Implementation of a Lean Model for Carrying out Value Stream Mapping in a silk Reeling process Industry

[1,] Y. Sujatha, [2,] Dr. K.Prahlada Rao
[1, 2,] *Department of Mechanical Engineering*
J.N.T.U.A, Anantapur, Andhra Pradesh

ABSTRACT
Value Stream mapping technique involves flowcharting the steps, activities, material flows, communications, and other process elements that are involved with a process or transformation. In this respect, Value stream mapping helps an organization to identify the non-value-adding elements in a targeted process and brings a product or a group of products that use the same resources through the main flows, from raw material to the arms of customers. In this study, a practical study carried out in a silk manufacturing process industry. The main aim was to draw the current state value stream mapping for the main. Further, the paper has identified some of the processes which can be carried out by the sub contractor and suggested measures to be taken up by the higher level management in reducing the non value added process. It discusses the reduction in the set up time and cycle time that can be obtained through the implementation. This paper also discusses the plan of action for improving the Future State Value Stream Mapping (FVSM). A FVSM for the manufacture of Base is drawn.

***Keywords*:** Current state value stream mapping (CVSM), Future state value stream mapping (FVSM), Value added time.

I. INTRODUCTION

This research work was conducted at a medium scale garment industry in Andhra Pradesh in order to critically analyze the company's manufacturing process and subsequently to identify the waste streams. A future state map was developed with the objective of improving the efficiency. Although this assignment was confined to a small manufacturing company, the positive results of VSM could be applied effectively, with necessary adjustment, to a majority of the medium scale silk reeling manufacturing process industries across in Andhra Pradesh. It will yield results as organizations are seeking ways to increase the value of their products and services by eliminating waste.

The demand for raw silk in India can be grouped under four main heads: domestic demand for traditional non-graded multivoltine; domestic demand for non-traditional silk fabrics made up of non-graded bivoltine silk; international demand for silk fabrics and readymades which requires graded bivoltine; and niche markets for special handloom fabrics, requiring local reeled silk and processed silk waste. In recent years, due to a shortage in domestic supply, India has emerged as a net importer of raw silk and yarn.

India is the only country in the world to produce all varieties of silk, viz mulberry, tasar, eri and muga, although only mulberry silk is important from the point of view of trade. Based upon the technology used, silk is called bivoltine or multivoltine, which essentially refers to the frequency with which the silkworm hibernates. Bivoltine silk is a better quality silk, based upon the strength and length of the fiber. The type of silk produced in India is multivoltine, as climatic conditions in India are not conductive to produce the higher-quality bivoltine silk.

