SOFTWARE FOR SIMPLE SCHEDULING RULES APPLICATION ON A FLEXIBLE MANUFACTURING SYSTEM – part I –

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Keywords: simple scheduling rules, the flexible manufacturing system, Gantt chart.

Summary: The aim of this paper is to present the simple scheduling rules application on the flexible manufacturing system presented in paragraph 1. For this purpose a software was created using Borland Pascal which generates the task's succession and the visualization chart. The received data should be processed and sorted using specific criteria.

1. THE FMS LAYOUT AND ITS COMPONENTS

At the University of Oradea, Managerial and Technological Engineering Faculty a flexible manufacturing system was design and wants to be realised. Parts of the FMS system exist, such as a CNC milling machine, two industrial robots. The design of FMS and FMS itself will be done through the research activity of teaching staff, which works in the fields of Robotics and Flexible Manufacturing Systems.

The block scheme of the FMS was in such way design to achieve the following functions:

- manufacturing function;
- quality assurance function;
- logistic function;
- automated storage and retrieval function;
- programming and control function.

In respect with those functions the FMS system has to contain the following subsystems:

I – pallet and raw material input and storage subsystem;
II, III – the manufacturing subsystem;
IV – the transfer subsystem;
V – the automated storage and retrieval subsystem;
VI – the main programming and control subsystem;
VII – the pieces output subsystem.

To work properly as an FMS system all those subsystems has to be integrated through materials, information and energy fluxes.

The raw materials enter in FMS system through subsystem I (pallet and raw material input and storage subsystem). The raw materials pieces are positioned on the pallets. The pallets are transferred to the next station by conveyor (the transfer subsystem). After manufacturing (subsystems II, III), the pallets with the pieces can be storage in the automated storage and retrieval subsystem. Evacuation of the pieces, both of that that passed quality tests or not is made through subsystem VII. The subsystem's VI main role is to coordinate from the informational point of view all the other subsystems.

