University of Pisa
MSc in Computer Engineering

Systems for Strategic Management and Support

LECTURE 13

http://www.iet.unipi.it/m.cimino/pdis/

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Simulating with Bonita and BIMP

- To use different BPMN simulators is recommended for a better reliability.
- In addition to the *Bonita BPM simulator*, we use *BIMP(*)*, a simple, fast, web-based simulator.
- BIMP and Bonita import the .BPMN (xml-based) format generated by Visual Paradigm. Thus, we recommend to generate the BPMN model with *Visual Paradigm Logizian*, and BIMP and Bonita as simulation tools.
- Main steps:

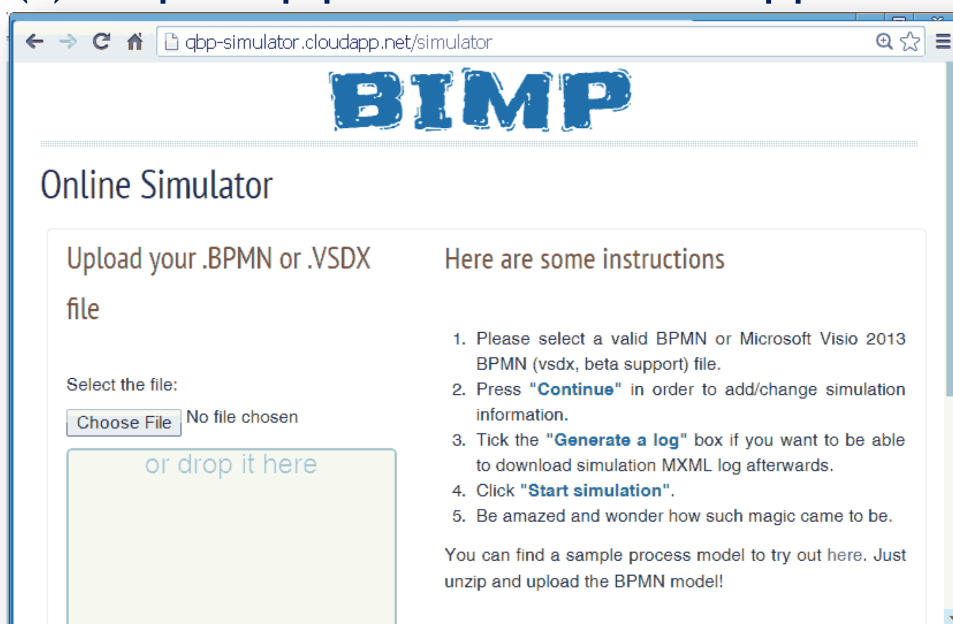
a) Generate the BPMN workflow with VP Logizian

b) File -> Export -> BPMN 2.0

c) On Bonita: Diagram -> Import -> BPMN 2.0 (select the XML file)

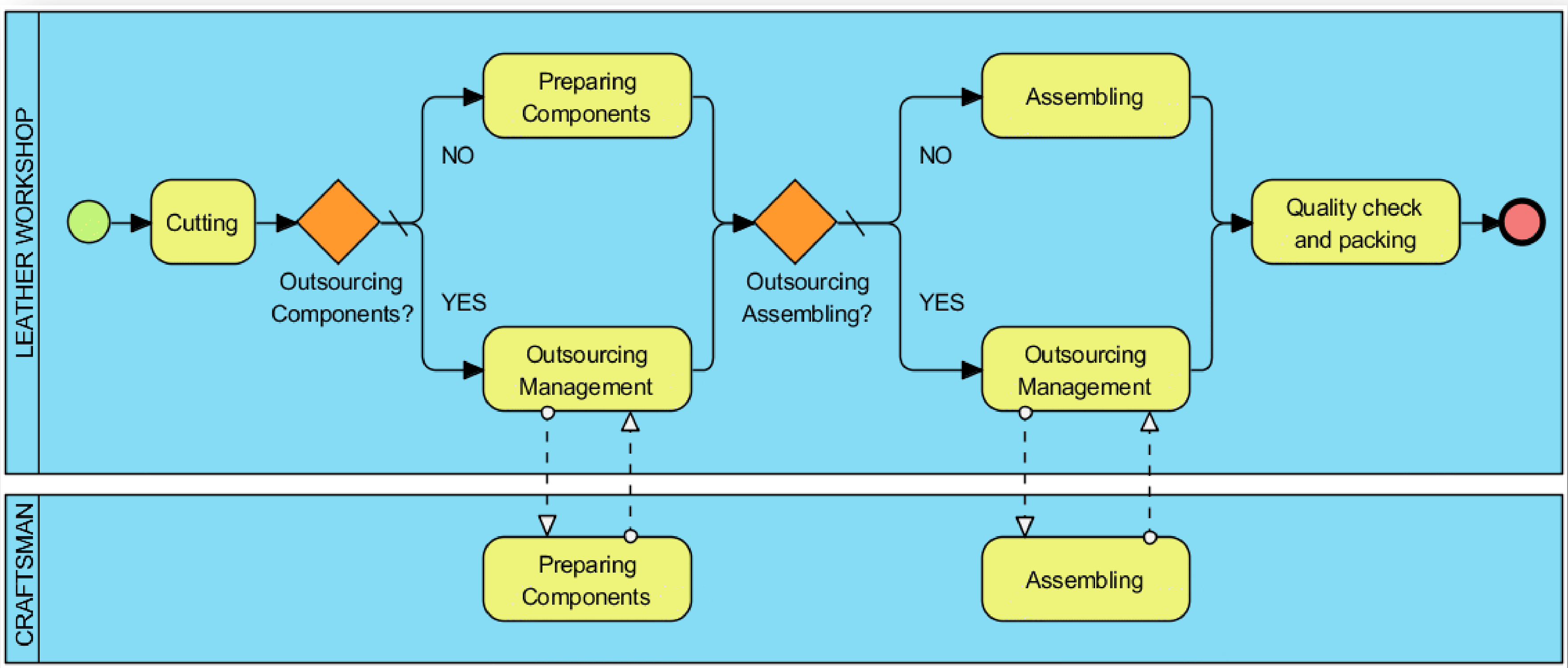
d) On BIMP: Choose File -> (Select the XML file)