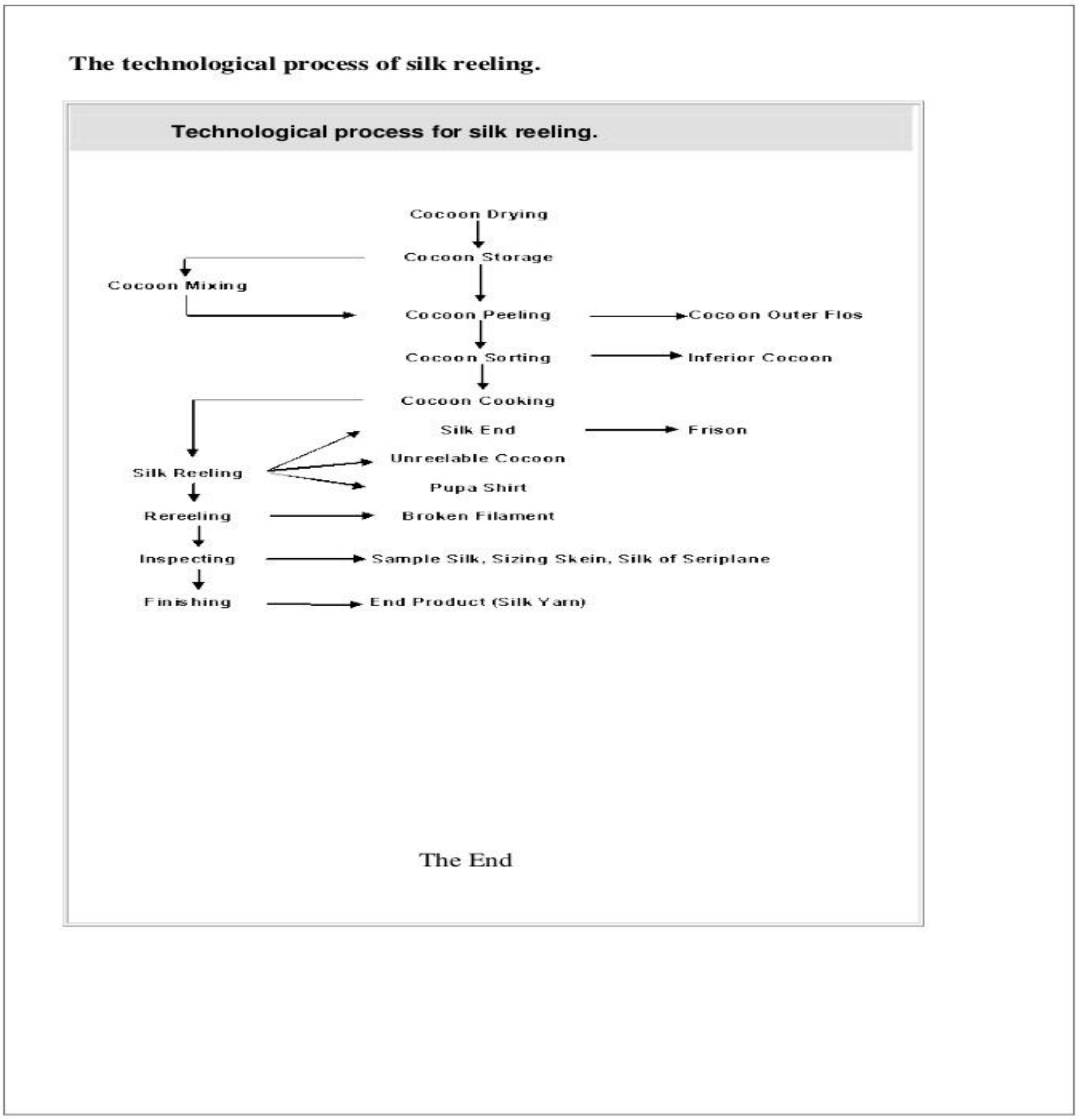
The present trends represent a limitation to price increases for silk produced in India by import from other silk producing countries like China, Brazil, Korea etc., as well as by substitution with other fibres including by artificial silk. It also appears unlikely that the present demands can be met merely by expanding mulberry area in order to increase cocoon and raw silk production. Future additional output in raw silk will therefore mostly have to come from substantial productivity increases, mainly area and labour productivity. Concurrently there is a growing demand for silk fabric among the growing Indian middle class and young urban consumers. The expanding power loom weaving industry typically produces these modern silk fabrics. The quality requirements imposed by this trend can only be met by bivoltine raw silk, although it is possible to produce high quality multi-bivoltine silk for conventional power loom.

The process of drawing silk fiber from the cocoon is called "reeling" the cocoons are cooked in hot water and the silk fiber in unwound from the cocoons. The silk consists of two proteins, the inner core of fibroin and an outer cover of gum sericin. During reeling, the cocoons are processed in hot water at 95-97°c for 10-15 minutes. This process is called cooking.

II. SILK REELING TECHNOLOGY

The single filament from the cocoon cannot be used for any purpose as it is too fine (2 to 3 denier). Hence based on the denier of the silk yarn required to be produced for any particular end use, a known number of filaments are combined and unwound together to form a single compact raw silk yarn. The unwinding of the filaments from softened cocoons in a water media, combining the filaments and winding the same onto a spool or reel is called reeling.

Softened cocoons are brushed to detect the end of the filament after which they are transferred to the reeling basin for unwinding the filaments. New filaments are added or joined to the existing filaments in the group, as and when any filament breaks or the filament in the cocoon is unwound completely, so that continuous raw silk yarn of a required denier is obtained



III. VALUE STREAM MAPPING

This paper describes an application of value stream mapping(VSM). Consequently, the present and future states of value stream maps are constructed to improve their production process by identifying waste and its sources. A noticeable reduction in cycle time and increase in cycle efficiency is confirmed. The production flow was optimized thus minimizing several non-value added activities/times such as bottlenecking time, waiting time, material handling time, etc.

