IMPROVING BUSINESS PROCESSES USING SIMULATION TOOLS

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The article describes how to improve business processes by using modeling and simulation tools. A dynamic business environment requires continuous improvement of business processes. By using process improvement tools, the enterprise gains insight into ongoing processes, which is the basic requirement for a planned change. The simulation tools provide professionals with the opportunity to build variants of the future organization of processes that are expected to deliver higher business performance. Using modeling tools, it is possible to describe and create the current map of the monitored processes. By introducing a change in processes, the simulation tool enables the future development of the key performance indicators monitored. In the present paper, the authors present the use of a tool for modeling and simulation of processes, where they address the role of improving the business processes of the company dealing with the production of books, magazines, paper packaging and promotional materials.

KEYWORDS

modeling, business processes, business processes, simulation, performance improvement

1 INTRODUCTION

In nowadays, companies are still looking for new ways, how increase productivity and profits. Most often, new technologies and devices are purchased, or different methods and standards are implemented in companies, allowing them to reduce production time and increase production. Another less-used option is improving business processes. For example, if an enterprise can communicate more quickly and flexibly with a customer and better meet his requirements for the price, it can deliver more orders and better fill own production capacity.

In printing industry, the speed of internal communication is as important as production itself. [Kovac 2015]

Often, customers are required to deliver the chosen product to the market at a precise date, in a short time horizon, and therefore a fast start of production is required [Manlig 2014]. Also, the book industry is specific because most of the customers are represented by publishers. These publishers send customer requests into multiple companies, and the one who responds fastest and offers the best price gets the offer.

In order to quickly send an offer and then start production, it is therefore necessary that all support processes be without unnecessary downtime and as short as possible. [Vazan 2016], [Votava 2008].

Therefore, there is a need to improving the business processes in selected company. This improvement concerns the high number of departments and staff, which is why the company required simulation. The proposal for improvement is offered by the company itself, which wants to prove the merits of this proposal by simulation to the owners of the company. [Rakyta 2016]

Simulation is a good tool for testing required changes in businesses. It is mainly used for financial or time-consuming changes. Research proves their suitability at various departments of the enterprise. [Gagliardi 2007]

2 CURRENT STATE IN COMPANY

The current state of business processes in the company is at an insufficient level, the processes take a long time, and the information flow is unnecessarily complicated due to the large number of departments. Because a large number of people work with the necessary information while processing the order, communication noise is generated. Necessary information is recorded in bad places or is duplicated, outdated or not enrolled at all, and because of the large number of people it is not possible to determine responsibility for internal complaints. These complaints arise if there is a discrepancy between the customer's requirements and the information entered in the technology card. Workers in manufacturing do not know how to produce properly if the data they own are wrong. All these deficiencies cause damages to the company in thousands of €.

2.1 Collecting input data

The process of processing the demand goes through the departments and employees e.g. see Tab.1. Employees were assigned an hourly salary to serve for the economic evaluation of the proposal. All data was discussed by the Personnel Department manager.

Department	Employee	Quantity	Income per hour
Sales	Sales Director	1	12 €
	Area Sales Manager	3	10 €
	Key Account Manager	2	9 €
	Dealer	17	8 €
Pricing	Manager	1	10 €
	Employee	4	8 €
Planning	Manager	2	9 €
	Schemer	2	8 €
Logistics	Manager	1	10 €
	Employee	2	9 €
Technology	Manager	1	11 €
	Employee	3	9 €
Data preparation	Manager	2	9 €
	Employee	7	7 €

Table 1. Organizational structure

All business processes were recorded and divided into responsible departments. Responsible staff have determined the duration of these processes. For more accurate input data, these times were written by **triangular distribution**. This distribution best reflects differences in the types of orders and

abilities of employees. The company also has new employees who cannot carry out their activities as quickly as long-term employees. Contracts are also of a different nature, so the processes must have a different duration too. e.g. see Tab.2.