(*) http://qbp-simulator.cloudapp.net



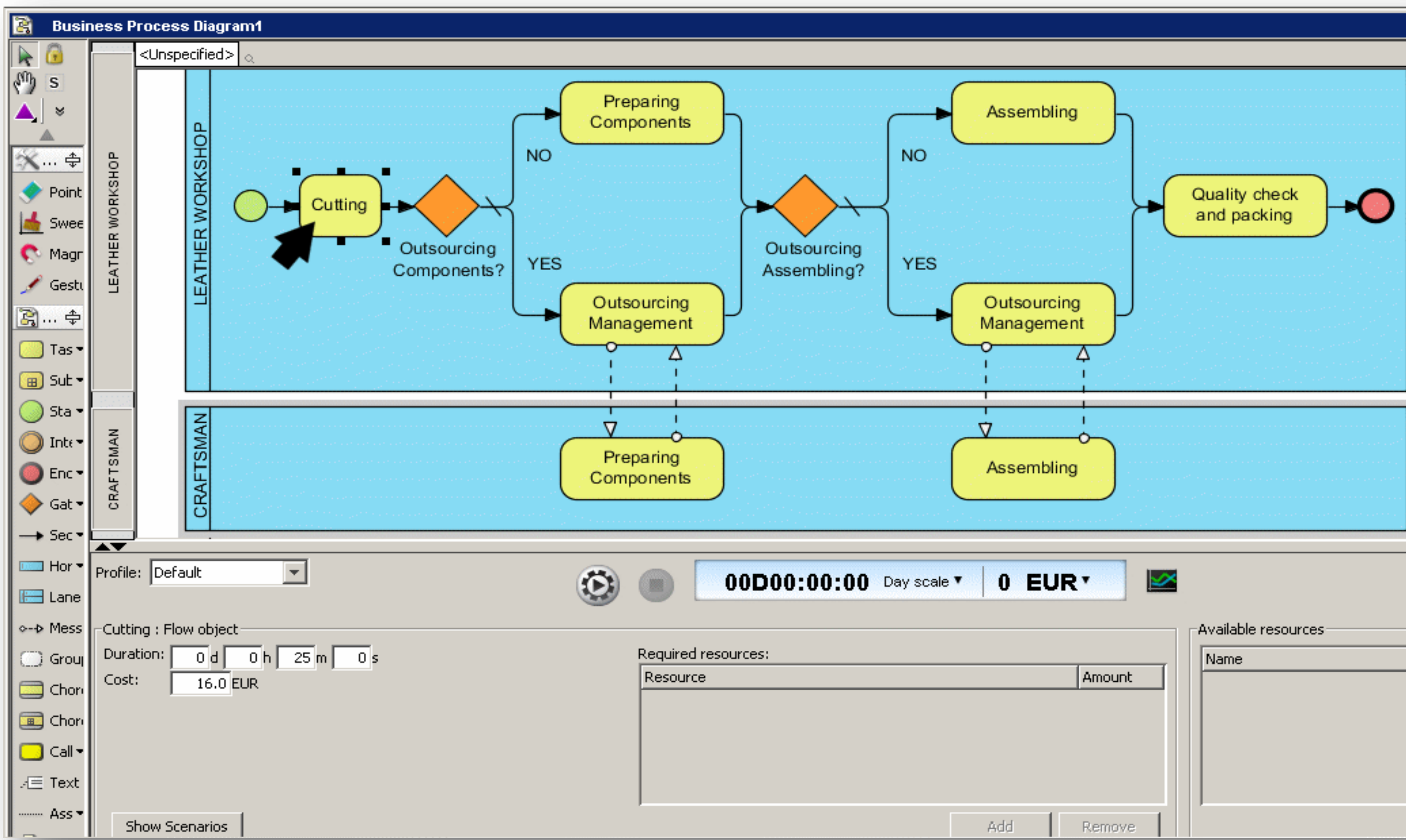
The process of bag manufacturing (on VP Logizian)

- The figure outlines the macro processes of bag manufacturing in a workshop. First, *cutting* and *preparing* components, where semi-finished products originate; then, *assembling* and *checking* against quality. If products are good, they are *packed* and shipped out. Otherwise corrective actions are triggered to handle error (not modeled).



● In the two exclusive gateways, the *make-or-buy* business decision is made, by comparing the costs and benefits of carrying out internal or external manufacturing of product components, via outsourcing to a third party specialist.

