Abstract No: 025-0897

Production Improvements through lean manufacturing and information technology

Luis Hernan Contreras Pinochet, Centro Universitário São Camilo, Rua Raul Pompéia, 144 – Cep. 05025-010 – São Paulo – SP – Brazil, luishernan@terra.com.br

Veronica Altheman, Centro Universitário São Camilo, Rua Raul Pompéia, 144 – Cep. 05025-010 – São Paulo – SP – Brazil, veronicaaltheman@yahoo.com.br

Claude Machline, Centro Universitário São Camilo, Rua Raul Pompéia, 144 – Cep. 05025-010 – São Paulo – SP – Brazil, claude.machline@fgv.br

POMS 23rd Annual Conference
Chicago, Illinois, U.S.A
April 20 to April 23, 2012

Abstract

The objective of this exploratory research is to find out the production improvements resulting from the convergence existing between Lean Manufacture (LM) and Information Technology (IT). A review of the literature indicated that this specific objective has not yet been explored, inasmuch as the Lean authors do not emphasize the use of the computer, since LM is simpler than IT and renders it unnecessary. A large percentage of papers (same 20%) focuses LM, indicating the relevance of this topic. To complement the study made on secondary data, a first hand research was conducted in a high tech factory, which uses extensively both LM an IT, indicating that a high degree of convergence between these techniques bring successful results.

Keywords: Lean Manufacture, Information Technology, Innovation, Just in Time – Kanban

I. INTRODUCTION OBJECTIVE OF THE PAPER

The objective of this paper is to show the convergence in the use of Lean Manufacture (LM) and Information Technology (IT).

Far from being incompatible, their simultaneous use brings synergy to the manufacturing process. An exploratory research in technical literature and in one high technology factory confirms this view.

2. BACKGROUND

Lean Manufacturing is a set of techniques oriented by a philosophy, which aims to eliminate all the activities which do not aggregate value to the final product nor to the service furnished.

Information Technology, which comprises integrated softwares, called Enterprise Resources Planning – ERP, encompasses all the functions of the company, such as Material Resources Planning – MRP, Manufacturing Resources Planning – MRP II, Warehouse Management System – WMS, Transportation Management System – TMS, Distribution Resources Planning – DRP, as well as the Marketing, Administrative, Accounting and Financial functions. These systems allow to optimize the logistic functions and the manufacturing activities, including purchasing, inventory management, production planning and programming, cost control and managerial reporting.

Aside from information systems, the computer technology modified totally, in the last five decades, the production methods. Many operations which were manually done are now performed under the direction of the computer.

Many parts can be obtained without any human contact, under the command of the computer, from project to product. The design is prepared with the help of a software called CAD – Computer Aided Design, specifications are computed through a software called CAE – Computer Aided Engineering, instructions to the machines are transmitted through the CAM – Computer Aided Manufacture. The whole context is called CIM – Computer Integrated Manufacture. In these expressions, the word "Manufacture" is a misname, because hands are not used anymore in factories. It would

be better to talk of “fingerfacture”, since only fingers are used to type instructions on the desktop keyboard.

It is necessary to comment on the genesis of Lean. After World War II, Japanese automobile manufacturers were facing extreme hardship. As Taiichi Ohno, Manufacture Vice-President of Toyota Motors Co. himself commented, they could not afford to keep a two month components inventory, like their American counterparts used to do. So they had to invent the Lean System, whose earmark is the obtention of zero inventory, since the supplier brings the parts just-in-time, every day. There is no in-process inventory either. Parts flow smoothly from machine to machine through a method of control based on colored cards, called Kanban.

Later, the Just in Time (JIT) way of production became a way of life, being extended to the whole company, from shop floor to offices. It evolved into a philosophy which consists in eliminating everything not strictly necessary. The Toyota Production System – TPS, encompasses a large number of techniques, some developed by the Toyota itself, or at least improved or extended by it, and many others borrowed from other Japanese, European and American companies.

