ETPN 2022 Project

Mestrado em Engenharia Informática e Computadores
Department of Computer Science and Engineering
Instituto Superior Técnico, Universidade de Lisboa
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Group 15

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1. Assumptions

1. We assumed that all scripts are of the same monetary value.

2. We assume the ineligible scripts are identified as such by the pharmacy information system.

3. We assume that any issues detected at the quality check are resolved by the pharmacist immediately during the verification of the drugs and their quantities.

4. We assume that since the actions of sealing the filled script in a bag and storing it in the pickup area are described in the pickup section, they are executed by the technician staffing the pickup window.

5. We assume that if a change in pickup time happens while the process has already begun the customer will be asked to wait (as the change is less than an hour before the initial pickup time).

6. We assume that after 7 days the tech at pickup will call the customer to inform them of a deadline of 5 additional days to pick up their script. The technician will then wait another 5 days. If the deadline passes, the script will be stored without effect.

7. We assumed that if the doctor, who would authorize an additional refill, remains unavailable until the customer's planned pickup time, the tech at the data entry will write "Doctor unreachable" on the script's label and place it on the "Dr. Denied box". Also, the tech will contact the Doctor until it is pick up time.

8. We assume that if the drugs are out of stock, the certified pharmacy technician will find the drug's availability in nearby pharmacies and request a drug stock-up.

   a. If the drug is available, they will ask for the customer's availability to pick up the filled prescription at the nearby pharmacy.

      i. If they can pick up the filled prescription at the other pharmacy, the certified pharmacy technician will pass the script to the other pharmacy and inform the client of the change.

      ii. If the customer shows no availability or the drug is not available, they will inform the customer of the delay in pickup time (so the customer can know to come to pick up later).

9. We assume that if a problem is identified in the script while doing the insurance check and that problem cannot be solved, the tech will write in the script "Customer has to pay full amount". In pickup, the tech will verify if that message is written in the script and if it is, the customer will be asked to pay the full amount of the prescription.

2. Opportunity Assessment

2.1. What percentage of defecting customers in 2000 are light users? Same question for heavy users.

We know that 7.2 million defecting regular users = #light users + #heavy users

And 55 million prescriptions = #light users * 5 + #heavy users * 40
As such we can create the following equation system:

7.2M = x + y	⇔ 7.2M - y = x	⇔ —
55M = 5*x + 40*y	55M = 5(7.2M - y) + 40y	55M = 36M - 5y + 40y
⇔ —	⇔ —	⇔ 7.2M - 5 420 857.14 = x
55M - 36M = 35y	19M/35 = y	y = 5 420 857.14

% defected light users = x = 6 657 142.857 light users / 7.2M * 100 = <u>92.46%</u>
% defected heavy users = y = 5 420 857.14 heavy users / 7.2M * 100 = <u>7.54%</u>

2.2. What is the volume of scripts lost annually to light defectors? Same question for heavy defectors?

Total estimate of lost prescriptions in 2000: 55 million
Volume of light scripts:
% defected light users * 55 million = 0.9246 * 55 million = <u>50.853 million</u>

Volume of heavy scripts:
% defected heavy users * 55 million = 0.0754 * 55 million = <u>4.147 million</u>

2.3. How many scripts are filled annually by CVS pharmacies?

In 2000, CVS started with 29.5 million members, lost 7.2 million regular members, and added 8.5 million members. (We can ignore the infrequent members as “infrequent customers contributed so little to the total volume of prescriptions filled by CVS”)

To answer this question, we will assume that the values stay the same as this year and that all incoming and defecting customers are equally distributed throughout the year.

Total members at the end of 2000 = 29.5M - 7.2M + 8.5M = 30.8 million members

Considering that the 7.2 million lost members estimated 55 million prescriptions:

7.2 million m — 55 million p	x = 55 * 30.8 / 7.2
30.8 million m — x million p	= <u>235.2(7) million annual prescriptions</u>

2.4. What is the average revenue per script?

Considering that “55 million annual prescriptions that, had they been filled by CVS, would have contributed to $2.5 billion in revenue”:

0.055 billion — $2.5 billion	x = $2.5 billion / 0.055 billion
1 — $x	= <u>$45 per prescription</u>

2.5. What revenue improvement could be obtained by reducing the defection rate due to poor customer service by 60%?

Improvement on Light users:

0.6 * 0.13 * 0.9246 * 7.2 million = 0.519 million would not defect

Improvement on Heavy users:

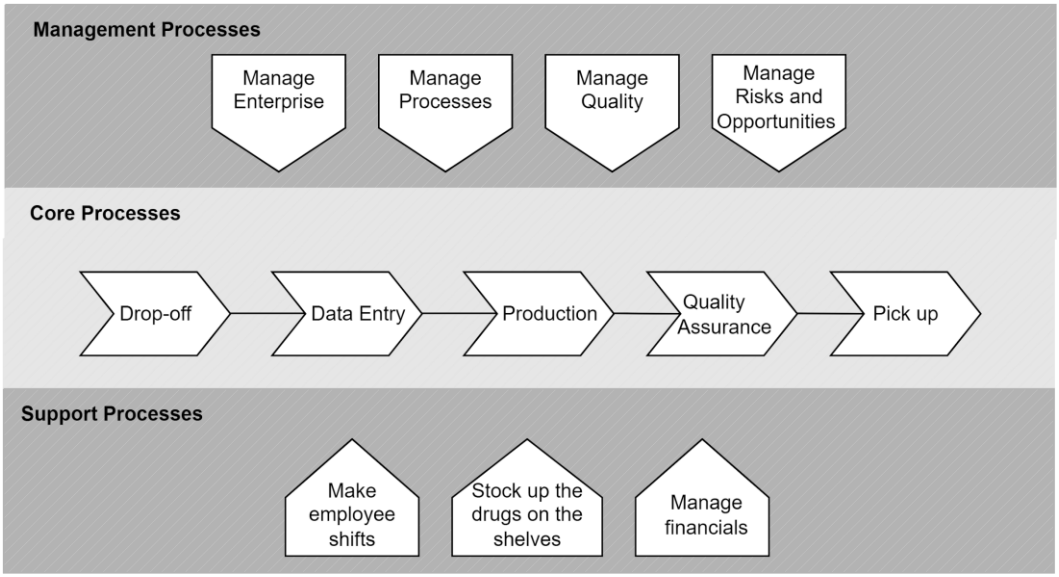
0.6 * 0.44 * 0.0754 * 7.2 million = 0.143 million would not defect

Revenue improvement of Light users: 0.519 million * 5 * $45 = $116.775 million

Revenue improvement of Heavy users: 0.143 million * 40 * $45 = $257.4 million

Total revenue improvement: 116.775M + 257.4M = $374.175 million

3. Business Process Architecture



Name of Process: Drop-off	
Vision: The objective of Drop-off is to receive a script from the customer as well as its pick-up time, registering the pickup time on the script. The final step is to place the script in the correct slot according to the pickup time.	
Process Owner: Technician	
Customer of process: ● Customer	**Expectation of customer:** ● Quick delivery of script and pick up time, so at pick up everything is ready at the expected time.
Outcome: Script delivered and placed in corresponding slot considering pick up time that the customer said.	
Trigger: Received script from customer.	