1. Select each task, and insert duration and cost per execution.

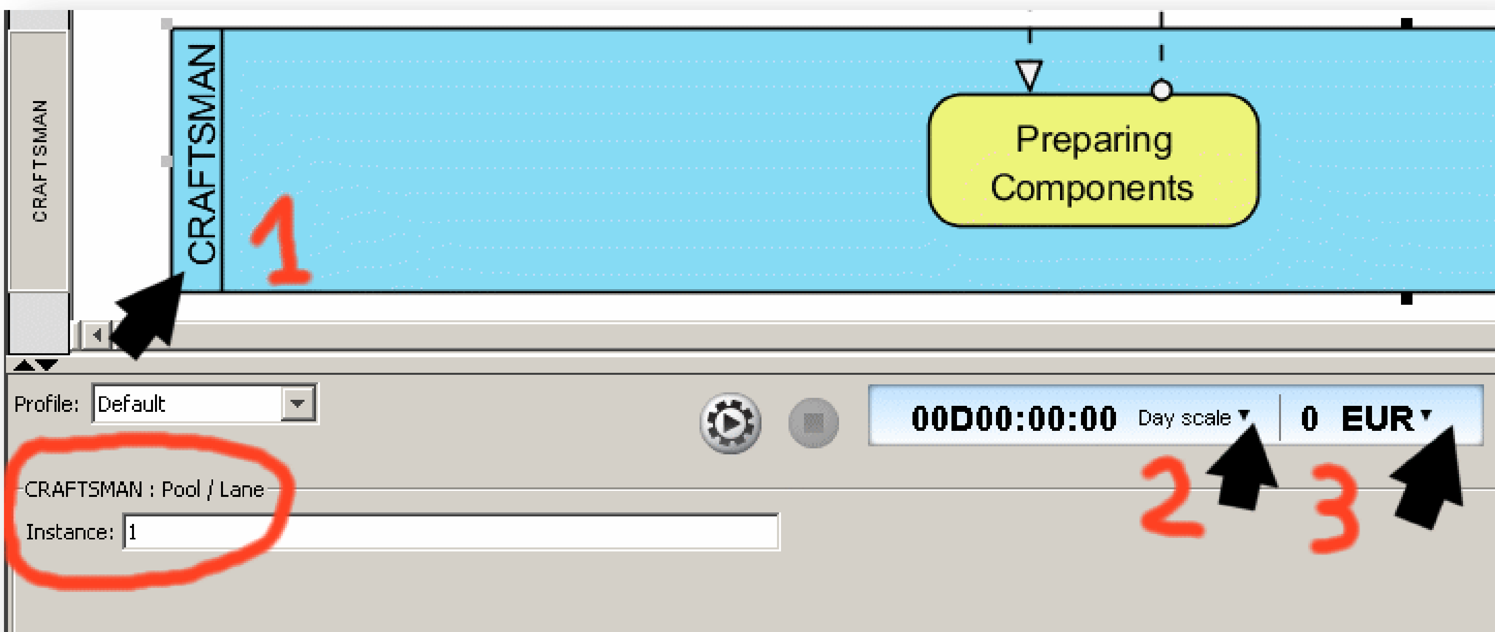


2. Data concerning all the activities of the model.

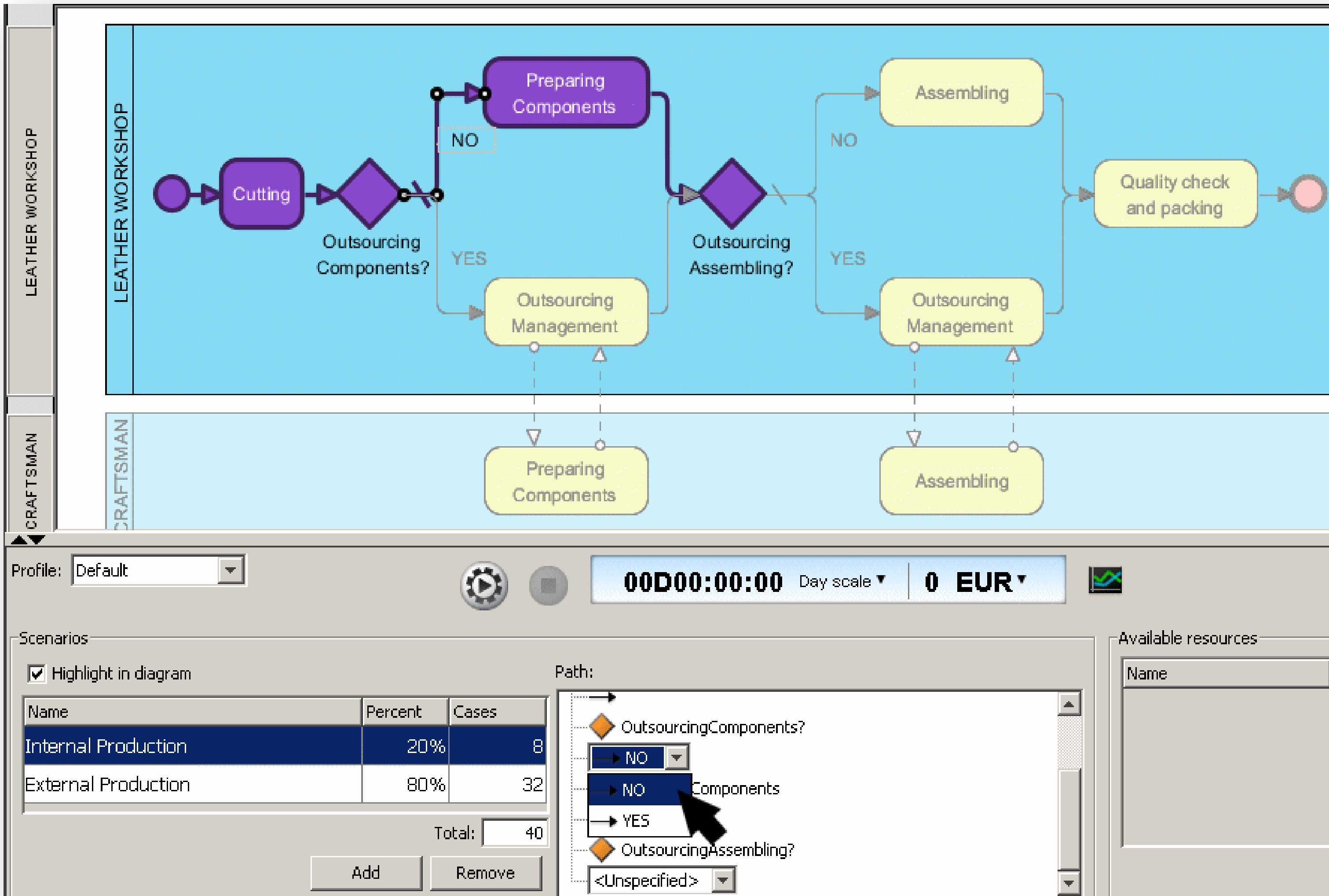
Activity	Average Duration	Average Cost (EUR)
Cutting	25	16
Preparing Components (internal)	28	31
Preparing Components (external)	24	48
Assembling (internal)	93	67
Assembling (external)	68	93
Quality check and packing	42	26
Outsourcing Management (*)	5	2

