Business Process Management

MASTER DEGREE PROGRAM, DATA SCINCE AND ADVANCED ANALYTICS– MAJOR IN BUSINESS ANALYTICS

CARING PHARMACY

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Introduction

Caring Pharmacy, is a pharmacy based in Portugal that was founded in 1998 and has a presence in Lisbon, Porto, Faro, Coimbra, Santarém, Torres Vedras, Braga, and Évora. The company has over 80 employees that belong to the most diversified departments. However, to reduce costs and optimize the purchasing process, it was necessary to understand, model, analyze and redesign this main process to that end. The process that will serve as an example will be relative to the pharmacy in Lisbon that receives about 220 customers per day, in its normal schedule (10h-18h) every day.

In addition to its optimization, this intervention also stems from some dissatisfaction expressed by customers since the process of this type of service provision is too slow, sometimes needing to extend the opening hours of the pharmacy or in extreme cases, it is not even possible to serve customers.

The Lisbon pharmacy employs 4 pharmacy technicians and 3 pharmacists, receiving €1000 and €1300 respectively.

All processes can be more easily analysed in the Bizagi Modeler file that will be sent along with this report.

Background

For this project focused on Caring Pharmacy, several concepts related to the topic of Business Process Management (BPM) were mentioned. BPM is about overseeing the way work is done in an organization to ensure consistent results and to take advantage of opportunities for improvement.

In this case, our process type is Order-to-cash where the customer fills out a product and it is delivered and paid for. Inside, we have the business process consisting of certain parts:

- Events - Things that occur automatically (no intervention, no duration);
- Tasks - A very simple activity that can be seen as a single unit of work;
- Decision Points - Points when a decision is made that affects the execution of a process. They affect the outcome of a process;
- Actors - Entities ranging from individuals to organizations, to information systems, to physical objects;
- Outcomes - Can be multiple. Characterized as positive (ideally) or negative (avoidable), dependent on whether the same process brought value to the actor(s) involved in the process.

According to the described texts, firstly, we proceeded with the modelling of the AS-IS processes. The AS-IS process shows your current processes - what your organization currently does. It is important to keep in mind that this AS-IS analysis can only show you what can be improved, but not necessarily how. AS-IS process mapping will only reveal your business processes as they currently are.

After the AS-IS models were created, we proceeded to analyse them from a qualitative and quantitative perspective. In the qualitative analysis, 2 analyses were prepared: Value Added Analysis and Waste Analysis. A value-added analysis aims to detect unnecessary steps in a process to eliminate them. Note that a step can be a task or part of a task since some tasks have several steps. As for Residue Analysis, it is the opposite of value-added analysis, since the former analyses steps from the positive perspective, while the latter analyses from the negative. The waste analysis aims to find "waste" along with the processes. Subsequently, the bottlenecks that specify as situations that cause waiting times were mentioned.

In the quantitative analysis, the AS-IS process simulation was created so that it was possible to quantify the final results of the overall process and each of the events, tasks and gateways.

These analyses were crucial to structure and organize the information and findings so that it was possible to establish a what-if analysis and mention the main problems through the issue log. The results include logs, as well as some statistics related to cycle times, average wait times and average resource utilization.

Based on the procedures mentioned above, TO-BE process models were proposed. These models are the result of applying improvement opportunities to the current business environment (AS-IS).

Actors and Processes

For better future orientation, in the activities that take place within the pharmacy, it was necessary to use careful process mapping to understand what exists and what could be changed, to be able to reduce unwanted waiting times. The macro process is an order-to-cash process, which is made up of 4 main processes, which define how the main business that takes place within the pharmacy happens. These 4 processes are:

- Receive Client;
- Enter and Check Prescription;
- Fulfil Order;
- Deliver and Payment.

Inside the pharmacy, we have 3 main actors, namely: the technician, who deals with the customer and bridges the gap between what happens in the back-office and what is requested by the customer; the pharmacist, who works in the back-office, and deals with the manipulation of the various drugs that are sold in the pharmacy; the computer system, which automatically manages tasks related to checks that need to be made whenever a drug is sold. Outside the pharmacy, we have some actors who act like outsiders, these being: The customer, who is the one who commands the action, although not belonging to the internal environment of the process; The doctor, who acts whenever necessary, in case there is a problem with a prescribed medicine or even with the prescription itself; The supplier, who has practically no intervention in the whole process, being only responsible for receiving orders from the pharmacy part, in case there is a stock rupture.

Assumptions

For a more precise and detailed analysis, so that the reader can understand all the steps that have been taken, a list of assumptions has been created and will be presented below:

1. The customer when entering expects to be attended to, since there are only 4 pharmacy technicians ready to attend;

2. All 4 pharmacy technicians are working at the same time, without breaks, on the pre-established schedule (There is no reference to the fact of any breaks that may exist);

3. When the drug is replaced due to the policies of each insurance, it is replaced by a generic drug. Thus, it is assumed that the substitute product is a generic drug;

4. After the order is prepared for shipping, it is assumed that the client always has enough money so that he/she can pay for the order, and there is no scenario in which the entire process is cancelled;

5. After the order is ready for shipping, it is assumed that all payment services are operational;

6. All processes that occur between the pharmacy and the insurance company are automatic, so there is no need to create an actor for this purpose;

7. In the association of times, a base value of 10% variation was considered, for eventual delays or advances. This association is considered for all cases in which the time is variable, and is therefore not a fixed time;

8. All the products the pharmacy sells are considered as drugs;

9. For the gateway present in the Receive Client process, which is relative to whether the prescription is in paper format or electronic message format, a 50/50 split in the probability of one of these events happening was considered;

10. The pharmacist works in a back-office, so there is no direct contact with the customer (face-to-face);

11. The technician checks the stock of medicine in the pharmacy system.

AS-IS Business Process

Order-to-Cash

Let's start with our macro process. This process consists of two major subprocesses, these being "Receive Client" and "Deliver and Payment", as can be seen in Figure 1.

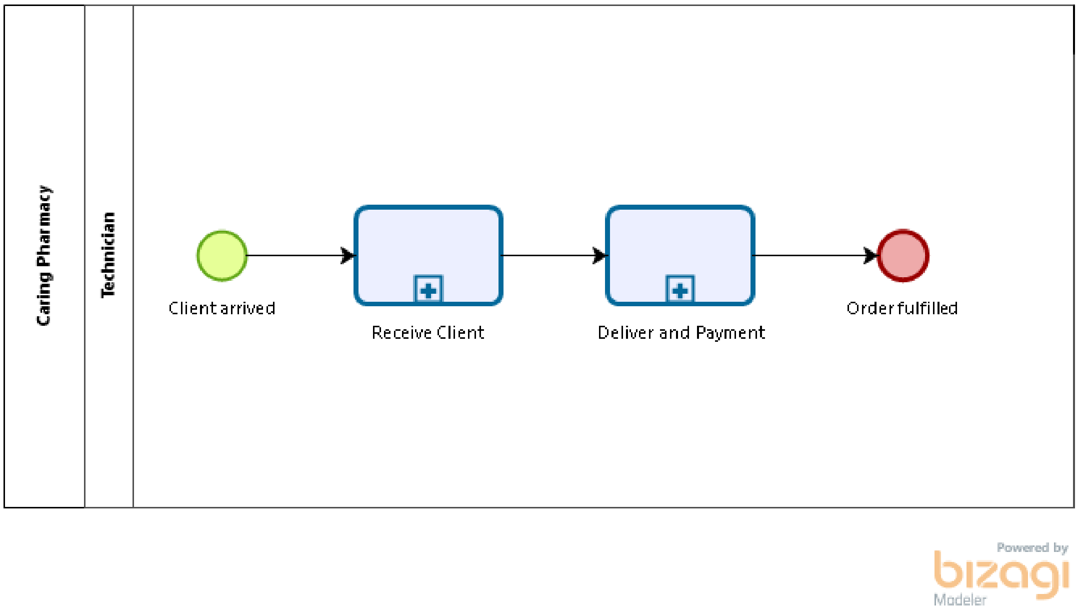

Figure 1. Order-to-Cash

As can be seen, the macro-process is only performed by the pharmacy technician, inside the pharmacy.

Receive Client

The "Receive Client" process, which turns out to be one of the sub-processes of our macro-process, consists of the iteration between the pharmacy technician and the client. The focus of this process is the reception that is done to the client, and that will lead to all the decision-making processes that will be done thereafter. As can be seen in Figure 2, the process is divided into several phases, and it is necessary to understand what the customer wants to buy, whether or not he has a prescription. If there is a prescription, a new subprocess will be started called "Enter and Check Prescription", if there is no prescription, the order goes directly to the "Fulfill Order" subprocess. There are also cases in which the order made by the customer ends, because the necessary conditions for the sale of a certain medicine, that the customer required, do not exist.

