ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

STUDY ABOUT THE IMPLEMENTATION OF KANBAN METHOD FOR FABRICATION MANAGEMENT CONCERNING THE MANUFACTURING LINE OF THE PRODUCT GAS COOKER GRATE

Florin BLAGA, Tiberiu VESSELENYI, Ioan MOGA
Universitatea din Oradea, Facultatea IMT, fblaga@uoradea.ro

Keywords: Just In Time, kanban, manufacturing

Abstract: The paper presents the possibility of implementation Just In Time (JIT) method in the case of the product ”gas cooker grate” fabrication line from SC METALICA SA.

1. Introduction

Just In Time (JIT) is a Japanese management philosophy which has been applied in practice since the early 1970s in many Japanese manufacturing organizations. It was first developed and perfected within the Toyota manufacturing plants by Taiichi Ohno as a means of meeting consumer demands with minimum delays. Taiichi Ohno is frequently referred to as the father of JIT

The JIT management principle is characteristic for the continuously organized production, on manufacturing lines. JIT is a managerial ”philosophy” founded on the logic of ”pulled” flows in which the production is triggered by the client request.

The management method based on JIT concept is Kanban (”label” in Japanese).

2. Calculation procedure of the manufacturing lots in JIT

For implementing the Kanban method, one must determine the number of kanban’s (labels) that are to be used. This depends on: the size of the manufacturing lot (request), the number of components of a certain type that are included in the final product, the time norm.

The labels number (kanban’s, containers) necessary for the ”i” post from the fabrication line is given by the following relation

$$K_i = \frac{d \cdot (\overline{w}_i + \overline{p}_i) \cdot (1 + \alpha_i)}{c_i} \quad , \quad i = \overline{1,n} \tag{1}$$

where:

d – the request provided for the considered time unit (an exchange);

$\overline{p_i}$ – average working time at the ”i” post;

$\overline{w}_i$ – average transport and waiting time for the ”i” post;

α_i – coefficient that defines the safety stock;

c_i – capacity of a container.

3. Case study – manufacturing of the gas cooker grate assembly

3.1. Product

The product ”gas cooker grate” is shown in figure1. It is included in the final product ”gas cooker”. Table 1 shows the product components and the quantity and time norm for each component.

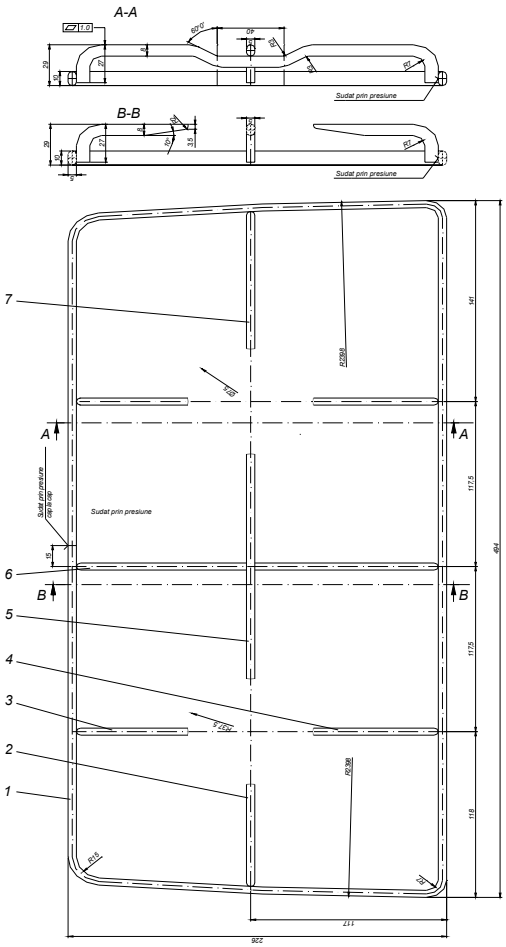

Table1. Components of the product "gas cooker grate"

Nr.	Item	Quantity [pcs]	Average working time [min]
1	Frame	1	0,25
2	Support element I	1	0,075
3	Support element II		0,075
4	Support element III		0,075
5	Support element IV		0,075
6	Transversal element		0,25
7	Support element V		0,3

Fig.1. Product "gas cooker grate"

3.2. Existent manufacturing line

The manufacturing line of the product "gas cooker grate" is shown in figure 2.