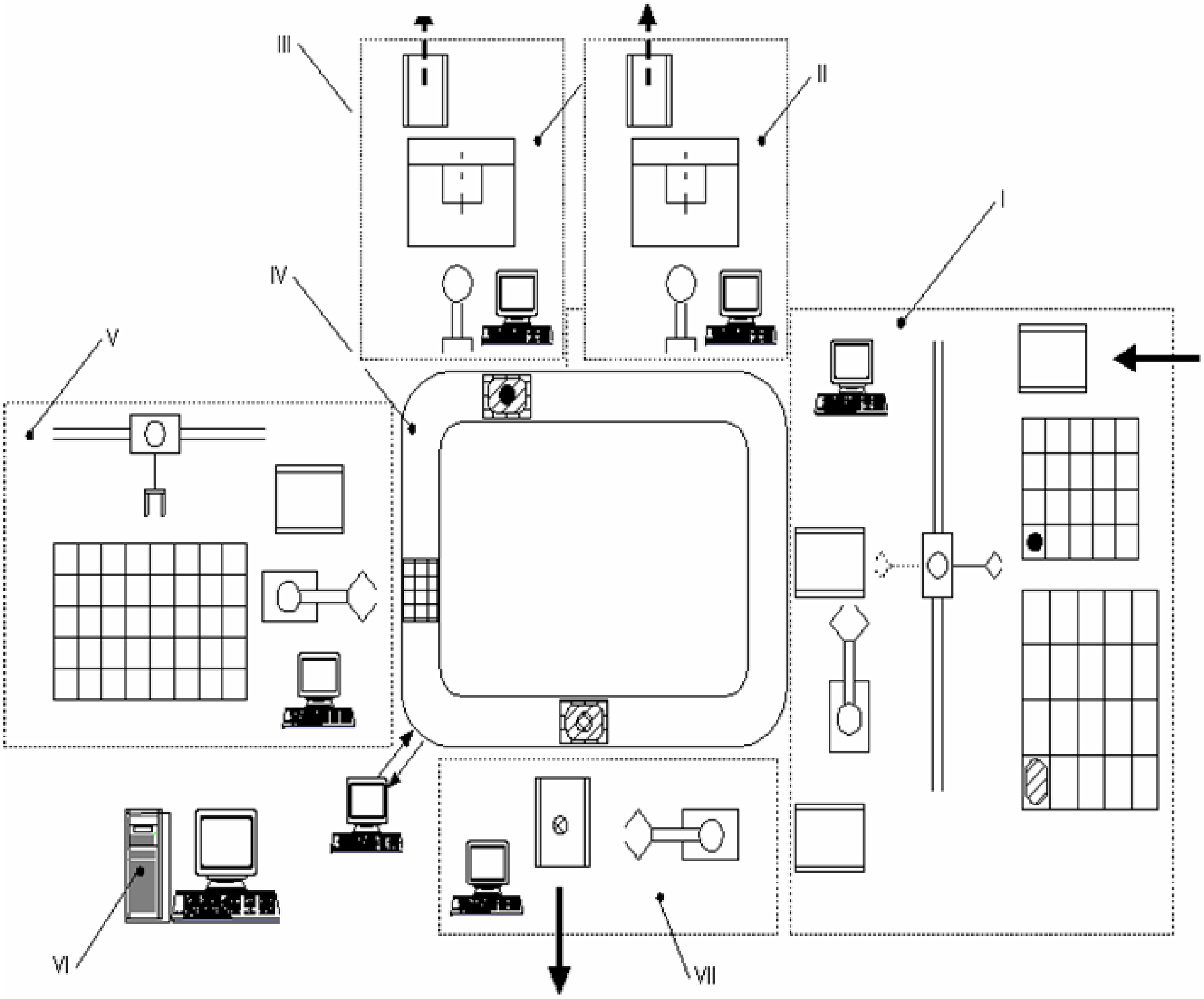


Fig. 1. Flexible Manufacturing System – layout

2. THE SOFTWARE

To see how the simple scheduling rules act on the flexible manufacturing system, presented in paragraph 1, a software was created using Borland Pascal. This software generates the task's succession and the Gantt charts. The received data should be processed and sorted using specific criteria.

A Borland Pascal based program was created to process data and to generate the charts.

The input data for the program are: number of tasks; number of machine tools; processing time t_i; initial moment r_{ti}; processing time d_i for all n jobs; make-ready time.

The simple scheduling rules are ordered by the program regarding the total manufacturing time efficiency.

The software has procedures for each simple rule and a chart generating procedure. These procedures are called from the main program body.

The SIO procedure flowchart of the program is presented in figure 2.

The flowchart diagram of the program is presented in figure 3.

