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The Simulated Process of a Production System using the Extend Program

With the help of the simulated process, it could be realized all kind of experiments on a model. It could be tested lots of ideas, a returning in time to make possible remaking of manipulation scripts of some key variables with the purpose of observation based on experiments the effect above some important indicators of performances.

1. Presenting the problem

In figure 1 is presented a production workshop made of four machines, in which are processed and assembled two components X and Y. Before they are assembled on machine 3, both components X and Y are submitted to the processing on machine 1 and machine 2. After the assembling on machine 3 of a component X with a component Y we obtain a new piece which is submitted to some processing on machine 4. If one of the machines is busy, then the components or the pieces must wait to be processed making intermediary stocks between different points of processing.

We know the following:

- Processing time of component X on machine 1 is a probable dimension with normal distribution having a average of 0.12 hour/piece and standard deviation of 0.04 hour/piece.
- Processing time of component Y on machine 2 is a probable dimension with normal distribution having an average of 0.18 hour/piece and standard deviation of 0.07 hour/piece.
- Machine 3 assembles one piece X with one piece Y. Assembling time is constant 0.36 hours for one piece X and 0.36 hours for piece Y
- Machine 4 processes each new piece obtained through assembling. Processing time of assembled piece is a probable dimension having a average of 0.7 hour/piece and standard deviation of 0.2 hour/piece.

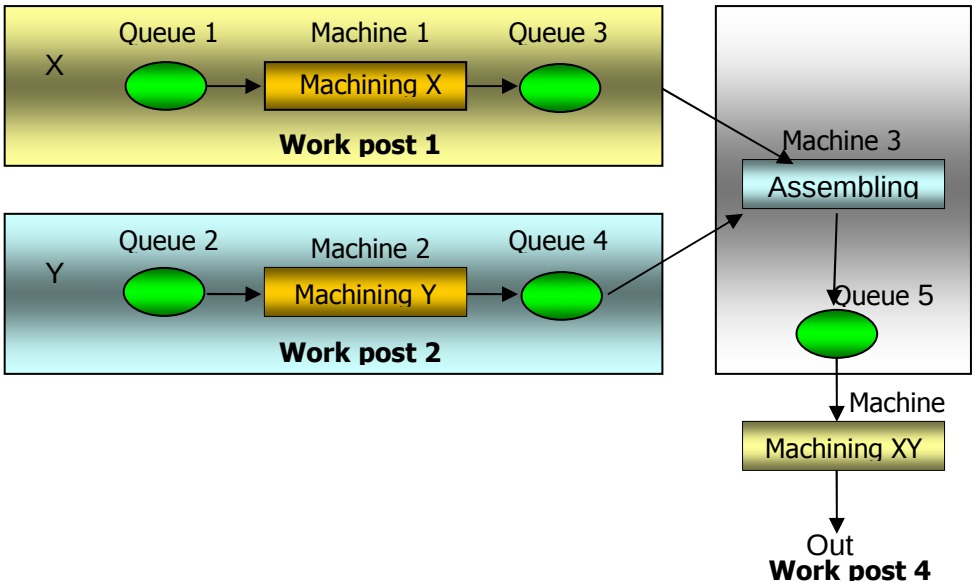

Figure 1. The production section.

For each waiting line it will be considered that the pieces are processed by the order that they arrive, so that serving discipline will be FIFO.

Storing space for pieces that wait to be processed is limited, that's why it will be specified the maximum capacity for each waiting line.

- Queue FIFO 1 capacity : 60 pieces
- Queue FIFO 2 capacity : 60 pieces
- Queue FIFO 3 capacity : 120 pieces
- Queue FIFO 4 capacity : 120 pieces
- Queue FIFO 5 capacity : 300 pieces

2. The objectives of simulated process.

- To analyze and understand the behavior of the production system
- Showing out the thin places in the production system which generate long waiting lines and crowded machines
- Exploitation of growing politics of the production.

3. Building a simulated process model.

The presented production system in figure 1 may be considered a waiting system. Simulated model will be a simulated model of discreet events. System's components are: two kinds of pieces which are processing, five intermediary stocks

which representing products waiting line who wait to be processed and four machines which representing the serving stations. That means that the system has eleven components. Time unit we will be using will be the hour. In figure 2 is represented the model of simulation in a working week with five days, in two shifts.