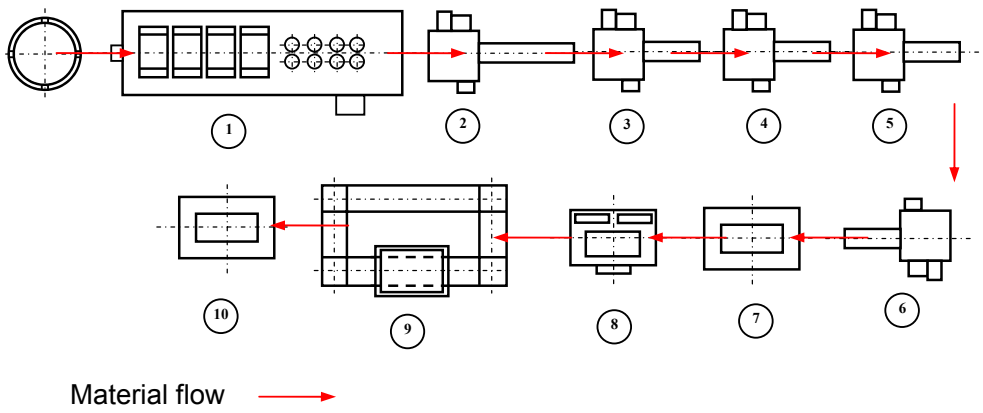

Fig. 2. Existent manufacturing line

The machines that consist the manufacturing line are the following:

1. Flat steel straightening machine;
2. Flat steel cutting machine;
3. Element I cutting and bending machine;
4. Element II cutting and bending machine;
5. Element III cutting and bending machine:
6. Element IV cutting and bending machine;
7. Grate frame bending machine;
8. Grate frame welding machine;
9. Gas cooker grate welding assembly;
10. Gas cooker grate straightening table.

3.3. Application of the JIT method in the case of the manufacturing line

The number of labels (Kanban's, containers) necessary for various manufacturing phases is determined with relation (1). A "request" of 200 assemblies "gas cooker grate" has been considered.

Table 2 shows the working posts, the kanban associated to each post, the calculated number of kanban's, the adopted number of kanban's.

Table 2. The working posts

Crt. nr.	Working post	Kanban associated	Calculated number of kanban's	Adopted number of kanban's
1	Gas cooker grate straightening table.	K1	5,5	6
2	Gas cooker grate welding assembly	K2	5,71	6
3		K3	5,71	6
4		K4	5,71	6
5		K5	5,71	6
6		K6	5,71	6
7	Grate frame welding machine	K7	2,75	3
8	Grate frame bending machine	K8	2,75	3

9	Element IV cutting and bending machine	K9	2,365	3
10	Element III cutting and bending machine	K10	4,73	5
11	Element II cutting and bending machine	K11	4,73	5
12	Element I cutting and bending machine	K12	2,365	3
13	Flat steel cutting machine	K13	5,71	6

The manufacturing line layout shown in figure 3 is proposed. After the introduction of JIT management system, the kanban traces and the containers traces are as in figure 3.