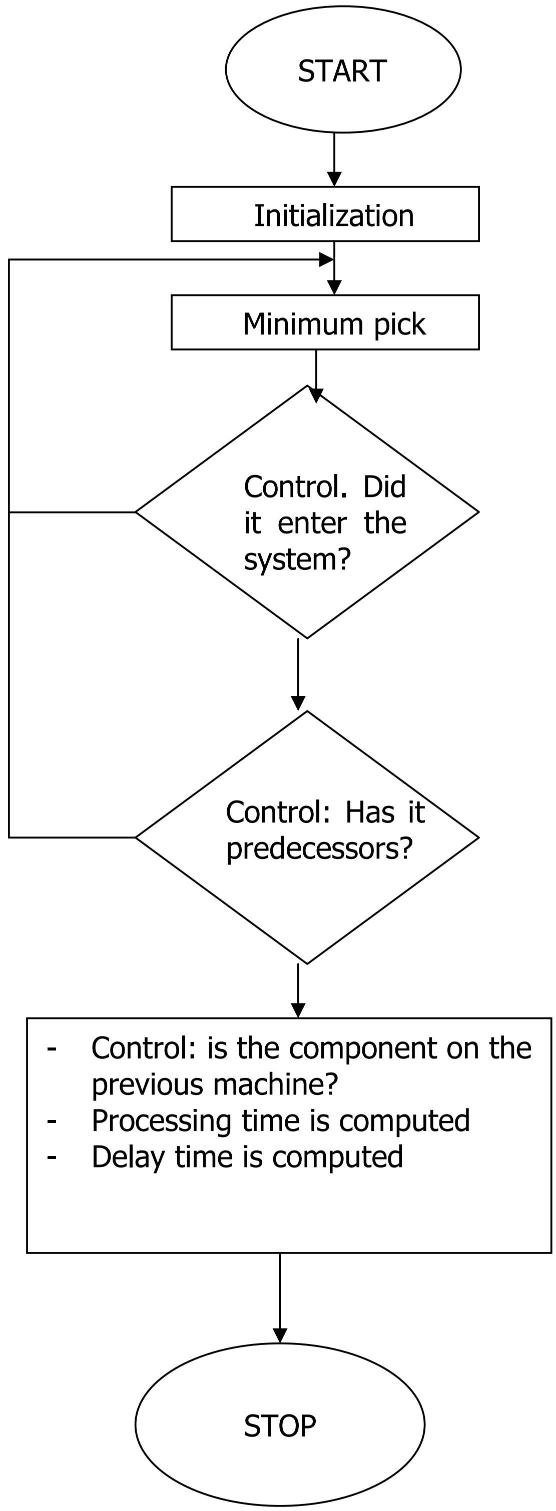


Fig.2. The SIO procedure flowchart

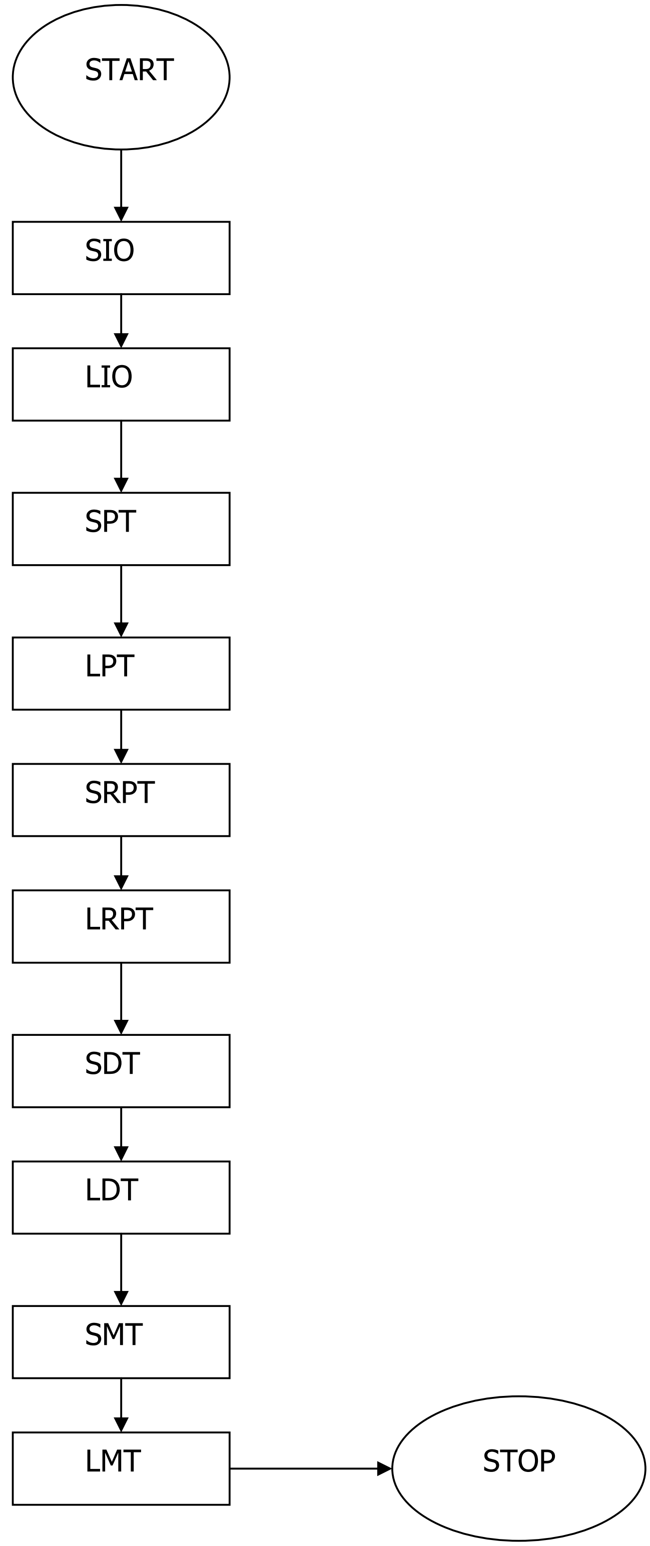


Fig.3. The flowchart diagram of the program