(*) Interfacing with the third party

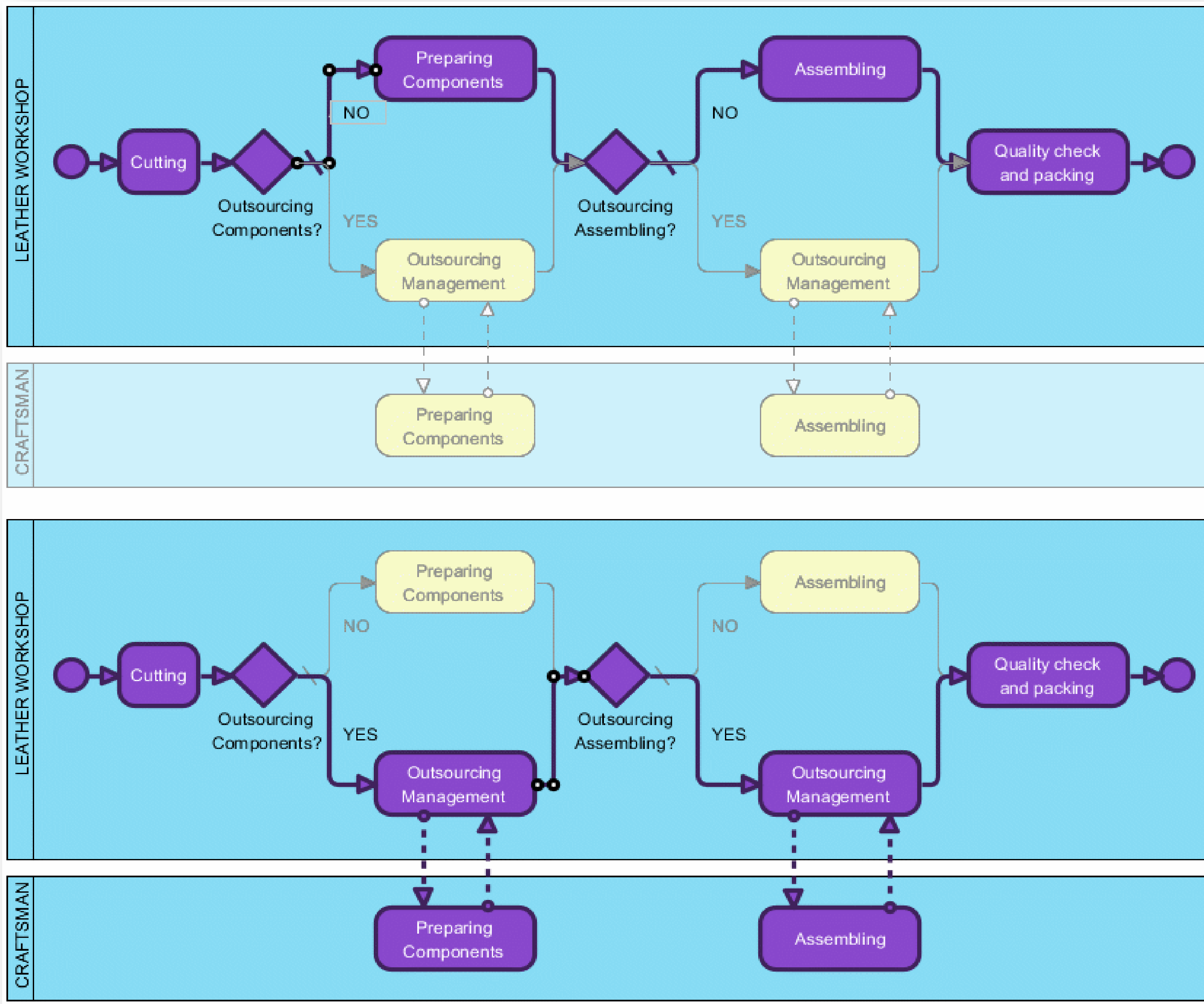
3. Define number of available instances (pools)[1], time scale [2] and currency[3].



4. Create a scenario: left-click on the diagram background and press *add*;
5. Insert the name (Internal production) and the number of cases;
6. Create the path of the scenario.



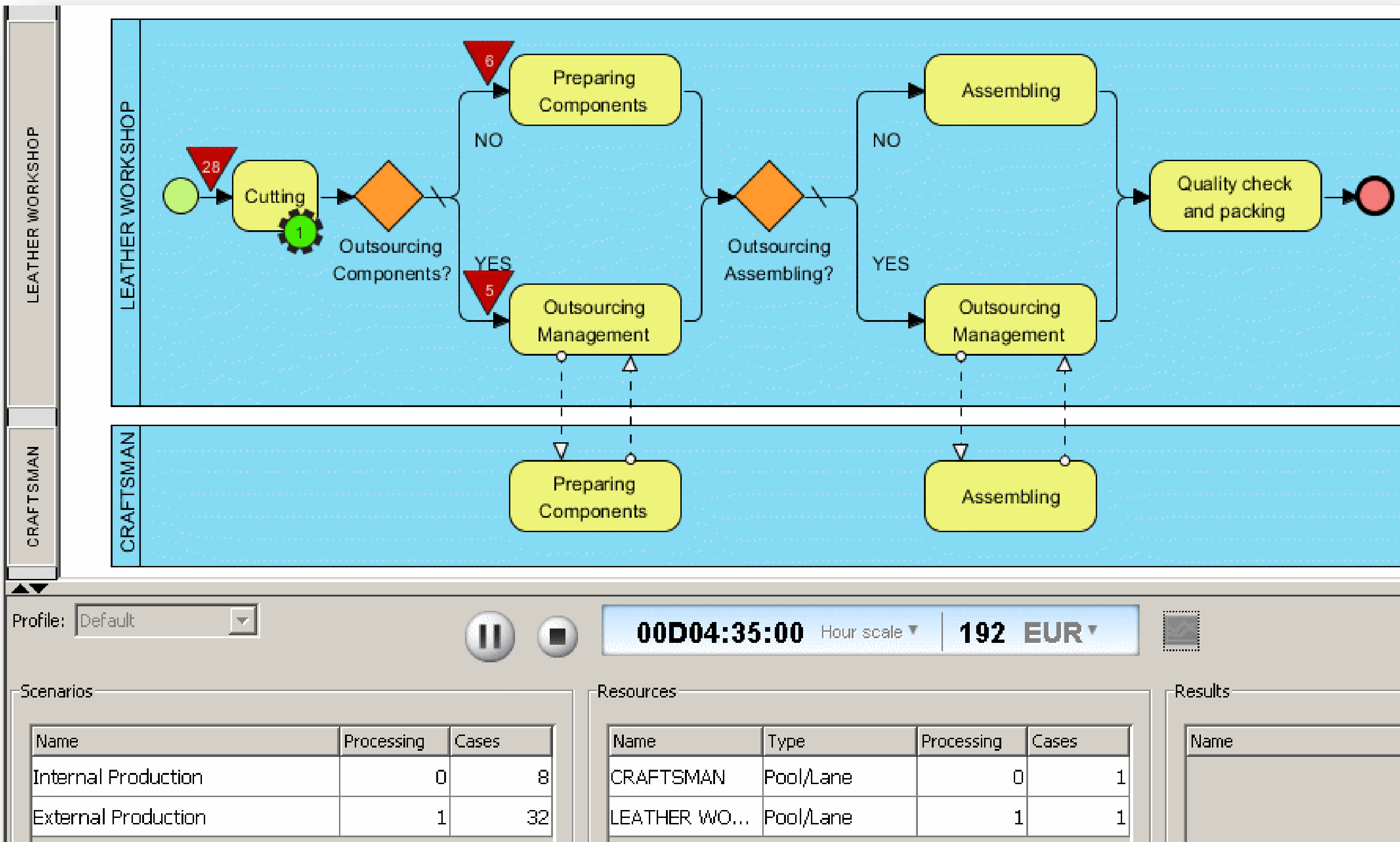
7. Two scenarios: internal production and (partially) external production.