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IV. LITERATURE REVIEW

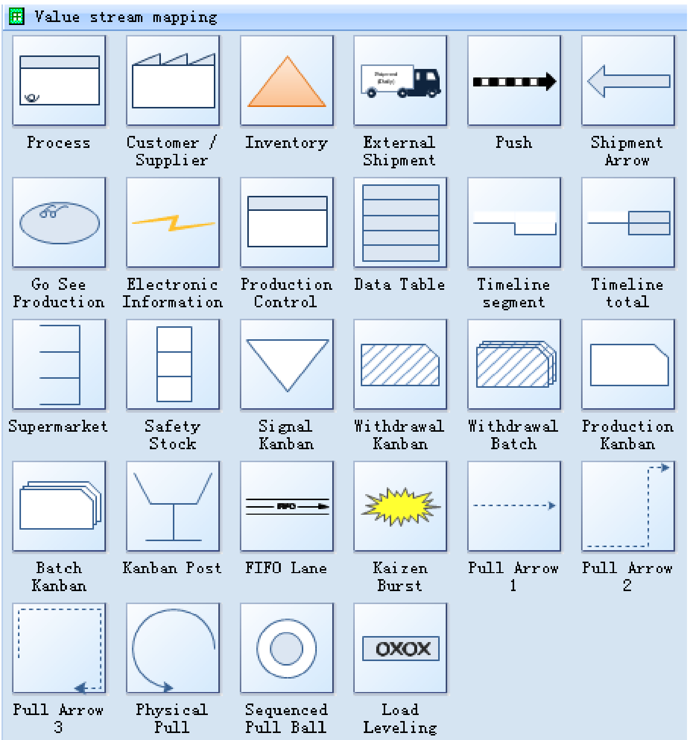
Currently, assembly lines are still fundamental to get the smoothing of production system (Miltenburg, 2001), and they are studied under several operative perspectives seeking its flexibility (El-Maraghy, 2005; Calvo et al. 2007). Both concepts are subjects of pull systems. In assembly lines, pull and lean systems are concepts frequently connected, although they pursue different objectives; pull system toward the reduction of work-in-process (WIP) and lean system toward minimizing the buffer variability (Hopp and Spearman, 2004). Moreover, with respect to the election of production control system in a pull system, the alternatives considered are focused on kanban (Monden, 1998) and constant work in process (CONWIP) (Spearman et al. 1990), both of them focused toward the reduction of WIP.

Although many tools exist, from its origin, VSM has demonstrated its efficacy (Womack and

Jones 1996; Sullivan et al. 2002; Abdulmalek and Rajgopal 2007; Serrano et al. 2008; Sahoo et al.

2008). Following the benchmarking perspective, as well the use of a contrasted tool, facilitates the interchange of improvements. It is a tool that provides communication solutions for practitioners to obtain maximum efficiency and definitions of theoretical development points to become a reference among redesign techniques (Serrano et al. 2008). A detailed description of VSM can be seen in Rother and Shook (1999). Thus, as improvement tool simplifies the measurement of times without added value, so the calculation of indexes of lean metrics is easier and it is possible to enhance the operative actions with strategic results.

This paper unifies several gaps and it shows how value stream transformation actions can achieve high levels of performance in a short time and in a real industry, inside a context of an assembly line with a small space and that it requires flexibility.