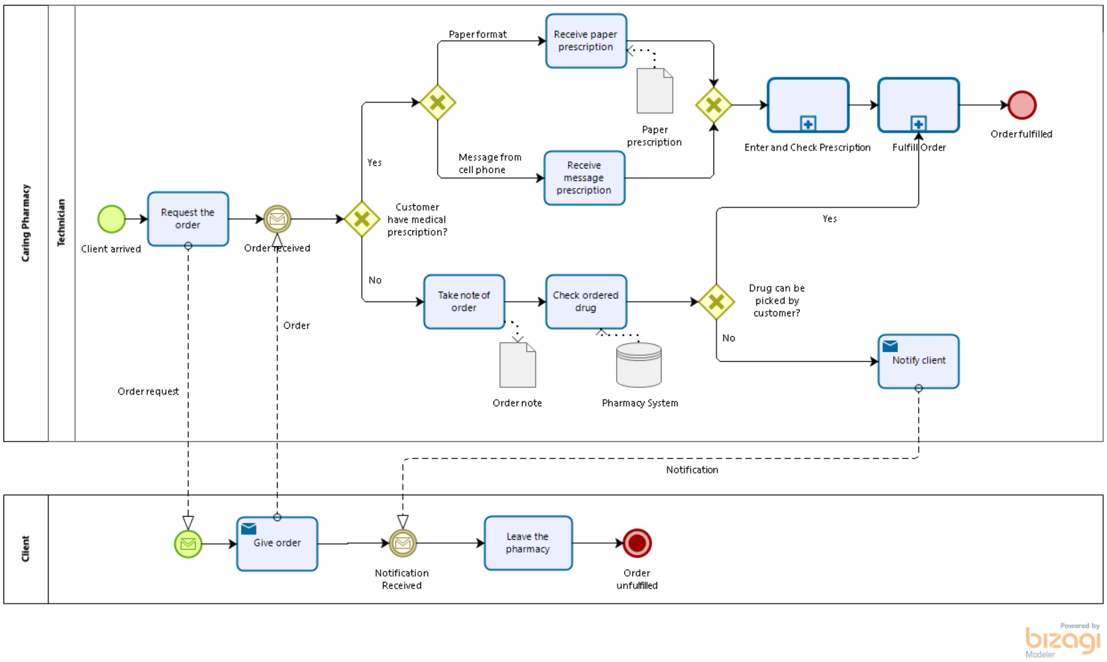

Figure 2. Receive Client

So, let's look at cases where there is a prescription from the client. How will the process then proceed?

Enter and Check Prescription

This process we are looking at is a bit more complex and consists of the 3 actors that are part of the pharmacy (technician, pharmacist, and computer system), but also the customer and the customer's doctor. As can be seen in the Figure 3, several procedures are performed to certify a particular drug that may be administered by the client. There is thus a verification by the computer system, about the viability of taking the medicine that was prescribed by the doctor. If there is a need to review what was prescribed by the doctor, it may be necessary to talk to the doctor, so that he or she can indicate if there was an error with the prescription or if there was simply no error, and the drug can be sold to the customer. After this security check, payment policies are activated by the customer's insurance companies. If there is a need to replace one of the drugs, a subprocess called "Drug Replacement" was created that will briefly explain this exchange. There is also another alternative, the eventual delivery of a new electronic prescription by the doctor, which will trigger the need to check everything again. If this possibility cannot exist, the process ends for the customer, who will have to come back another day to complete his order.

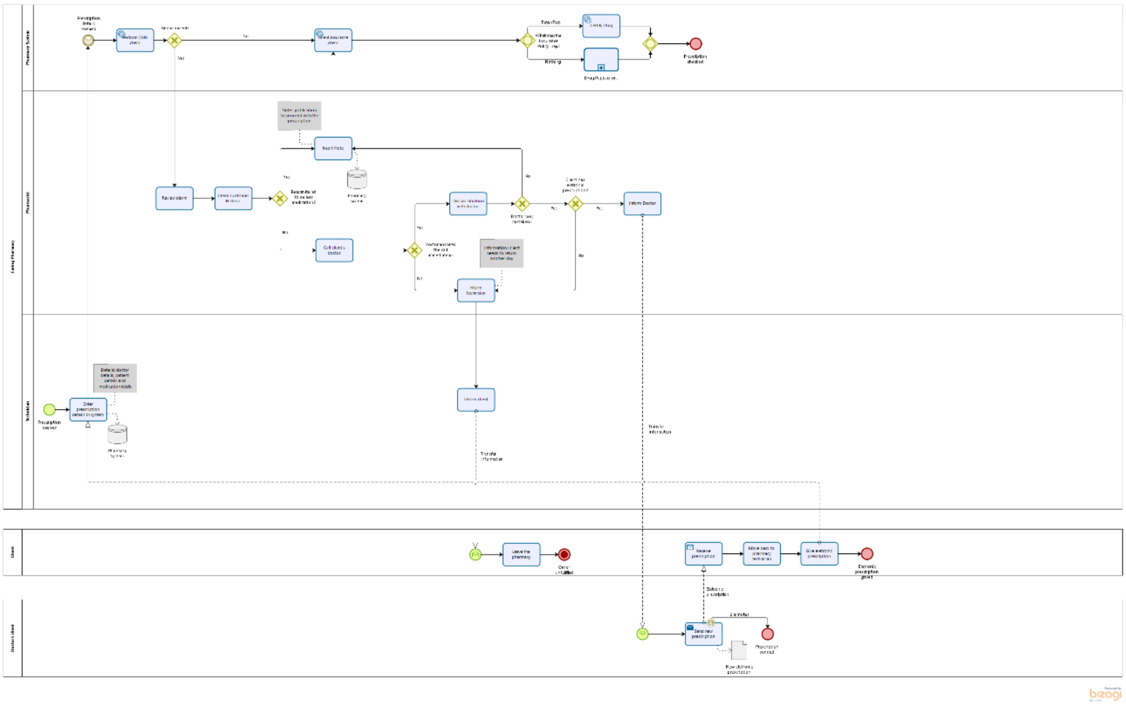

Figure 3. Enter and Check Prescription

Drug Replacement

This process takes place in the presence of the pharmacy technician, the pharmacist, and the customer, and aims to replace a drug. After checking the policies of the client's insurance company, it is sometimes necessary to call the patient's doctor to explain the situation, but the doctor does not always answer, which may lead to the client having to pay for the medication in full. The customer doesn't always pay for it, and if he does, he comes back another day with a new prescription, starting the order-to-cash process all over again (Figure 4).

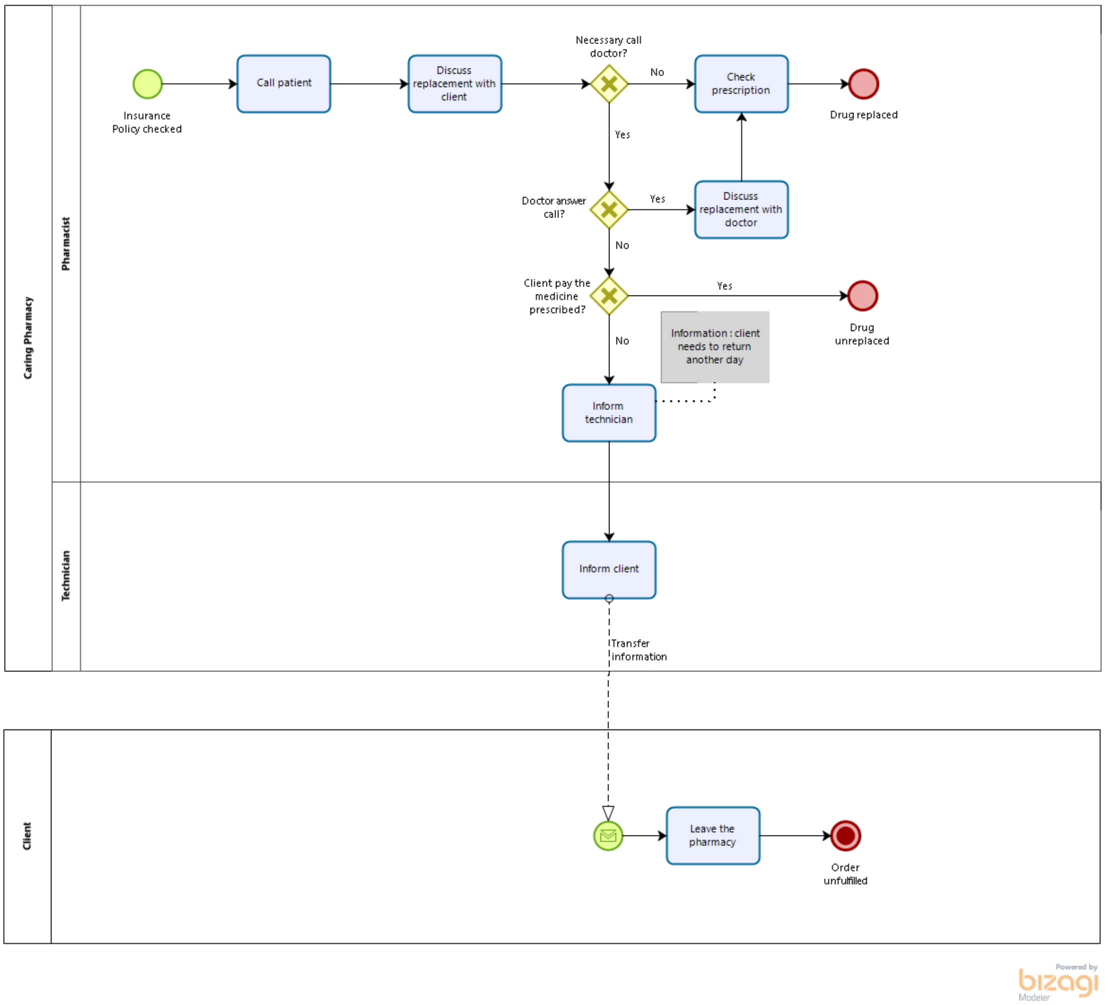

Figure 4. Drug Replacement

Fulfill Order

After the prescription check and customer receiving processes have been done, we proceed with this process that consists of the pharmacist, the technician, the customer, and the supplier who has only a small role in the whole process. The goal of this process is to obtain the medicine that was selected before, however, lack of stock can be a problem that will lead to waiting times that need to be analysed. The absence of a particular drug may lead to its substitution (Figure 4) or even to the pharmacy ordering the drug from its supplier. If there is a need to order this product, the customer will have to come back another day when the drug becomes available (Figure 5).