	Activity	Owner	Activity type	Responsible department	Duration		
					Min.	Avg.	Max
1	Submitting request	Customer	Activity (start point)	Customer			
2	Processing the request	Dealer	Subprocess	Business	-	-	-
3	Receiving demand	Dealer	Activity	Business	0:10	0:20	0:35
4	Is the customer new?	Dealer	Decision	Business	0:05	0:10	0:20
5	Checking and approving the customer	Sales director	Activity	Business	0:05	0:20	0:40
6	Creating a price quote	Dealer	Activity	Business	0:02	0:05	0:15
7	Writing the necessary information	Dealer	Activity	Business	0:03	0:08	0:12
8	Creating a price	Pricing department employee	Subprocess	Pricing	-	-	-
9	Receiving the request	Pricing department employee	Activity	Pricing	0:02	0:04	0:10
10	Are data complete?	Pricing department employee	Decision	Pricing	0:01	0:02	0:04
11	Communication with shopping department	Pricing department employee	Activity	Pricing	0:03	0:10	0:15
12	Writing missing information	Dealer	Activity	Business	0:01	0:03	0:07
13	Are we able to make an order?	Pricing department employee	Decision	Pricing	0:05	0:07	0:12
14	Communication with technology department	Pricing department manager	Activity	Pricing	0:03	0:10	0:15
15	Do we have the technology to produce?	Technology manager	Decision	Technological	0:05	0:15	0:30
16	Processing the request for price	Pricing department employee	Activity	Pricing	0:02	0:05	0:07
17	Material determination	Logistics department employee	Subprocess	Logistics	-	-	-
18	Receiving the request for material	Logistics department employee	Activity	Logistics	0:02	0:04	0:10
19	Is special material required?	Logistics department employee	Decision	Logistics	0:01	0:02	0:03
20	Checking and securing special material	Logistics department manager	Activity	Logistics	0:02	0:10	1:00
21	Is material on stock?	Logistics department employee	Decision	Logistics	0:01	0:02	0:05
22	Communication with suppliers	Logistics department employee	Activity	Logistics	0:05	0:10	0:17
23	Selecting the suitable material	Logistics department manager	Activity	Logistics	0:05	0:10	0:20
24	Checking selected material	Logistics department manager	Activity	Logistics	0:02	0:05	0:10
25	Determining the date of material loading	Logistics department employee	Activity	Logistics	0:02	0:05	0:07
26	Production planning	Schemer	Subprocess	Planning	-	-	-
27	Receiving the request for schedule	Schemer	Activity	Planning	0:02	0:05	0:09
28	Controlling available information	Schemer	Activity	Planning	0:01	0:02	0:04
29	Are data complete?	Schemer	Activity (start point)	Planning	0:01	0:05	0:09

