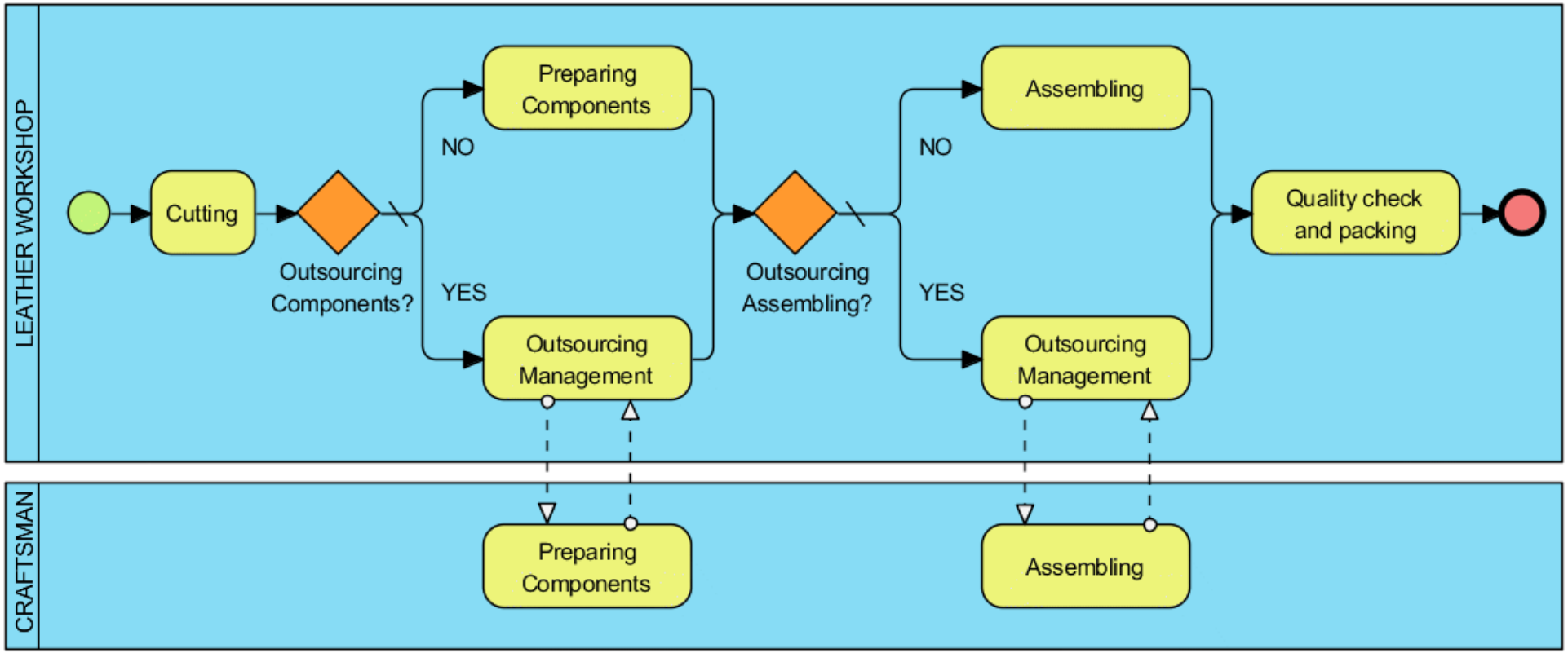
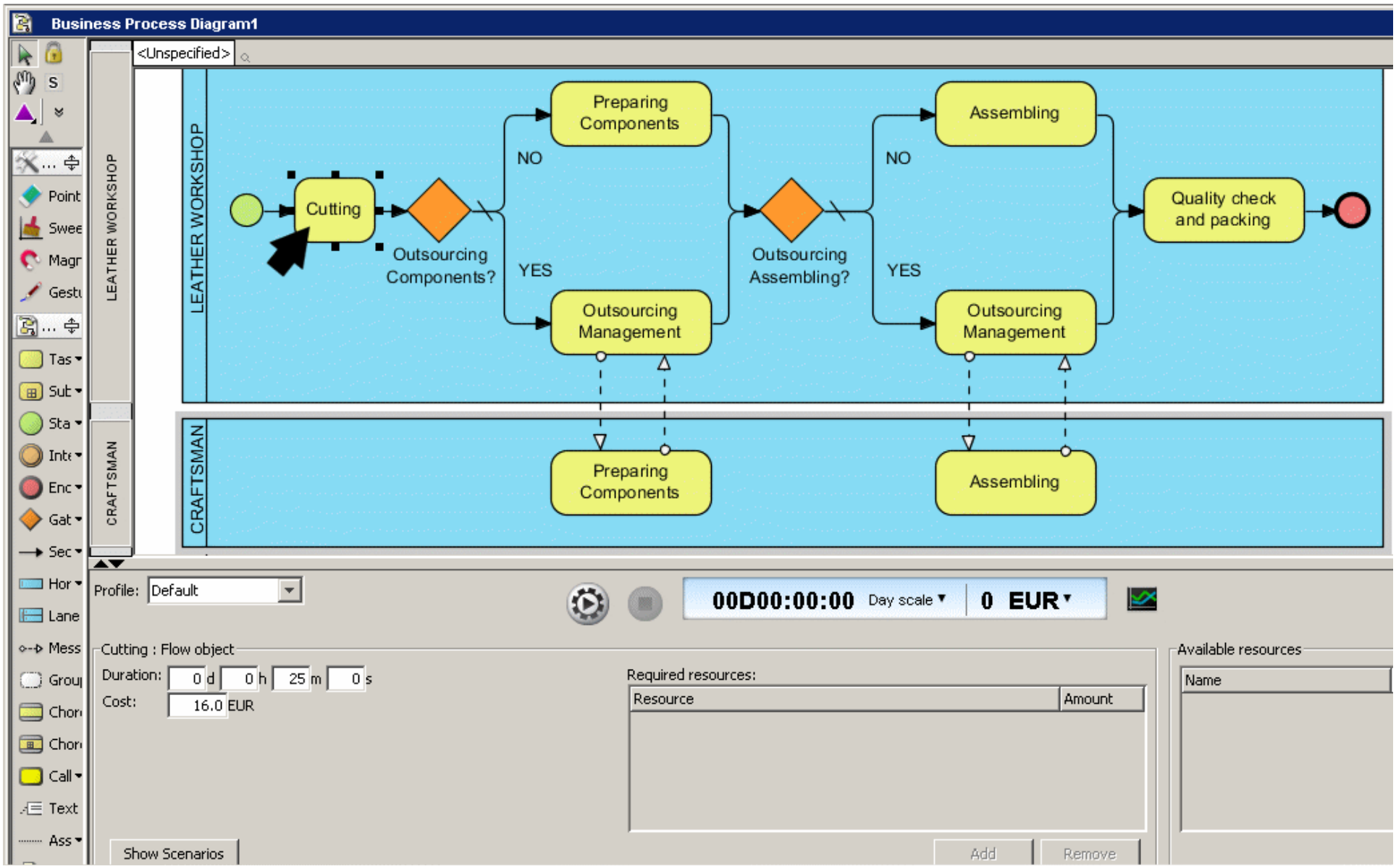
The process of bag manufacturing

- 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.