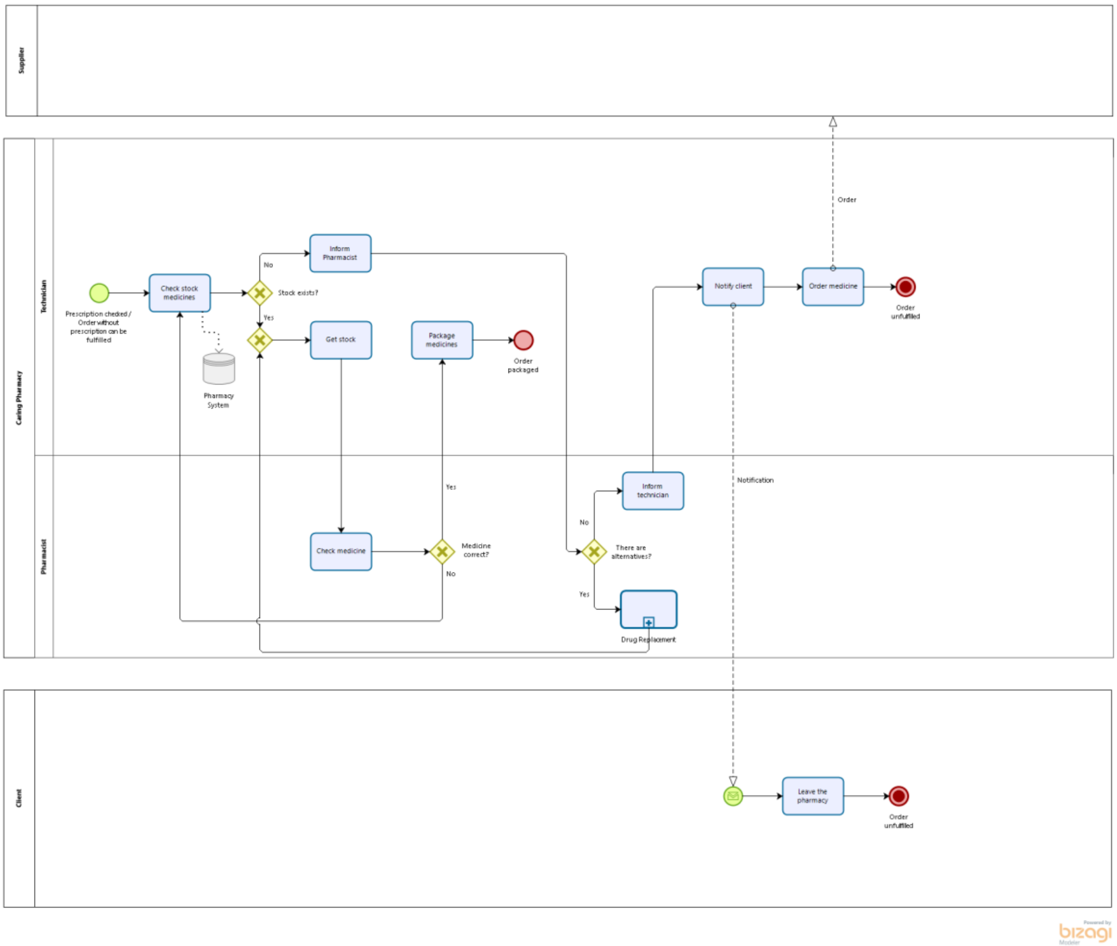

Figure 5. Fulfill Order

Deliver and Payment

Finally, after all the previous processes are completed, the customer pays, and the pharmacy technician delivers the medicine to the customer (Figure 6).

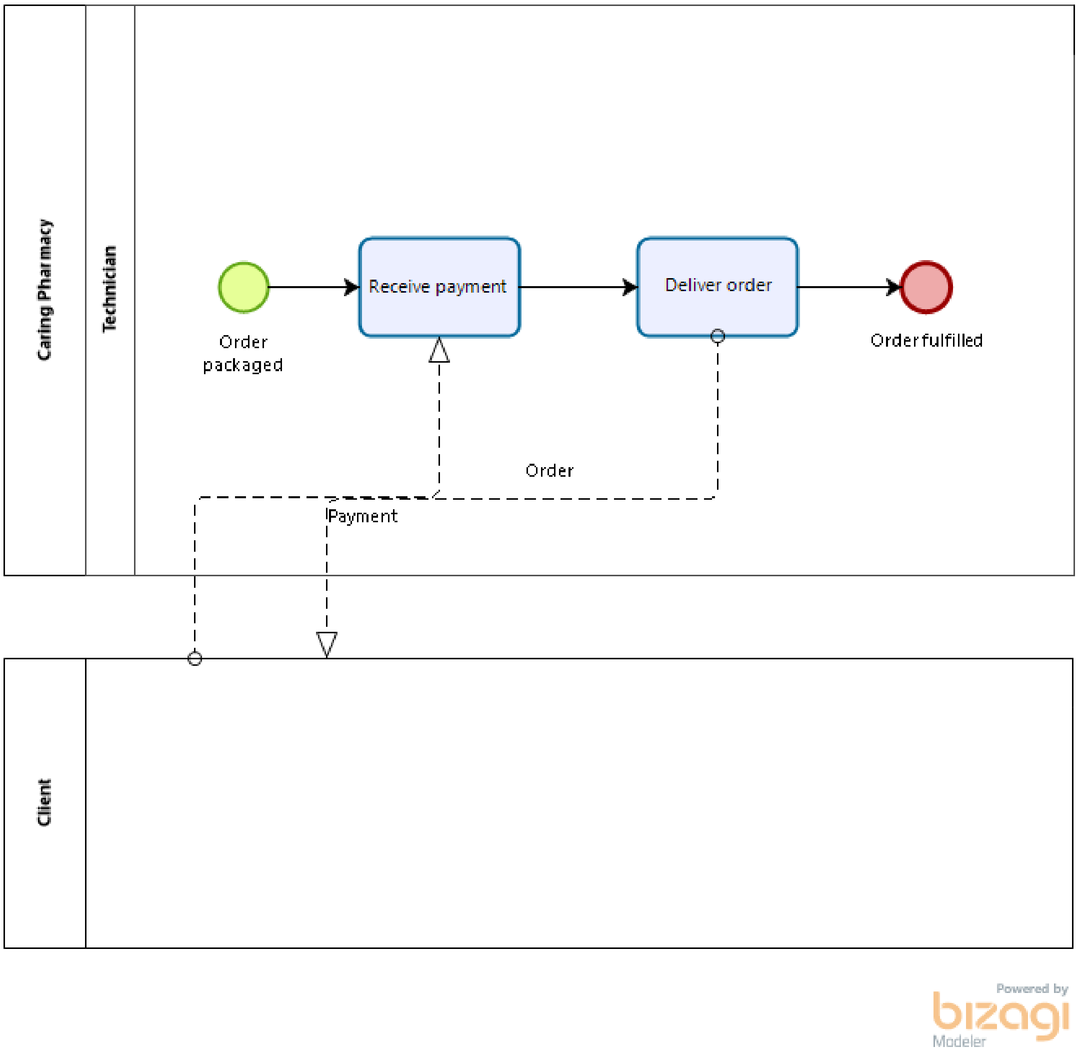

Figure 6. Deliver and Payment

Qualitative Process Analysis

Value Added Analysis

Process	Step	Performer	Classification
Order-to-cash	Receive Client	Technician	VA
	Deliver and Payment	Technician	VA
Receive Client	Request the order	Technician	NVA
	Give order	Client	VA
	Take note of order	Technician	NVA
	Check ordered drug	Technician	BVA
	Notify Client	Technician	VA
	Leave the Pharmacy	Client	NVA
	Receive paper prescription	Technician	BVA
	Receive message prescription	Technician	BVA
	Enter and Check Prescription	Technician	VA
	Fulfill Order	Technician	VA

Enter and Check Prescription	Enter prescription details	Technician	BVA
	Perform DUR check	Pharmacy System	BVA
	Review alarm	Pharmacist	NVA
	Check client history	Pharmacist	VA
	Insert Note	Pharmacist	NVA
	Call client's doctor	Pharmacist	VA
	Discuss situation with doctor	Pharmacist	VA
	Inform Technician	Pharmacist	NVA
	Inform Doctor	Pharmacist	VA
	Inform client	Technician	VA
	Leave the Pharmacy	Client	NVA
	Send new prescription	Doctor's Client	NVA
	Receive prescription	Client	NVA
	Move back to Technician	Client	NVA
	Give electronic prescription	Client	NVA
	Check client insurance	Pharmacy System	VA
	Certify drug	Pharmacy System	VA
	Drug replacement	Pharmacy System	VA

