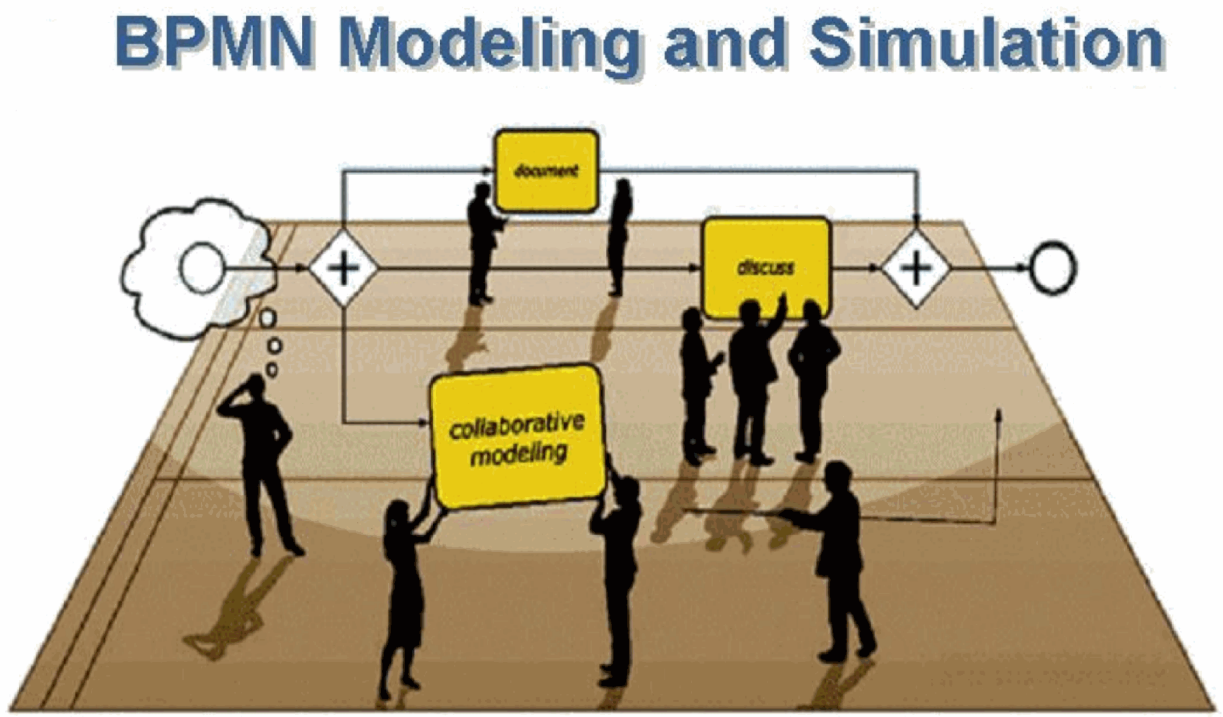
University of Pisa

MSc in Computer Engineering

Supply Chain Operation Management

"Large and complex organizations are a tangible manifestation of advanced technology, more than machinery itself." (J.K. Galbraith)



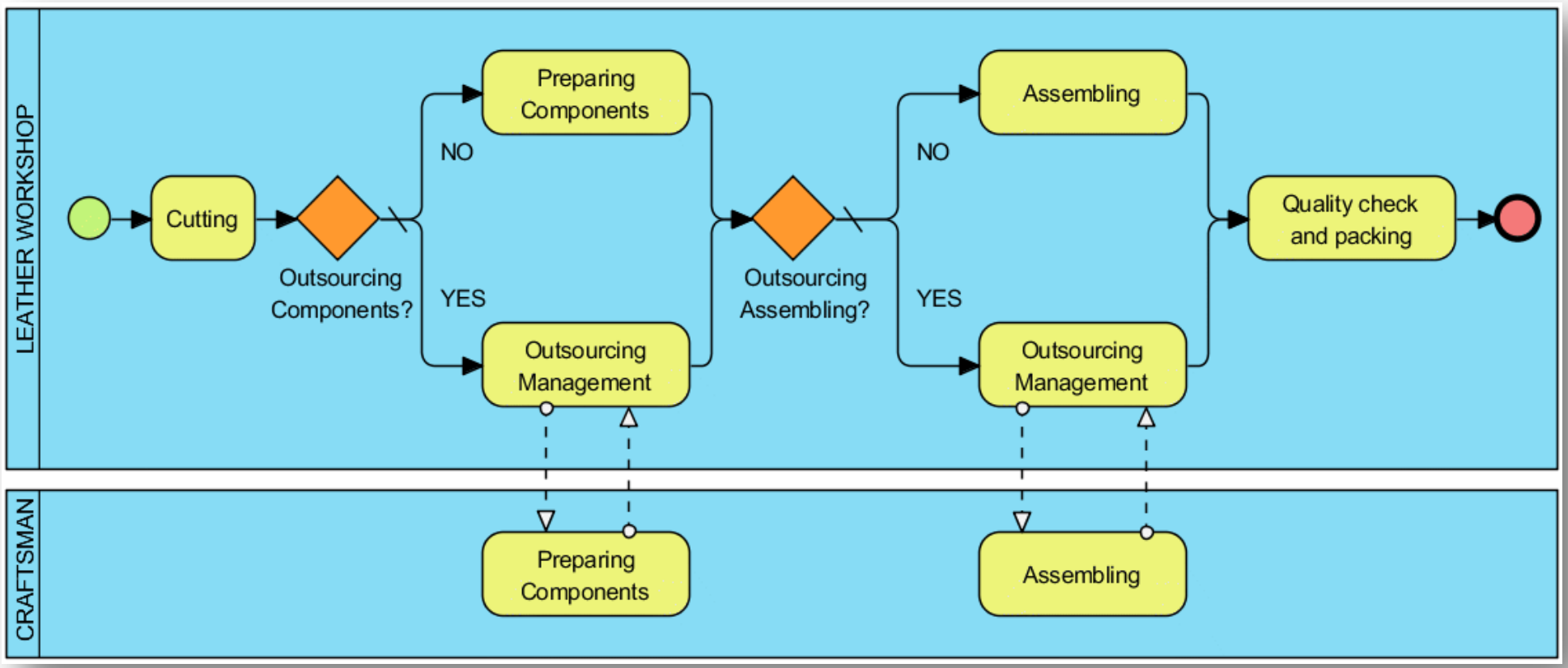
Lectures

Mario G. Cimino, Department of Information Engineering, Center for Logistics Systems

Pisa, March-May 2016, Monday 14.30-17.30, Room: ADInform2

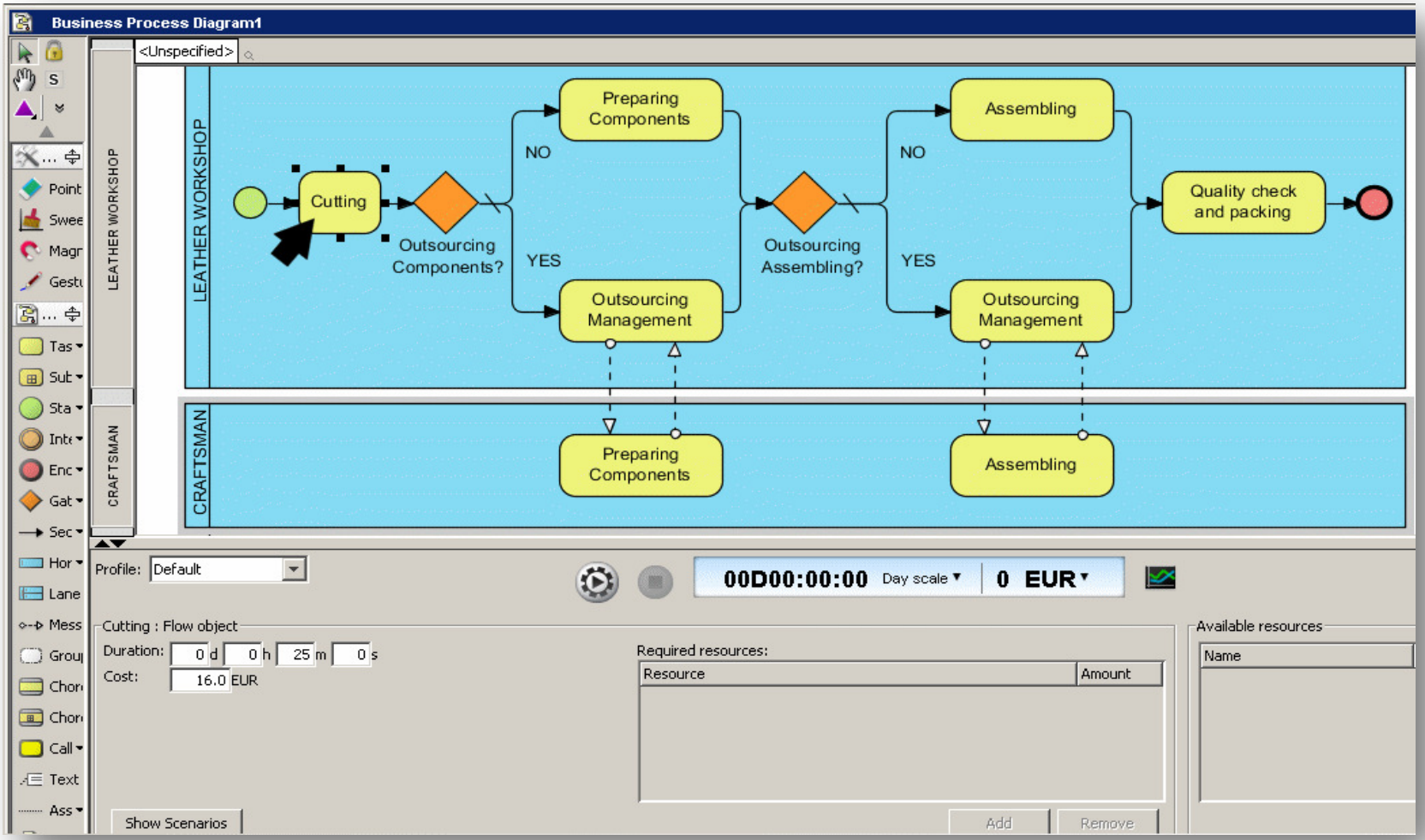
The process of bag manufacturing (on VP Logizian)

- 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.