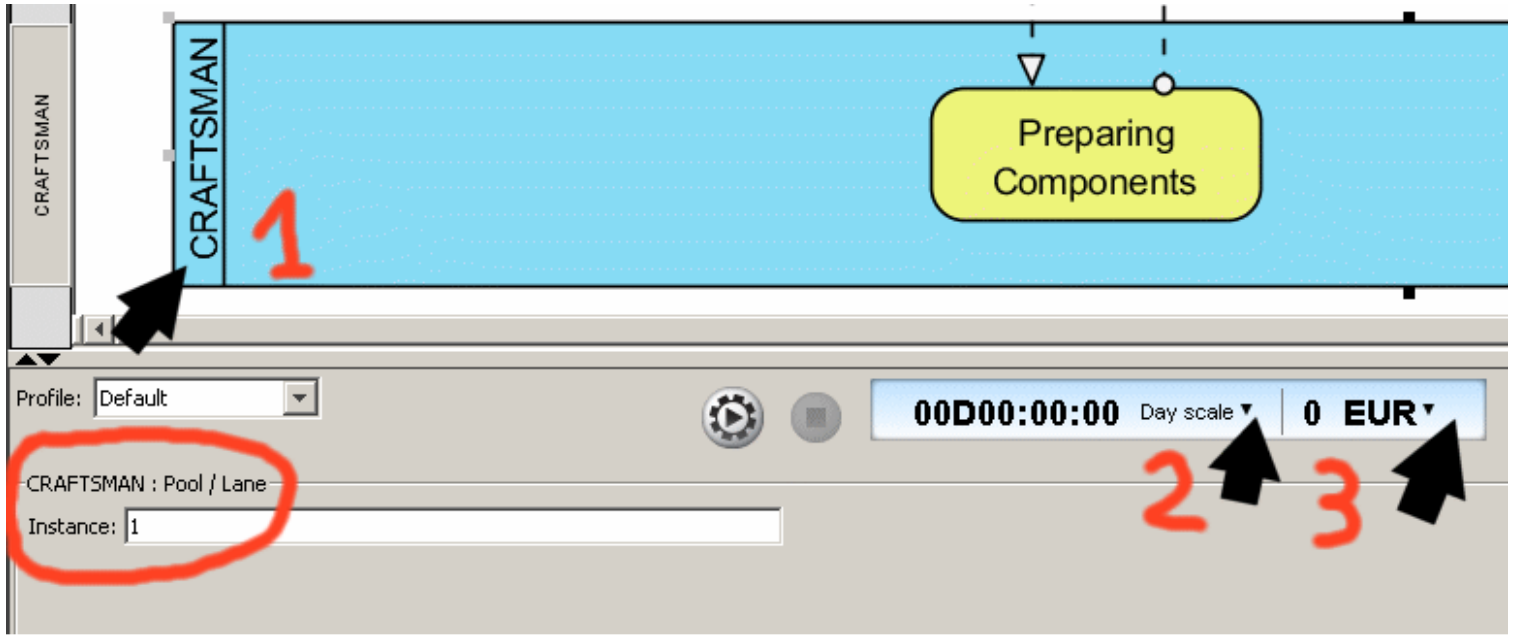


2. Data concerning all the activities of the model.

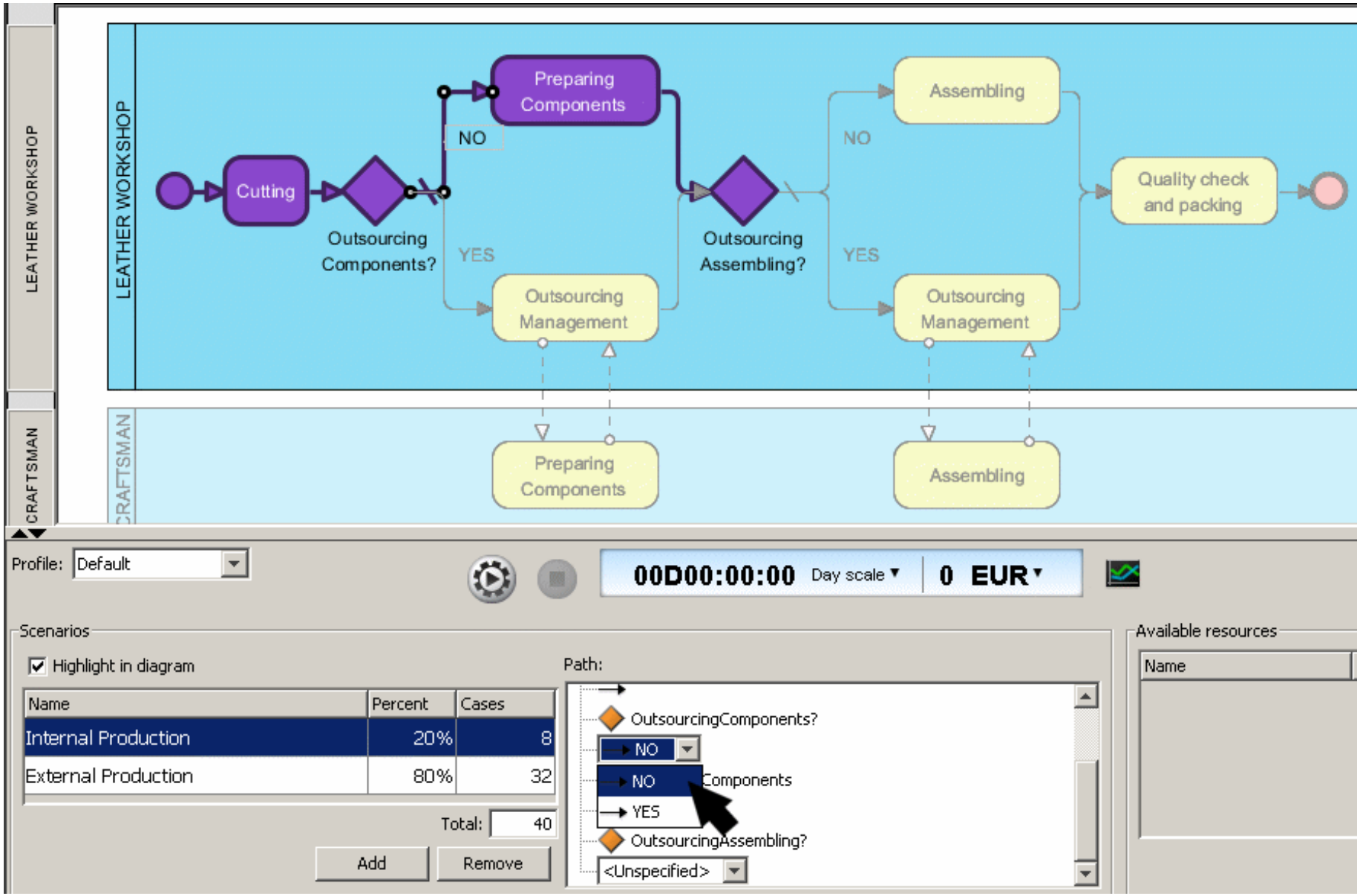
Activity	**Average Duration**	**Average Cost** (EUR)
Cutting	25	16
Preparing Components (internal)	28	31
Preparing Components (external)	24	48
Assembling (internal)	93	67
Assembling (external)	68	93
Quality check and packing	42	26
Outsourcing Management *	5	2