First activity: Question customer about pick up time
Register pickup time on the script
Last activity: Place script in the slot corresponding to pick up time

Interfaces inbound: Not Applicable
Interfaces outbound: Data Entry

Required resources:
- Human resources: Technician;
- Information, documents: script, pickup time;
- Materials, infrastructure: box divided into hours.

Process Performances Measures:
- Cycle time;
- Error rate.

Name of Process: Data Entry

Vision: Enter prescription data into the pharmacy information system to perform a drug utilization review and an insurance check, to check for any issues regarding the prescription, both related to customer health or payment.

Process Owner: Technician

Customer of process:	**Expectation of customer:**
● Customer	● Careful and conservative check of any issues regarding the drug in the prescription. Identification and correction of problems with insurance and payment of the prescription.

Outcome: Prescription data entered the pharmacy information system and a “Drug utilization review” and Insurance check is performed.

Trigger: The hour of the corresponding slot arrives.

First activity: Take hour’s scripts and enter data into pharmacy information system
Perform automated Drug utilization review
Last activity: Perform Insurance check

Interfaces inbound: Drop-off
Interfaces outbound: Production

Required resources:
- Human resources: Technician;
- Information, documents: script, prescription information and specifics;
- Materials, infrastructure: box with dropped-off scripts, pharmacy information system, computer.

Process Performances Measures:
- Cycle time;
- Error rate.

Name of Process: Production

Vision: The goal of production is to count and verify the drugs to fill the script.

Process Owner: Certified Pharmacy Technician

Customer of process:	**Expectation of customer:**
● Customer	● Script filled with correct drugs in the correct amount.

Outcome: The script is filled with the correct drugs in the correct amount.

Trigger: Data entry was completed

First activity: Count the correct amount of drugs for the script
Last activity: Verify if the drugs are correct for the script.

Interfaces inbound: Data Entry
Interfaces outbound: Quality Assurance

Required resources:
- Human resources: Certified pharmacy technician;
- Information, documents: script;
- Materials, infrastructure: drugs.

Process Performances Measures:
- Cycle time;
- Operational cost;
- Error rate.

Name of Process: Quality Assurance

Vision: The objective of the quality assurance phase is to make sure that filled scripts contain exactly the right drugs in the right quantities and that all other details are correct.

Process Owner: Pharmacist

Customer of process:	**Expectation of customer:**
● Customer	● Script filled and verified in a timely manner.

Outcome: Verified filled script to be delivered to pick up phase

Trigger: Production phase ends

First activity: Verify drugs
Verify drug quantities
Last activity: Verify script details

Interfaces inbound: Production
Interfaces outbound: Pickup

Required resources:
- Human resources: Pharmacist;
- Information, documents: script;
- Materials: drugs.

Process Performances Measures:
- Cycle time;
- Operational costs;
- Error rate.

Name of Process: Pickup

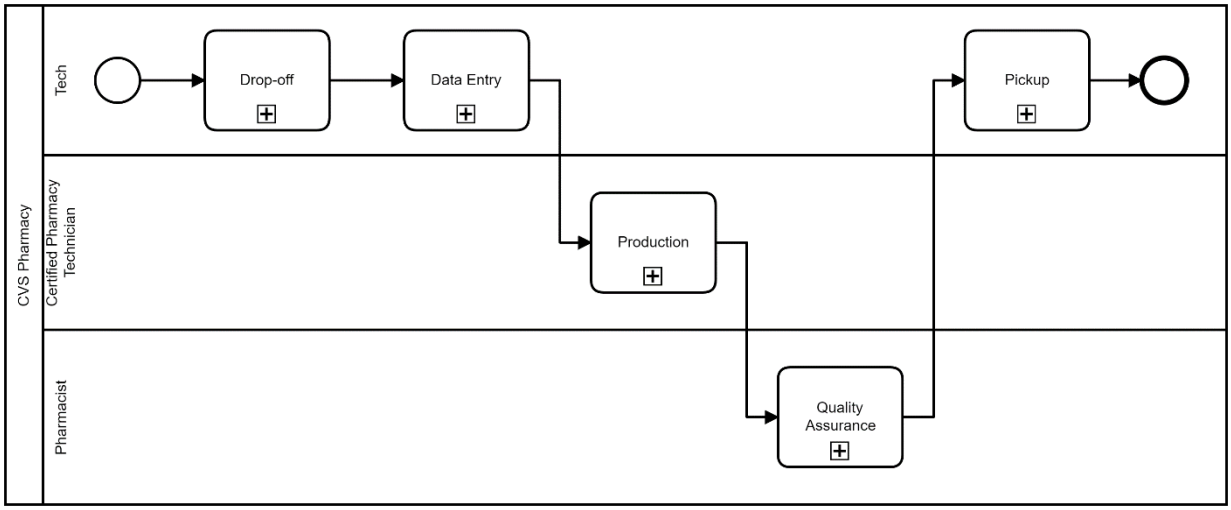
Vision: The goal of the pickup phase is that when customers arrive to pick up their prescriptions, the technician staffing the pickup window can search for the right prescription among the bags already sealed and stored correctly, and then verify customers' identities, and handle payment.