Drug Replacement	Call patient	Pharmacist	VA
	Discuss Replacement with client	Pharmacist	VA
	Check prescription	Pharmacist	BVA
	Discuss Replacement with doctor	Pharmacist	VA
	Inform Technician	Pharmacist	NVA
	Inform client	Technician	VA
	Leave the Pharmacy	Client	NVA
Fulfill Order	Check stock medicines	Technician	BVA
	Get Stock	Technician	NVA
	Check medicine	Pharmacist	VA
	Package medicines	Technician	VA
	Inform Pharmacist	Technician	NVA
	Drug replacement	Pharmacist	VA
	Inform Technician	Pharmacist	NVA
	Notify Client	Technician	VA
	Order medicine	Technician	BVA
	Leave the Pharmacy	Client	NVA
Deliver and Payment	Receive payment	Technician	BVA
	Deliver Order	Technician	VA

Waste Analysis

Category	Waste Type	Tasks
MOVE	Transportation	Client receive new electronic prescription from doctor
		Client gives electronic prescription to Technician
	Motion	Pharmacist goes inform Technician that the client needs to return another day
		Client moves back to Technician
		Pharmacist goes inform Technician that the client needs to return another day
		Technician get stock
		Technician goes inform Pharmacist that doesn't exist stock
		Pharmacist goes inform Technician that there are no alternatives
HOLD	Inventory	Client waits for new electronic prescription from doctor
	Waiting	Pharmacist waits for new electronic prescription from doctor
OVER-DO	Defects	Doctor sends new electronic prescription to client
	Over Processing	Technician request order to client
		Pharmacist review alarm raised
		Pharmacist insert note with justification for prescription
	Over Production	Technician take note of client order

Bottlenecks

Bottlenecks are all tasks/activities that cause waiting times and generally correspond to all situations that represent handovers (constant passing of process flow between participants)

The bottleneck identification was done by checking the value-added analysis and reading the simulation results, specifically, in the Avg. Time waiting for a resource.

Through the value-added analysis, it is possible to detect a task that causes waiting time, namely: "Pharmacist waits for a new electronic prescription from the doctor". This activity requires a 2-minute wait.

From the simulation results, we can verify through the following image the first 10 tasks that have the highest Avg. time waiting for a resource. All these activities are the ones that have an average time greater than 1 minute.

In conclusion, we considered as bottlenecks the task "Pharmacist waits for a new electronic prescription from the doctor" along with the 10 activities represented below (Figure 7).

Name	Type	Instances completed	Instances started	Min. time	Max. time	Avg. time	Total time	Min. time waiting resource	Max. time waiting resource	Avg. time waiting for resource
Call client's doctor	Task	8	8	0	3m	1m 19s	10m 33s	0	3m	1m 19s
Review alarm	Task	67	67	0	4m 2s	1m 16s	1h 25m 17s	0	4m 2s	1m 16s
Check medicine	Task	185	185	23s	4m 52s	1m 45s	5h 26m 23s	0	4m 30s	1m 15s
Inform Client	Task	8	8	0	4m 7s	1m 15s	10m 5s	0	4m 7s	1m 15s
Insert Note	Task	61	61	25s	4m 31s	1m 45s	1h 47m 44s	0	4m 5s	1m 15s
Inform technician	Task	22	22	0	4m 1s	1m 13s	26m 59s	0	4m 1s	1m 13s
Discuss replacement	Task	16	16	4m 56s	7m 41s	6m 12s	1h 39m 23s	0	3m 30s	1m 12s
Call patient	Task	180	180	0	5m 23s	1m 8s	3h 25m 1s	0	5m 23s	1m 8s
Check prescription	Task	172	172	0	4m 40s	1m 6s	3h 10m 20s	0	4m 40s	1m 6s
Check Customer Historic	Task	67	67	48s	4m 57s	2m 2s	2h 16m 23s	0	3m 55s	1m 2s

Figure 7. Main Bottlenecks of the Process

Quantitative Process Analysis

Simulation AS-IS

To make a simulation it is necessary to group all the processes that took place in AS-IS so that there is only one lane (actions that take place inside the pharmacy) and with all the pools (actors that the pharmacy contains) that make it up. Thus, 4 Milestones were created, corresponding to our main processes, which are: "Receive Client", "Enter and Check Prescription", "Fulfill Order" and "Deliver and Payment" (Figure 8). Once again, it's better if the Bizagi Modeler is checked to analyze this.

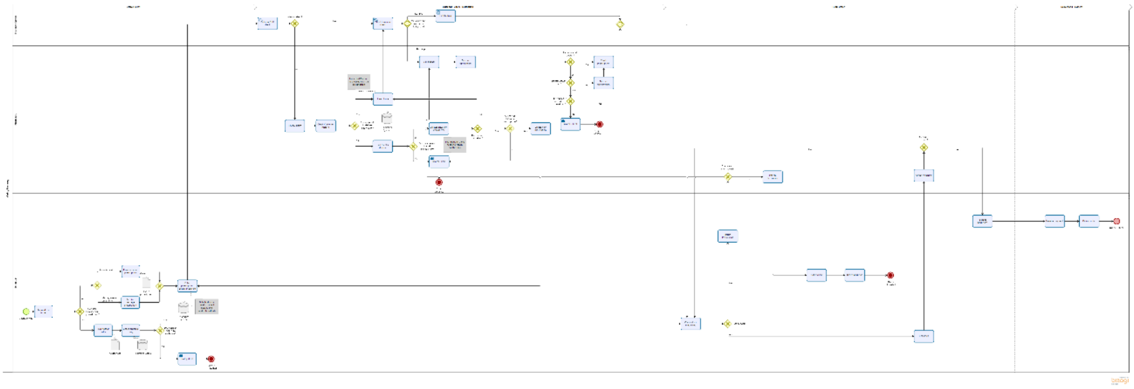

Figure 8. Simulation

After all times, percentage variations, delays, and resources were allocated, we proceeded to the verification and analysis of the results. This can be verified in the .csv file that will be part of the delivery, named "Simulation Output AS-IS".

First, when analysing the utilization of the resources that are predetermined in the pharmacy structure, the results are not bad, as they show a utilization rate in both cases of almost 90% (Figure 9), and it is a result that makes some sense in what would be expected before analysing this factor. However, the problems that the pharmacy faces remain unsolved, and therefore, it is necessary to analyze in detail, task by task, to understand what times are being misspent, what times could be changed, and/or even what task flows could be omitted to increase customer satisfaction?

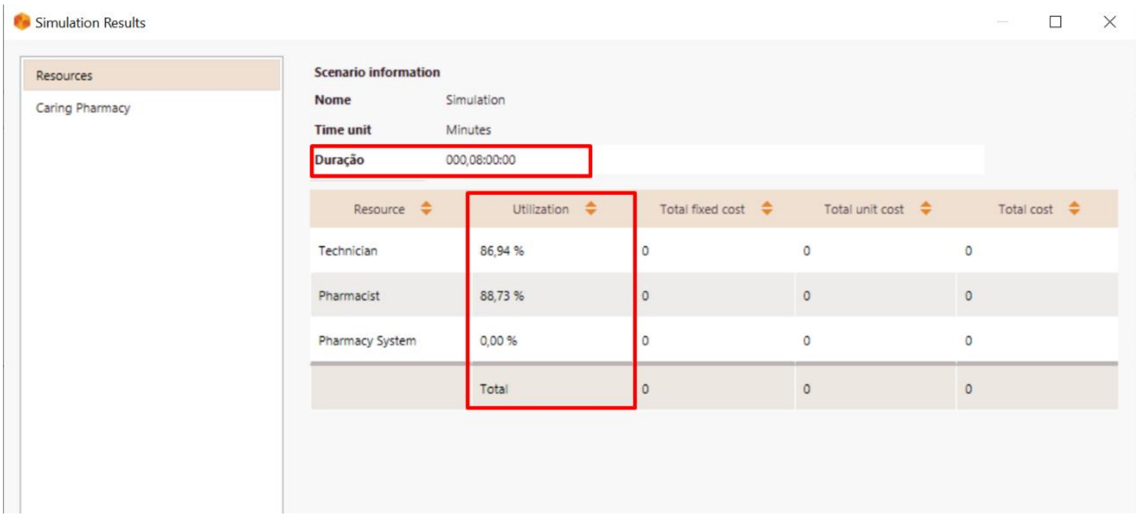

Figure 9. Utilization of Resources

Moving on now to the detailed analysis, to know how long each task takes and what waiting times we have, let's analyze the following (Figure 10).