A list of these main techniques follows:

- Just in Time (no waste)
- Kanban (zero inventory)
- Just on Time (machine setup, also called SMED, single minute exchange die, meaning machine setup done in a few minutes)
- CELLS (groups of machines dedicated to a family of products, arranged together in a U-Shaped layout)
- Dedicated Factories (each is specialized in a family of products)

- The pull concept (carry out production only if there is demand for it)
- Pokê-Yokê (fixtures which prevent human errors)
- Andon (lights, green, yellow, red which indicate to all people the status of the machine)
- Jidoka (or autonomation, stopping automatically or manually the machine as soon as it produces defective items)
- Polyvalence (worker shows many abilities, and operates various machines, is multiprofessional)
- Total Preventive Maintenance – TPM (workers are able to do first aid maintenance of equipment)
- Self Management (workers manage themselves, dispensing supervision, inspection, help)

The literature associates frequently the six sigma methodology to the Lean doctrine,

originating the expression: “Lean-Six Sigma Methodology”. While Lean is concerned with productivity, Six Sigma deals with quality. Some Six Sigma tools adapted or developed by firms like Matsushita, Motorola, General Electric are the following;

- Statistical Quality Control, Process Control (control the quality during, not after, the production, using samples). Created by Shewhart, in 1930).
- Quality Control Circles (workers themselves gather and make suggestins to improve quality)
- Ishikawa Fishbone (a practical chart to analyze problems and find the root causes)

- Pareto Charts (histograms used to visualize data)
- Suggestion Boxes (they were already used in occidental firns in the XIX Century)
- PDCA Cycle (method to solve problems, alow called Deming Cycle, Shewhart Cycle. It means: Plan, Do, Check, Act)
- Kaizen (the permanent will and search for improvement and perfection)
- 5S (training and conscientization of all employees. The meaning of these five words is:

  Seiri: eliminate the unnecessary

  Seiton: put your things in orden

  Seiso: maintain clean your workplace

  Seiketsu: keep net and clean

  Shitsuke: obey standards, be disciplined

The present century economy shows two crucial characteristics: the growth of the service segment and the ever increasing importance of information Technology (IT). These trends are accelerating and one can hardly conceive of any business without a central role playied by IT nor of any advanced economy without a predominance of services.

A third characteristic has emerged in the last twenty years: an increase of ruthless local and global competition. More exactly, they are wars disguised as competition. The survival challenge, the need to be technologically up to date, impels all companies to adapt continually new managerial techniques. It is not only individual firms which are constantly threatened by new products and new competitions. Whole segments, whole countries can be wiped off the map by the surge of lower cost, better

quality goods. It happened with occidental companies eliminated by Japanese entrants. On their turn, Japanese companies are threatened by South Korean enterprises, which must fear the Chinese ones, not to mention the South Asia menaces.

Companies, segments, countries live in an ever changing scenario which requires continuous adaptation to always more stringent requirements and conditions. If they do not react and adopt new methods, new doctrines, new cultures, they will perish.

3. Methodology

The research was conducted in two steps. The first one was an extensive bibliographic survey undertaken in order to find out the extent to which the theme of convergence between Lean and IT had already been studied.

The authors were also interested to appraise the relevance of the Lean methodology in modern production, by studying the space it occupies in modern literature. The documents examined were abstracts and papers published in conferences and in journals in the last 12 years (1999 – 2011).

The second step was a field study, covering the case of an industrial company which had adopted the LM and used extensively IT. The manager responsible for the implantation was interviewed and the factory was visited to observe the results obtained.

4. The Bibliographic Survey

The bibliographic survey consisted in several tasks. The first one was to compute the percentage of use of the several LM tools cited in Journals papers,

Conferences Annals and Abstracts, monographs and dissertations, for the last 12 years, from 1999 to 2011.