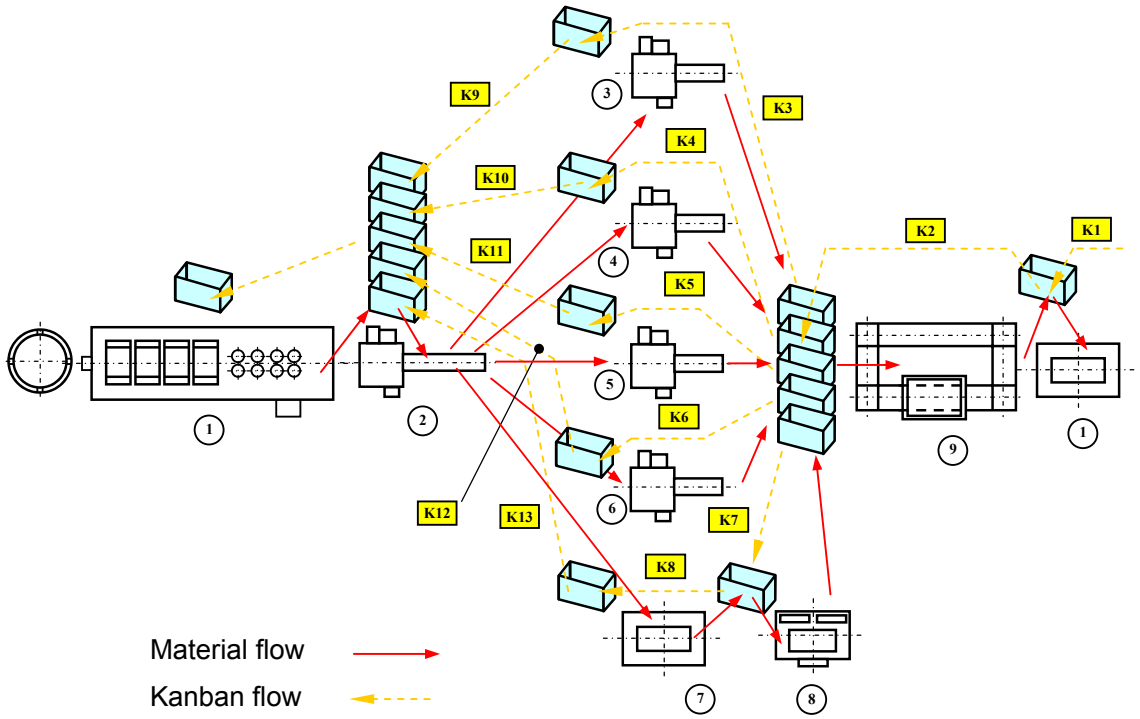

Fig.3. Manufacturing line using the Kanban method

3.4. Petri nets modeling

The Petri nets model of the manufacturing line for product ”gas cooker grate” is shown in figure 4. The model significances are shown in table 3.