Process Owner: Technician

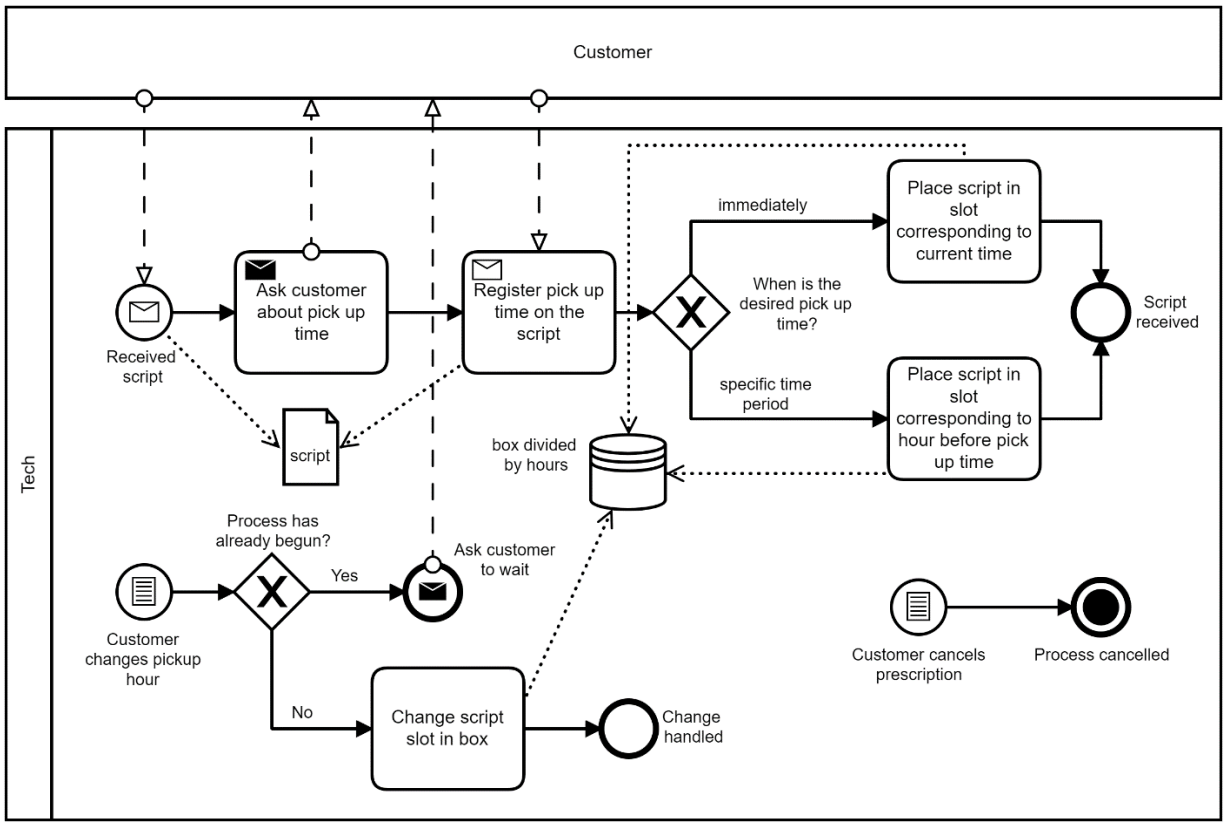
Customer of process: ● Customer	**Expectation of customer:** ● Quick and timely pickup of their correctly filled script.
Outcome: Picked up script and payments handled.	
Trigger: Quality assurance phase ends.	
First activity: Seal script in bag Store bag in pickup area in alphabetical order Search for right prescription among bags Verify customers' identity **Last activity:** Take any required payments from customer	
Interfaces inbound: Quality Assurance **Interfaces outbound:** Not Applicable	
Required resources: ● Human resources: Technician; ● Information, documents: script, customers' information, payment plan; ● Materials, infrastructure: bag storage, payment structure.	
Process Performances Measures: ● Cycle time; ● Operational costs; ● Error rate.	