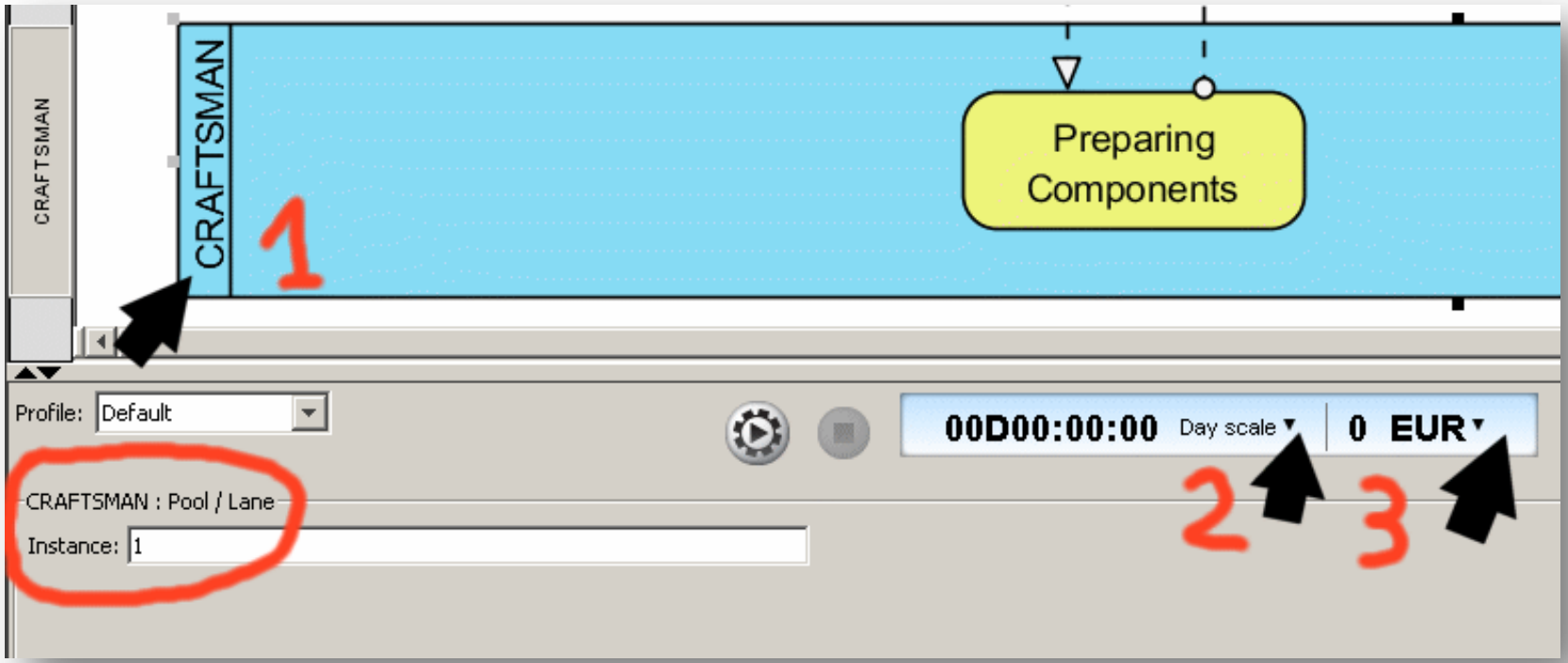


2. Data concerning all the activities of the model.

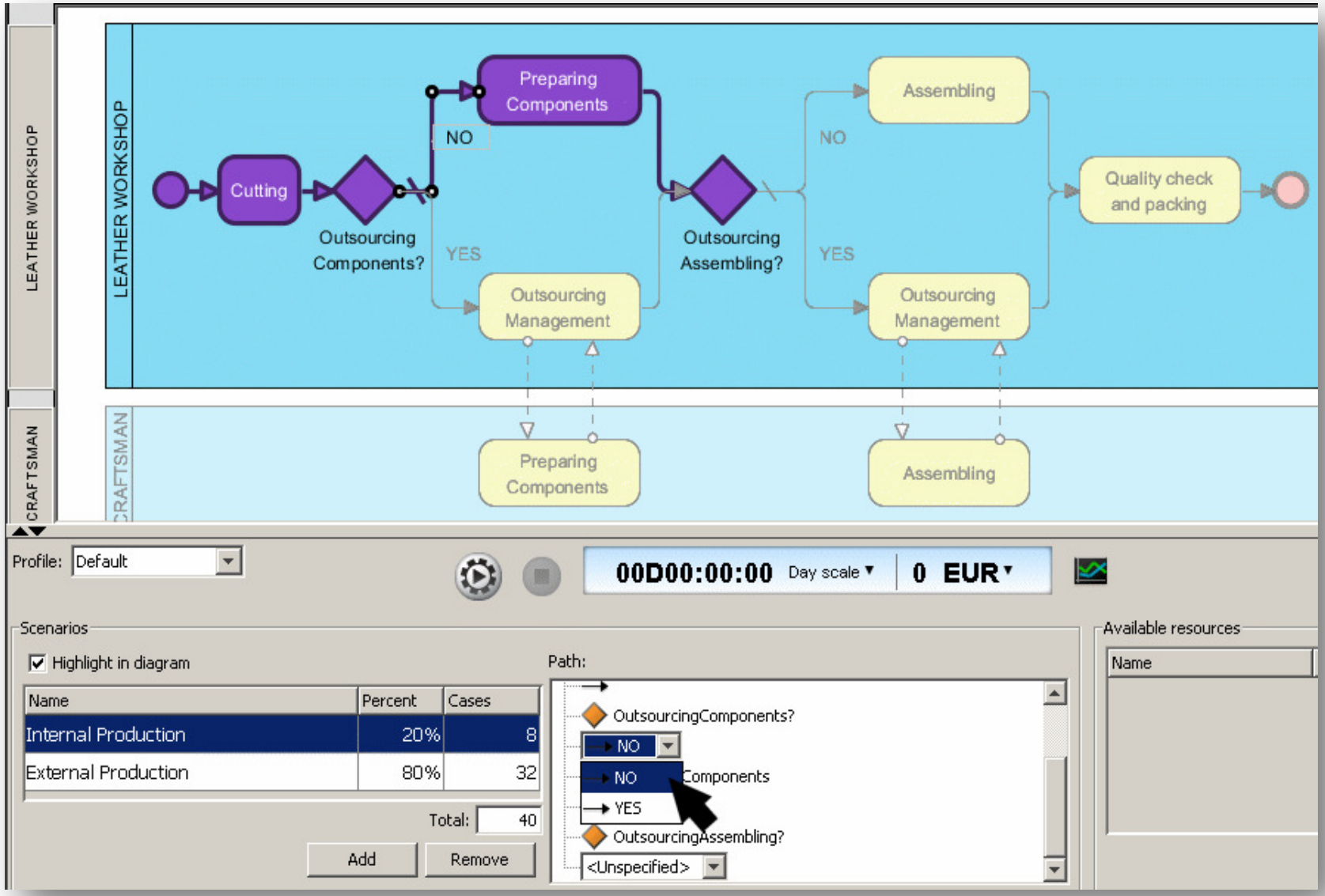
Activity	Average Duration	Average Cost (EUR)
Cutting	25	16
Preparing Components (internal)	28	31
Preparing Components (external)	24	48
Assembling (internal)	93	67
Assembling (external)	68	93
Quality check and packing	42	26
Outsourcing Management (*)	5	2