Source: lean tools and techniques book

<u>Researchmethodology:-</u>

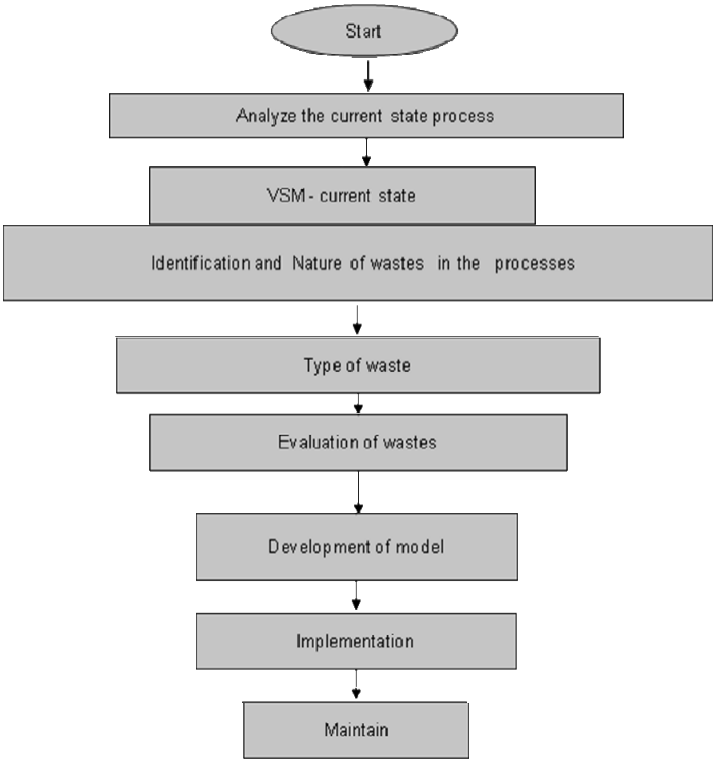


Figure 2 Methodology Flowchart

V. VALUE STREAM MAPPING

A manufacturing system operates with timing of step-by step activities. The various steps in implementation of VSM are shown in Figure 3 and are discussed

5.1. Preparation of Current State Map

Interaction with the industry information of the customer's requirement. The company has a wide

Table 2. VSM input data

Customer Order	1500(per month)
demand	30kg (per day)
Working Hours	One Shift 9 Hours (per day)
Break	One Hour (per day)
Raw Materials	One weak

Table 3. Process cycle time

Process	Cycle time (sec)
stifling	2700 sec
Drying of coons	1200 sec
Sorting	600 sec
Deflossing	900 sec
Cocoon riddling	1200 sec
Cocoon boiling	900 sec
Cocoon Brushing	600 sec
Reeling	28800 sec
Thread steaming	600 sec
Re-reeling	14400 sec
Finishing	600 sec
Packing	600 sec

5.2. TAKT Time: A Benchmark for Process Pace

Takt demonstrates the rate at which the customer buys the product. TAKT reflects the frequency at which the product has to come out of the manufacturer to meet the customer demand. From Figure 4 Takt time is calculated by dividing available working time per shift (in sec) with the customer demand per shift.

Available Time =Working hours – Breaks= (9 x 60x 60) – (1 x 60 x60) = 28800 sec

$$\text{TAKT Time} = \frac{\text{Available working time per shift}}{\text{Customer demand per shift}}$$

TAKT Time = 28800/30

= 960 sec

TAKT time = 960 seconds Demand=900 kg /month Demand per shift=30 kg / day

5.3. Process improvement (Removing Bottlenecks)

Improvements in quality, flexibility and speed are commonly required .The following lists some of the ways that processes can be improved.

- Rearranging the layout to eliminate large amounts of inventory between operations
  - Add additional resources to increase capacity of the bottleneck (an additional machine can be added in parallel to increase the capacity)
  - To improve the efficiency of the bottleneck activity
- Minimize non-value adding activities (decrease cost, reduce lead time)
  - Eliminating the batching and moving to one piece flow