8. Click the *Play/Stop/Pause* buttons to simulate;

9. Look at the red inverted triangles (tokens queues) and at the green gears (processing tokens);

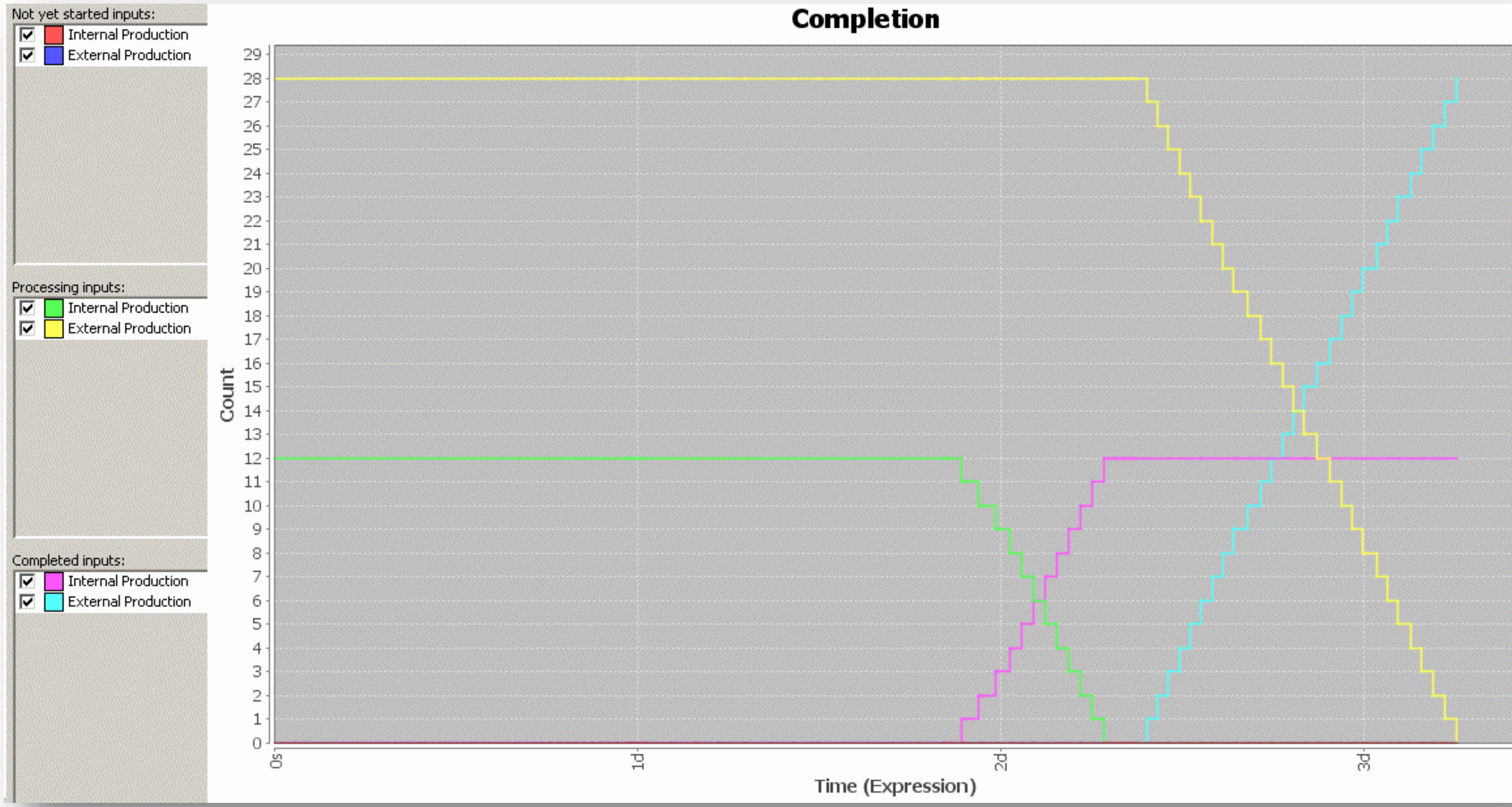
10. Look at the final duration and cost;