4. As-Is Business Process model

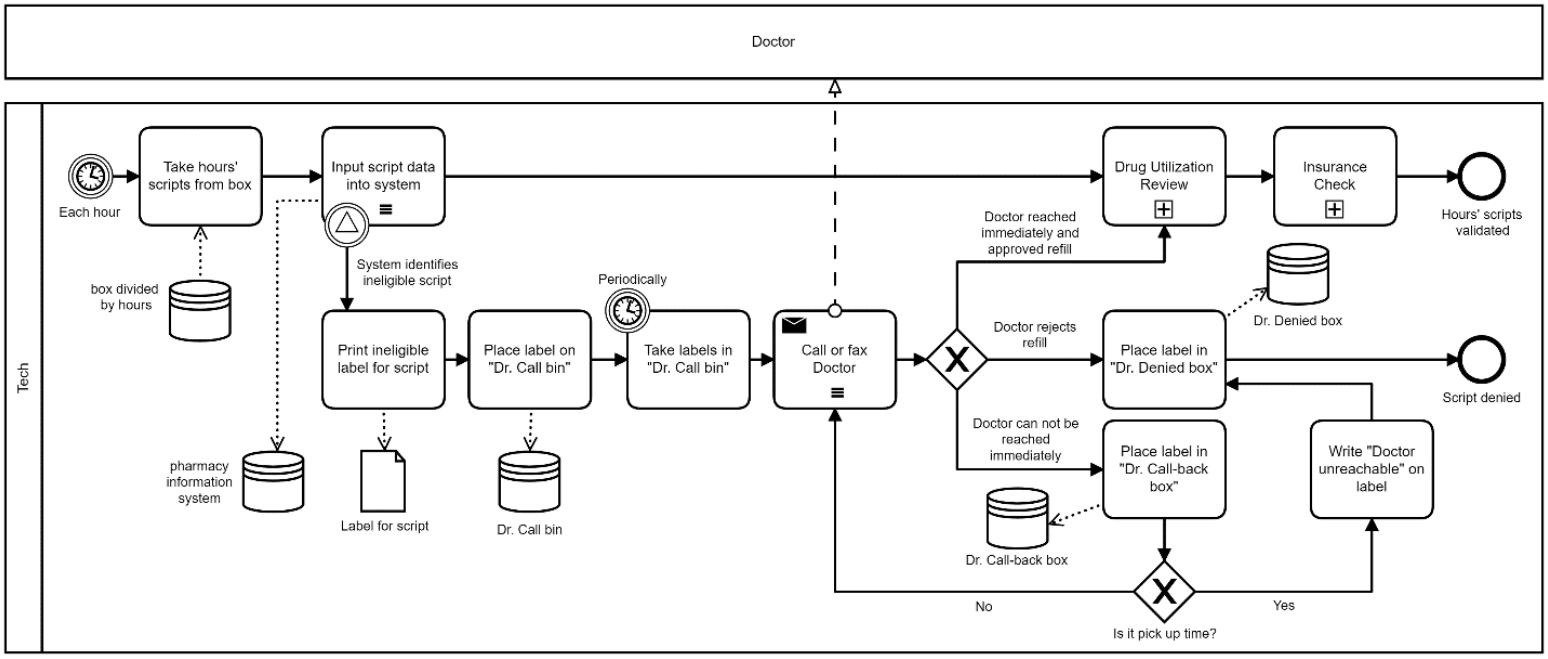
General High-level model



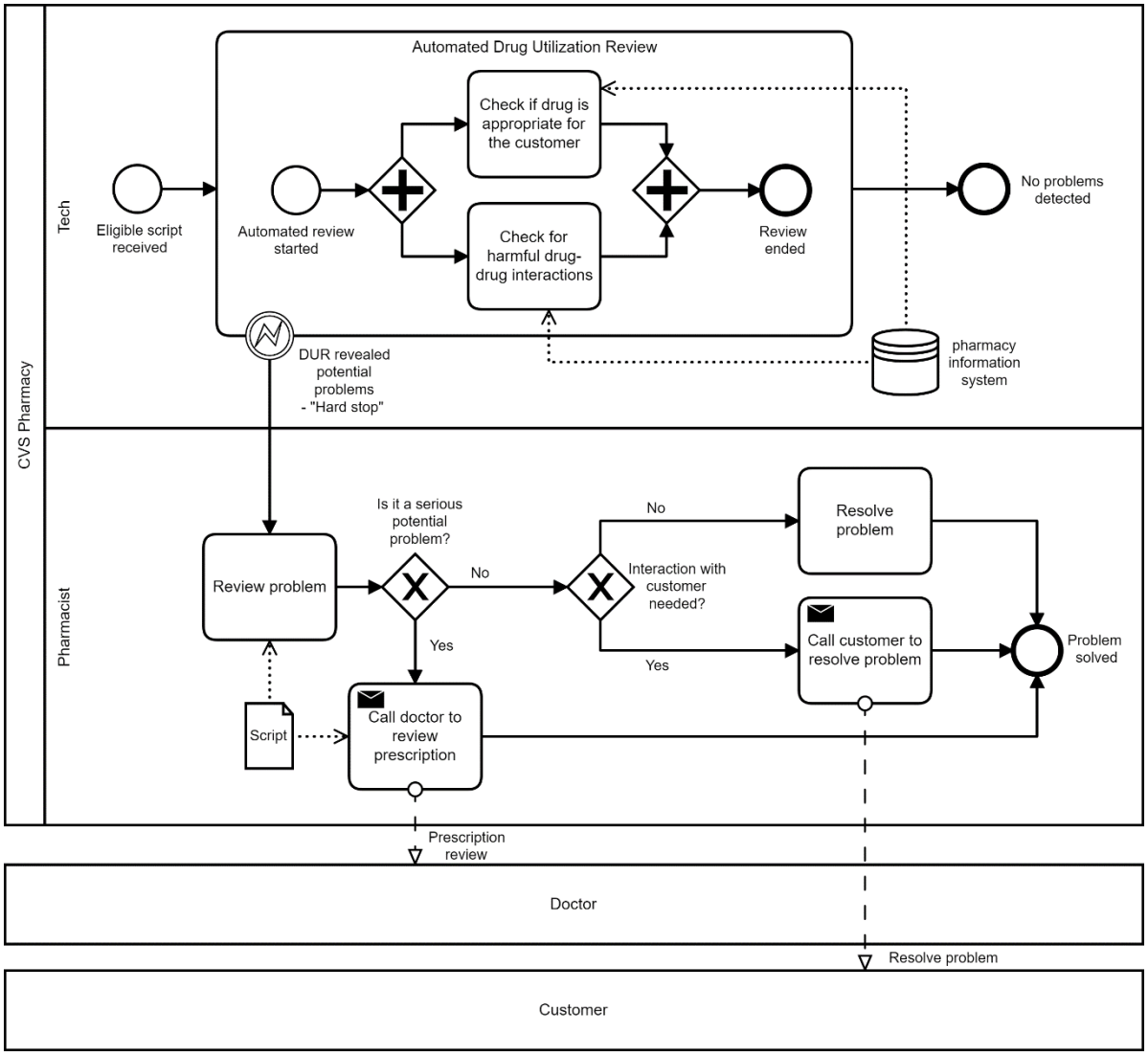
Drop off



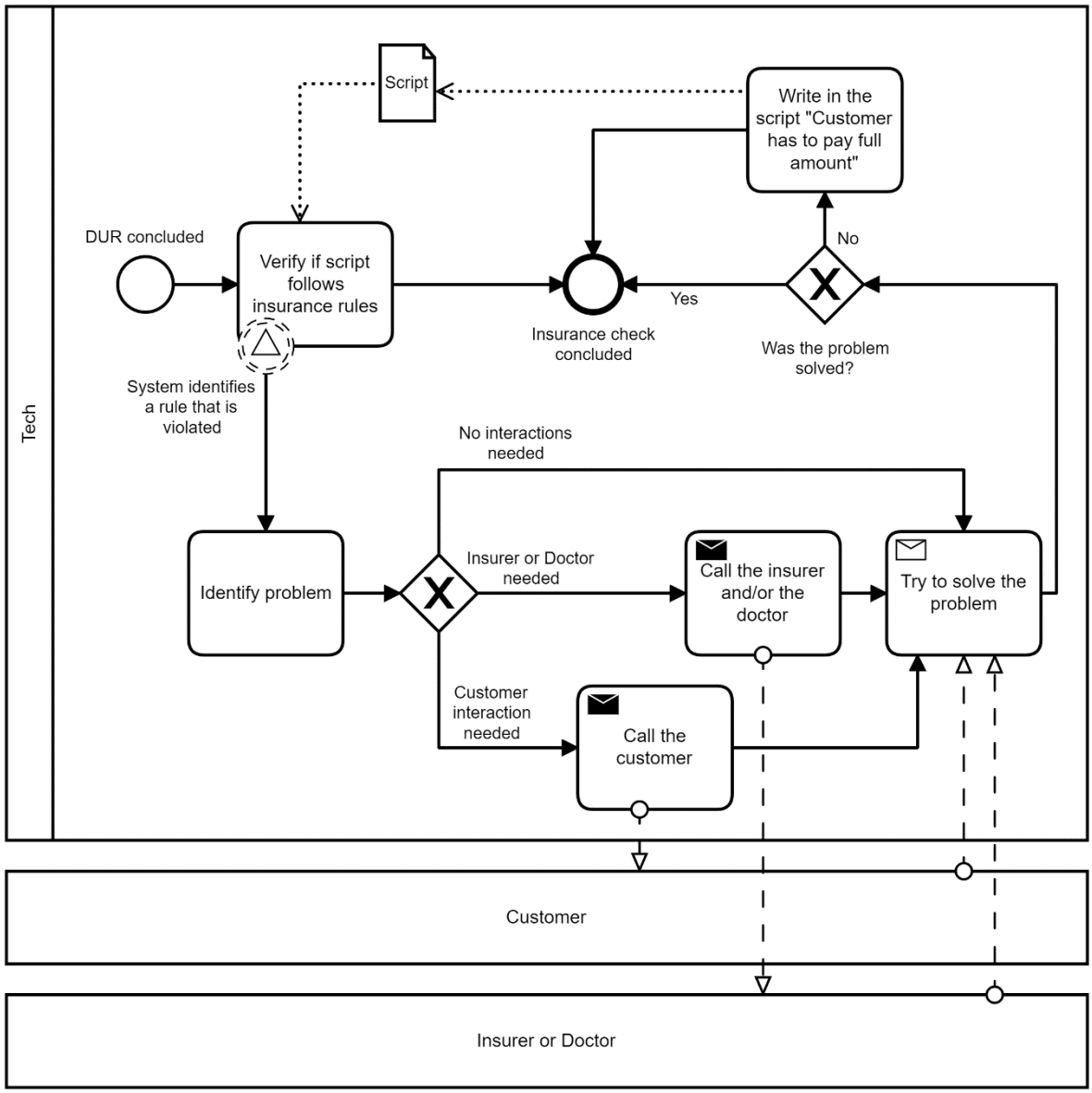
Data Entry



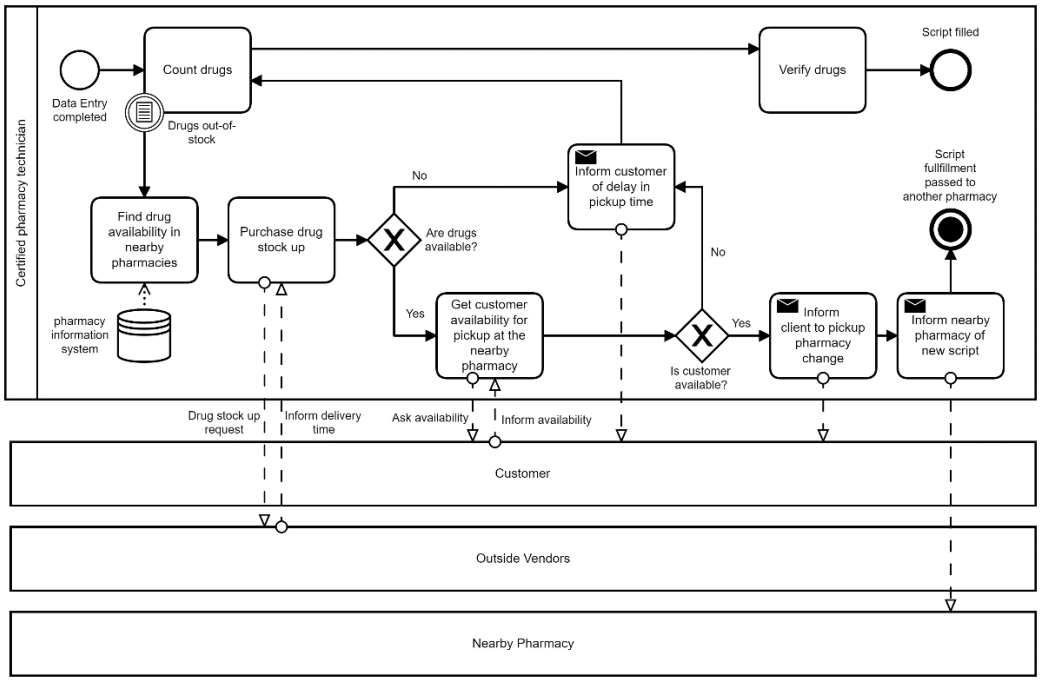
Drug Utilization Review



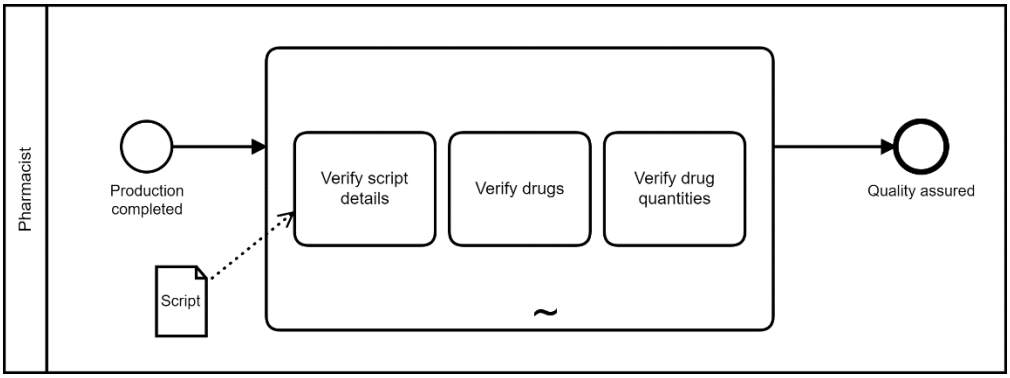
Insurance Check



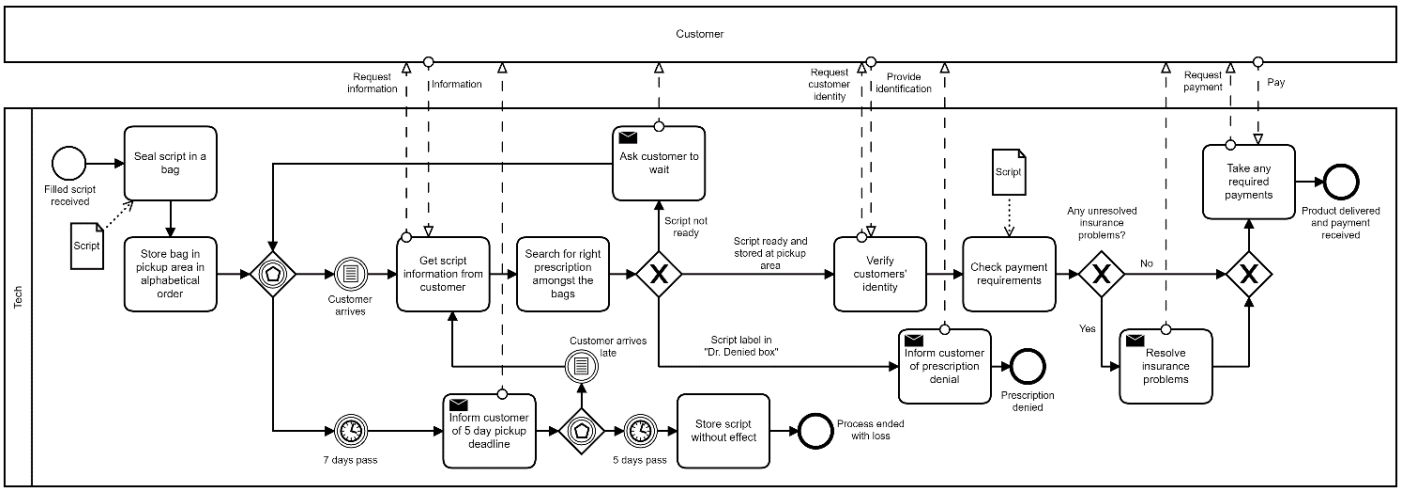
Production



Quality Assurance



Pick up



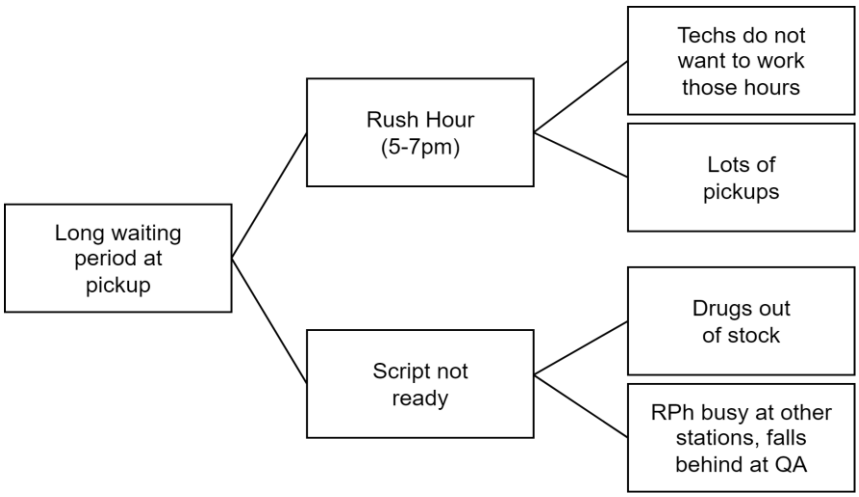
5. As-Is Business Process Analysis

Issue Register

Issue Name	In-store process for handling refill authorizations not optimized
Issue Priority Number	1
Short Description	The customer drops off an ineligible script that will enter a process of refill authorization.
Assumptions	CVS fills 235.2(7) million scripts annually. Given that “No refill allowed” scripts are 6% of total scripts and require from 20 minutes to 3 days to resolve.
Qualitative Impact	The authorization process generates a waiting period that can delay the delivery of the product to the customer.
Quantitative Impact	From 235.2(7) million * 0.06 * 20 min = 282.324 min To 235.2(7) million* 0.06 * 4320 min = 60 981.984 min in delays.

Issue Name	DURs arise frequently and RPh must intervene