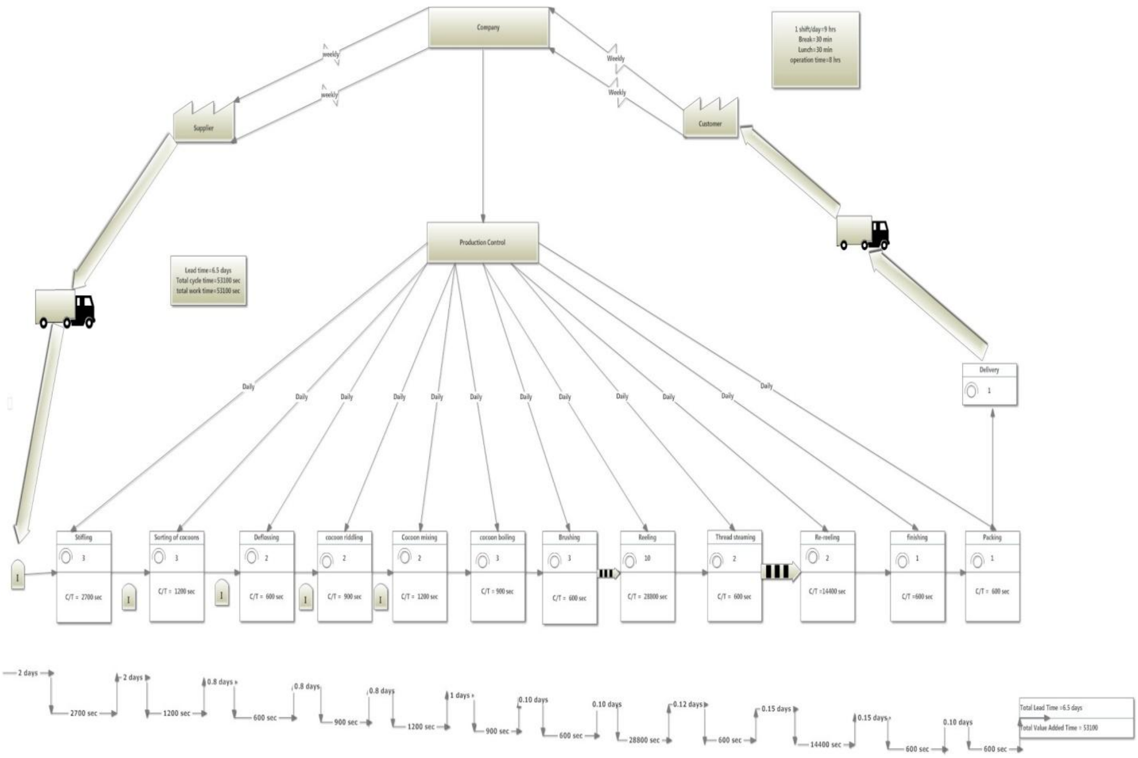


Fig:- **Current state value stream mapping**

Current layout

The current layout silk reeling manufacturing process . the silk reeling process as shown in the above figure. From the figure the flow of material are from one process to another process . the cocoons are converted one stage to another stage to cocoon stifling , sorting, storage, cocoon boiling in this process was observed that the wastage is more so hear lean manufacturing tool to improve the value added time and reduce the wastage . it was decided to carry out discussions with the mangers, engineers and workers and the issues relating to the increase in value added time were pointed out. Further, the the authors used the questionnaires and collected the data regarding the awareness, knowledge and implementation difficulties faced by the employees and the management in its effective implementation. Finally, based on the feedbacks collected, it was decided to suggest the following lacuna in the process of manufacture and suggested remedial measures for the same .Finally, a future state value stream map was proposed to be implemented.

Future state value stream mapping:-

It was observed that processed like Cocoon sorting, cocoon boiling, cocoon reeling can be eliminated waste can be eliminated reduced by improving the quality of silk .

To carry out online inspection and scrap reduction programs.

To implement Kaizen technique for the effective Boiling process

To review the work sequence in order to reduce idle time

To identify value added versus on value added elements and minimize/ eliminate non value added operations

Hence the following steps were suggested for the improvement of the process of manufacture below figure. Shows the future state vale stream mapping implementation.