Figure 1: shows the results. The tool JIT was the most used, 22% of citations, followed by loss by process (14%) and waste elimination (9%).

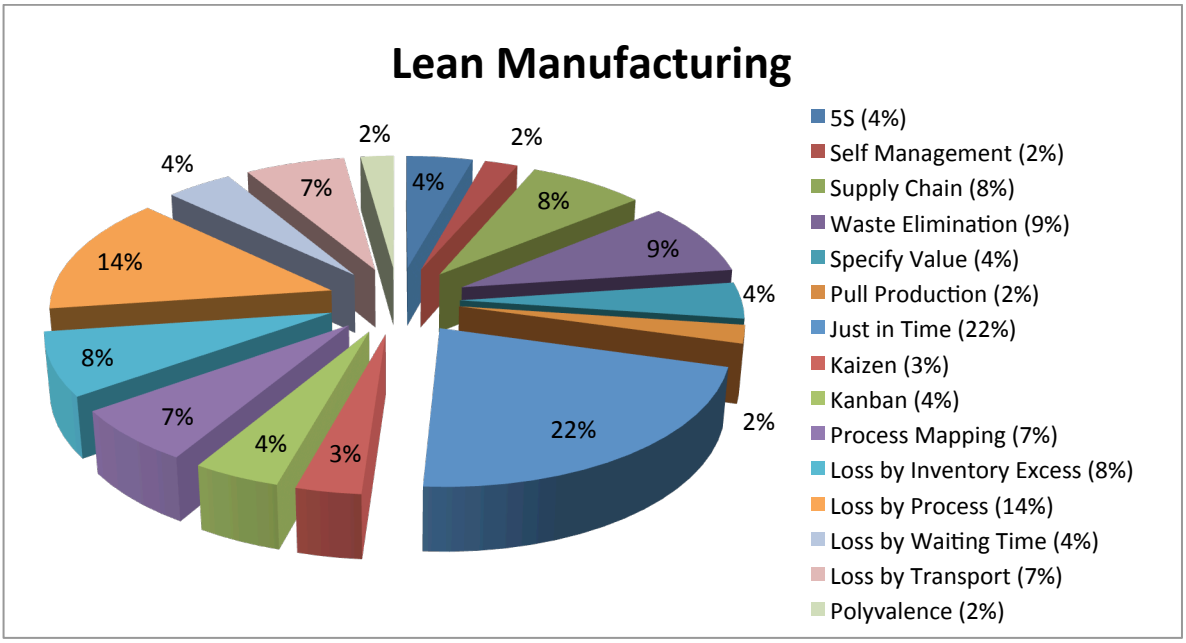

Figure 1: Percentage of use of the diverse tools of Lean Manufacture

Source: Authors, from Bibliography

A similar computation was done for IT. The tools mentioned as being more popular, as shown in **Figure 2**, are: ERP, 21%; Process Control, 21%; SCM, 11%