30	Checking date data with dealer	Planning department manager	Subprocess	Planning	0:05	0:15	1:00
31	Capacity recalculating	Schemer	Activity	Planning	0:02	0:03	0:05
32	Scheduling in software	Schemer	Decision	Planning	0:03	0:04	0:05
33	Is the date appropriate?	Schemer	Activity	Planning	0:01	0:02	0:03
34	Communication with dealer	Schemer	Activity	Planning	0:05	0:10	0:27
35	Changing the date	Planning department manager	Activity	Planning	0:03	0:06	0:10
36	Confirm the date in the software	Schemer	Subprocess	Planning	0:01	0:02	0:03
37	Completing the request	Pricing department employee	Activity	Pricing	0:05	0:13	0:20
38	Sending a offer	Dealer	Decision	Business	0:05	0:07	0:20
39	Approval of the offer	Customer	Activity	Customer	-	-	-
40	Does the offer meet the requirements?	Customer	Activity	Customer	1:00	4:00	1 d.
41	Sending an approved offer	Customer	Decision	Customer	1:00	3:00	5:00
42	Communication with company and rejecting an offer	Customer	Activity	Customer	0:05	0:10	0:20
43	Sending data	Customer	Activity	Customer	2:00	8:00	2 d.
44	Receipt of the contract	Dealer	Activity	Business	0:10	0:20	0:40
45	Confirming the date	Schemer	Activity	Planning	0:01	0:10	1:00
46	Ordering paper	Logistics department employee	Activity	Logistics	0:10	0:50	2:00
47	Data processing	Data preparation employee	Subprocess	Data preparation	-	-	-
48	Receiving and processing of data	Data preparation employee	Activity	Data preparation	0:17	0:20	0:30
49	Data controlling	Data preparation employee	Activity	Data preparation	0:10	0:12	0:40
50	Are the data processes able?	Data preparation employee	Decision	Data preparation	0:05	0:10	0:20
51	Data repairing	Data preparation employee	Activity	Data preparation	0:05	0:50	2:00
52	Data optimization	Data preparation employee	Activity	Data preparation	0:40	0:50	0:55
53	Printing preview	Data preparation employee	Activity	Data preparation	0:13	0:25	0:30
54	Illuminating plates	Data preparation employee	Activity	Data preparation	0:35	0:42	0:50
55	Creating a technology	Technology employee	Subprocess	Technological	-	-	-
56	Receiving offer and assigning a technician	Technology manager	Activity	Technological	0:08	0:15	0:30
57	Creating main technology	Technology employee	Activity	Technological	0:05	0:17	0:35
58	Are changes required?	Technology manager	Decision	Technological	0:01	1:00	3:00
59	Changing technology	Technology manager	Activity	Technological	0:10	0:20	1:00
60	Sending technology	Technology employee	Activity	Technological	0:01	0:05	0:10

Table 2. Mapped business processes in company

Another necessary data for simulation model is the number of entry demands and contracts. The company average gets 900 demands per month e.g. see Fig. 1, but only 40% of them will company receive like contracts e.g. see Tab.3. This fact has been incorporated into the simulation setup so that the simulation model has been the most appropriate copy of the real state.

Month	Number of demands	Number of contracts	%
January	932	297	32%
February	905	340	38%
March	910	350	38%
April	881	320	36%
May	789	285	36%
June	867	391	45%
July	821	280	34%
August	806	408	51%
September	970	432	45%
October	987	441	45%
November	1121	456	41%
December	1005	428	43%
Sum	**10994**	**4428**	**40%**

Table 3. Number of demand and percentage acceptance of orders

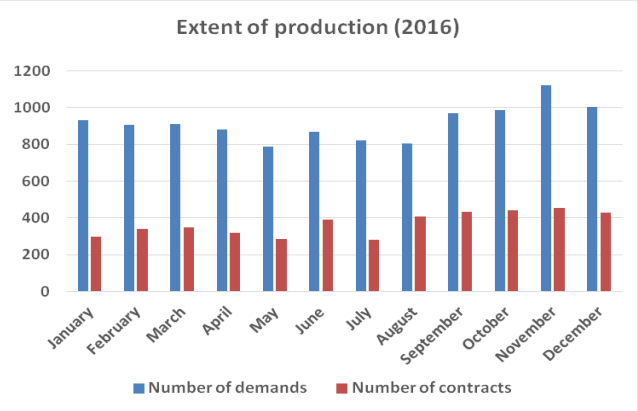

Figure 1. Extent of production graph

3 CREATING SIMULATION MODEL

After reviewing all the tracking process data, process modeling by QPR ProcessGuide software will be followed. Software shows the processes by using flowcharts e.g. see Fig.2. The simulation model was filled with data about the individual processes, how they are followed and how long employees perform them.

Using Table 1, we completed the simulation model with the necessary data on individual worker e.g. see Fig.3. Information such as the number of employees per unit, hourly wage, and process responsibility will help us evaluate the results of the simulation. Figure 4 shows how the duration of the process was set using a triangular distribution.