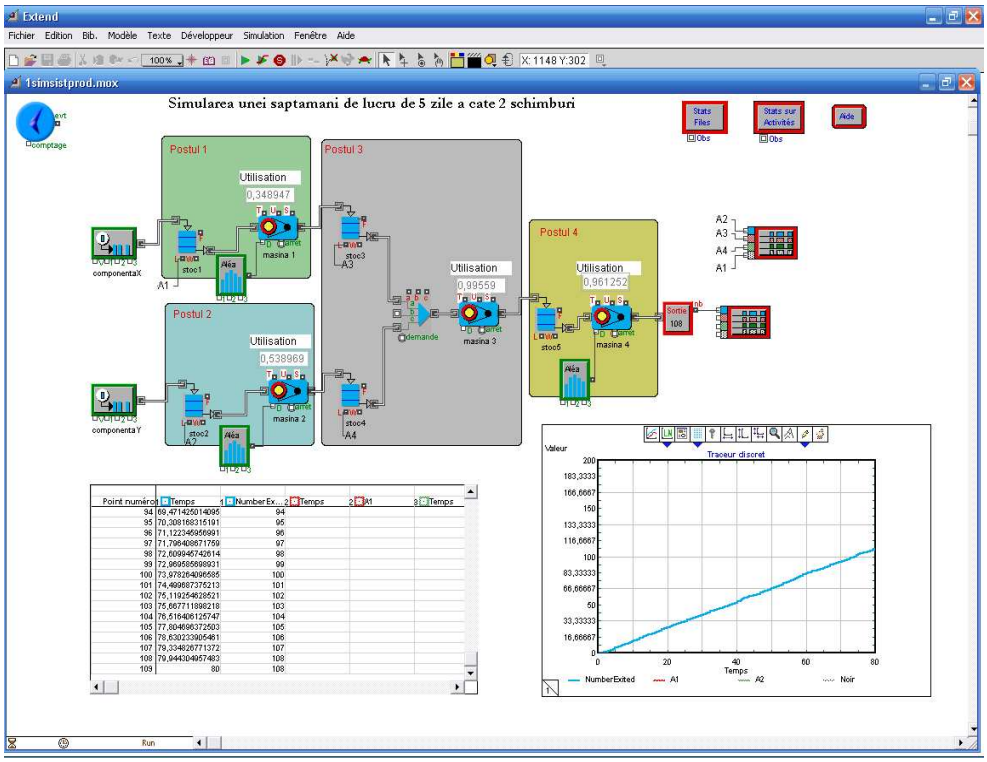

Figure 2. The model with 4 working stations.

After the beginning of simulated process, it will open a window for graphic representation of the fallowing process results, at the using rank of the serving stations and of waiting time of pieces in stocks. It could be observed that the using rank of serving stations presents big variations at the beginning of simulated process, but after 30 simulated hours, this is stabilizing. Explaining this evolution consists in the fact that simulated process begins without stocks. Totally has been realized 109 pieces in one week of simulated process.

Average number of finished pieces in one hour is approximate 0.73.

With the help of "Stats Activities" block, represented in figure 3, we could observe that machine 3 had the biggest using rank of 99.7 %, fallowed by the machine 4 with 99.3 5, as we could observe that on machine 1 and machine 2 has been processed 344 pieces, which from, only 221 have been assembled on machine 3 and 109 processed on machine 4.

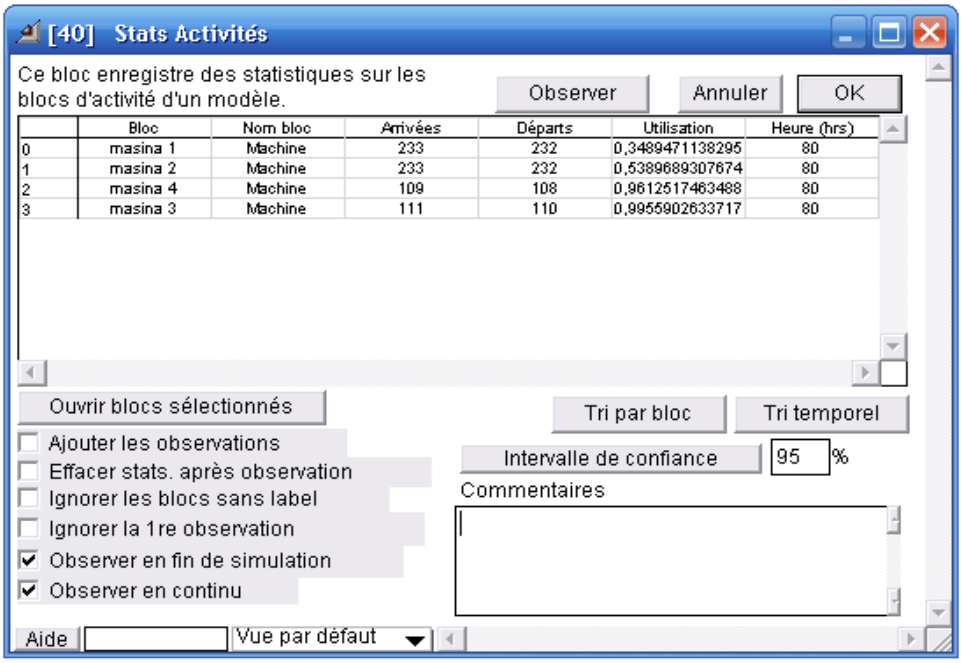

Figure 3. The dialog window of Stats Activities block.

Block "Stats Queues" of "Discrete" library furnished us some data regarding the five intermediary stocks of the analyzed system.