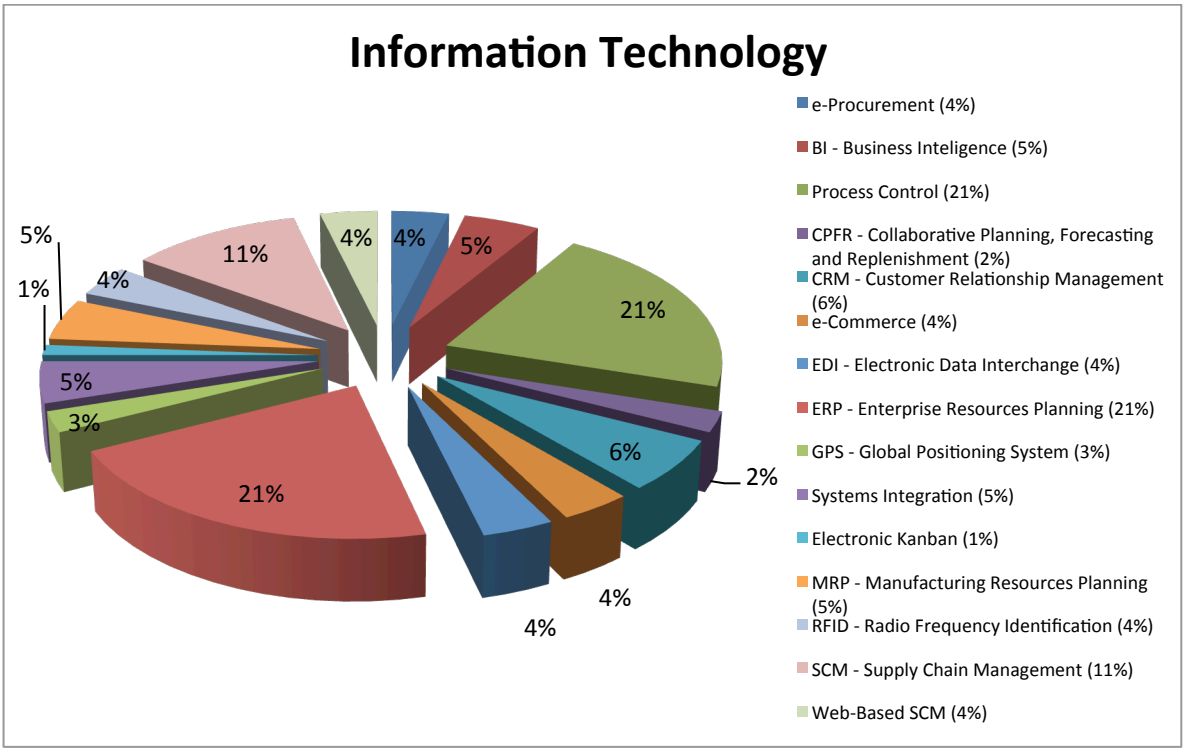

Figure 2: Percentage of use of the diverse tools of Information Technology
Source: Authors, from Bibliography

To ascertain the incidence of LM citations in POMS 2011 management conferences, the number and frequency of the words LM, Six Sigma and JIT, mentioned in the titles of papers, were computed. It was found that 22 papers, in a total of about 1,000, bore one of these words in their title, resulting in a 2% frequency. In the abstract titles, it was not found any association between the words information technology and Lean, JIT or Six Sigma.

5. The Case Study

The case study was done in the Alpha Company, (disguised name) situated in the heart of the most industrialized district of Brazil, near São Paulo City; the Alpha is a branch of a large German company, specialized in manufacturing components for

industrial automation and for products such as vehicles, refrigerators, compressors, washing machines and other appliances.

The Alpha was founded in Germany, in 1925. It is active in the whole world, caring for 300,000 clients, in 176 countries. It employs 13.000 people and supplies more than 40,000 different final products, such as automated boxes, valves, pistons, tubes, pipes, for mechanical, pneumatic, electric and electronic automation and control, to the most diversified industrial sectors.

Alpha operates factories in 50 countries, owns 2,900 patents, launches 100 new products each year, sells US$ 2.4 billion per year and invests 7.5% of it sales in research and development, and 1.5% in training.

The Brazilian Alpha factory was started in 1968. It produces a range of 25,000 diverse products and 10,000 components. A typical production lot size has 10,000 units. This job shop exports half of its production to many countries. An equal amount of raw material -special steel and aluminum alloys- , and semi-manufactured goods- is imported.

The productive sector is located in a large hall divided in 17 cells, separated by wooden panels. Five or six workers handle each cell. The total number of workers is 90. The factory works two shifts. Each cell contains two on three modern numerically commanded machine tools.

The decision to go Lean in all its factories was taken in 2006 by the German central direction. The Brazilian unit is considered one of its most successful accomplishments, or even one of the best LM achievements worldwide.