* Interfacing with the third party

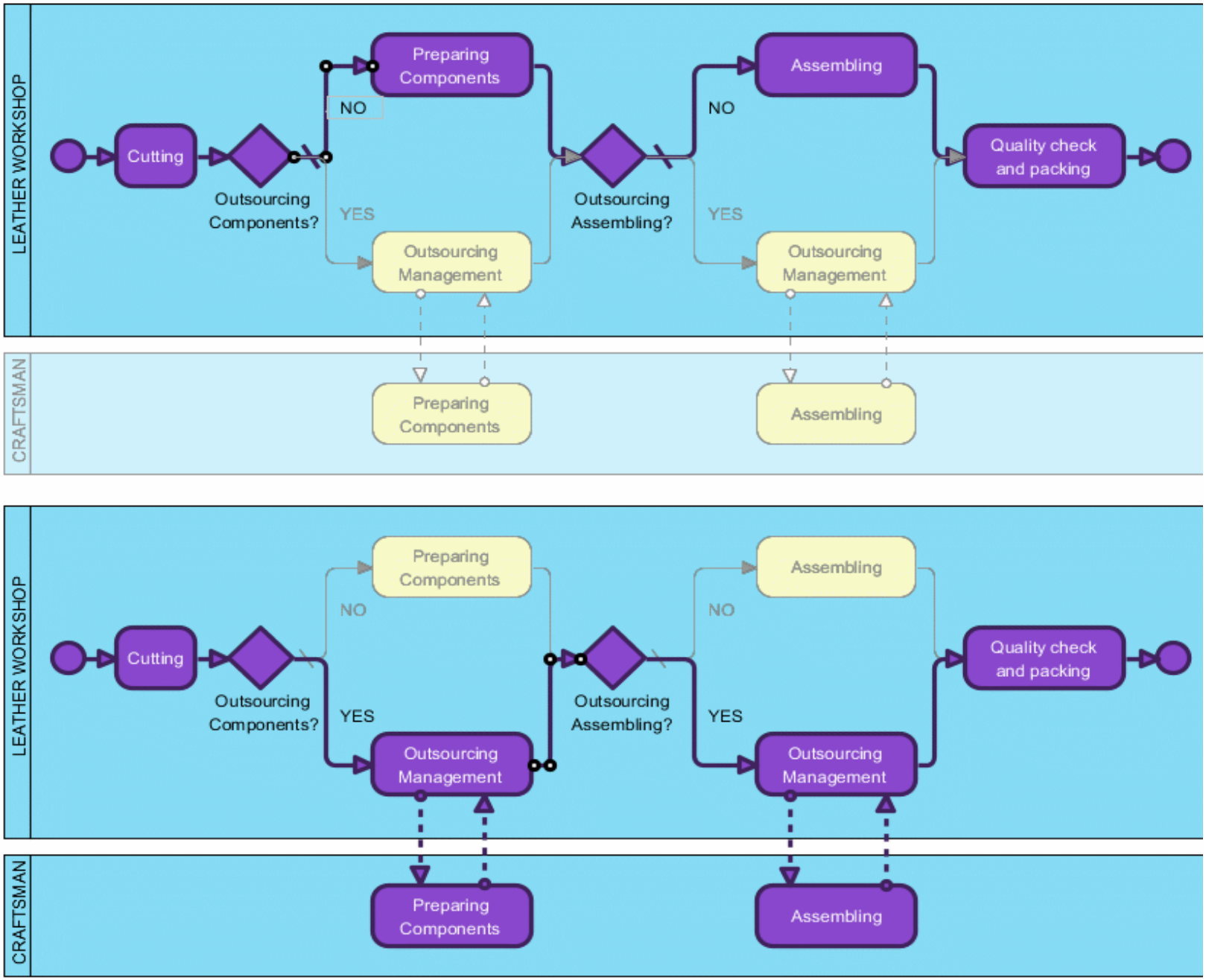
3. Define number of available instances (pools)[1], time scale [2] and currency[3].