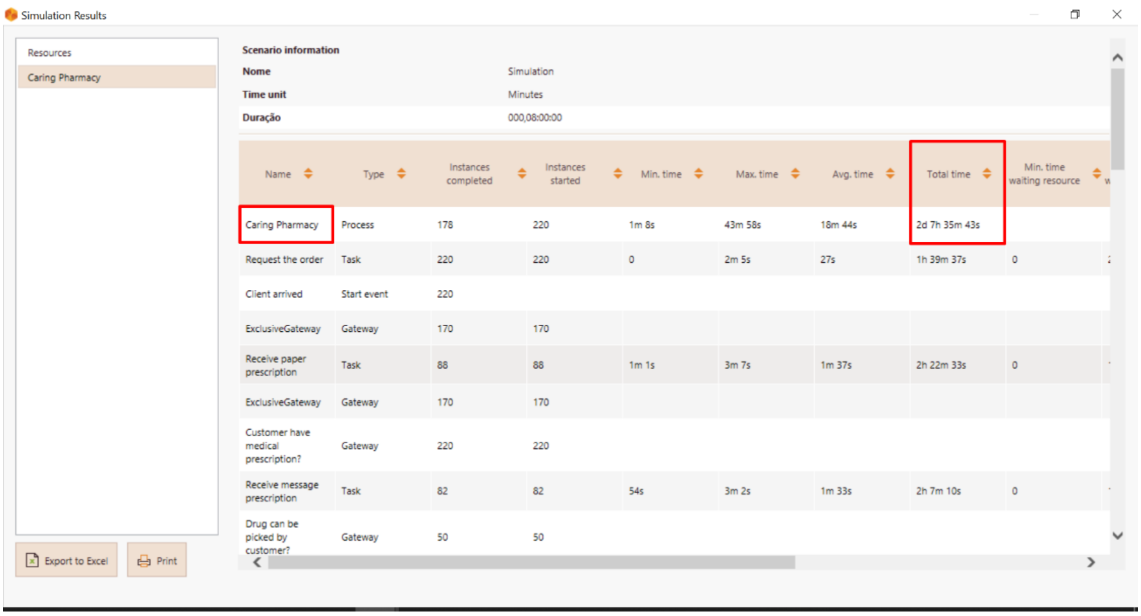

Figure 10. Total Time of the Process

The total time that is presented to us, is a terrible time to carry out 220 daily processes. This factor tells us that in an 8-hour day with these results, a good portion of the customers would not be served, since they are far beyond the normal working hours expected in the pharmacy. Each customer takes an average of 15 minutes to be served (2 days 7 hours 35 minutes and 43 seconds / 220 customers). This can be justified by the various scenarios that can occur within the pharmacy, leading to long-time processes. But is the waiting time also very high?

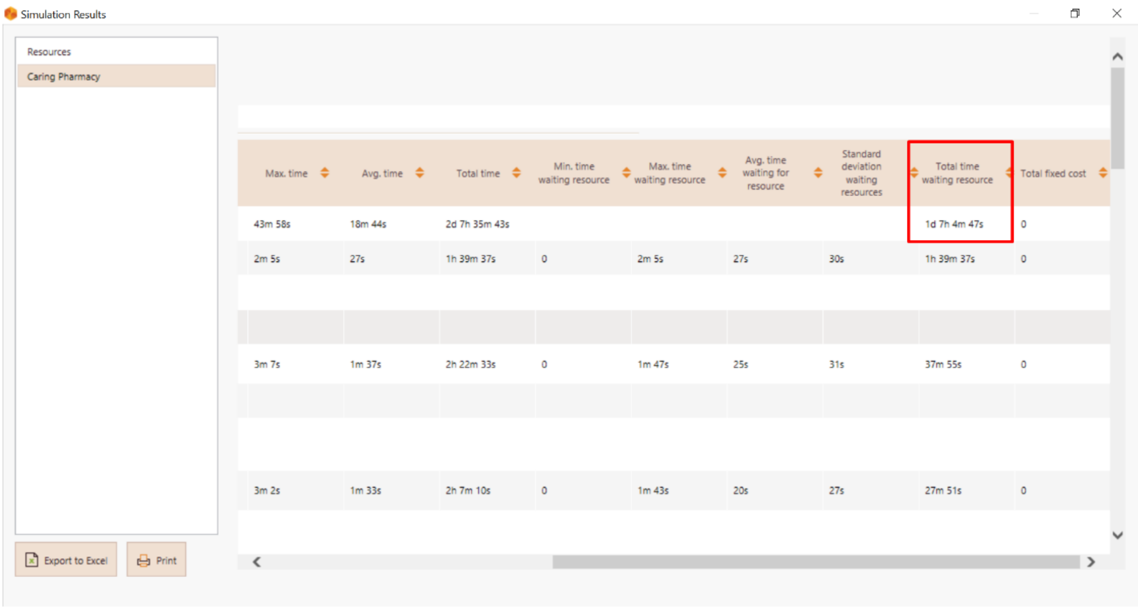

Figure 11. Total Time Waiting Resource

From the analysis in Figure 11, the waiting time between tasks is too high and could be one of the main problems the pharmacy is facing at the moment. Each customer loses an average of 8.5 minutes (1 day 7 hours 4 minutes 47 seconds / 220 customers) in waiting time each time they are part of one of the processes. Thus, it becomes extremely important to know which tasks of this very process have long delay times, because it may be necessary to explore new ways to reduce this problem.

Issue Register

Issue	Priority	Description	Data and assumptions	Qualitative impact	Quantitative impact
Issue 1: Takes note of order unnecessarily	3	After client gives the order, Technician takes note of client order and there's no mention that he will use it, being an unnecessary step	50 clients without prescription each day give order to 1 of 4 Technicians. This task has an average time of 0,72 minutes (43 seconds)		(50/4)*43=537,5sec 537,5/60=9min Total time waiting resource: 15m41s
Issue 2: Review alarm raised by the system	2	After system preform DUR check and raise the alarm, pharmacist review it to perform a more exhaustive check	67 clients give prescription and the alarm is raised. 1 of 3 Pharmacists review this alarm. The review takes about 1m16 of average time (76 seconds)	Employers doesn't trust in theirs informatic systems	(67/3)*76=1697,3sec 1697,3/60=28,3min Total time waiting resource: 1h25m17sec
Issue 3: Pharmacist inform Technician for latter inform client unnecessarily	2	When doctor doesn't answer the calls or client doesn't have electronic prescription,	The pharmacist works in a back-office, so there is no direct contact with the customer (face-to-face).	Doesn´t make sense pharmacist pass information to technician when he can call to client or make	

		Pharmacist inform Technician that he needs to return another day and Technician informs client		contact with him and even create a relationship.	
Issue 4: Client and Pharmacist waiting for new electronic prescription	2	To found reason to deliver drug to customer, pharmacist needs to call client's doctor and if he was mistaken and client has electronic prescription, doctor will create a new one and client and pharmacist waits until it's sent	Client and pharmacist waits during to 2minutes. For each these tasks occurs 1 time.		1*2=2min per each electronic prescription creation
Issue 5: Technician moves to get the stock	1	After technician check the medicines stock in the	185 times 1 of 4 technicians get the stock. This task takes 1,2 minutes		(185/4)*1,2=55,5 min

		system and realised that exists, he goes to get it	of average time.		
Issue 6: Technician get stock	1	If stock exists, technician needs to get stock moving to warehouse	1 Technician in 4 goes get stock 185 times. This task takes 1,21 minutes of average time		(185/4)*1,21=55, 96min
Issue 7: Order medicine by Technician	2	After realising that doesn't exist stock and there are no alternatives to satisfy the client, Technician have to notify client of the situation and only after these events Technician proceeds with the order medicine task.	This task happens with 22 clients for 1 of 4 Technicians. Has 2,1 minutes of average time	Not having an automatic system that does the orders leads to customer dissatisfaction because pharmacy employees don't have required drugs of clients	(22/4)*2,1=11,55 min

What-if Analysis

The what-if analysis is based on the analysis of the results obtained from the simulation that was done earlier. Thus, several scenarios will be presented with their positives and negatives, indicating what costs and benefits, could come, from a possible decision making by the pharmacy's management. All the results will be highlighted right after the presentation of the different cases.

The doctor is no longer part of the process

With the removal of the possibility of the doctor's intervention in the whole process of selling to the client, it will be possible to gain a lot of time in terms of total, as well as, waiting times. However, this would imply changing the process itself and could jeopardize the quality of service expected by the client. It is therefore advisable to understand the real need for this procedure to remain part of the process.

Hire 1 Technician

By hiring a technician, the duration and waiting times of tasks will go down considerably. However, this will incur a cost of €1000.

Hire 1 Technician and 1 Pharmacist

By hiring a technician and a pharmacist, the duration and waiting times of tasks would seriously go down considerably. However, this will incur a cost of €2300.

Remove Check Medicine Task

When removing the "Check Medicine" task, we need to ensure with a high confidence rate that the medicine is correct. This will incur a cost, so there is a possibility to make this task an automatic task. This could happen if the pharmacy wants to implement an internal automatic medication dispensing system. The cost is a bit uncertain, as we would need more data to conclude this factor.

Remove Review Alarm and Check Customer Historic Tasks

By removing the "Review Alarm" and "Check Customer Historic" tasks, it will be possible to save time that is very relevant for the whole process. However, to remove these tasks we would need to ensure that the tasks are still performed automatically. This would imply a cost, again a bit uncertain, as we would need more information. By making these tasks automatic, whenever after performing the "DUR Check" if there was an alarm triggered, the system would compare the drug analysed with the customer's history, comparing the components of the drug to any allergies and/or derivatives seen in the past.