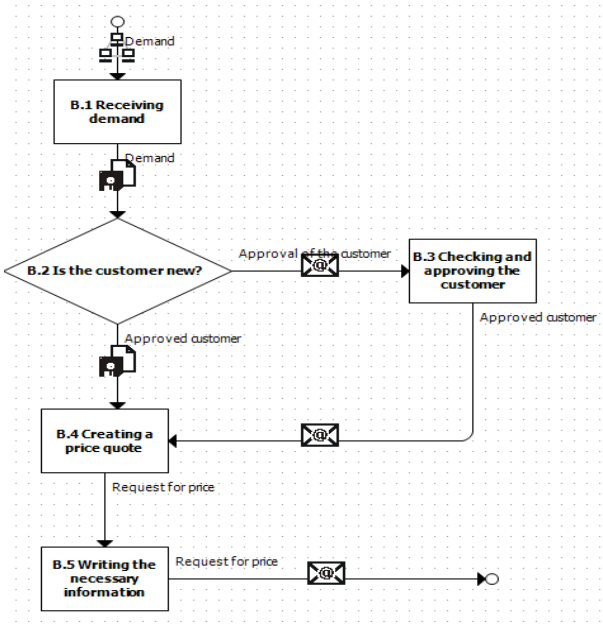

Figure 2. Process receiving demand in software

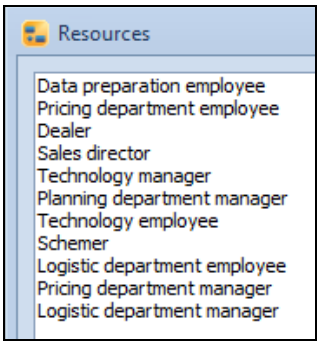

Figure 3. Human resources in software

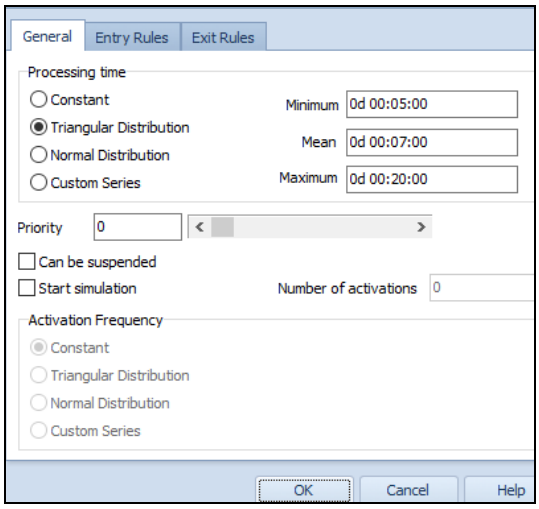

Figure 4. Set duration of process

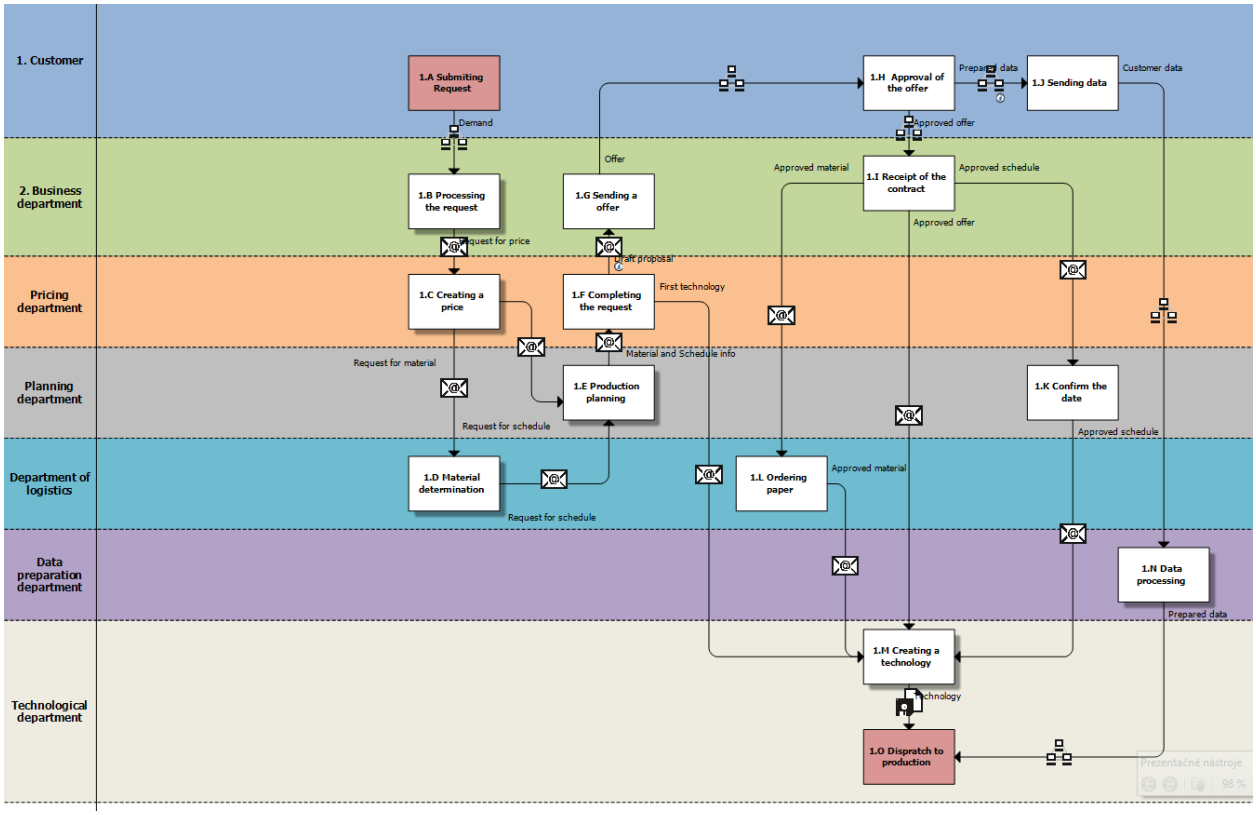

Figure 5. Simulation model in software

4 SIMULATION OF THE SELECTED PROCESS

The simulation model was started after entering the input data and setting the number of **activations** to 250, which is equal to the weekly average of the queries. It was also set that out of these 250 queries, only 40% would be accepted as a contract. Table 4 shows processing time, in simple and in hard contract.

Type	Processing time
Minimum	0d 7:28:05
Maximum	3d 8:46:56
Average	**1d 4:24:03**

Table 4. Processing time in actual state

This time is important up to individual processes and departments. See Fig. 6,

Main Processes	%
Sending data	79,1
Ordering paper	9,6
Receipt the contract	3,9
Completing the request	2,5
Sending a offer	2,3
Confirm the date	2,2
Dispatch to production	0,3

Table 5. Percentage proportion of processing time

Another important factor is the monitoring of waiting times in processes e.g. see Fig.7. In the chart, red color shows employee overloaded, and purple color shows waiting time before processes.

The simulation results for actual state in company evaluated the cost of workers in the amount **21 280€.**