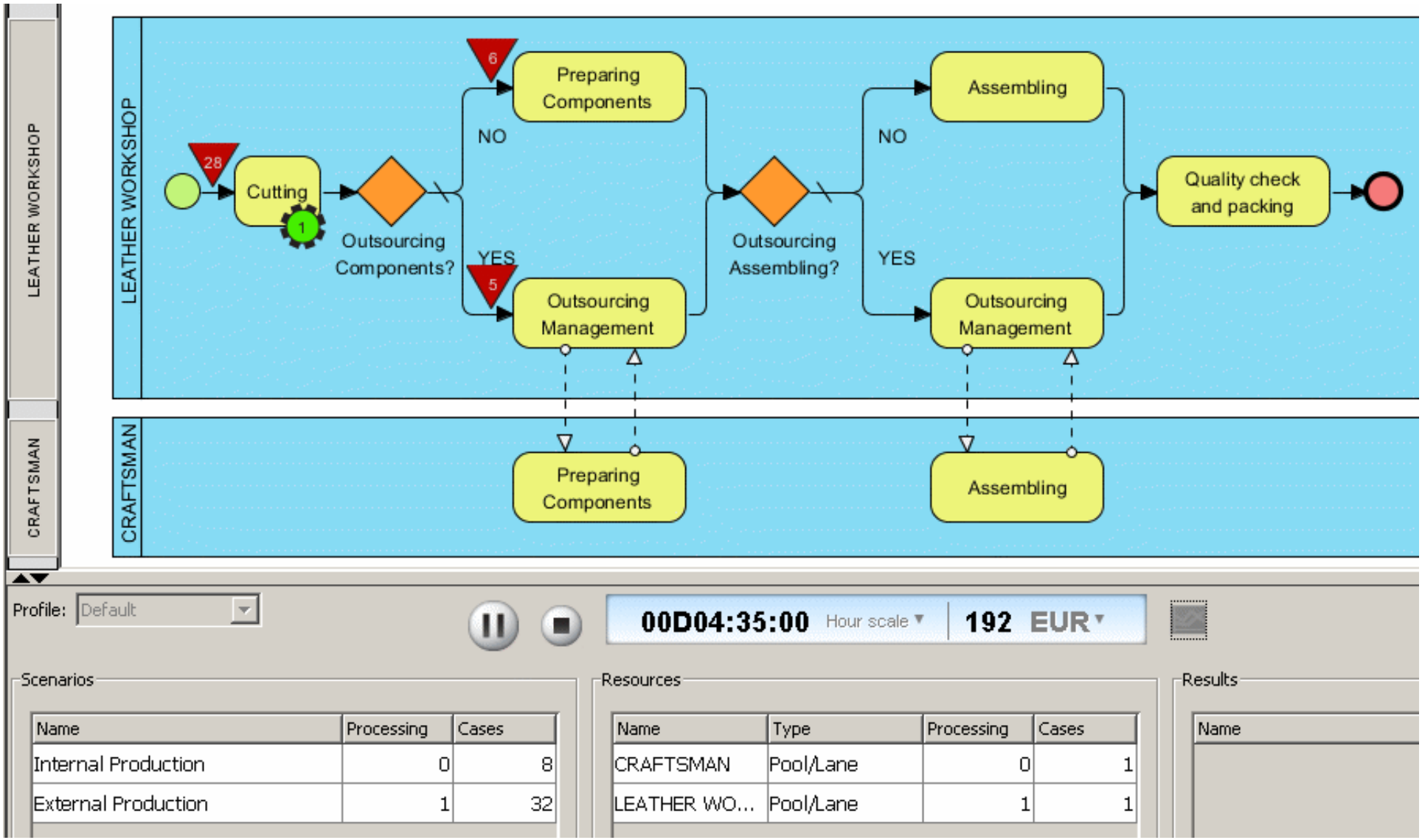
4. Create a scenario: left-click on the diagram background and press *add*;
5. Insert the name (Internal production) and the number of cases;
6. Create the path of the scenario.



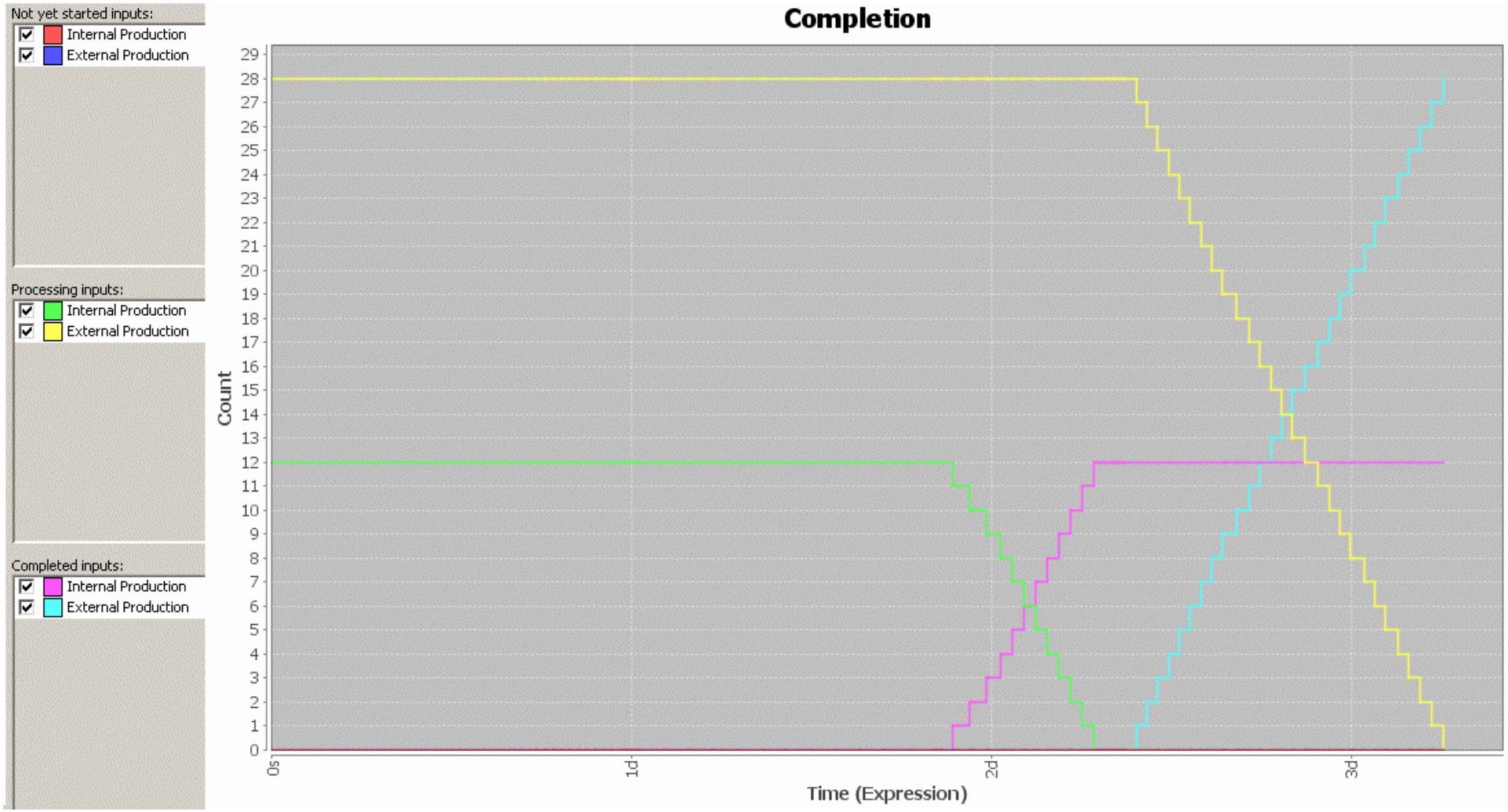
7. Two scenarios: internal production and (partially) external production.