Issue Priority Number	2
Short Description	Drug utilization review encounters problems when comparing the current script with the patients’ past scripts and the pharmacist will need to intervene.
Assumptions	The DUR generated a hard stop for 20% of all scripts. Over 90% of hard stops were resolved by pharmacists without involving the prescribing doctor. CVS fills 235.2(7) million scripts annually.
Qualitative Impact	For the hard stops that need to involve the prescribing doctor the stop generates a long waiting period, even if each call is answered immediately and only lasts one minute. While all hard stops will require the intervention of the pharmacist and thus may generate delays in quality assurance.
Quantitative Impact	235.2(7) million * 0.2 * 0.1 = 4.7054 million hard stops that require the involvement of the prescribing doctor. 235.2(7) million * 0.2 = 47.054 million times pharmacists are called to review a hard stop annually.

Why-why diagram



Value-Adding tables

Steps for Drop-off	**Performer**	**Classification**
Ask customer pickup time	Technician	VA
Register pickup time	Technician	VA
Place script in correct slot	Technician	BVA
Change script slot in box	Technician	NVA

Steps for Data Entry	**Performer**	**Classification**
Take hours' scripts from box	Technician	NVA
Input script information into system	Technician	BVA
Print ineligible label for script	Technician	NVA
Place label on "Dr. Call bin"	Technician	NVA
Take labels in "Dr. Call bin"	Technician	NVA
Call or fax Doctor	Technician	BVA
Place label in "Dr. Denied box"	Technician	NVA
Place label in "Dr. Call-back box"	Technician	NVA
Write "Doctor unreachable" on label	Technician	NVA
Perform Drug utilization review	Technician	VA

Perform Insurance check	Technician	BVA

Steps for Drug Utilization Review	**Performer**	**Classification**
Check script against all the patients' other prescriptions	Technician	VA
Check for harmful drug-drug interactions	Technician	VA
Review problem	Pharmacist	NVA
Call doctor to review prescription	Pharmacist	NVA
Resolve problem	Pharmacist	NVA
Call customer to resolve problem	Pharmacist	NVA

Steps for Insurance Check	**Performer**	**Classification**
Verify if script follows insurance rules	Technician	BVA
Identify problem	Technician	NVA
Call the insurer and/or the doctor	Technician	NVA
Try to solve the problem	Technician	NVA
Call the customer	Technician	NVA
Write in the script “Costumer has to pay full amount”	Technician	BVA