Remove Take Note of Order and Check Ordered Drug Tasks

With the implementation of an app to be developed, in which the goal would be to be used by customers who do not have a medical prescription. Before arriving at the store, the customer would have already placed his order in the app, and would only need to go to the pharmacy to pick up the medicines. The cost is uncertain because we would need more information. Implementing such a system would increase the speed with which the process would be carried out, however, in addition to the cost of creating this app, there would be a risk that the pharmacy management would have to assume, since, for an older population, such technology could be a little difficult to iterate, and could even lead to the loss of these customers.

Transform Order Medicine into an Automatic Task

By transforming the "Order Medicine" task into an automatic task, a minimum limit could be set for each medicine, thus ensuring that the stock of that medicine would never run out and would be automatically ordered from the supplier as soon as this minimum limit was reached. The cost is uncertain, but it would ensure that many of the customers who leave the pharmacy unhappy because they did not get the medicine, would get that medicine, thus offsetting any cost this implementation might have.

Everything Above

By implementing all of the above we could drastically reduce task duration times as well as waiting times. However, this may not be feasible, given any tasks that are too critical for pharmacy management.

Comparing Analysis

As can be seen in Figure 12 and Figure 13, the only scenario where there is a good resource allocation for both the pharmacist as well as the pharmacy technician is scenario 4, which corresponds to removing the "check medicine" task. In both cases, the top 3 resource allocation scenarios are highlighted.

Resource	Scenario	Utilization	Total fixed cost	Total unit cost	Total cost
Technician	Simulation	79,81 %	0	0	0
Technician	Scenario 1 - Doctor	92,94 %	0	0	0
Technician	Scenario 2 - +1 Technician	75,19 %	0	0	0
Technician	Scenario 3 - +1 Both	75,22 %	0	0	0
Technician	Scenario 4- Tirar Check Medicine	88,11 %	0	0	0
Technician	Scenario 5 - Alarm into Auto Task	91,37 %	0	0	0
Technician	Scenario 6 - Take Note	75,33 %	0	0	0
Technician	Scenario 8- Everything	55,17 %	0	0	0
Technician	Scenario 7 - Tirar Order Medicine	81,15 %	0	0	0

Figure 12. Technician Utilization

Pharmacist	Simulation	94,83 %
Pharmacist	Scenario 1 - Doctor	82,06 %
Pharmacist	Scenario 2 - +1 Technician	82,99 %
Pharmacist	Scenario 3 - +1 Both	62,27 %
Pharmacist	Scenario 4- Tirar Check Medicine	86,73 %
Pharmacist	Scenario 5 - Alarm into Auto Task	79,44 %
Pharmacist	Scenario 6 - Take Note	93,51 %
Pharmacist	Scenario 8- Everything	54,04 %
Pharmacist	Scenario 7 - Tirar Order Medicine	95,47 %

Figure 13. Pharmacist Utilization

As for the associated times, from the Figure 14 and Figure 15you can conclude that by modifying the resources that the pharmacy has available, you can significantly reduce the total time and the total waiting time. Regarding the scenario in which all transformations are applied together, it seems clear that it is the one that offers better times, although, to apply it, it is necessary to understand to what extent the pharmacy management is willing to invest.

Name	Scenario	Type	Instances completed	Instances started	Min. time	Max. time	Avg. time	Total time
Caring Pharmacy	Simulation	Process	174	220	1m 13s	1h 1m 52s	27m 41s	3d 8h 17m 34s
Caring Pharmacy	Scenario 1 - Doctor	Process	191	220	59s	23m 38s	12m 27s	1d 15h 40m 34s
Caring Pharmacy	Scenario 2 - +1 Technician	Process	191	220	59s	21m 12s	8m 58s	1d 4h 34m 1s
Caring Pharmacy	Scenario 3 - +1 Both	Process	191	220	59s	17m 38s	7m 44s	1d 38m 53s
Caring Pharmacy	Scenario 4- Tirar Check Medicine	Process	171	220	1m 35s	55m 59s	16m 54s	2d 10m 54s
Caring Pharmacy	Scenario 5 - Alarm into Auto Task	Process	182	220	1m 26s	32m 30s	11m 55s	1d 12h 9m 3s
Caring Pharmacy	Scenario 6 - Take Note	Process	166	220	0	1h 9m 59s	26m 3s	3d 4m 39s
Caring Pharmacy	Scenario 8- Everything	Process	183	220	0	24m 33s	6m 20s	19h 21m 57s
Caring Pharmacy	Scenario 7 - Tirar Order Medicine	Process	171	220	1m 44s	1h 25m 6s	27m 26s	3d 6h 11m 40s

Figure 14. Total Time

Max. time	Avg. time	Total time	Min. time waiting resource	Max. time waiting resource	Avg. time waiting for resource	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
1h 1m 52s	27m 41s	3d 8h 17m 34s					2d 6h 52m 34s	0
23m 38s	12m 27s	1d 15h 40m 34s					16h 5m 12s	0
21m 12s	8m 58s	1d 4h 34m 1s					4h 58m 38s	0
17m 38s	7m 44s	1d 38m 53s					1h 3m 30s	0
55m 59s	16m 54s	2d 10m 54s					1d 38m 29s	0
32m 30s	11m 55s	1d 12h 9m 3s					13h 6m 12s	0
1h 9m 59s	26m 3s	3d 4m 39s					1d 23h 28m 46s	0
24m 33s	6m 20s	19h 21m 57s					25m 46s	0
1h 25m 6s	27m 26s	3d 6h 11m 40s					2d 5h 40m 7s	0

Figure 15. Total Time Waiting Resource

TO-BE Business Process

For TO-BE modelling we then have the following changes:

Order-to-Cash

Regarding the macro process, it didn't suffer any changes, continuing to have only 2 subprocesses.

Receive Client

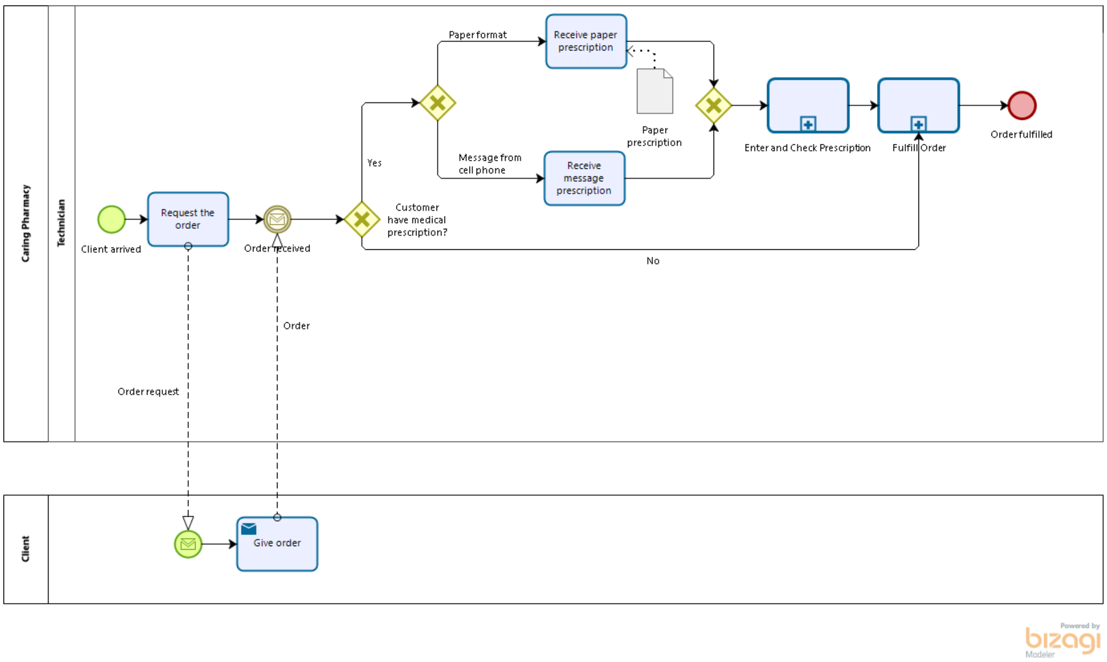

Figure 16. Receive Client

The first major change occurs in the "Receive Client" process. While in the AS-IS model, when a customer did not have a prescription, he would have to go through several tasks until reaching the eventual "Fulfill Order", in the TO-BE modelling it is proposed that whenever the customer does not have a prescription, it is necessary to use the pharmacy's mobile application (Figure 16).

The mobile application to be developed would aim to simplify and speed up all tasks that take place at that moment, giving less waiting time to the customer so that he can proceed with his order, as well as, to the pharmacy itself that would have all tasks related to the non-existence more optimized. Thus, the mobile application would always ask the customer for all the medicines he intends to buy, exercising a kind of medicine order, which would then only need to be picked up at the pharmacy locally. After receiving the customer's order, the app would create a direct link with the customer's history and directly compare the components of the medicine with any allergies or complications the patient may have, thus providing a very fast and effective service. All the processes that take place within the APP could be analysed in the future so that they can be optimized. However, with the creation of this APP, there are some risks to be taken into account. For an older population, which has difficulties with technology could be a problem, since for this process to work this way, we would always need a smartphone, and a set of procedures done by the client. The pharmacy management will therefore have to analyze which customers they have, to understand if they are willing to take this risk. On the other hand, for any customers new to the pharmacy, this procedure would require them to install the pharmacy's app and place an order. In the case of not being a registered customer with a history in the pharmacy, an order form would have to be created, with a QR Code for demonstration at the entrance of the store.