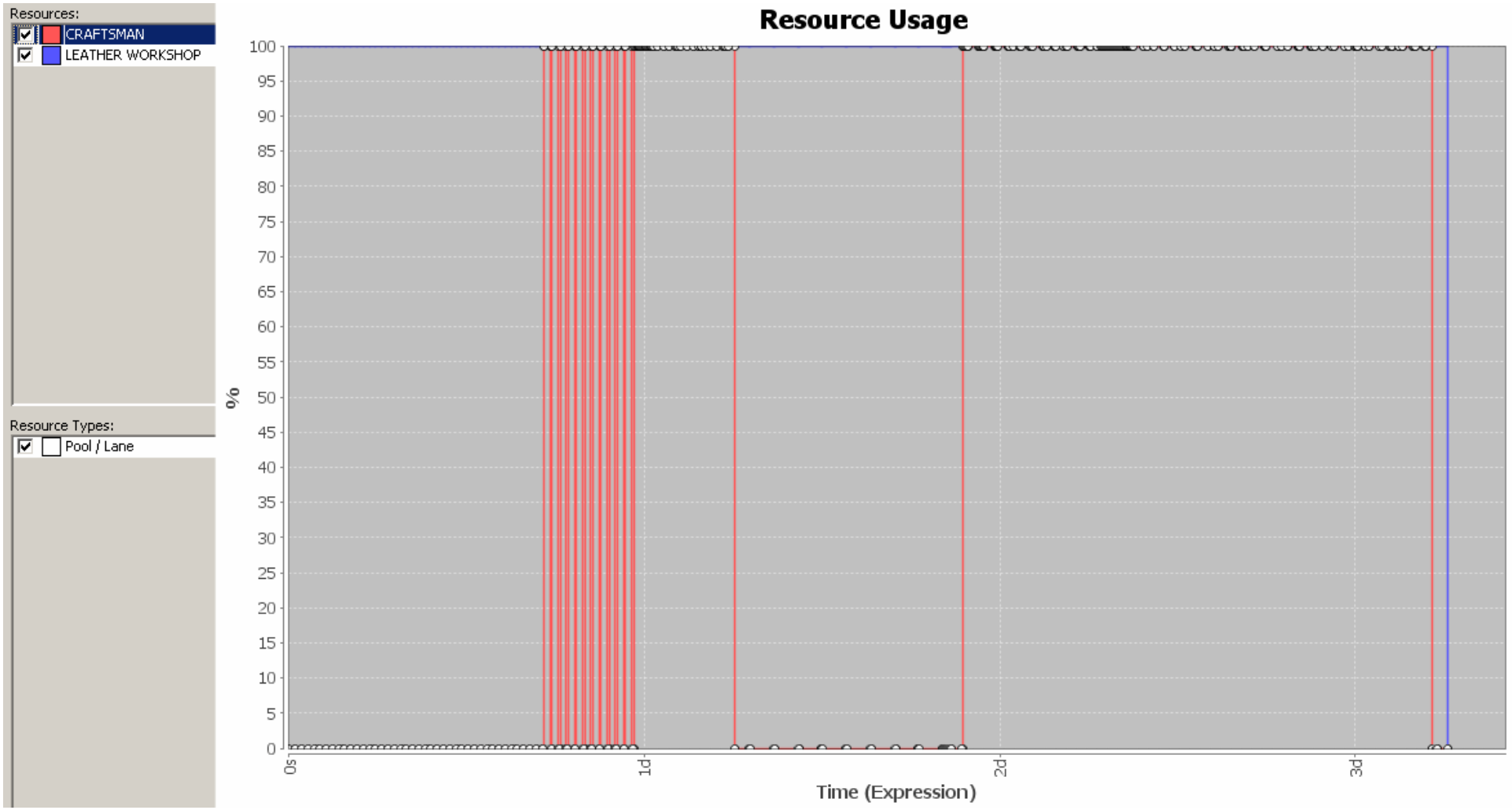
8. Click the *Play/Stop/Pause* buttons to simulate;
9. Look at the red inverted triangles (tokens queues) and at the the green gears (processing tokens);
10. Look at the final duration and cost;