(*) Interfacing with the third party

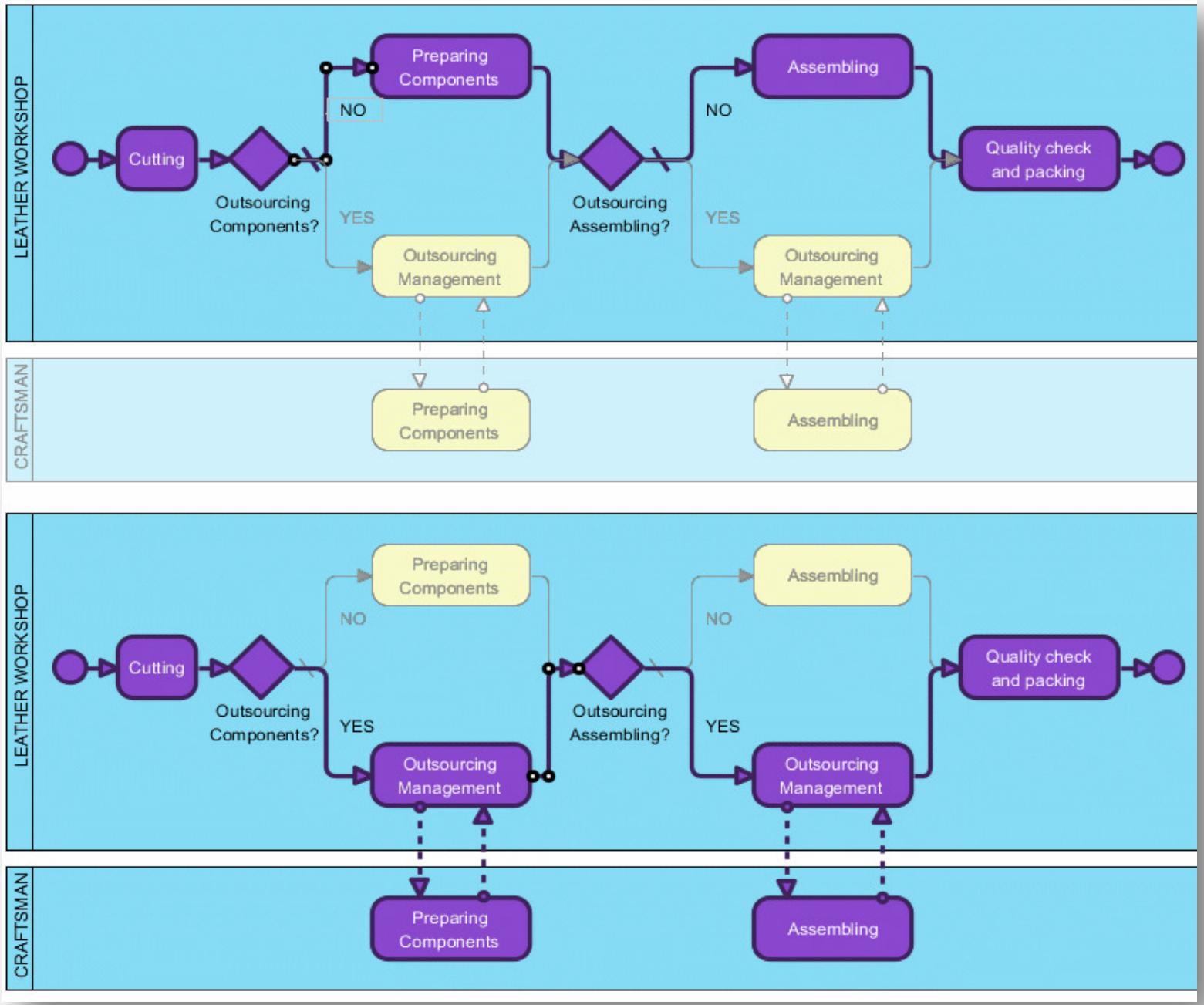
3. Define number of available instances (pools)[1], time scale [2] and currency[3].



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.



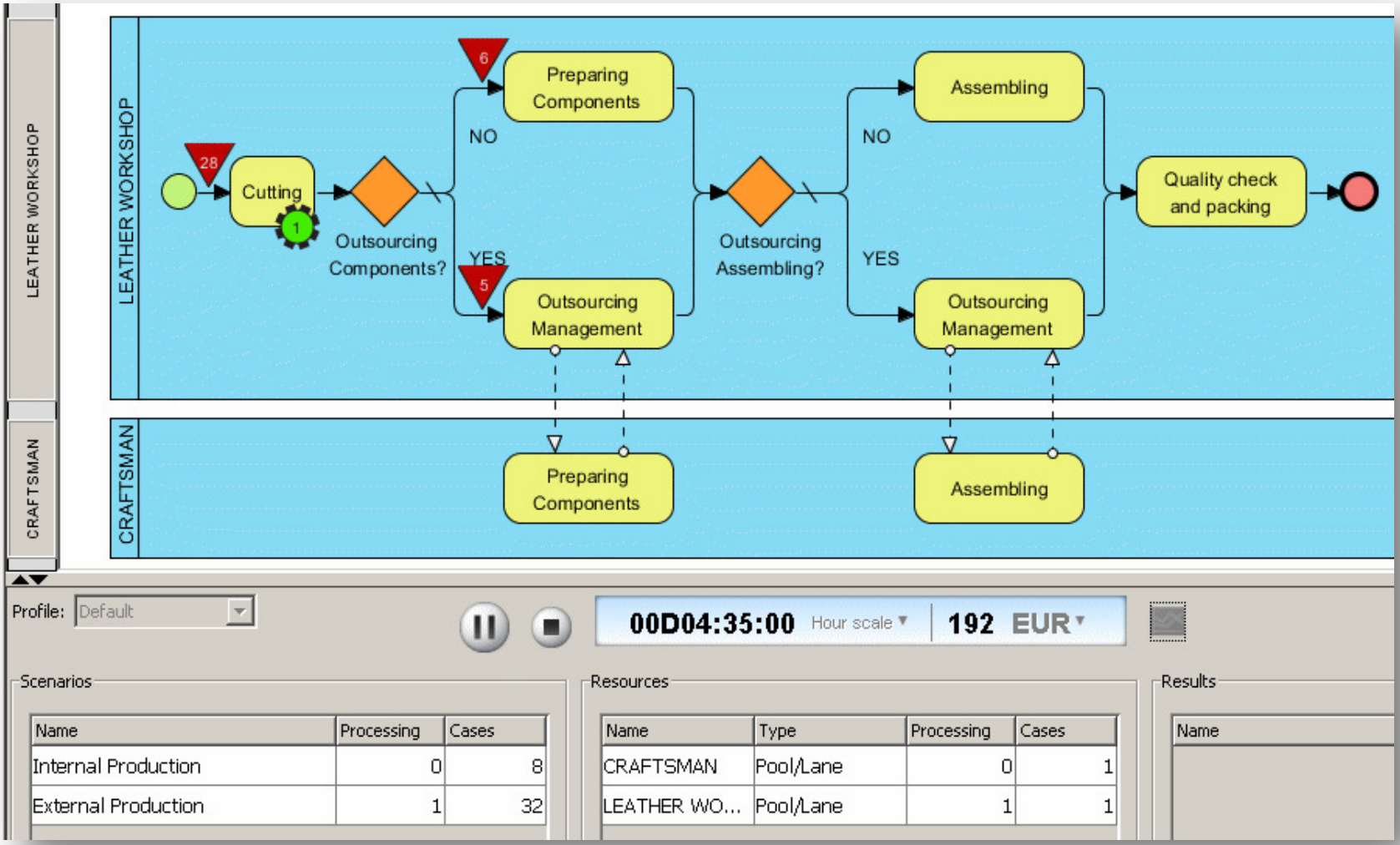
7. Two scenarios: internal production and (partially) external production.



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);

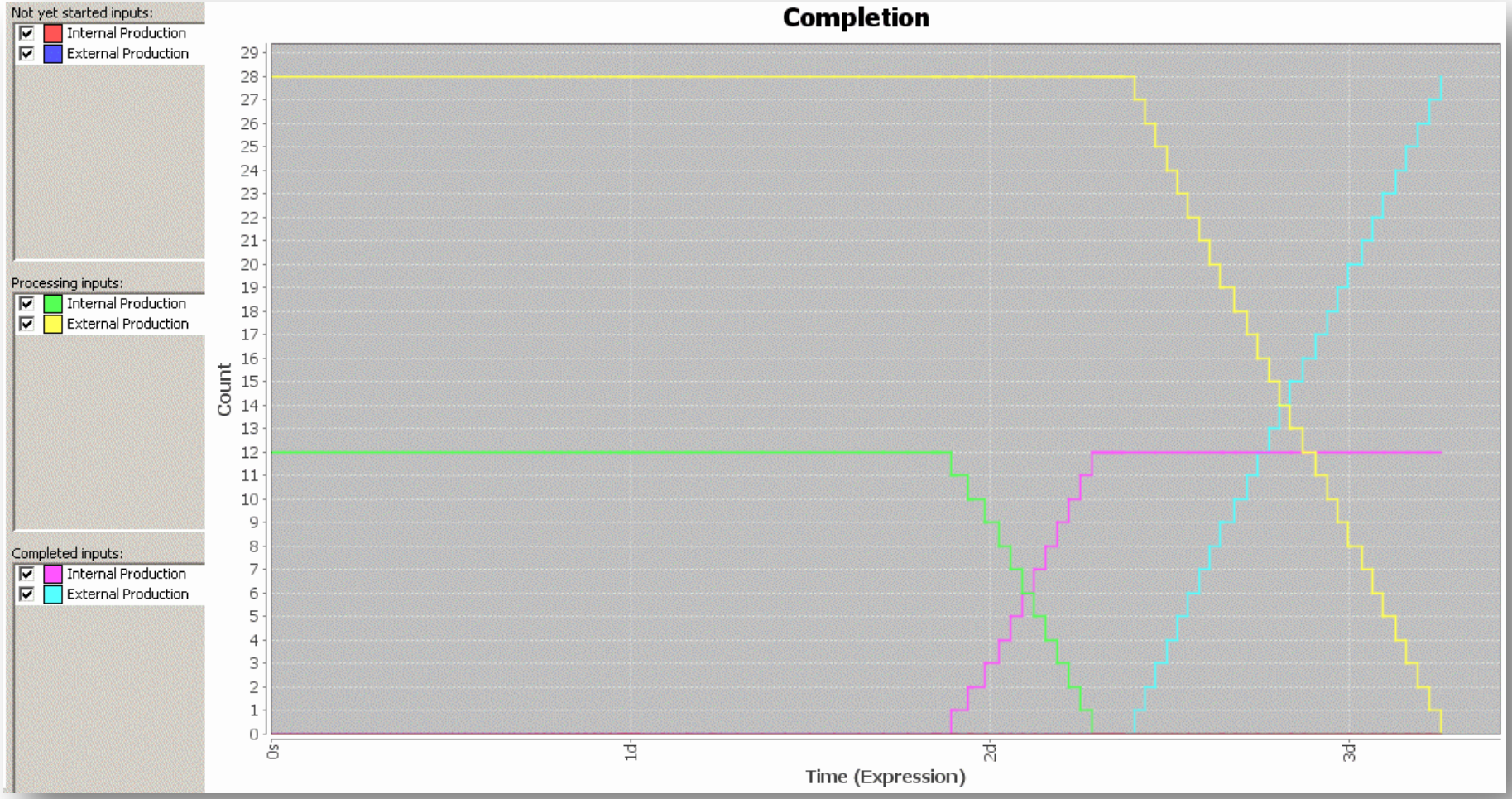
10. Look at the final duration and cost;