Enter and Check Prescription

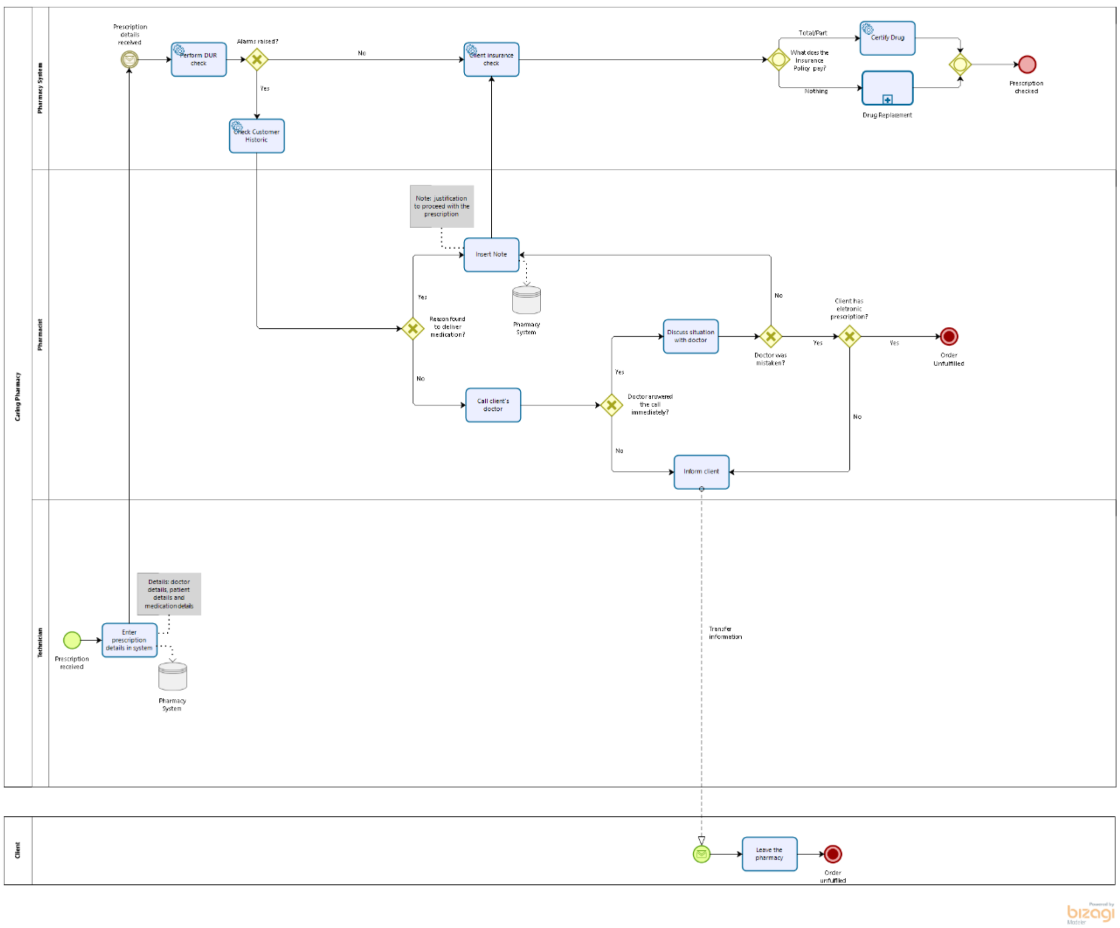

Figure 17. Enter and Check Prescription

Regarding the "Enter and Check Prescription" process (Figure 17), after the "Perform DUR check" task has been performed and if any alarm has been triggered, the "Check Customer Historic" task will be automatic and performed by the pharmacy system, which will directly compare the customer's history with the composition of the drugs the customer intends to buy. This process is done automatically and therefore takes virtually no time at all.

Regarding the creation of a prescription for cases where the doctor has made a mistake, the pharmacy will no longer have a response to this factor, since this whole procedure of obtaining a new electronic prescription was too time-consuming, both for the customer and for those working in the pharmacy (pharmacist). So, if this happens, the customer should come back another day with this situation resolved. However, this brings a negative consequence, since we do not have enough information to state that this is a crucial set of procedures for the operation of the pharmacy. It is not known whether this can be a differentiation factor before other competitors, and for this reason, the proposal we make may go against what the pharmacy's management has pre-established. Still, it is considered that removing this succession of events will have many more benefits for the pharmacy than losses. This is the decision to be made by the pharmacy's management.

Finally, the pharmacist now has a direct relationship with the customer, since it is the customer who informs the pharmacist (not in person) when a customer's request cannot be met. Theoretically, the implementation of this direct link will be beneficial for the final customer to gain confidence in the pharmacy.

Drug Replacement

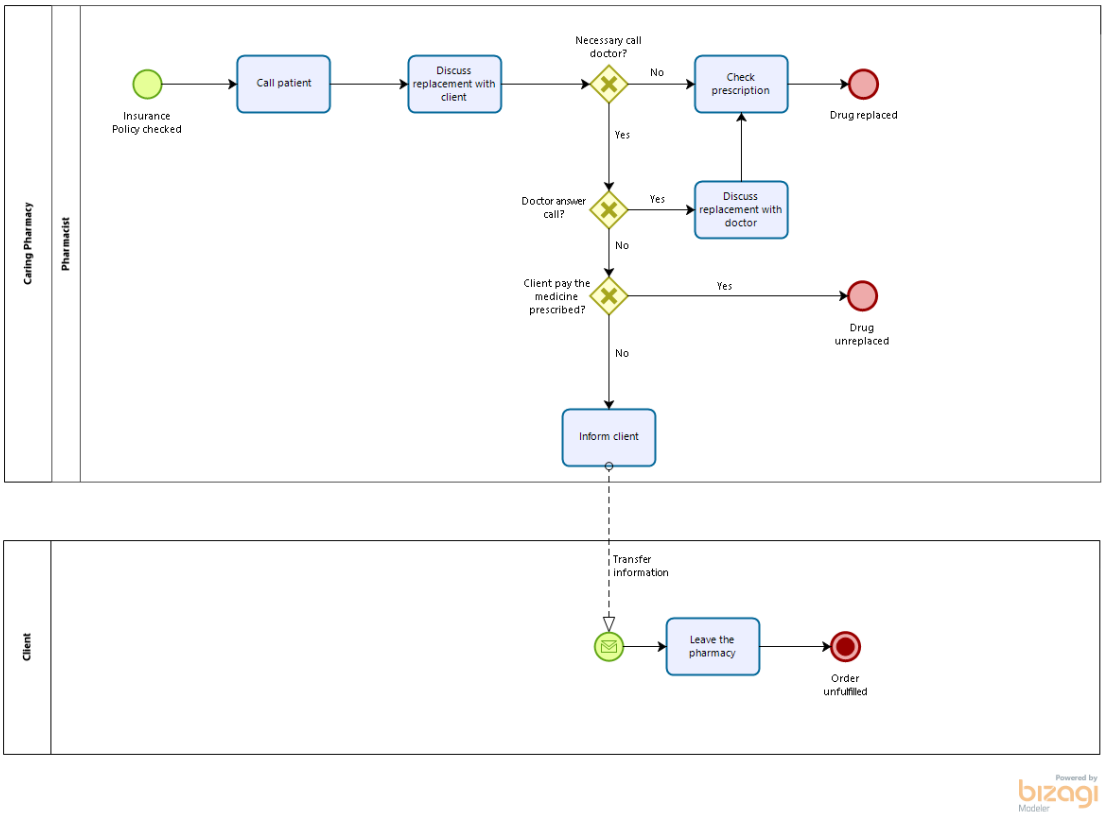

Figure 18. Drug Replacement

In this process (Figure 18), the only change that has been made is the same as in the previous process, that is, the pharmacist now has a direct relationship with the client.