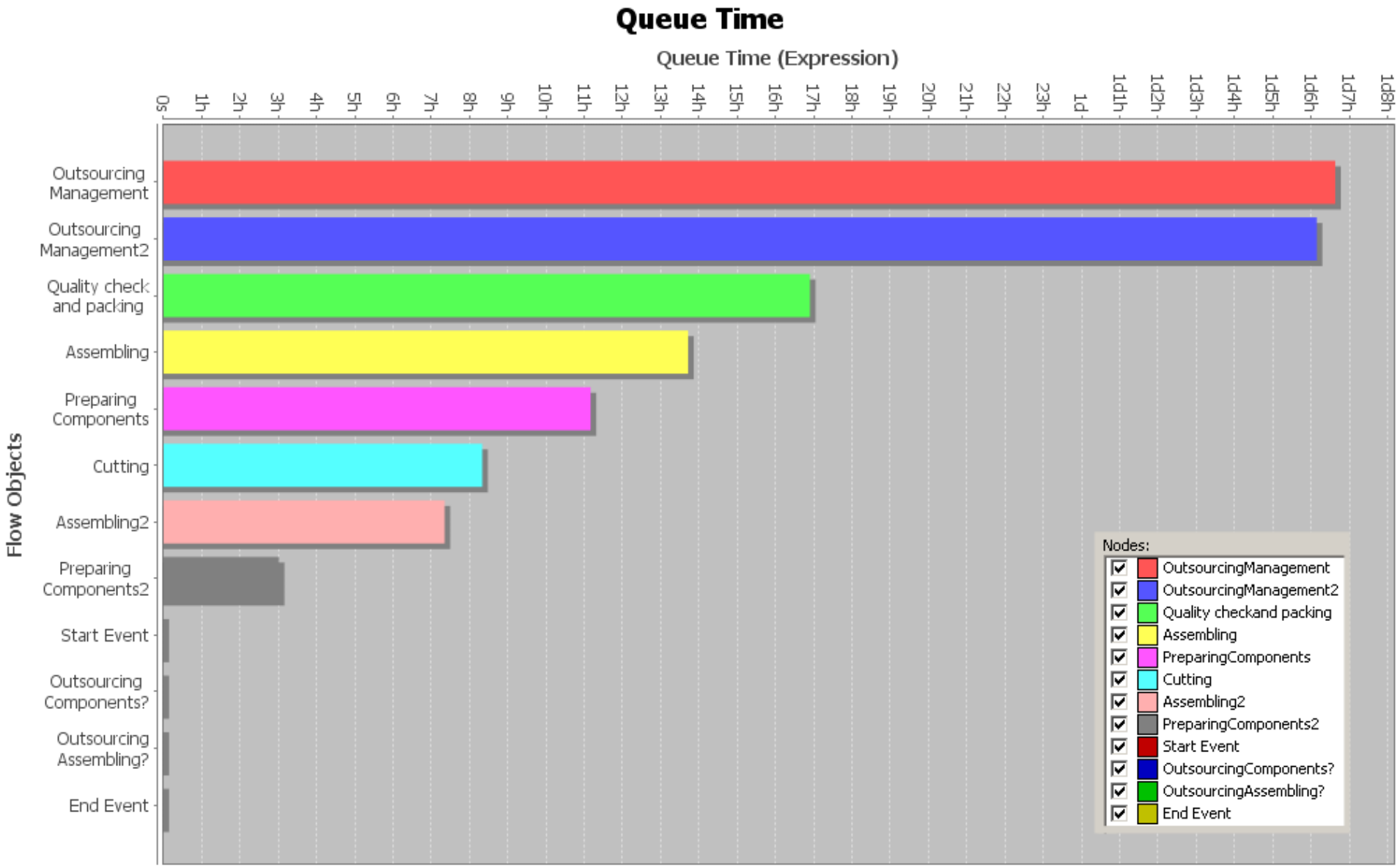
11. The two scenarios are executed considering the related number of tokens, e.g., 30% and 70%;
12. Click on the logo  for plotting important duration and cost parameters;
13. **Completion** against time: to be processed, processing, and processed tokens:



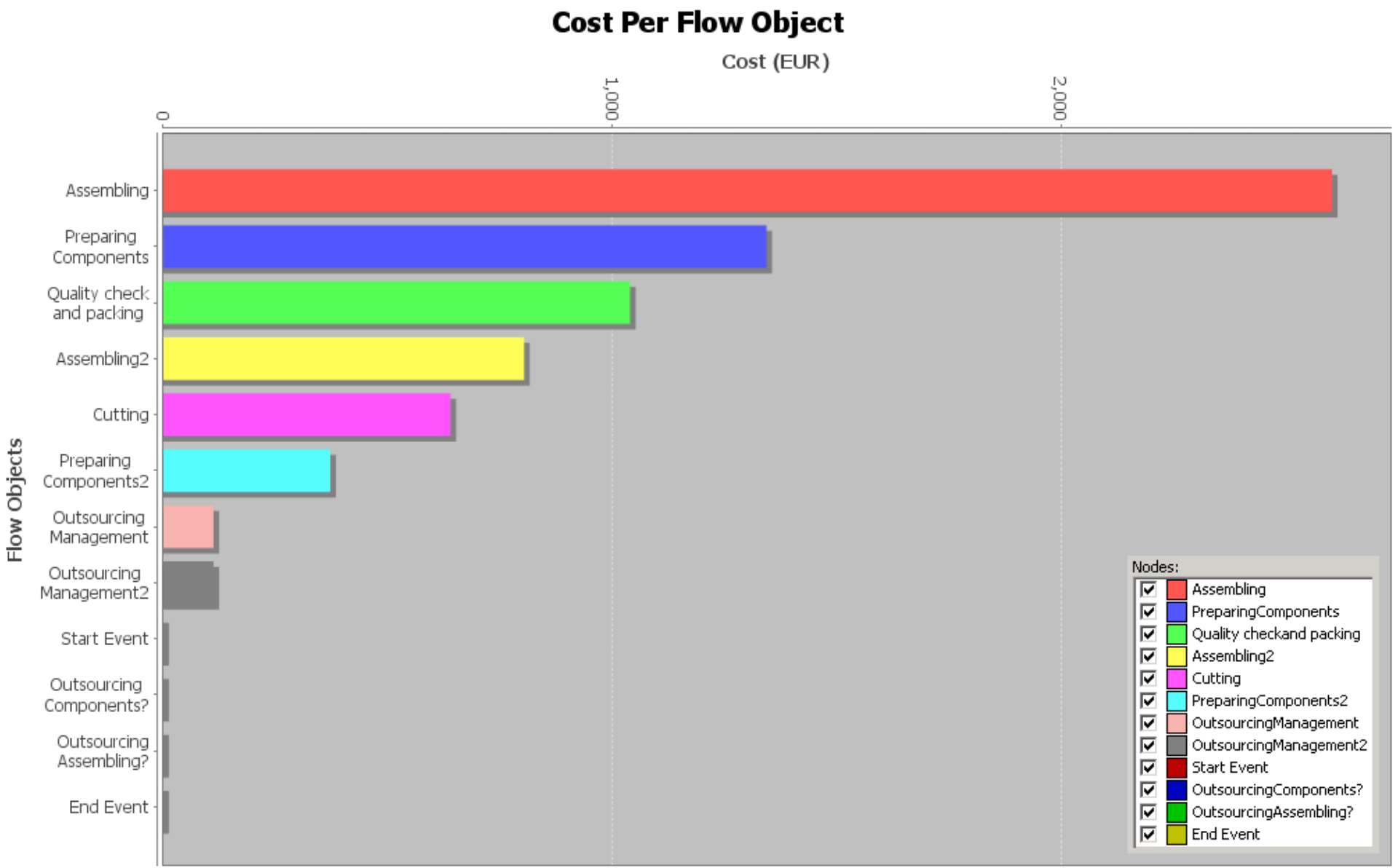
14. **Resource usage** against time:



15. Queue time



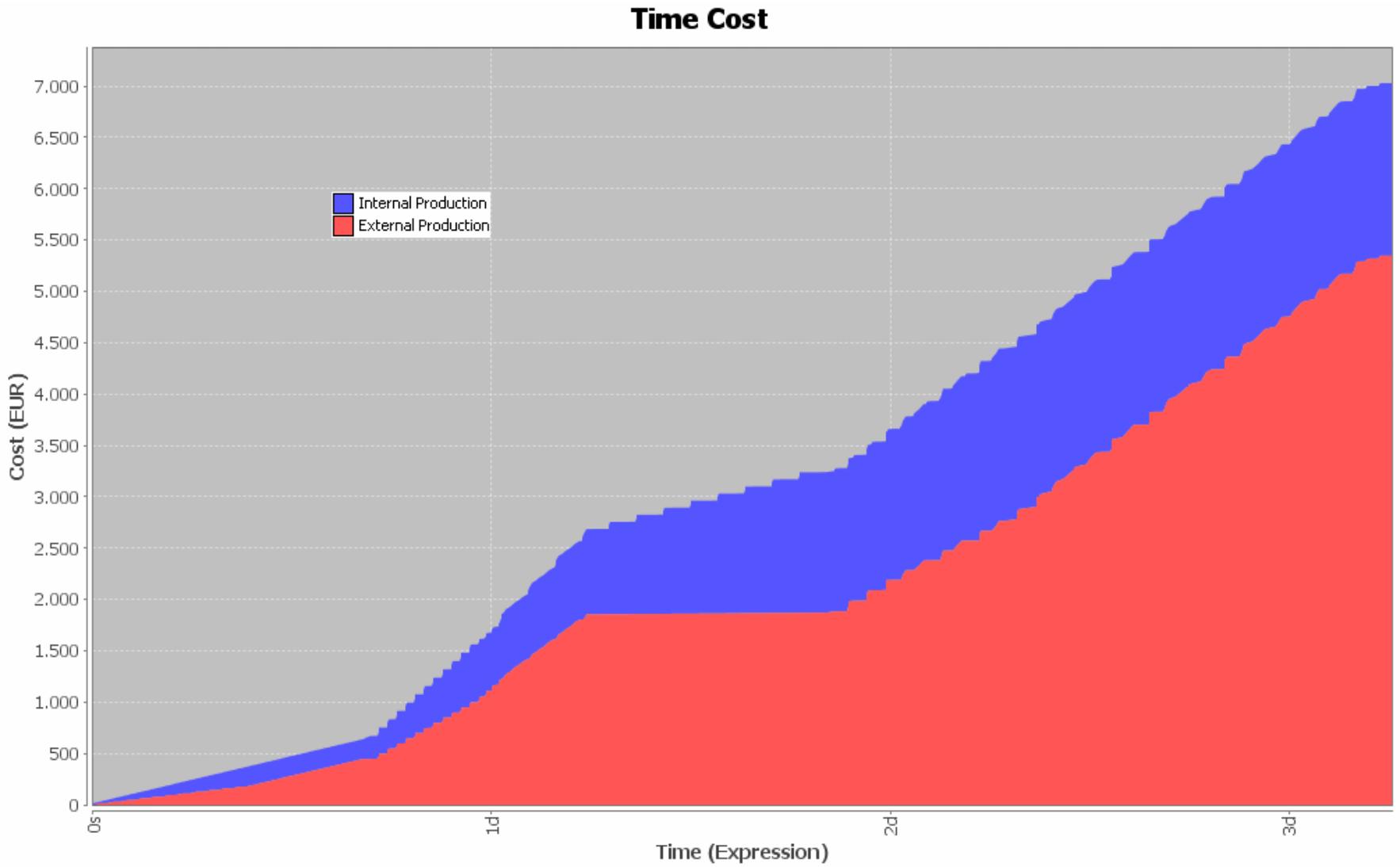
16. Cost per flow object (cost per use)



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



19. **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;

