the fundamental commitment of the people involved in the final assembly. It also included improved integrated groups of programming between the production line and the warehouses. These findings confirm the researches of (Sackett and Williams, 2003; Hüttmeir *et al*, 2009; Seth *et al*., 2008; Singh *et al*., 2010; Meissner, 2010), among others that refers to the use of auxiliary methods of JIT, as in this case, which contributes to the improvement and the quality of the production processes with a real involvement of the work teams, in a planned and systematic way.

Other significant aspects of this implementation are the intangible gains made from the new method of the Supply Project, more specifically related to employee involvement and regarding the sustainability of the economic activity; generating a sense of responsibility to reduce losses caused by high inventories and the desire to continued success of the process. Those tangible and intangible gains contribute to the competitiveness of the company, because the cost dimension of processes is one of the key factors in the strategic context, which can become a competitive advantage.

The study has limitations with regard to its ability to generalize. In fact, this case study demonstrates how a Brazilian multinational industry from the metal mechanic sector does specific improvements in terms of production management through technology strategies. It addresses the implementation of a new method of Supply Project, supported by the concepts of JIS, and applied to the specific reality of a company. Such effort shows that further research can be carried out in a more comprehensive way, exploring the theme in other companies in the region, or even do comparative studies of the company in other parts of the world

REFERENCES

Alstete, J.W., J.P. Meyery, 2010. Structuring innovation in the knowledge management platform: perceptions and practices. *Journal of Information & Knowledge Management*, 9(1): 1-14.

Amasaka, K., K.H. Sakai, 2010. Evolution of TPS fundamentals utilizing new JIT strategy: proposal and validity of advanced TPS at Toyota. *Journal of Advanced Manufacturing Systems*, 9(2): 85-99.

Browning, T.R., R.D. Heath, 2009. Reconceptualizing the effects of lean on production costs with evidence from the F-22 program. Journal of Operations Management, 27(1): 23-44.

Conboy, K., 2009. Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development. *Information Systems Research*, 20(3): 329-354.

Conteh, N.Y., G. Forgionne, W.D. Schulte, K.J. O'sullivan, 2006. The Merits of a just-in-time knowledge management (JITKM) approach to decision-making support. *Journal of Information & Knowledge Management*, 5(4): 269-277.

Deleryd, M., K. Vannman, 1998. Process capability studies for short production runs. *International Journal of Reliability Quality and Safety Engineering*, 5(4): 383-401.

Hines, P., M. Holwegand, N. Rich, 2004. Learning to evolve; A review of contemporary lean thinking.Lean Enterprise Research Centre, Cardiff Business School, Cardiff, UK. International Journal of Operations & Production Management, 24(10): 994-1011.

Holweg, M., F. Pil, 2001. Successful build-to-order strategies start with the customer. *Sloan Management Review*, 43(1): 74-83.

Hüttmeir, A., S. Tréville, A. Ackere, L. Monnier, J. Prenninger, 2009. Trading off between Heijunka and Just-In-Sequence. *International Journal of Production Economics*, 118(2): 501-507.

Khoo, M.B.C., S.H. Quah, H.C. Low, C.K. Chang, 2005. Short runs multivariate control chart for process dispersion. *International Journal of Reliability, Quality and Safety Engineering*, 12(2): 1127-1147.

Lambert, M.D., M.C. Cooper, 2000. Issues in Supply Chain Management. Industrial Marketing Management, 9: 65-83.

Malhotra, N.K., 2006. Basic marketing research: a decision-making approach. 3nd ed. Upper Saddle River, N.J.: Pearson/Prentice Hall, 2006.

Matson, J., J. Matson, 2007. Just-in-time implementation issues among automotive suppliers in the southern USA. *Supply Chain Management: An International Journal*, 12(6): 432-443.

Meissner, S., 2010. Controlling just-in-sequence flow-production. *Logistics Research*, 2(1): 45-53.

Monden, Y., 1983. *The Toyota production system*. Portland:Productivity Press.

Ouyang, L.Y., K.S. Wu, C.H. Ho, 2006. The single-vendor single-buyer integrated inventory problem with quality improvement and lead time reduction: minimax distribution-free approach. *Asia-Pacific Journal of Operational Research*, 23(3): 407-424.

Saberi, S., R.M. Yusuff, 2012. An exploratory study into advanced manufacturing technology (AMT) usage in Malaysian small and medium-sized enterprises (SMEs*). International Journal of Innovation and Technology Management*, 9(2): 1250015-1-1250015-20.

Sackett, P.J., D.K. Williams, 2003. Data visualization in manufacturing decision making. *Journal of Advanced Manufacturing Systems*, 2(2): 163-185.

Sakai, H., H.K. Amasaka, 2008. Demonstrative verification study for the next generation production model: application of the advanced Toyota production system. *Journal of Advanced Manufacturing System*, 7(2): 195-219.

Seth, D., N. Seth, D. Goel, 2008. Application of value stream mapping (VSM) for minimization of wastes in the processing side of supply chain of cottonseed oil industry in Indian context. *Journal of Manufacturing Technology Management*, 19(4): 529-550.

Singh, B., S.K. Garg, S.K. Sharma, S.K.C. Grewal, 2010. Lean implementation and its benefits to production industry. *International Journal of Lean Six Sigma*, 1(2): 157-168

Sloan, J.C., T.M. Khoshgoftaar, 2009. Testing and formal verification of service oriented architectures. *International Journal of Reliability, Quality and Safety Engineering*, 16(3): 137-162.

Sohal, A., A. Eggleston, 1994. Lean production: experience amongst Australian organizations. International Journal of Operations & Production Management, 14: 135-150.

Tan, K.H., K. Platts, 2002. Managing manufacturing action plans. *International Journal of Innovation Management*, 6(4): 369-385.

Wagner, S.M., S. Silveira-Camargos, 2011. Decision model for the application of just-in-sequence. International Journal of Production Research, 49(19): 5713–5736.

Weber, R.P., 1990. Basic content analysis. 2 ed. Newbury Park: Sage Publications.

Werner, S., M. Kellner, E. Schenk, E.G. Weigert, 2003. Just-in-sequence material supply: a simulation based solution in electronics production. *Robotics and Computer-Integrated Manufacturing*, 19(1-2): 107-111.

Yin, R.K., 2009. Case study research: design and methods. 4nd ed. Thousand Oaks, CA: Sage Publication.

Yingling, J.C., R.B. Detty, J. Sottile Jr., 2000. Lean manufacturing principles and their applicability to the mining industry. *Mineral Resources Engineering*, 9(2): 215-238.