Interrupting requests were used in some procedures, as shown in the following figure:

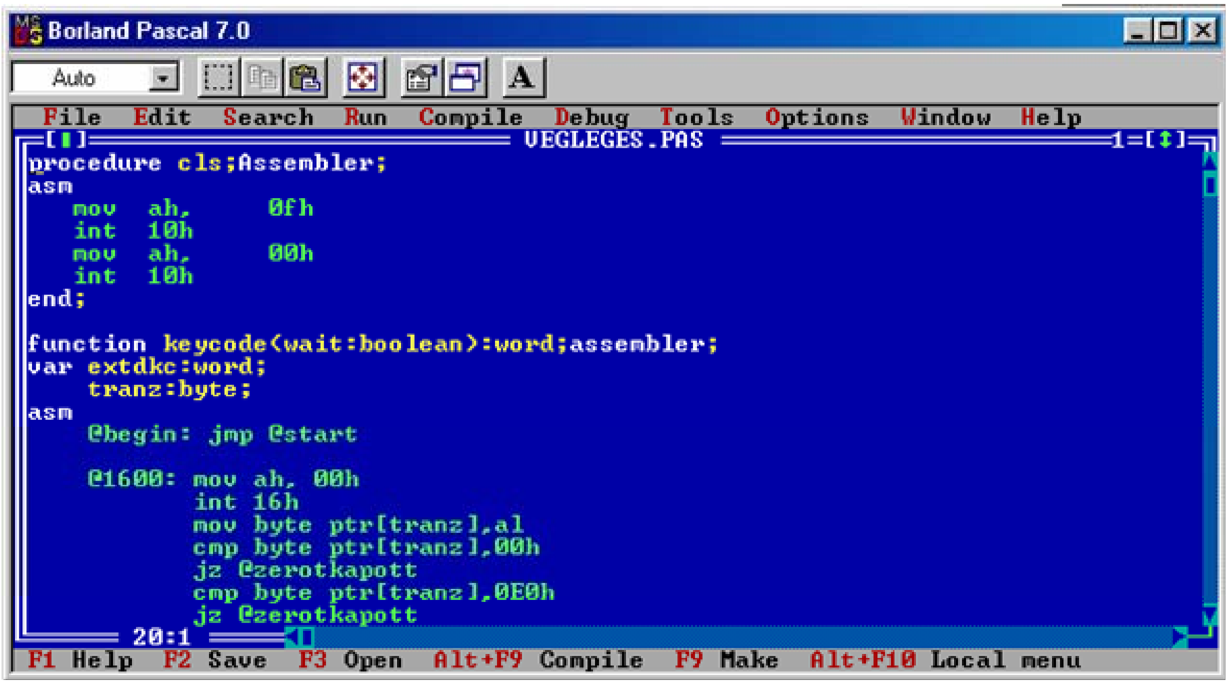


Fig.4. Interrupting requests

The following image shows the main program:

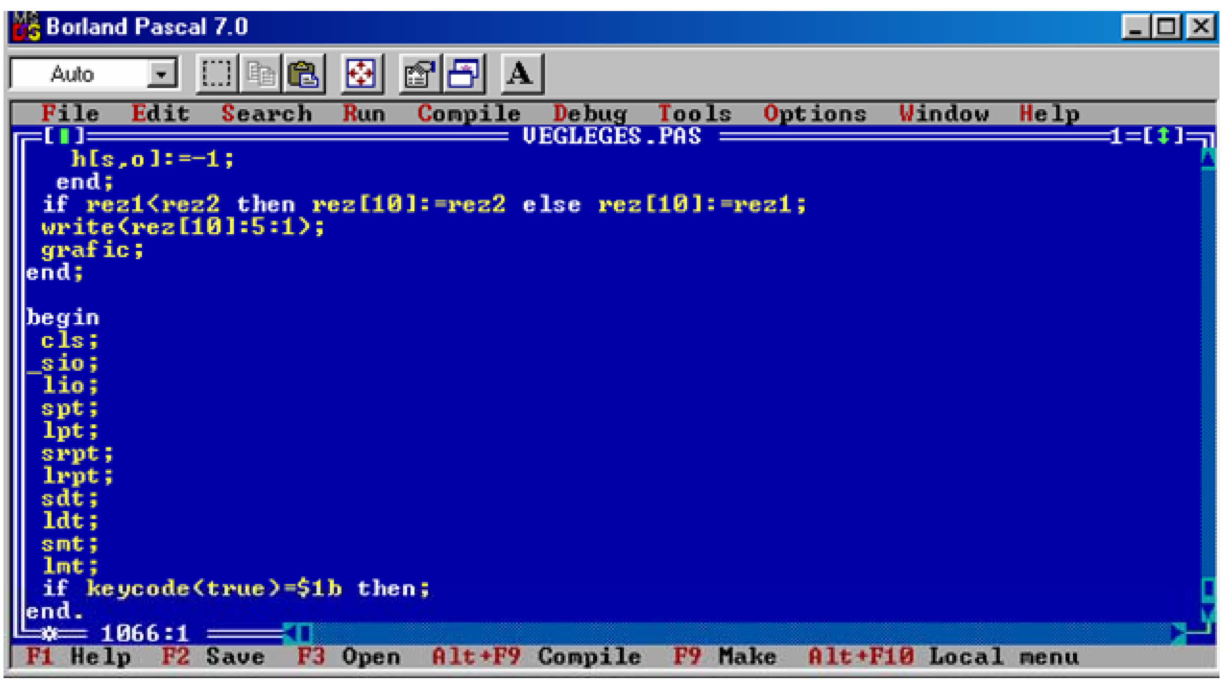


Fig.5. The main program

3. INPUT DATA

This is the wide scale used representation which illustrates the principles of simple rules use presented in this paper. The chosen simple scheduling rules are applied to the current flexible system which was presented earlier in the paper.

The input data are the following:

- Number of tasks n=8;
- Number of machine tools m=2;
- Processing time t_i;

Table 1. Processing time

	machine 1	machine 2
Part 1	5 min	8 min
Part 2	7 min	3 min
Part 3	2 min	11 min
Part 4	5 min	6 min

- Initial moment r_{ti};

Table 2. Initial moment r_{ti}

	The moment of entering in the system
Part 1	0 min
Part 2	0 min
Part 3	1 min
Part 4	2 min

- Processing time d_i for all n jobs;

Table 3. Processing time d_i for all n jobs

	Processing time d_i
Part 1	15 min
Part 2	12 min
Part 3	7 min
Part 4	12 min

- Make-ready time and adequate resources for tasks completion. The rule is: delay time.

Table 4.