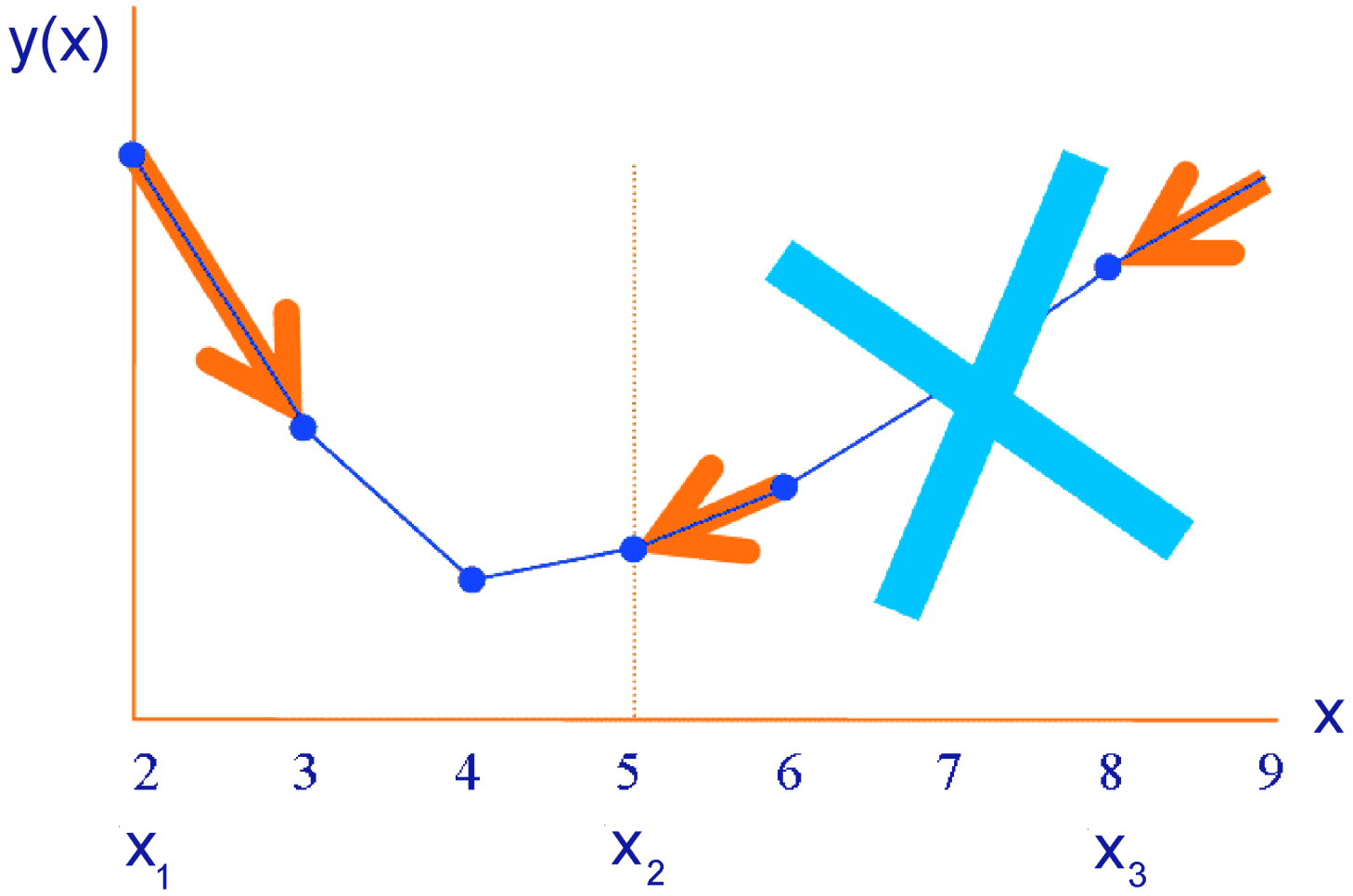
b) x_1=0% → 3g 6h 52' 7640€, with maximum queues on the assembling stage, which is a process with larger duration, with respect to the other processes;

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;

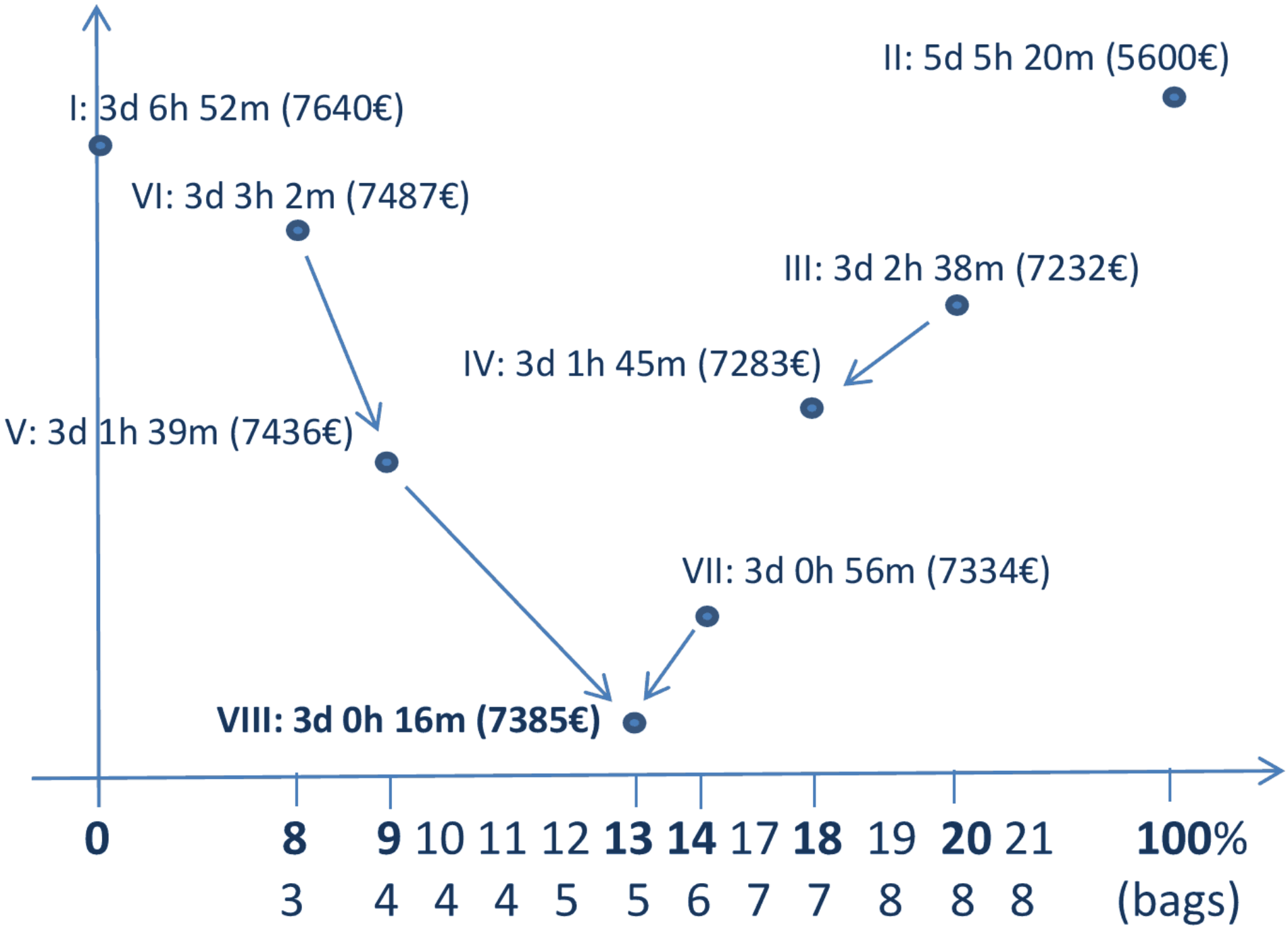
e) Is 20% the best solution in terms of total duration? Assuming that there is a unique minimum, it can be efficiently found by using a **binary search**;

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€.


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