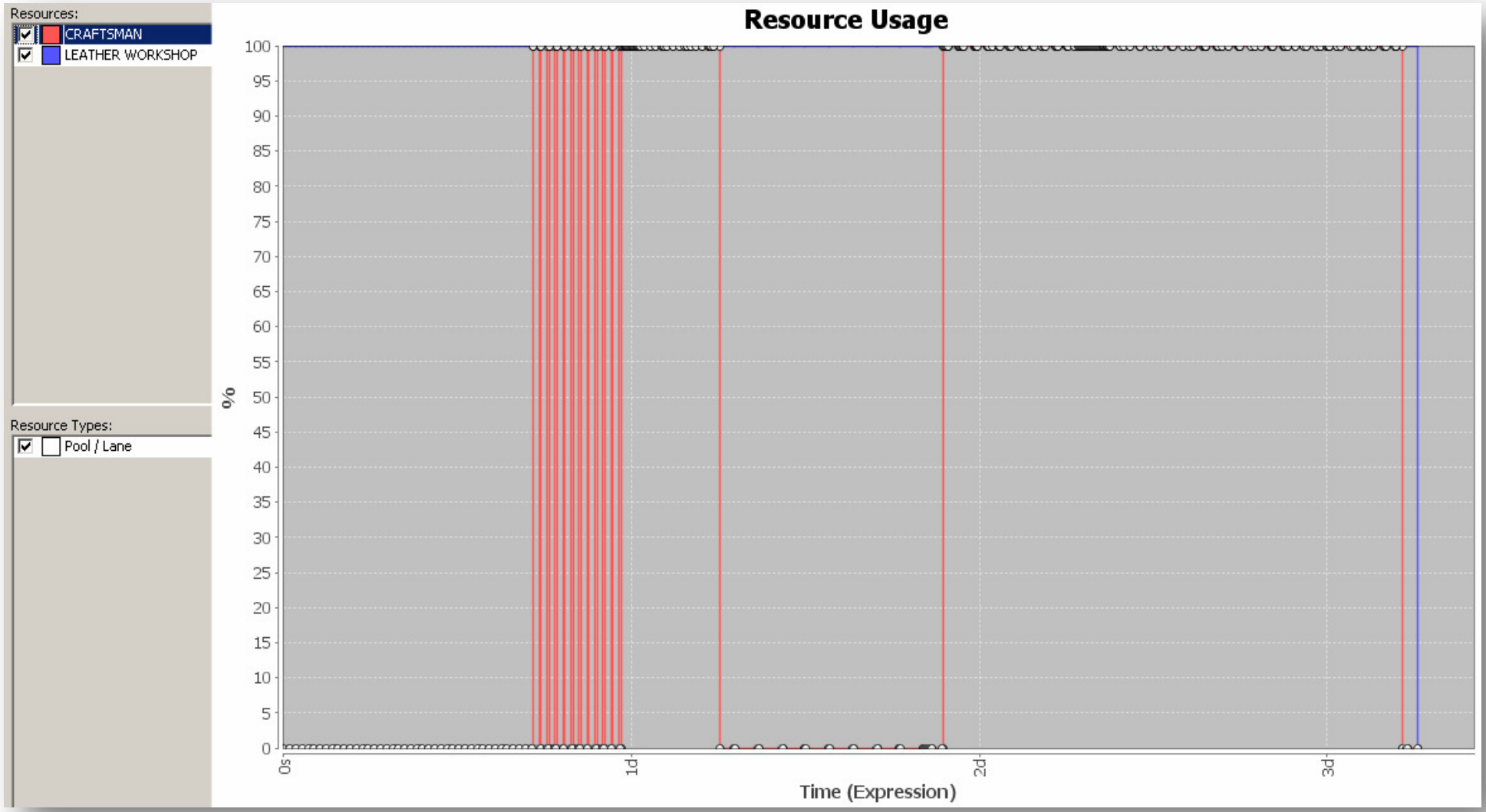
11. The two scenarios are executed considering the related number of tokens, e.g., 30% and 70%;

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

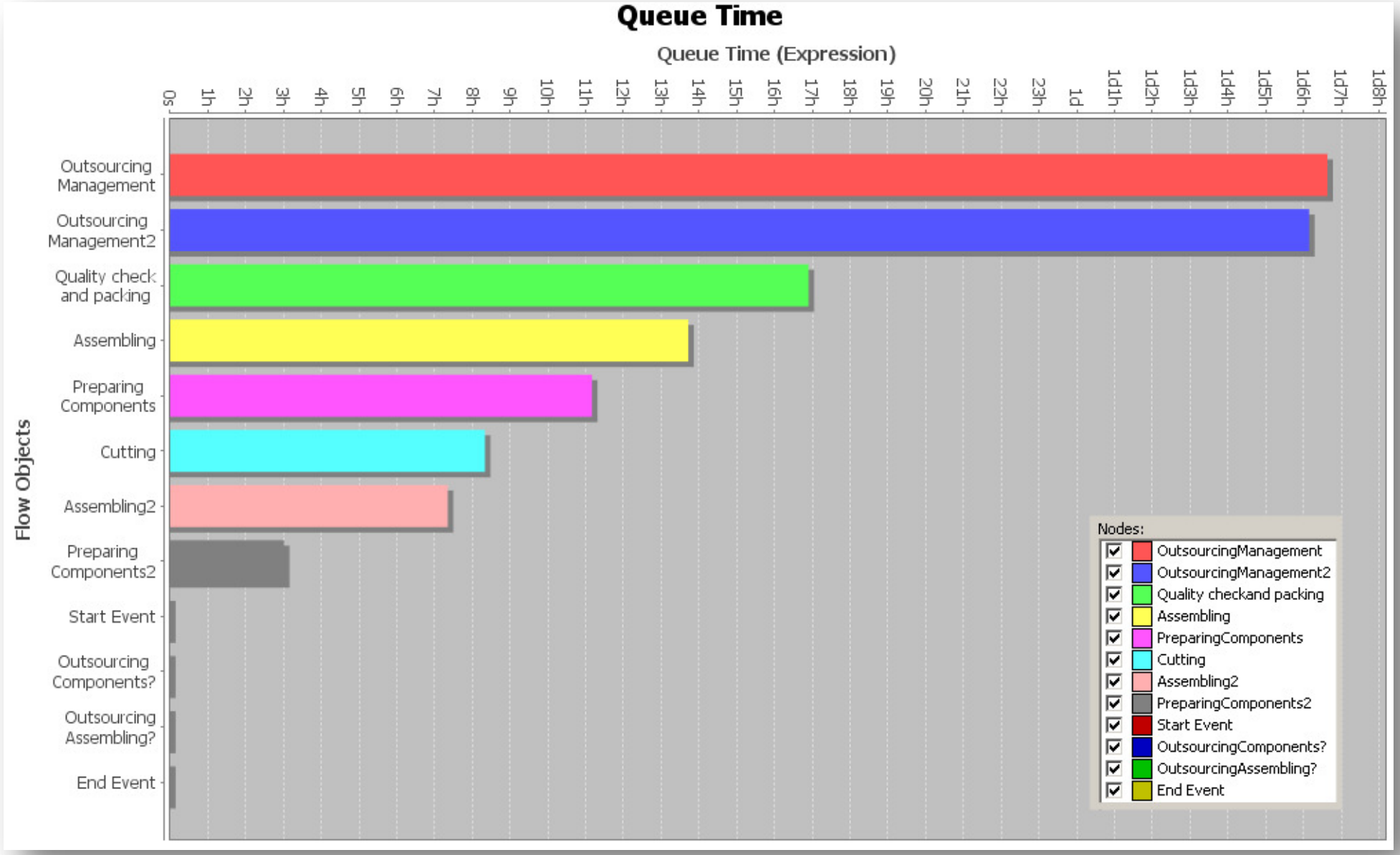
13. **Completion** against time: to be processed, processing, and processed tokens:



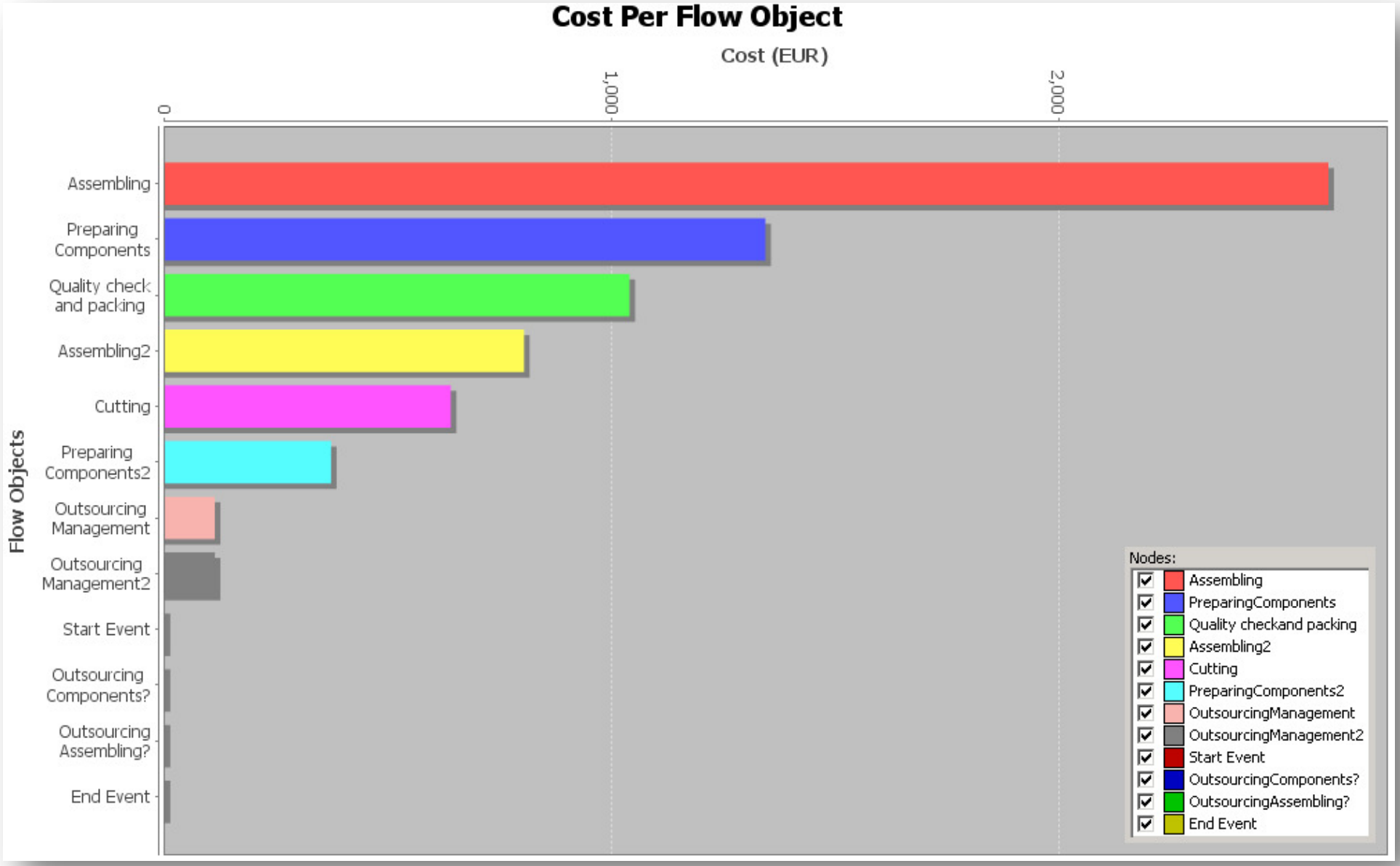
14. **Resource usage** against time:



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;

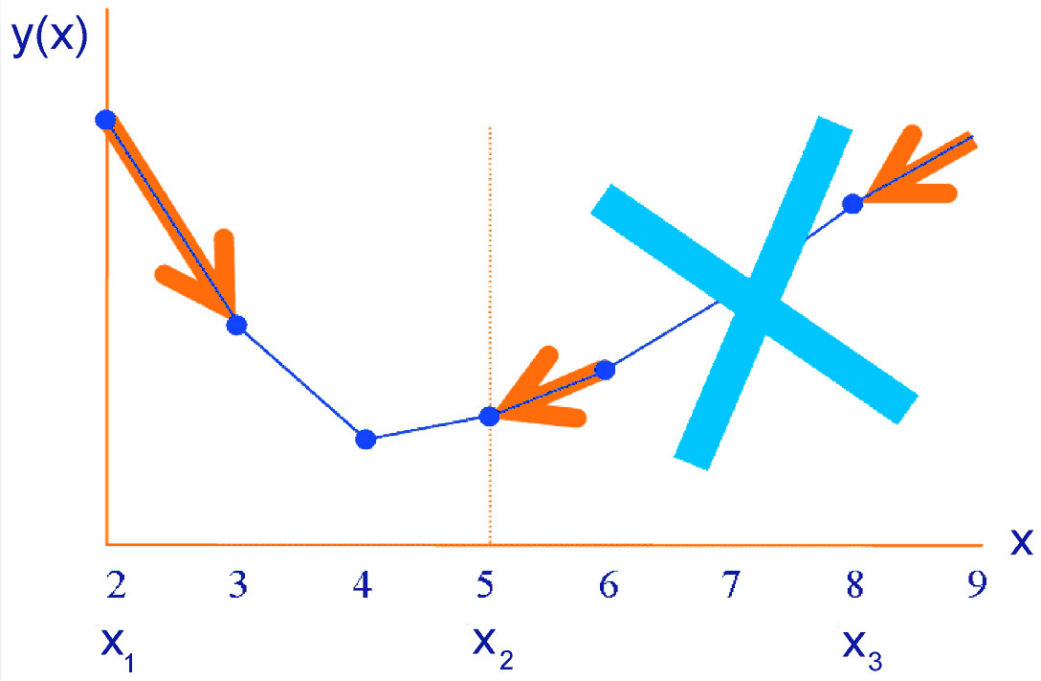
b) x_1=0% → 3g 6h 52' 7640€, with maximum queues on the assembling stage, which is a process with larger duration, with respect to the other processes;

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;

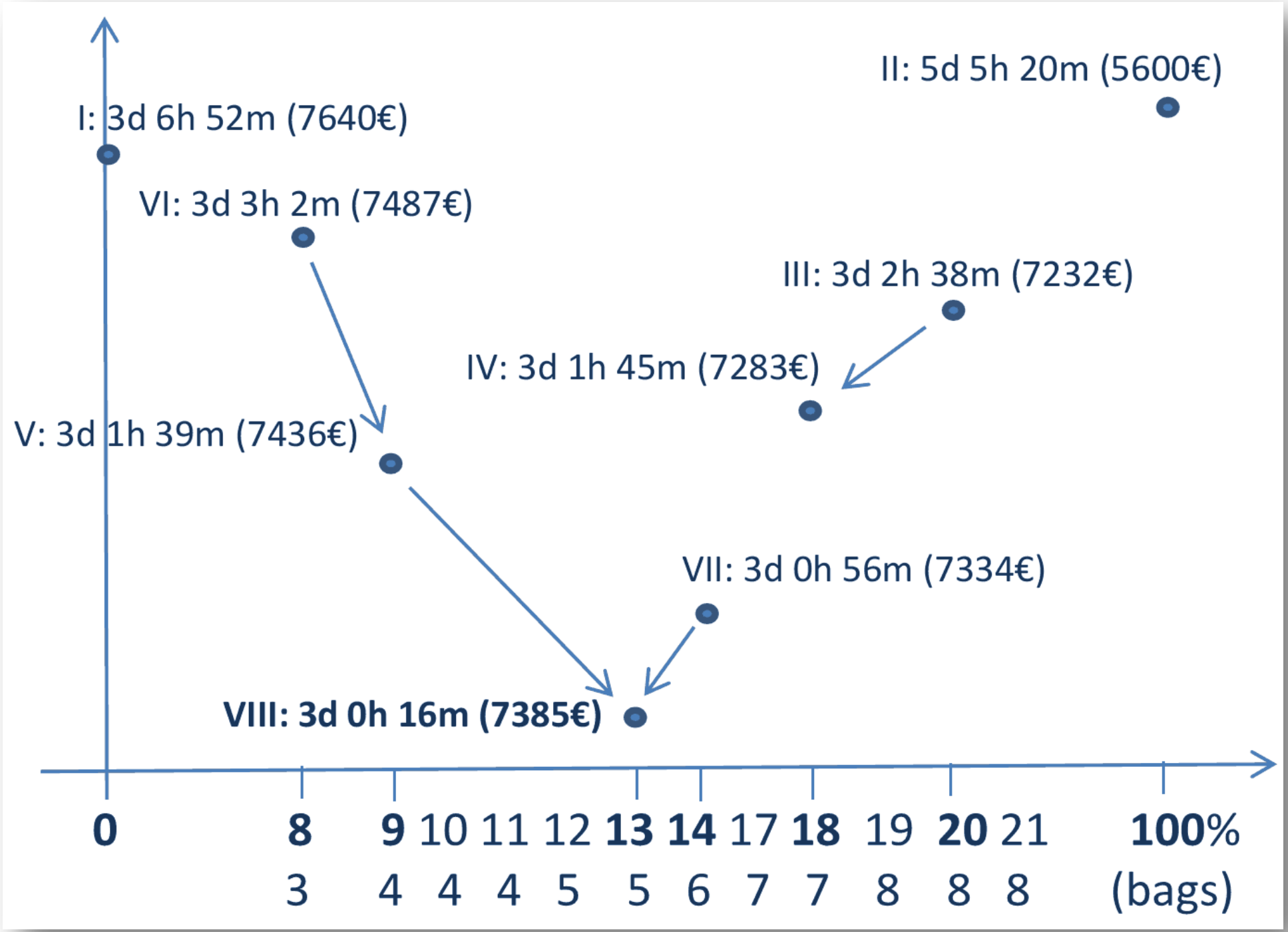
e) Is 20% the best solution in terms of total duration? Assuming that there is a unique minimum, it can be efficiently found by using a **binary search**;

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.