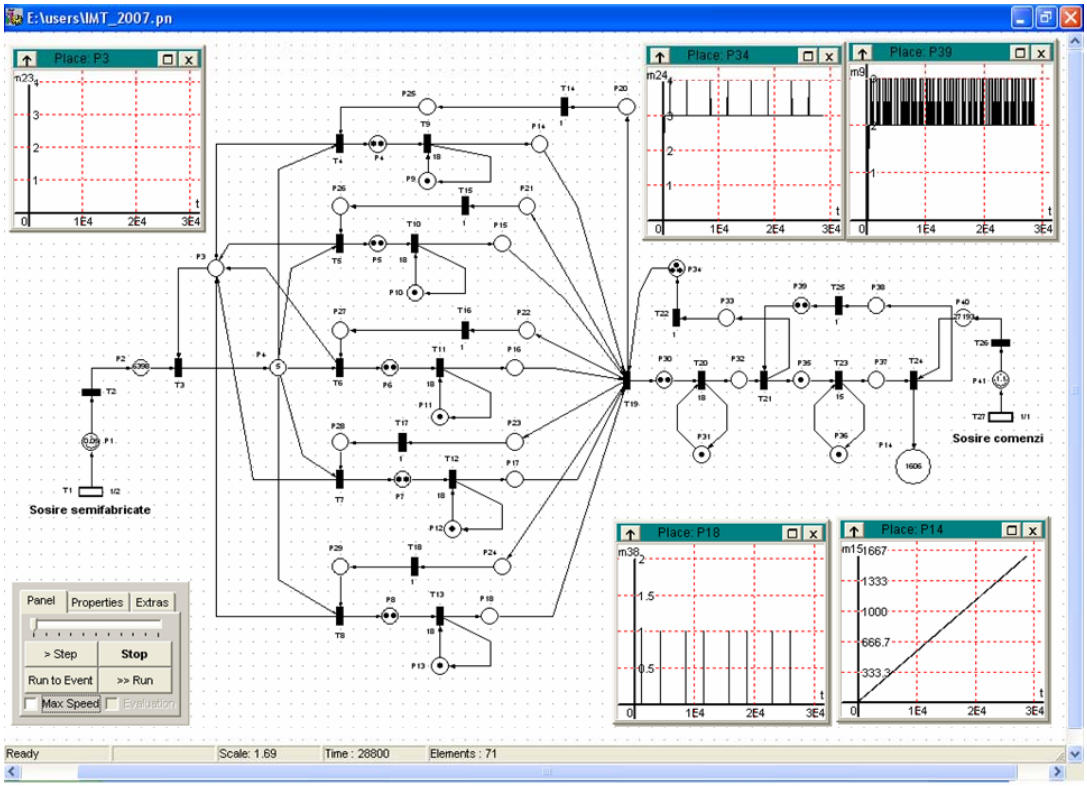

Fig.4. Petri nets model of the fabrication line

Table 3. Positions and transitions significances of the Petri networks model

Crt. nr.	Symbol	Type	Signification
1	$T1$	Transition	Arrival pieces
2	P_2, P_{14}, P_{15}, P_{16}, P_{17}, P_{18}, P_{32}, P_{37}	Place	Output stocks
3	T_2, T_3, T_9, T_{10}, T_{11}, T_{12}, T_{13}, T_{20}, T_{23}	Transition	Manufacturing
4	P_1, P_4, P_5, P_6, P_7, $_{18}$, P_{30}, P_{36}	Place	Input stocks
5	P_{20}, P_{21}, P_{22}, P_{23}, P_{24}, P_{33}, P_{38}	Place	Free kanban
6	T_{14}, T_{15}, T_{16}, T_{17}, T_{18}, T_{22}, T_{25}	Transition	Kanban transfer
7	T_4, T_5, T_6, T_{10}, T_7, T_8, T_{19}, T_{21}, T_{24}	Transition	Pieces transfer
8	T_{27}	Transition	Request arrival
9	T_{28}	Transition	Request transfer
10	P_{40}	Place	Request confirmation

By means of this model, the fabrication line performance parameters can be estimated by simulation. So, the production during one shift is of 1606 pcs.

4. Conclusions

The general objective of the JIT production is the decrease of the transition times in the production process, by means of drastically reducing the stationary stocks. As result, we obtain a non-interrupted flux of small lots of products over the entire production process. The most efficient JIT applications were in the recurrent (repetitive) production, operations during which groups of standard products are made at high speeds and in big amounts, with materials that move in continuous flux.

The application of the JIT principle in the case of the product ”gas cooker grate” fabrication line from SC METALICA SA would determine the increase of the productivity and of the products quality. Of course, this should be done gradually, at first upon a small number of working posts. Also, some psychological blockages must be overcome and we should ask ourselves the same question as the American managers, concerning the Japanese in ’80: ”if they can do that, why can’t we?”.

The Petri networks modeling and simulations can provide information that can be used by decisional factors in taking measures for structurally and functionally optimization of the fabrication systems.

References:

[1] Benichou, J.,Malhiet, D., *Études de cas et exercices corrigés en gestion de production*, Les éditions d’ organisation, Ed. Hèrmes, Paris, 1991

[2] Cheng, T.C.E., S. Podolsky. Just-In-Time Manufacturing - An Introduction. 2nd ed. London: Chapman & Hall, 1996

[3] Cokins, Gary, *Activity-Based Cost Management, Making it Work: A Manager's Guide to Implementing and Sustaining an Effective ABC System*, Ed. Irwin Professional Publications, 1996

[4] Ohno,K.,Nakashima,K. andKojima,M., Optimal numbers of two kinds of kanbans in a JIT production system. International Journal of Production Research, 33, 1995

[5] Shigeo Shingo, Andrew P. Dillon, *A Study of the Toyota Production System from an Industrial Engineering Viewpoint*, Ed. Hardcover, 1998

[6] William A. Sandras, *Just-In-Time: Making It Happen: Unleashing the Power of Continuous Improvement*, Ed. Hardcover, 1995

[7] Yasuhiro Monden, *Toyota Production System: An Integrated Approach to Just-In-Time*, Ed. Business Tech, 1996