Steps for Production	**Performer**	**Classification**
Count drugs	Certified pharmacy technician	VA
Verify drugs	Certified pharmacy technician	VA
Find drug availability in nearby pharmacies	Certified pharmacy technician	BVA
Purchase drug stock up	Certified pharmacy technician	BVA
Get customer availability for pickup at the nearby pharmacy	Certified pharmacy technician	NVA
Inform costumer of delay in pickup time	Certified pharmacy technician	NVA
Inform client to pick up pharmacy change	Certified pharmacy technician	NVA
Inform nearby pharmacy of new script	Certified pharmacy technician	NVA

Steps for Quality Assurance	Performer	Classification
Verify correct drugs	Pharmacist	VA
Verify correct drug quantities	Pharmacist	VA
Verify script details	Pharmacist	BVA

Steps for Pickup	Performer	Classification
Seal script in a bag	Technician	VA
Store bag in pickup area in alphabetical order	Technician	BVA
Get script information from customer	Technician	VA
Search for right prescription amongst the bags	Technician	BVA
Verify customer' identity	Technician	BVA
Check payment requirements	Technician	BVA
Take any required payments	Technician	BVA
Resolve insurance problems	Technician	NVA
Ask customer to wait	Technician	NVA
Inform customer of 5-day pickup deadline	Technician	NVA
Store script without effect	Technician	NVA
Inform customer of prescription denial	Technician	VA

6. Business Process Redesign

In our redesign process we identified three changes:

a. Assigning the activities of sealing the completed script in a bag and of storing the bag in the pickup area in alphabetical order to the pharmacist after completing the quality assurance.

This change promotes a minor increase in the workload of the pharmacist while significantly releasing the technicians' handling of the prescriptions, thus increasing the technicians' availability to deal with the customers who come to pick up their filled scripts, and consequently balancing the process line.

This change is expected to resolve the "Long lines at pickup" problem that was identified by the PSI team, by having more available time for the technicians to deal with the customers as they would no longer have to bag and store the completed scripts.

For this, a change of layout would be required to improve the process in such a manner that the handling time of the sealing and storing would not significantly increase the pharmacist's handling time.

Since the pharmacist is already handling the prescription, this change would not be too drastic as the handling of the quality check can be directly placed in the bag and then directly onto the correct storage area without further handling.

To quantify the potential impact of this change we can look at the most critical point in a workday - peak hours between 5 pm and 7 pm - where we have 120 prescriptions being picked up in those two hours.

If we assume they are evenly distributed between the two hours (thus having 60 scripts per hour) and take the 160s average execution time for pickup, we can calculate the workload at pickup per hour during that time:

60 scripts * 160s = 9600s / 3600s = 2.6(6)h.

This implies more than two technicians working during peak hours, meaning the third technician must juggle all the tasks assigned to technicians.

If we apply our suggested change, assuming that the sealing and storing of the script takes approximately 40s we can make the same calculations:

60 scripts * (160s - 40s) = 60 * 120 = 7200s / 3600s = 2h.

Here we can see that by applying this change we can either reduce the number of techs needed for pickup during peak hours and free up the third technician for all the other tasks, or we can have the same three technicians working the pickup window and thus decrease the waiting period for this phase of the process.

b. <u>Performing the Data Entry during the drop-off process, thus as soon as each script arrives.</u>

In the As-is model, the validation of the script, meaning the verification of the eligibility of the script, the DUR check, the insurance check and the stock verification are all activities that are only started an hour before the planned pickup time.

This means that if any of the steps of validation identify a problem that may lead to a situation in which the prescription cannot be fulfilled, the process is stopped until the problem is resolved, which leads to delays.

With this change, the issue of "script not ready yet" is handled ahead of time and any delay implications (contacting the doctor, contacting the insurance company, requesting stock replenishment) are handled before production starts.

This means that by checking that the drug is in stock, performing the automated DUR and insurance check and verifying the eligibility of the script as soon as it arrives there is a better chance that any identified problems are resolved before the pickup time.

Additionally, the performance of the validation ahead of time would grant the pharmacist more flexibility to manage their time concerning the resolution of DUR Hard Stops, since the resolution of these problems no longer has a one-hour constraint, nor is it required to be solved during the script fulfillment and thus can be moved to off-peak hours.

To quantify the potential impact of this change we can start by calculating the pharmacist's daily workload.

For these calculations we will consider the change made in 6.a), and thus assume that the newly assigned activities of sealing and storing the script are done in 20s (less time than if performed by the technician at pickup given that the pharmacist is performing the quality check directly into the bag).

Given that we do not have enough data to know how long the pharmacist would take to correct any problems identified during the quality assurance process, we will further assume that the correction process will take the full amount of time of collecting the drugs and redoing the quality assurance, even if the necessary correction steps are very small.

Thus, for the 200 daily prescriptions and for a correction of 2% of them:

200 scripts * (60s + 20s) + (0.2 * 200) scripts * (120s + 60s) = 16 000 + 4 * 180
= 16 720s / 3600s = 4.6(4) h.pharmacist.

This shows that a pharmacist has a workload of 4.6(4) hours with work related to quality assurance alone (without including the change of 6.a) the workload would be 3.5(3) hours).

We then calculated the daily technician occupation by calculating the cycle time of the process (assuming the change in 6.a) is already applied to the pickup execution time):

(60s drop-off + 60s data entry + 120s insurance check + 120s production + 120s pickup) * 200 prescriptions = 96 000s / 3600s = 26.(6)h.

The workload is divided amongst two technicians during 10 of the 12 hours in the workday and by three for the other 2 hours. This means that the total time the technicians have available in one workday is 2h * 3 techs + 10h * 2 techs = 26h.

With these calculations, we can see that the technicians are clearly overloaded (without the implementation of the change in 6.a) it is 28.(8)h) - 26.(6)h > 26h.

For the pharmacist, this change in association with continuous production (change described in 6.c)) and adequate production planning is expected to free up time for the validation process, which can be performed uninterruptedly in the other (12h - 4.6(4)h =) 7.3(5) hours in which the pharmacy is open.

For the technicians, this change will reduce the stoppages in production related to validation and stock, and in association with continuous production and adequate production planning is expected to make more time available for insurance checks.

Assuming that the 120s execution time is a statistical time that considers the aforementioned stoppages, we can further assume that by removing the stoppages from

production we can obtain a significant decrease in execution time - up to 75%. This reduction will significantly free up technician time that will allow an efficient implementation of action 6.c).