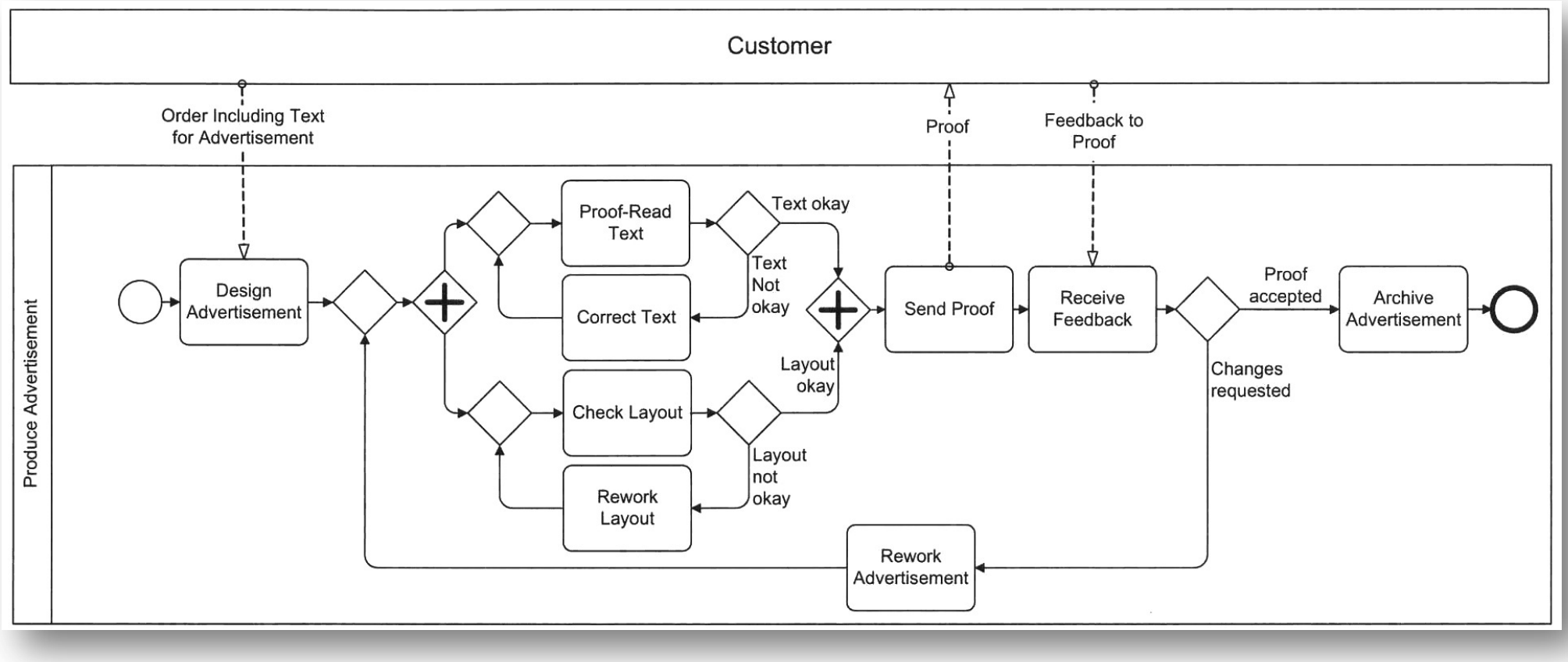
g) e.g. if the total duration goes down on the right side of x_1, and on the left sides of x_2 and x_3, then the minimum is between x_1 and x_2.

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€.


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)

Homework: advertising agency

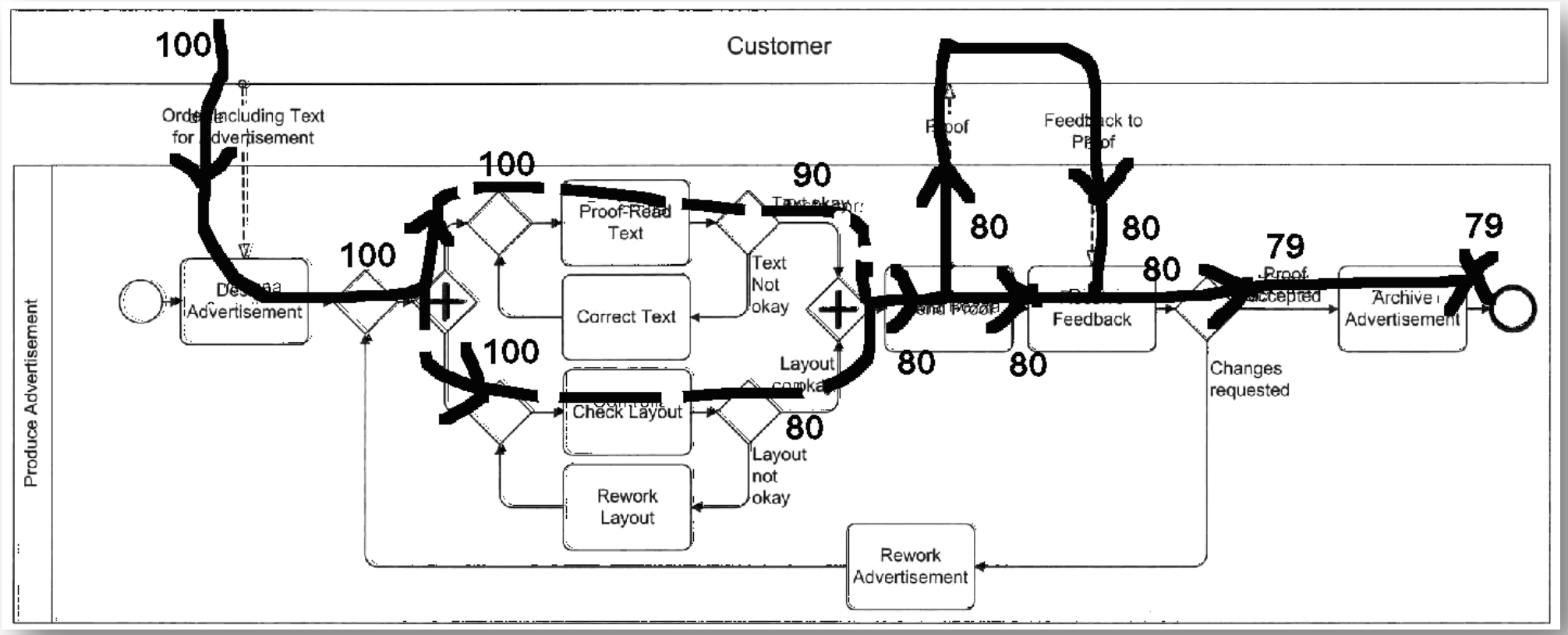
- Describe in semi-formal natural language the following process model, describing how an advertising company produces an advertisement, and which messages it exchanges with the customer.
- Given 100 starting tokens, determine the number of ending tokens for each scenario (path), considering the following branching proportions at each gateway: text not okay (10%), Layout not okay (20%), changes requested (1%).
- At each scenario, assume "happy" cases maximizing completd orders.