If the experiments are repeated for one week many times, we could obtain other results. For the determinations of trust spell (interval) for average waiting time of pieces in lines, it will repeat the experiments many times (more the 30). At the same time it will be simulate 100 hours, 160 hours and 1000 working hours, repeated up to 30 times, and the important data are presented in table 1, 2 and 3.

Table 1.

Simulation time [hours]	Number of finite products [pieces]	Productivity
80	109	1.36
100	139	1.39
160	227	1.41
1000	1430	1.43

We could observe from that tables that, when we increase simulation time, the production time of one piece decrease, because the stocks grow. It's recommendable to use rank of machine 1, 2 and 3 decrease and at machine 4 increases.

Table 2.

Simulation time [hours]	Medium lenght in Queue FIFO 3 [pieces]	Medium lenght in Queue FIFO 4 [pieces]	Medium lenght in Queue FIFO 5 [pieces]
80	103	86	54
100	107	89	66
160	111	104	105
1000	118	117	267

Table 3.

Simulation time [hours]	Functioning machine 1 [%]	Functioning machine 2 [%]	Functioning machine 3 [%]	Functioning machine 4 [%]
80	50	75	99.7	99.3
100	47	73	99.7	99.4
160	42	62	99.9	99.7
1000	22	33	62	99

By the point of view of the analyzed production system, machine 4 could be considered "thin place" because it has the biggest process time: 0.70 hours average, and 1.35 hours maximum.

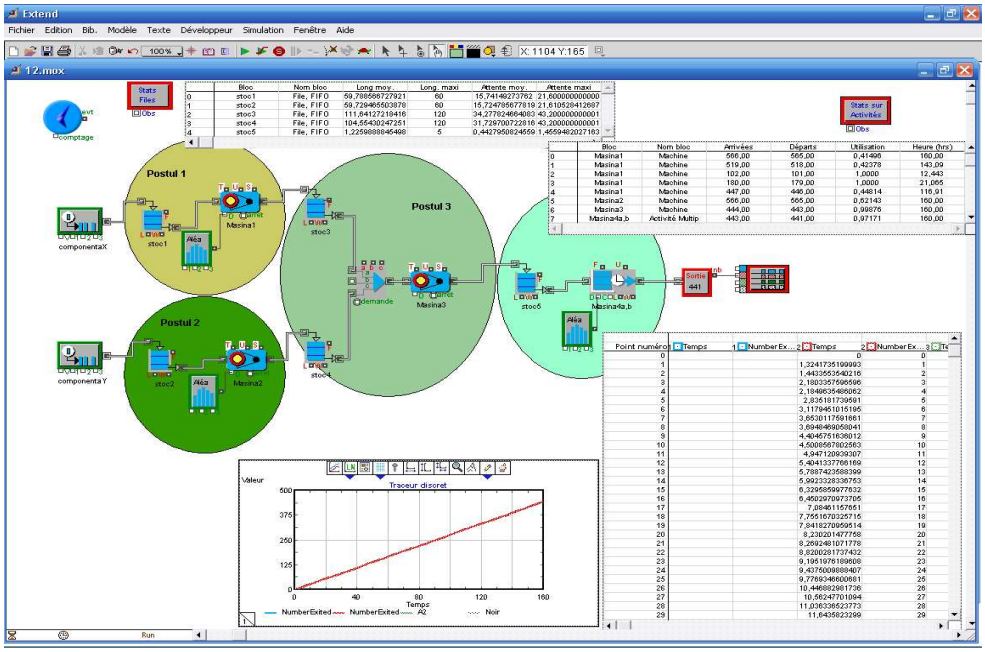

Figure 4. The model with 5 working stations.

If we are introducing the machine 4b (figure 4), who needs to work parallel with machine 4a, we could reduce intermediary stock number 5 and increase the using rank of all the machines and productivity. In one week of simulated work, the productivity has increased from 1.36 to 2.72 pieces/hour, for simulated spell of 100 hours the productivity has increased from 1.39 to 2.74 pieces/hour, and for two weeks, from 1.41 to 2.75 pieces/hour.

At the same time it could be observed in figure 4, in right up corner that the using rank of all machines has increased. In cloned table in dialog window of "Stats Queues" block, it could be observed that average length of stock 5 has been decreased from 2.67 to 1.22 pieces.

4. Conclusion

The functioning in parallel at post 4 of work, of two machines, has leaded to the increasing of stock 5; at the considerable grow of using rank of all the machines from working post 1, 2 and 3, which leads a doubling of the production.

References

[1] ***** *Manuele d'utilisation d'Extend*. IUT Bethune, 2003.

[2] Habchi G. *Modelling and Simulation of Complex Production Systems.* Editorial, Special Issue of SIMPRA, vol. 8, n° 5, December 2000. *Guest Editor – Selected Papers from the 2nd French Conference on Modelling and SIMulation (MOSIM'99).*

[3] Habchi G.,Berchet C. *Le Pilotage Industriel : Concepts de Base pour une Approche Intégrée.* RFGI, Revue Française de Gestion Industrielle, Vol. 18, N° 2, 1999, pp. 55-72.

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