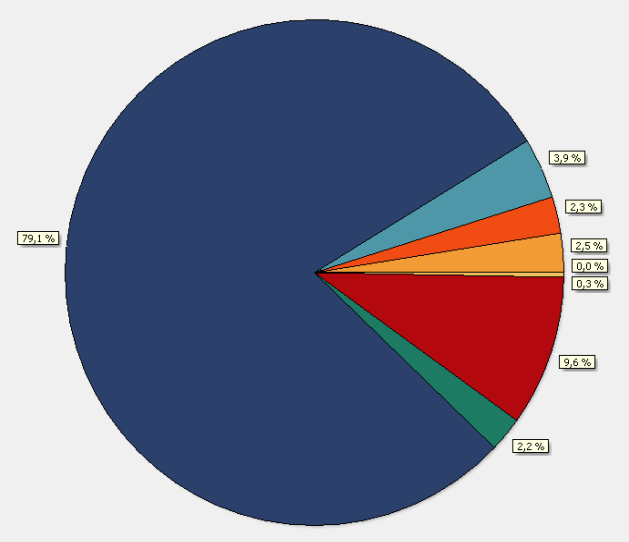

Figure 6. Proportion of processing time to business processes

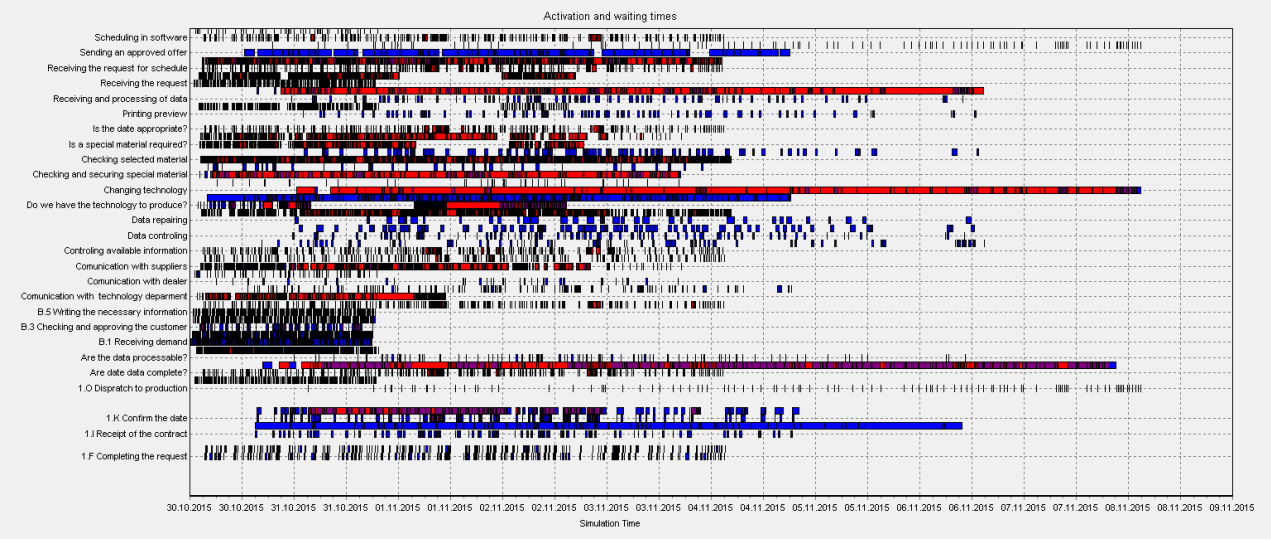

Figure 7. Overloading and waiting time in simulation model

The results show the obvious shortcomings of the high weekly burden on employees in all departments. These drawbacks lead to the above errors, such as recorded information in bad places or duplicating information, outdated or not enrolled at all.

5 SOLUTION DESIGN

An enterprise has already proposed a solution that is based on a new job position. This job position will be name project manager, and will be performed by employees from all departments. Also dealers will be divided into senior and junior salesman. Senior will only travel around important customers, and maintain good relations with them. Junior salesman will be writing and preparing every necessary information from customers to company, e.g. see **Fig. 8**. Project manager will be substituting pricing, planning and logistic department. This change will removed information noise, and necessary information will be clearer. In the case of internal complaints, it will also be easier to look for the responsible employee.

For the correct comparison of results, the solution model has the same number of **activations,** like actual simulation model. 250 activations exactly match the weekly numbers of requests from customers.

The result is improved and simplified flowchart with fewer departments, e.g. see **Fig.9.** The design shows employees have more time and they are not overloaded more, e.g. see **Fig.10.** In solution only employees who are overloading are technology employees. This department must be optimized in the near future. The simulation results for solution model evaluated the cost of workers in the amount **18 175€.**

The simulation of the proposal proved that the management's proposal is well-founded and can save **15**% of the salary costs.