BP Modeling: semi-formal specification and scenarios

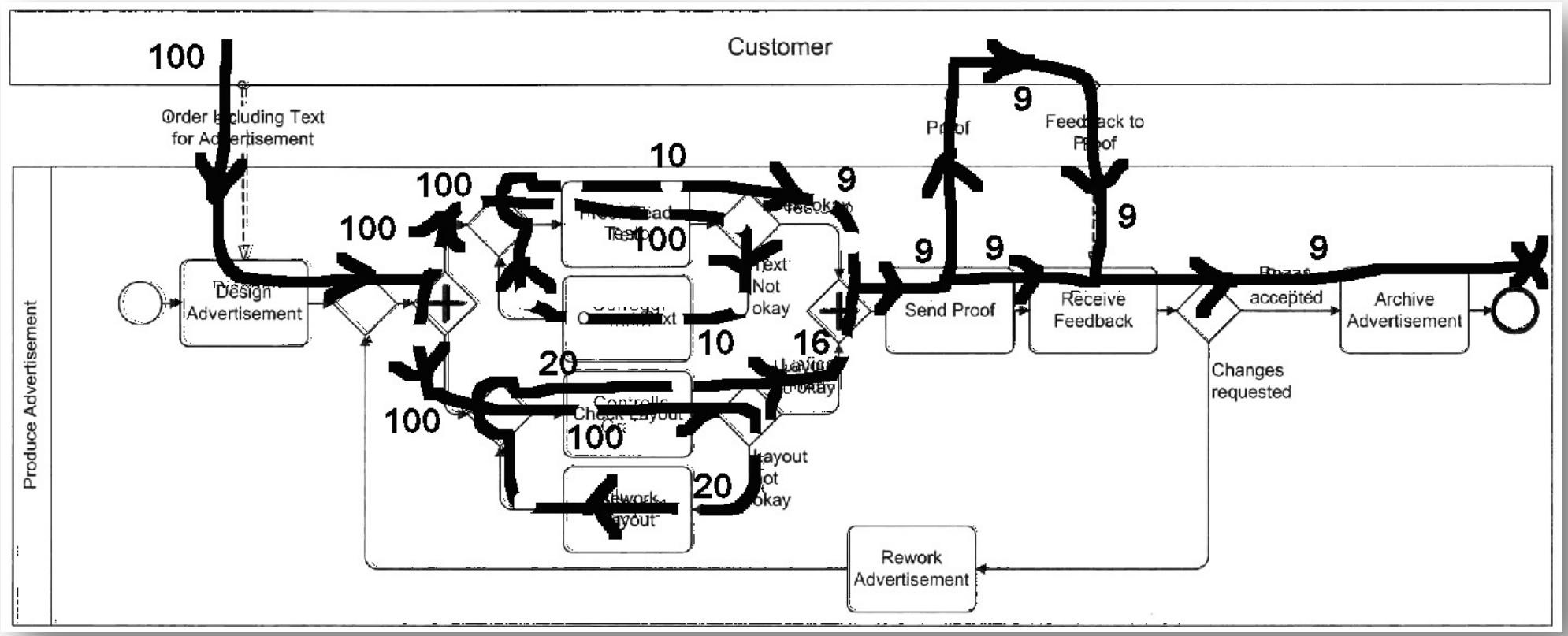
S1) (TEXT OK || LAYOUT OK) & NO CHANGES:
(100*0.9 || 100*0.8) = MIN(90,80) & 80*0.99 = **79 (+10 texts w)**

- In the best (“happy”) case, 80 orders are ok and 20 orders are wrong: 10 of them have both text and layout wrong, other 10 have only layout wrong (and the text is waiting). In the worst case 70 orders are ok and 30 orders are wrong: 20 of them have only layout wrong, other 10 of them have only text wrong.
- Assuming the “happy” case, 10 texts are still, without layout, and 80 orders can proceed.



S2) (TEXT NO || LAYOUT NO) & (TEXT OK || LAYOUT OK) & NO CHANGES:
(100*0.1 || 100*0,2) & (10*0.9 || 20*0.8) = MIN(9,16) & 9*0.99 = **9 (+7 layouts w)**

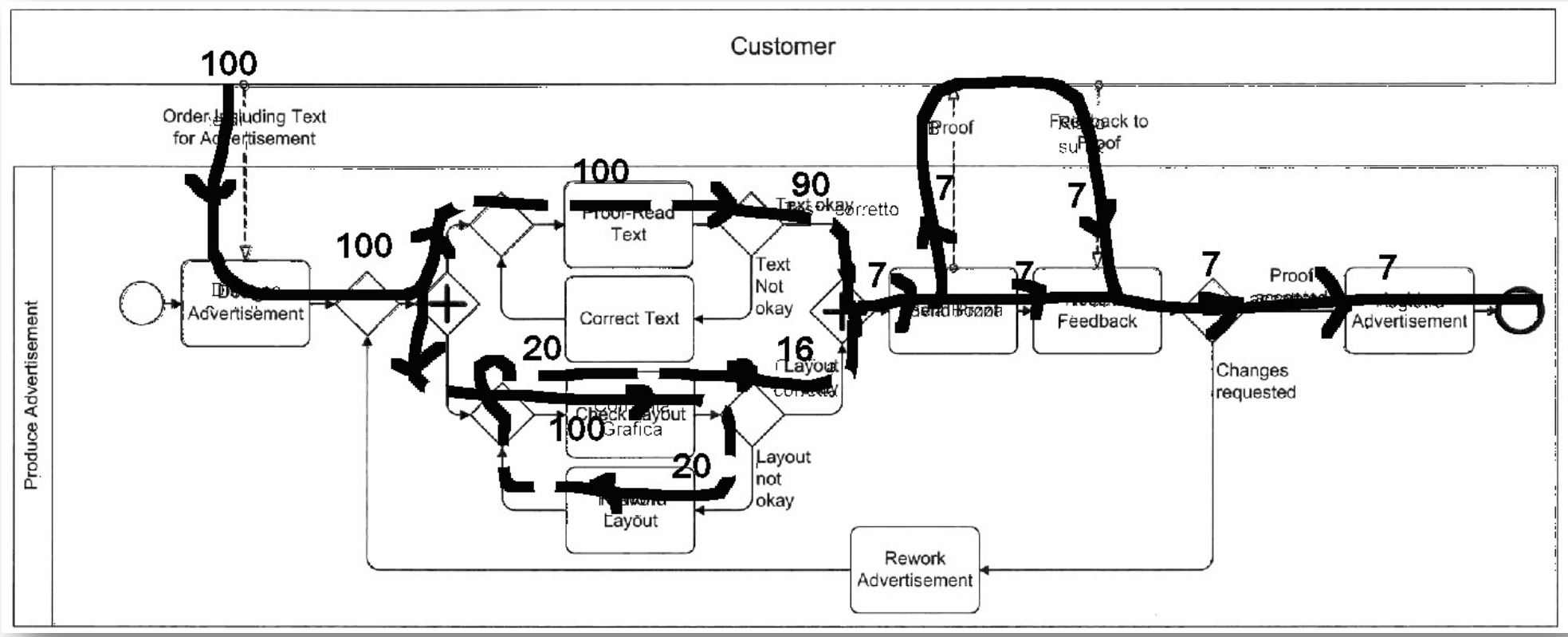
- In the best (“happy”) case, after the first cycle of correction, 9 orders are ok with text and layout, 1 text is wrong, 7 layouts are ok, 4 layouts are wrong.
- Assuming the “happy” case, 7 layouts are still, without text, and 9 orders can proceed.



BP Modeling: semi-formal specification and scenarios

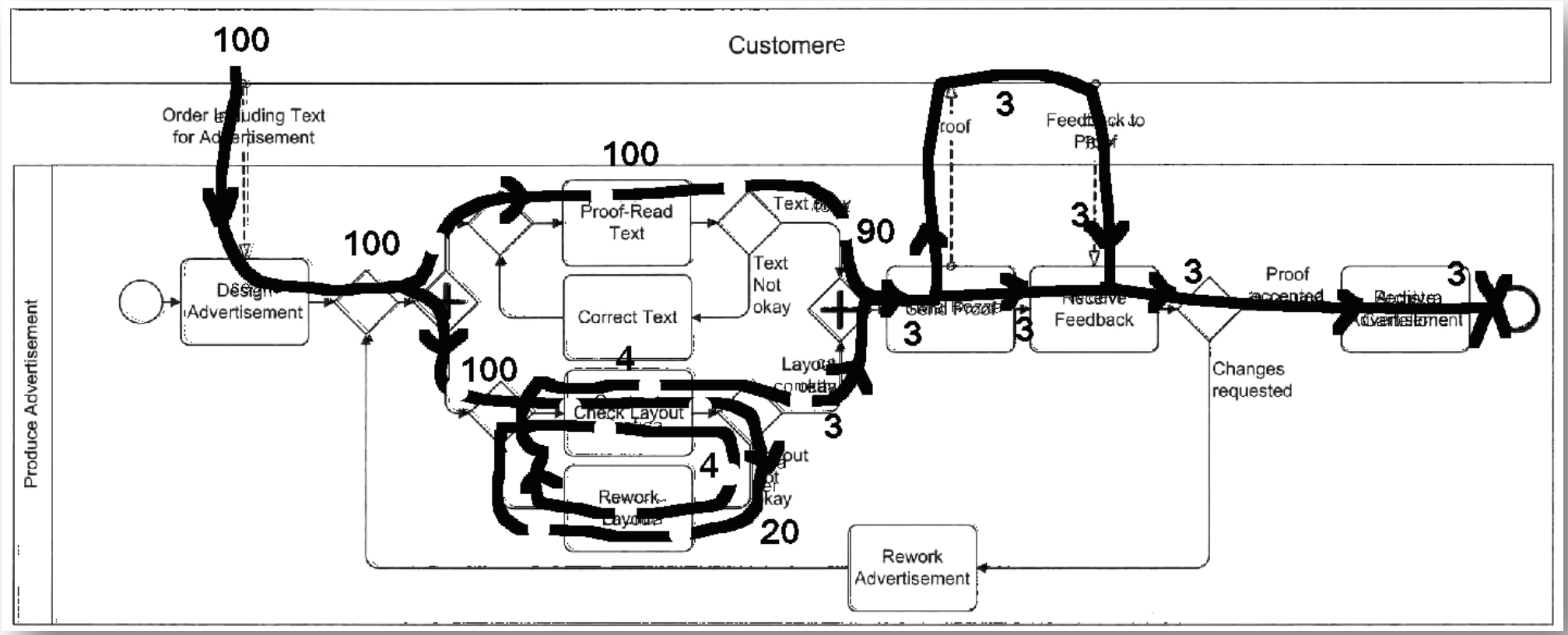
S3) In the “happy” case the 7 layouts waiting in the S1 can be combined with the 10 texts waiting in the scenario S1, thus providing 7 additional orders:
S1) 79 + 10 texts w; S2) 9 + 7 layouts w;
S3 = 10 texts w of S1 + 7 layouts w of S2:
(TEXT OK || LAYOUT NO) & (TEXT OK || LAYOUT OK) & NO CHANGES:
(10 texts w of S1 || 7 layouts w of S2) & (10 || 7) = MIN(10,7) & 7*0.99 = 7 (+3 text w)