Fulfill Order

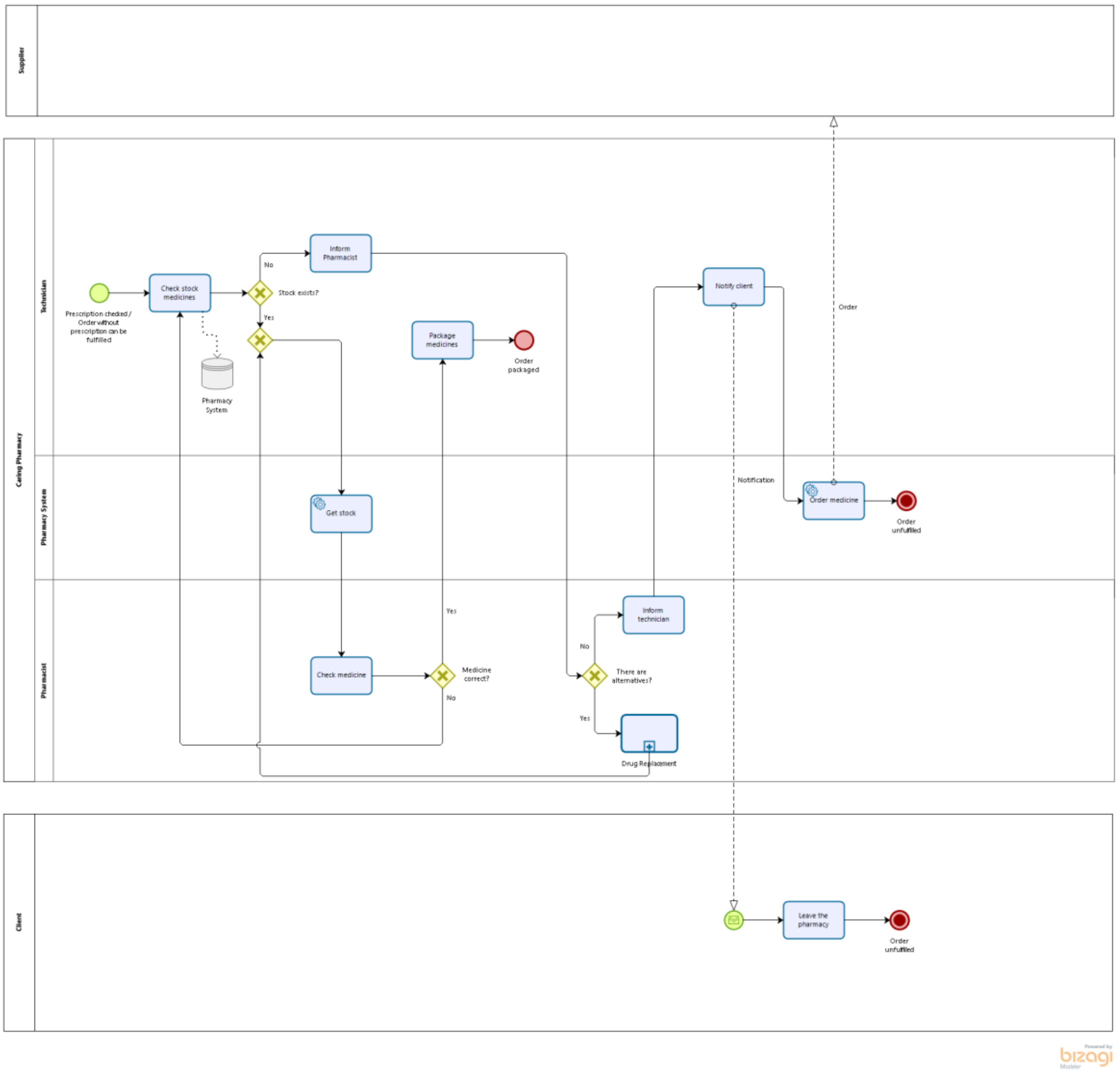

Figure 19. Fulfill Order

Regarding the "Fulfill Order" process (Figure 19), we again have a task that undergoes a change that will incur (uncertain) costs, but that will greatly facilitate the entire current process, as well as future ones, because it can be seen as an investment. It would then require an investment in an automatic medication collection system, where the pharmacy technician will only have to order the medication, which will arrive in a few seconds. Thus, the "Get Stock" task would be performed by the pharmacy system and in an automatic way. Also, the "Order Medicine" task would be automatically performed by the pharmacy system, since whenever it was verified that a certain medicine was ordered by the technician and that there was no stock of it, it would trigger an automatic order to the supplier. This would save time lost by the pharmacy technician, thus making it an automatic task.

Deliver and Payment

The "Deliver and Payment" process also remained unchanged.

Simulation TO-BE

Moving on now to the simulation. After analysing and removing the various tasks that have been done, it has been concluded that there is no need to hire more employees to the pharmacy. In terms of cost/benefit, hiring one more pharmacy technician and one more pharmacist would allow us to gain approximately 1 hour in total time, but given the cost (+€2300/month) and the poor use of the resources available, the best solution is not to hire or fire anyone (Figure 20).

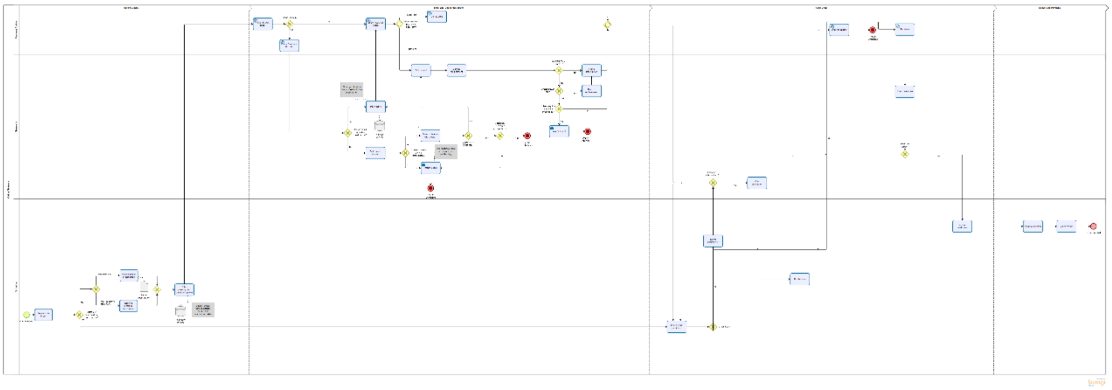

Figure 20. Simulation

Regarding the use of resources (Figure 21), it can be concluded that this is not the best, however, given the drastic decrease in the total process time and especially the near-zero total waiting time, the best option will be to keep all the employees that the pharmacy has.

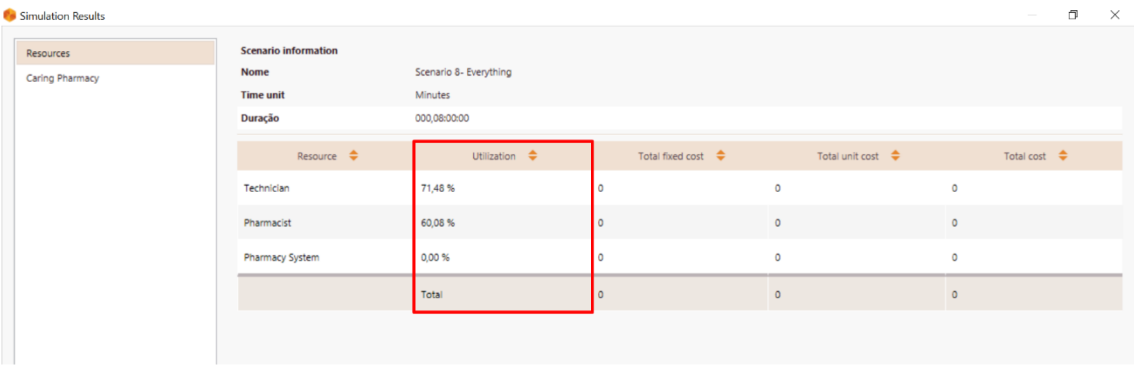

Figure 21. User of Resources in TO-BE

Figure 22. Total Time TO-BE

Figure 23. Total Time of Waiting Resource TO-BE

It is possible to recognize a considerable improvement in the total time values (Figure 22) as well as the improvement in waiting times (Figure 23).

With the removal of the previously mentioned tasks, it was possible to reduce the waiting time between customers, which will certainly meet the pharmacy's wishes. To obtain total times lower than those obtained, the pharmacy management will have to understand which processes it is willing to give up to reconcile with its pre-defined objectives. It is, therefore, necessary to understand if, for example, direct contact with the customer's doctor should continue to exist or not, because, without this contact, it would be possible to considerably reduce customer service times, even though there would be many more cases of customers leaving the store without the medication and/or dissatisfied. Perhaps the creation of an external medication delivery channel could be a good alternative to explore in the future.

Conclusion

From the allocation of resources to the distribution of tasks, there is a real need to optimize all the processes that make up the entire process of selling medicines to the end customer. It is necessary and urgent to understand which activities are crucial to the business, identifying in which points of the process the pharmacy differ from its competitors, as well as which are those activities that the pharmacy management is willing to give up to increase the number of customers it serves per day. In addition to this market study, the pharmacy should also use customer satisfaction surveys (for example) to try to understand what makes its customers prefer this pharmacy to others. Since the customer is the originator of the whole process, we need to understand their needs so that we can adapt the business to them.

Regarding waiting times, without the need to hire or fire people, and by omitting some tasks that were considered less relevant to the process, or even by replacing them with already optimized solutions, it was possible to drastically reduce the waiting times that occur inside the pharmacy, making it a very fluid process. Still, if the existence of the close relationship with the customer's doctor is no longer part of the critical tasks for the pharmacy, it will be possible to have practically no waiting times associated with it, in addition to greatly reducing the total service time for the 220 customers the pharmacy receives per day.

This leaves the need for a meeting with the pharmacy to discuss which points can no longer be part of the process so that a new process can be designed in which, for example, the relationship with the customer's doctor no longer exists.

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