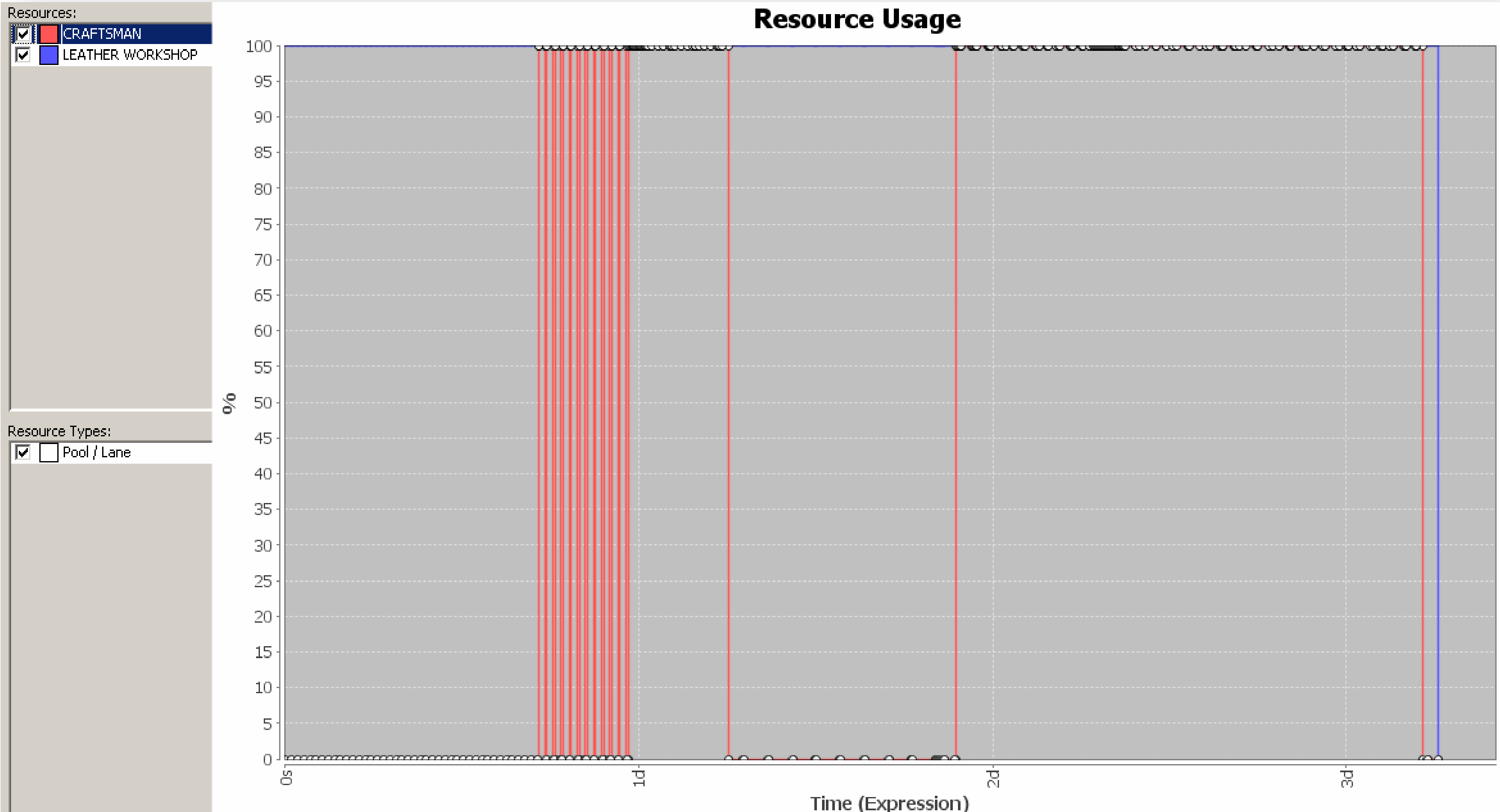
11. The two scenarios are executed considering the related number of tokens, e.g., 30% and 70%;

12. Click on the logo for plotting important duration and cost parameters;

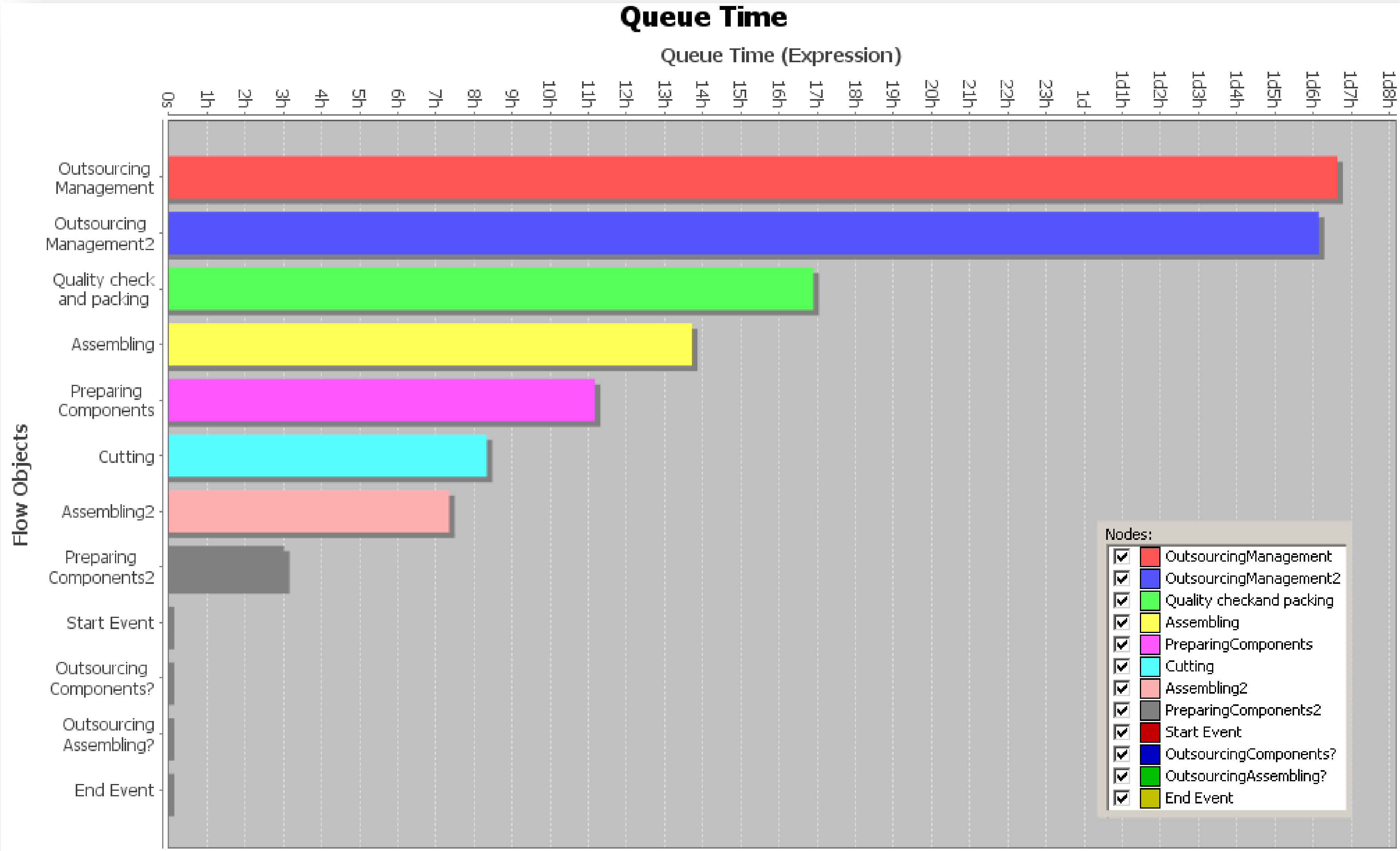
13. **Completion** against time: to be processed, processing, and processed tokens:



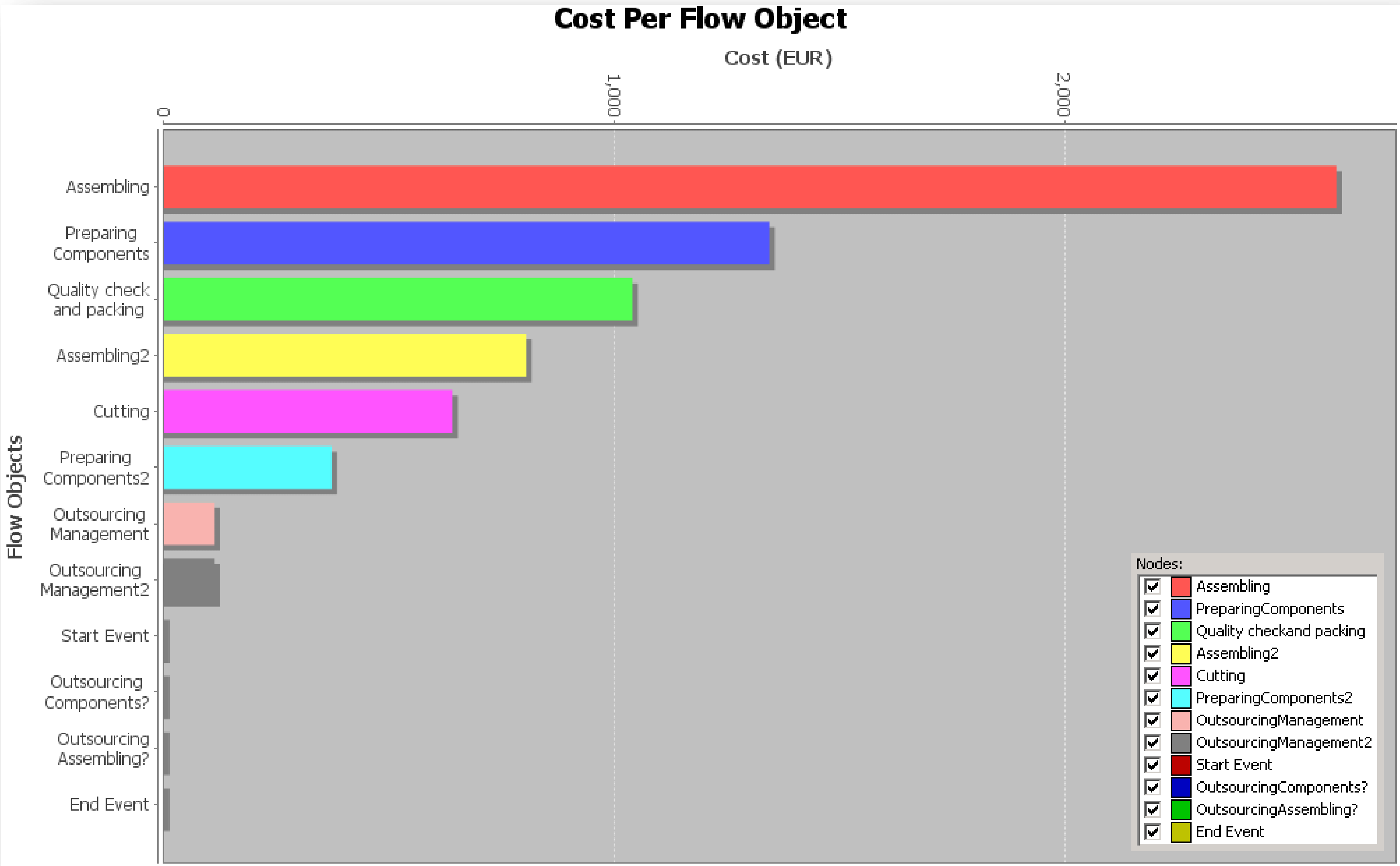
14. **Resource usage** against time:



15. Queue time:



16. Cost per flow object (cost per use):



17. Other costs:

	Input Name	Number Of Instance	Cost Per Instance (EUR)	Total (EUR)
1	External Production	28	191	5,348
2	Internal Production	12	140	1,680

18. Time cost:

Exercise

- Suppose to aim at producing 40 bags, by combining internal and external production scenarios, with a single bag workshop and a single third party specialist.
- Simulate:

  a) a scenario of totally internal production; analyze results/plots;

  b) a scenario of partially external production; analyze results/plots;

  c) find a combination of the two scenarios so as to carry out the process in both less time and cost, with respect to (a) and (b).

Solution

Let x_1 be the percentage of bags that are produced internally, and y(x) the total duration of the production process of 40 bags.

a) x_1=100% → 5g 5h 20' 5600€, with maximum queues on the last phases, due to the sequential character of the workflow;

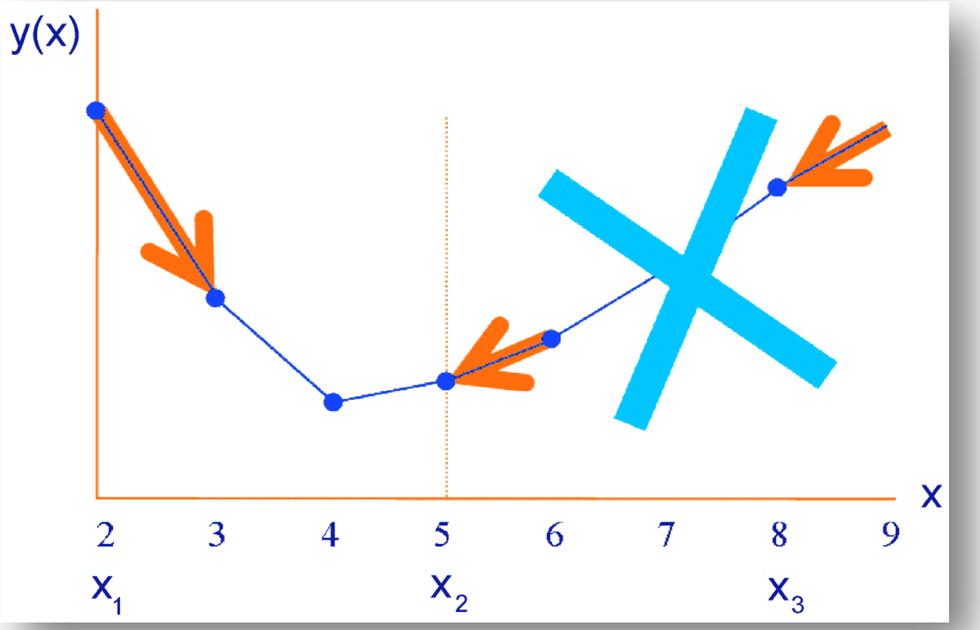
b) x_1=0% → 3g 6h 52' 7640€, with maximum queues on the assembling stage, which is a process with larger duration, with respect to the other processes;