S1 + S2 + S3 = 79 + 9 + 7 (+3 text w) = **95 (+3 text w)**



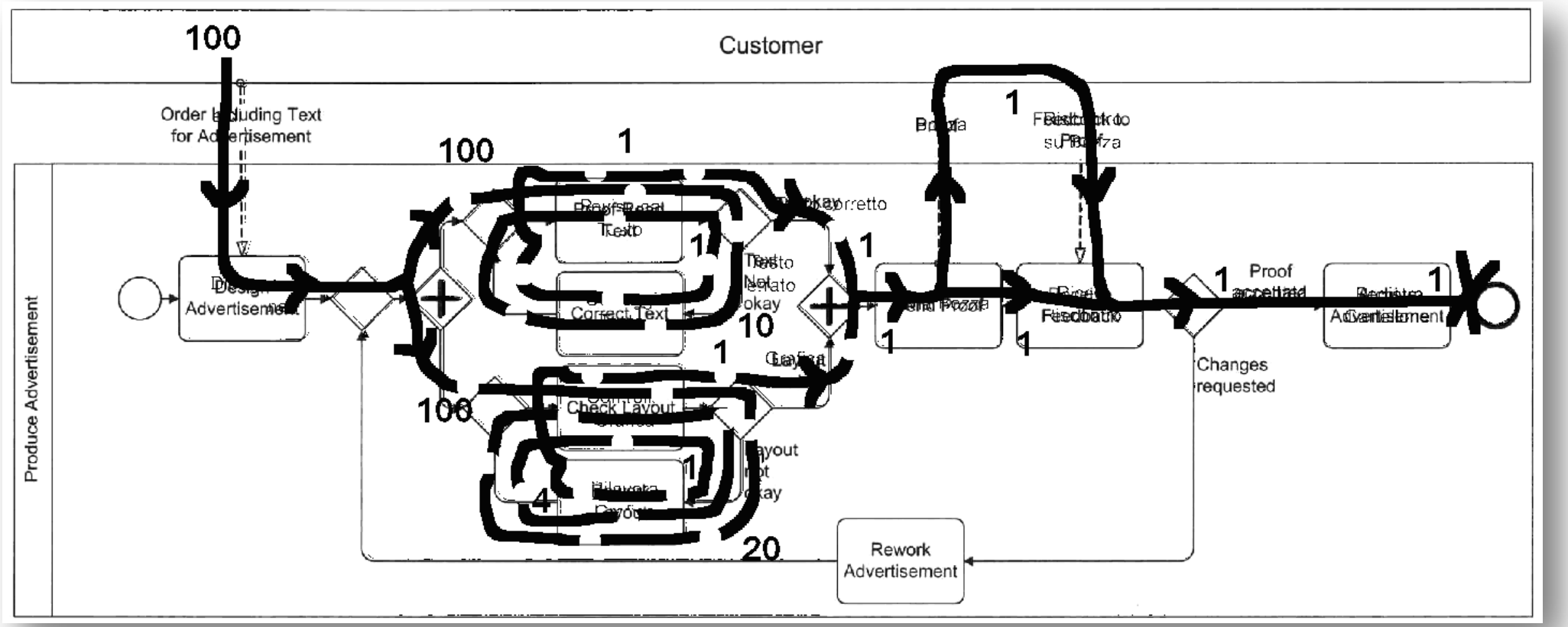
S4) In the “happy” case the 3 texts waiting resulting from S1+S2+S3 can be combined with other layouts. Such layouts can result from a variant of the scenario S3 in which 4 layouts are corrected twice, thus producing 3 right layouts.
(TEXT OK || LAYOUT NO) & (TEXT OK || LAYOUT NO) & (TEXT OK || LAYOUT ok) &
NO CHANGES:
(3 texts w of S1+S2+S3 ||100*0,2) & (3 || 20*0.2) 6 (3 || 4*0.8) = MIN(3,3) & 3 *0.99 = **3**

S1 + S2 + S3 +S4 = 79 + 9 + 7 + 3 = **98**



BP Modeling: semi-formal specification and scenarios

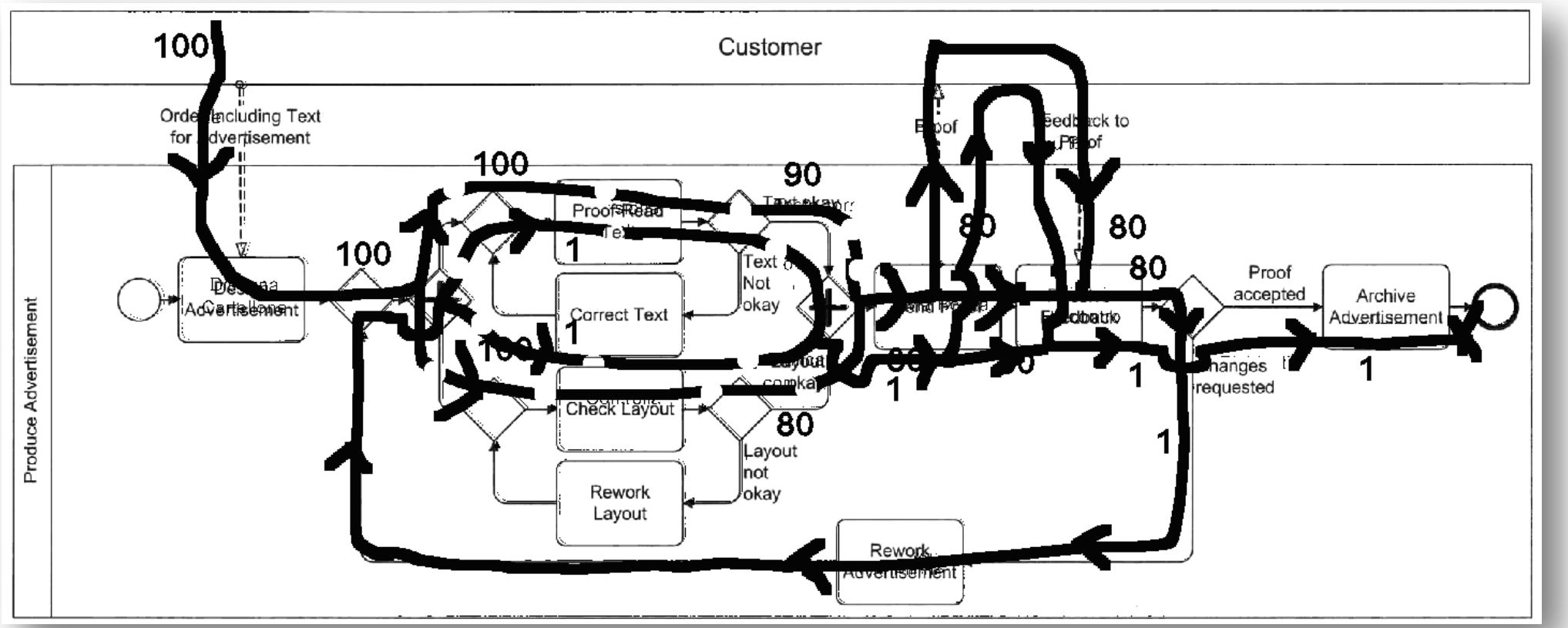
S5) (TEXT NO || LAYOUT NO) & (TEXT NO || LAYOUT NO) & (TEXT OK || LAYOUT NO) & (TEXT OK || LAYOUT OK) & NO CHANGES:
(100*0.1 || 100*0.2) & (10*0.1 || 20*0.2) & (1 || 4*0.2) & (1 || 1) = MIN(1,1) & 1*0.99 = **1**



BP Modeling: semi-formal specification and scenarios

S6) (TEXT OK || LAYOUT OK) & CHANGES & (TEXT OK || LAYOUT OK) & NO CHANGES:
(100*0.9 || 100*0.8) = MIN(90,80) & 80*0.01 & (1*0.9 || 1*0.8) = MIN (1,1) & 1*0.99 = **1**

S1 + S2 + S3 + S4 + S5 + S6 = 79 + 9 + 7 + 3 + 1 + 1= **100**



Questions

Suppose that the tasks of proof-read, check, and feedback must provide the same result when applied to the same content (text and/or layout):

1. The Customer can request changes to the layout, and subsequently to the text.
   ❑ true ❑ false

2. Even if the Company reworks the advertisement by applying exactly all changes requested by the Customer, the Customer can subsequently request new changes.
   ❑ true ❑ false

Answers

1. **False**: because the task *rework advertisement* will change the layout only, and then the tasks *proof-read text* and *feedback to proof* will return again *text ok* (as they must provide the same result when applied to the same text).

2. **True:** because the activities of proof-read, check, and feedback can provide a different result when applied to a new content.