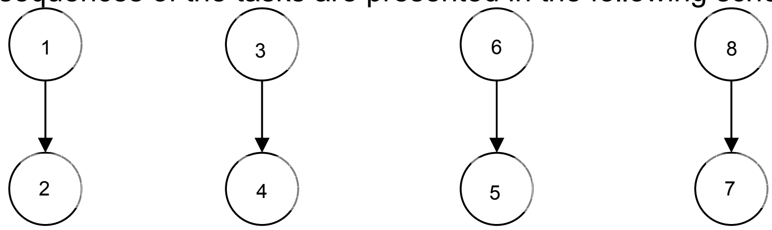
T i/j machine 1	1	2	3	4
1	-	3.5	2	3
2	3	-	1.5	2.5
3	2.5	1	-	1
4	2	2	1	-

- Make-ready time and adequate resources for tasks completion

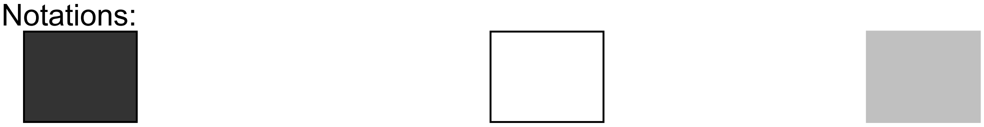
Table 5.

T i/j machine 2	1	2	3	4
1	-	4	2	1
2	1	-	3	3
3	2.5	1.5	-	2
4	2	2	1	-

The sequences of the tasks are presented in the following scheme:



Notations:



Delay time processing time make-ready time

Using the above data inputs, the FMS Gantt chart when the SIO rule (the task with the shortest execution time) was selected is presented in figure 6.

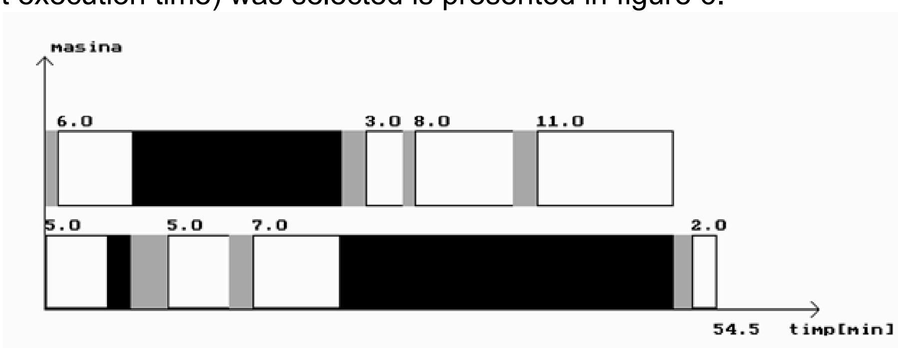


Fig.6. The FMS Gantt chart with SIO rule

The achieve results if SIO rule is use are: the task sequence is S1-S8-S7-S3-S4-S2-S6-S5; total manufacturing time is 54,5 min; total task execution time is 47 min; total make-ready time is 12.5 min; total delay time is 46 min; first component delay time is 23 min; second component delay time is 17 min; third component delay time is 47.5 min; fourth component delay time is 3 min; total delay time is 23+17+47.5+3=90,5 min.

4. CONCLUSIONS

The software developed by authors is a useful instrument in the performance evaluation of the fabrication systems. It offers valuable information in the real systems functioning optimisation process.

5. REFERENCES

1. Kovacs, Fr.,Țarcă, R., Blaga, F., Tripe, V., *Sisteme de fabricație flexibilã,* Ed. Univ. Oradea, 1999.

2. BLAGA, Fl., *Studii teoretice în vederea stabilirii funcției de ordonanțare,* Referat nr. 2, Univ., Oradea, 2000.

3. Blaga Fl., Tarcă, R., Mihăilă, I., Țarcă, I., *About the manufacturing scheduling in FMC-2R-2002 flexible manufacturing cell,* ROBOTEP 2004 7th International Conference on Automation/Robotics in theory and practice Kosice, ISBN 80-8073-134-9, Slovak Republic, pp 160-167, pg. 8, 2004.