It will also reduce the processing time of 3hours on average per contract. In year 2016, company have 4400 contracts, so they can save **12 000** hours with this solution. The proposal should also prevent the creation of internal complaints in the enterprise that have emerged as a result of information noise.

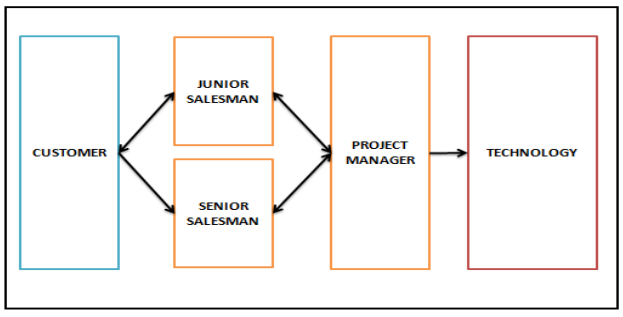

Figure 8. New organization flow

Table 5 shows processing time for solution model.

Type	Processing time
Minimum	0d 5:18:57
Maximum	3d 1:55:08
Average	**1d 1:54:20**

Table 6. Processing time for solution

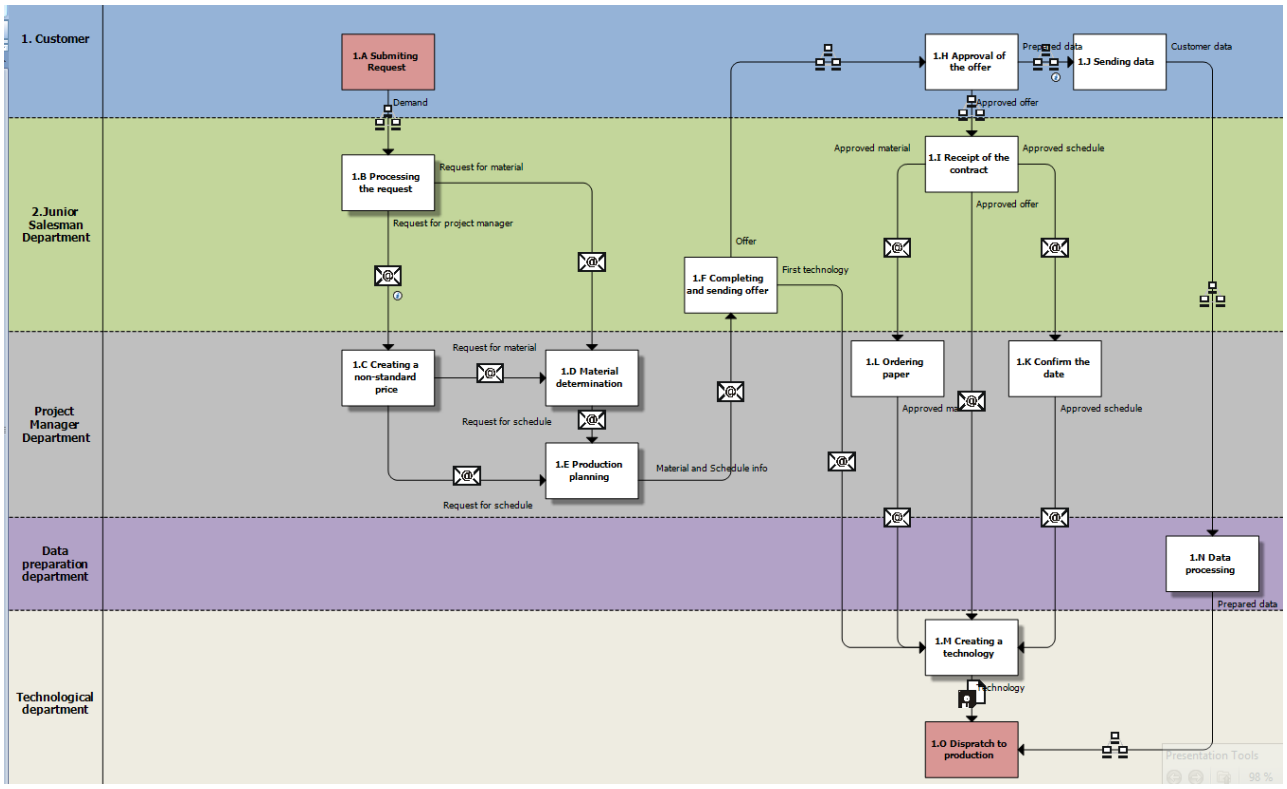

Figure 9. Solution model in software

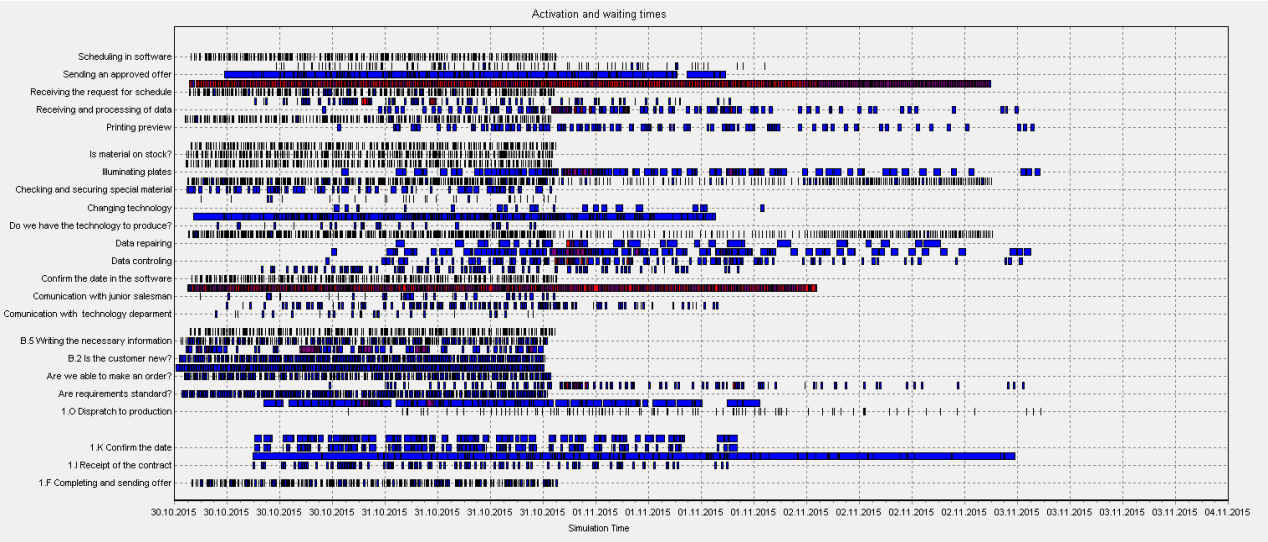

Figure 10. Activation and waiting times in solution design

6 CONCLUSION

Solving these problems requires a lot of time and employees energy. Several tools have been developed to facilitate and streamline this activity. QPR ProcessGuide is a simple and flexible tool that allows you to create a model to keep track of problems and refinements. Through graphs and spreadsheets, it enables clear and aggregate analysis. Everyone in an enterprise can access intranet models, modify them to improve communication within an organization, and significantly reduce the amount of work needed to build communications material. It provides insight into the administrative processes where the hidden wastage of society often occurs.

To sum up, we showed that simulation has substantiation in improving business processes. And can evaluate the proposed changes before they are introduced. This is important factor, when these changes affect employees. Also, more research is needed to better understand the system dynamics. We think that the simulation software QPR ProcessGuide, will allow us conducting such future research.

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