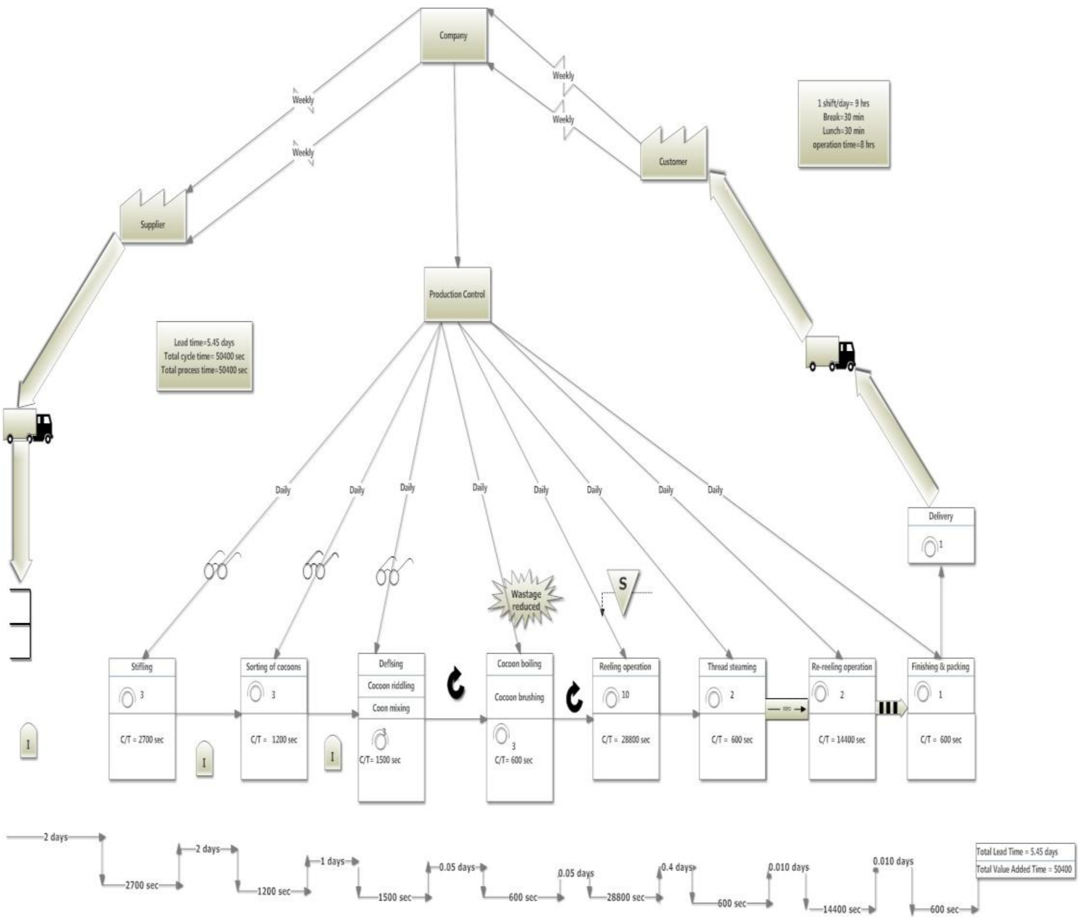


Fig:- Future state value stream mapping

REFERENCES

[1] Abbett D., Payne V. (1999), Gulfstream value stream tour; *presentation at 1999 Lean Summit.*

[2] Badrinarayana S., Vishnupriya Sharma. (2007), Value stream mapping as the systems way of optimizing the flow in an organization for producing of goods, Proc in a Challenge for Collaborative Manufacture systems; *APCOMS 2007*; Bali, 5th -6th Sept.

[3] Doolen T., Nagarajan R.D, Hacker M.E. (2002), Lean manufacturing: An electronics manufacturing perspective; *Proc. of the 2002 IERC*; Orlando, FL, May 19-22

[4] Hines P., Rich N. (1997), The seven value stream mapping tools; *International Journal of Operations & Production Management* 17(1); 46-64.

[5] Hyer N.L., Wemmerlov U. (2002), The office that lean built; *IIE Solutions* 34; 37-43.

[6] Jones D. T. (2006), From lean production to lean consumption- Chairman; Lean Enterprise Academy, UK, *www.leanuk.org.*

[7] Jones D.T., Hines P., Rich N. (1997), Lean logistics; *International Journal of Physical distribution & logistics Management* 27(3/4); 153-173.

[8] McDonald T., Van Aken E.M., Rentes A.F. (2002), Utilizing simulation to enhance value stream mapping: A Manufacturing case application; *International Journal Of Logistics: Research and Applications* 5(2); 213-232.

[9] Moore R. (2006), Selecting the right manufacturing improvement tools, ISBN: 0750679166; *Elsevier Science & Technology Books*.

[10] New C. (1993), The use of throughput efficiency as a key performance measure for the new manufacturing era; *The International Journal of Logistics Management* 4(2); 95-104.

[11] Ohno. T. (1988), The Toyota production system: Beyond large-scale production; Productivity Press; Edition I.

[12] Rother M., Shook J. (1999), Learning to see: Value stream mapping to add value and eliminate muda; 2 Edition, Brookline, MA; The Lean Enterprise Institute Inc.

[13] Shingo Shigeo (1989), A study of the Toyota production system from an industrial engineering viewpoint; Productivity Press; Portland, OR.

[14] Simchi-Levi D., Kaminsky P., Simchi-Levi E. (2004), Designing and managing the supply chain, concepts strategies and case studies; McGraw-Hill.

[15] Womack J.P., Jones D.T. (1998), Lean thinking: Banish waste and create wealth in your corporation; New York, Free Simon & Schuster.

[16] Womack J.P., Jones D.T. (2005), Lean solutions: How companies and customers can create value and wealth together; New York, Free Press.

[17] Womack J.P., Jones D.T., Roos D. (1990), The machine that changed the world: The story of lean production; New York, Simon & Schuster.