The LM system changes completely the factory aspect. It actually does not look anymore like a working place, but more as a laboratory or a clinic. All workers wear immaculate aprons. The waxed floor shines. The walls are totally covered by

colored charts displaying plans, programs, schedules, objectives, flows, processes, results. Each wall is a cockpit.

Many of the Lean techniques described in 2. are implemented in the São Paulo Alpha facility. All cells posesses tens of standardized bins and containers to hold received and processed parts. Messengers circulate from cell to cell to withdraw and deliver parts.

The initial investment in fixtures and bins is estimated to have been half a million dollars. Yearly benefits brought by LM, most of them attributed to the inventory reduction brought by JIT-KANBAN, are considered to be 1.5 million dollars. Low moving items inventory was as high as nine months. The pull concept helped to reduce the average production inventory to one month. It takes 20 days to ship raw material and other input from Europe to Brazil and this in-transit material is inventory, one has to pay for the moment it leaves the export country.

Without an integrated ERP system, which schedules, orders and controls, the factory would not be able to handle thousands of jobs, parts and products. Without CIM, one could not program the modern machining centers. Without computer commanded machinery one could not fabricate the high tech products within the very tight tolerances specified by the clients.

Summarizing, without IT there would be no LM in that factory.

5. Conclusion

Which are the innovations brought by Lean Manufacture.

The objectives of racionalize production, increase efficiency-productivity, reduce losses, eliminate scrap and rework are at least as old as the Scientific School of Administration. Before 1930, F.W. Taylor, F. and L. Gilbreth, H. Ford I and others proclaimed incessantly the need to analyze and improve work methods, and invented many ways to attain high levels of effectiveness.

What these pioneers did not achieve, and this is LM foremost contribution, was the obtention of a culture of efficiency. Nor was it possible to reach it in the first decades of last century, with the fear of unemployment, the unions constant claims for better wages and working conditions, the prevailing mistrust between management and employees.

LM, in contrast, mobilizes the team of managers and workers, provokes enthusiasm, makes people see ways for improvements which nobody saw before.

In complex production situations, like in the factory studied here, it was seen that LM and IT combine perfectly, achieving not only synergy but even symbiosis. One cannot figure out any possibility, with complex products and processes, to reach efficiency without having LM and IT in perfect synchronism. IT handles all the data and LM does the job.

Bibliographic References

ALUKAR, George. **"Create a Lean, Mean Machine".** Quality Progress, April, 2003.

BUFFA, E.S.; MILLER, J.G. **Production Inventory Systems: Planning and Control**. 3ºed. Homewood: Richard D. Irwin, 1979.

CHASE, R.; AQUILANO, N. **Operations Management for Competitive Advantage.** 10º ed. New York: Irwin, Mcgraw-Hill, 2004.

Garvin, David. **The processes of organization and management.** Sloan Management Review, V. 39, N. 4. Summer, 1998.

IMAI, Masaari. **Kaizen, the key to Japan's Competitive Success.** Tokio: The Kaizen Institute, 1986.

OHNO, Taiichi. **Toyota Production System: Beyond Large Scale Production.** Portland Oregon: Productivity Press 1988.

ORLICKY, J.A. **Material Requirements Planning.** New York. Mc Graw Hill, 1975.

SCHOENBERGER, Richard J. **Japanese Manufacturing Techniques: Nine hidden lessons in simplicity.** New York: Free Press, 1982.

SHINGO, S.A. **A Revolution in Manufacturing: The SMED System.** Cambridge: Productivity Press, 1985.

SLACK, Nigel. **The Manufacturing Advantage.** London: Mercury Books, 1991.

SLACK, N.; CHAMBERS, S.; JOHNSTON, R. **Operations Management**. London: Pitman, 2001.

WOMACK, J.L.; JONES, D.T.; ROOS, D. **The Machine that Changed the World.** New Yor: Rawson Associates, 1990.