c) by carrying out internally some units, the assembling is parallelized, thus reducing queuing effects, and then saving total time and cost; e.g.. x_1=20% → 3g 2h 38' 7232€;

d) In the context of luxury handbags production, for a given quality level that is guaranteed by the control quality process, the **total duration** of the process is the main Key Performance Indicator (KPI), rather than the total production cost;

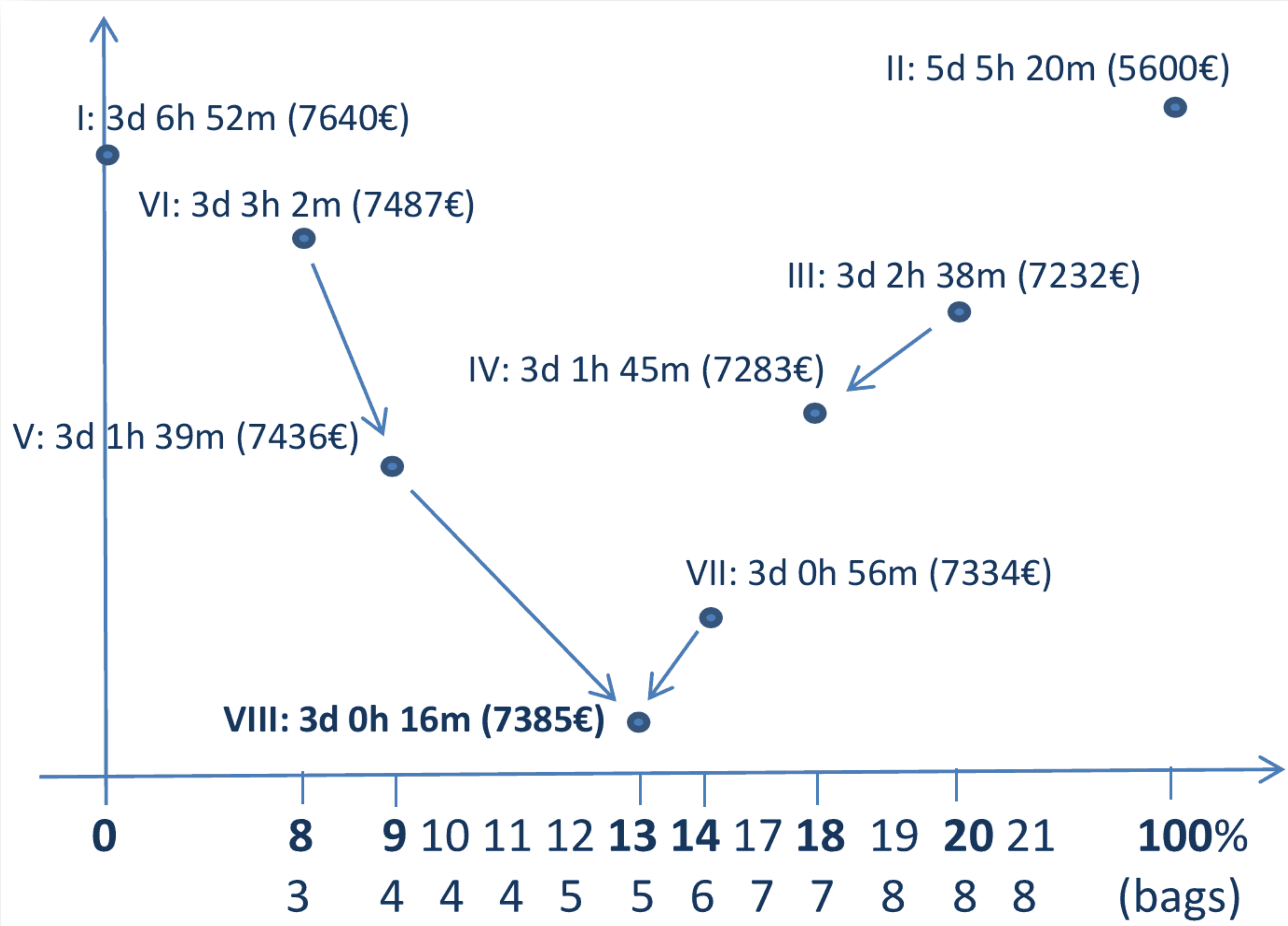
e) Is 20% the best solution in terms of total duration? Assuming that there is a unique minimum, it can be efficiently found by using a **binary search**;

f) Given x_1 and x_3, calculate the total duration of the process for x_1, x_3, and for the center $x_2=(x_1+x_3)/2$, as well as for a value very close (dx) to each of these points. On the basis of the **descent direction** we can establish the position of the optimum with respect to the center.



g) e.g. if the total duration goes down on the right side of x_1, and on the left sides of x_2 and x_3, then the minimum is between x_1 and x_2.

h) By carrying out **8** simulations, it can be determined that the optimum is located at x=12-13%, i.e., 5 bags produced internally and 35 externally, with a total duration of 3d 16m, and a total cost of 7385€.


II: 5d 5h 20m (5600€)
I: 3d 6h 52m (7640€)
VI: 3d 3h 2m (7487€)
III: 3d 2h 38m (7232€)
IV: 3d 1h 45m (7283€)
V: 3d 1h 39m (7436€)
VII: 3d 0h 56m (7334€)
VIII: 3d 0h 16m (7385€)
0
8 3
9 4
10 4
11 4
12 5
13 5
14 6
17 7
18 7
19 8
20 8
21 8
100% (bags)

Exercise: simulate the same case on Bonita and BIMP.

- To simulate only two scenarios in a statistical engine, the workflow has been simplified

- Costs in Bonita are represented as a cost per use of resource. Convert the fixed cost of Logizian to (average) cost per use.