In this manner, we can make sure that production never falls behind and that the validation process is done with care, now that it does not have to be rushed and that it allows for the insurance check of multiple scripts at once (i.e., call one insurer and solve a batch of scripts that have that same insurer).

c. Performing continuous production within planned timeframes.

Given that currently, the prescriptions only start being prepared one hour before their planned pickup time, any problems that arise must be solved quickly within that time frame.

If production is performed continuously within planned timeframes, we expect to resolve the "Long waiting periods at pickup" (analyzed in the why-why diagram in section 5) by attempting to solve the issues that lead to it.

We expect to achieve this by starting the production of each script as soon as possible, (meaning as soon as any issues that would stop production have been resolved) as well as by optimizing the production timeframes to match the planned pickup times.

Assuming that from 4 pm to 7 pm technicians will handle the fulfillment of 120 prescriptions (given they start the process one hour before):

(60s data entry + 120s insurance check + 120s production + 120s pickup) * 120 prescriptions = 50 400s / 3600s = 14h of work

And that during these 3 hours, the pharmacy has 2h * 3 techs + 1h * 2 techs = 8h of work available, we can see that this is their most critical period.

If we implement this change we can remove the fulfillment of the prescriptions from peak hours, this can be executed by implementing the change in 6.b) - which allows the identification and correction of any problems as soon as possible - in association with the assignment of periods of time, outside peak hours, for the production and consequently quality assurance of the prescriptions. This leads to production being done ahead of time and thus removes the pressure on off-peak hours.

With the implementation of all these changes, we can expect a decrease in the waiting periods at pickup to almost zero, a decrease in insurance check time by optimizing the process, an improvement of validation quality indexes as validation is done with time and given the removed pressure on technicians during peak hours, we can expect better customer service.

We can further expect that the decrease in waiting periods can lead to time savings for customers and thus promote higher customer retention by reducing defection due to poor customer service, as we have improved customer satisfaction.

We also considered other changes which we later discarded:

d. Organizing the bags in the pickup area in order of process number and not alphabetically.

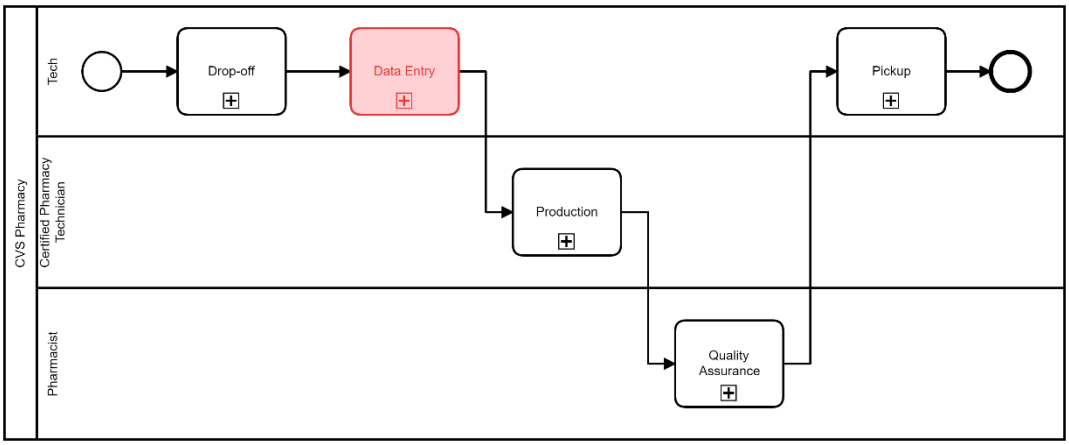
We thought of this change as the pickup technician looking for a number instead of a name is easier when searching for the prescription bag.

However, we discarded this idea due to its infeasibility. This idea would need the customer to know and hold on to the number of their process, even if the technician at drop-off gave each customer a ticket, there would always be the problem of a customer losing their ticket. This would cause an even bigger time consumption when matching names with process numbers.

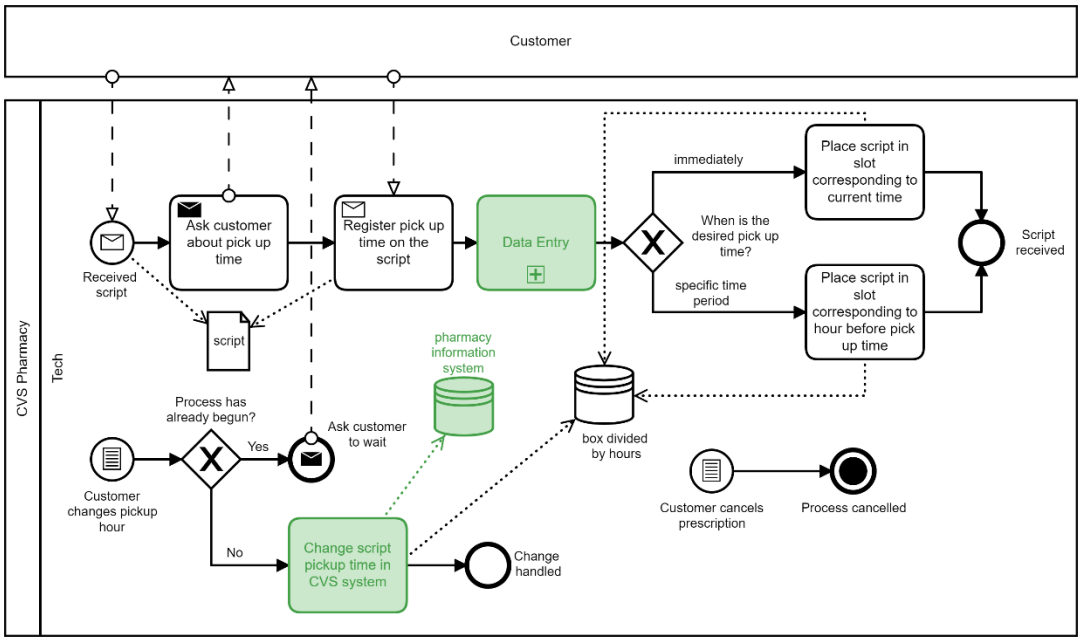
7. To be Business Process model

In the development of our “To be” model, we identified the removed items in red and the added ones in green.

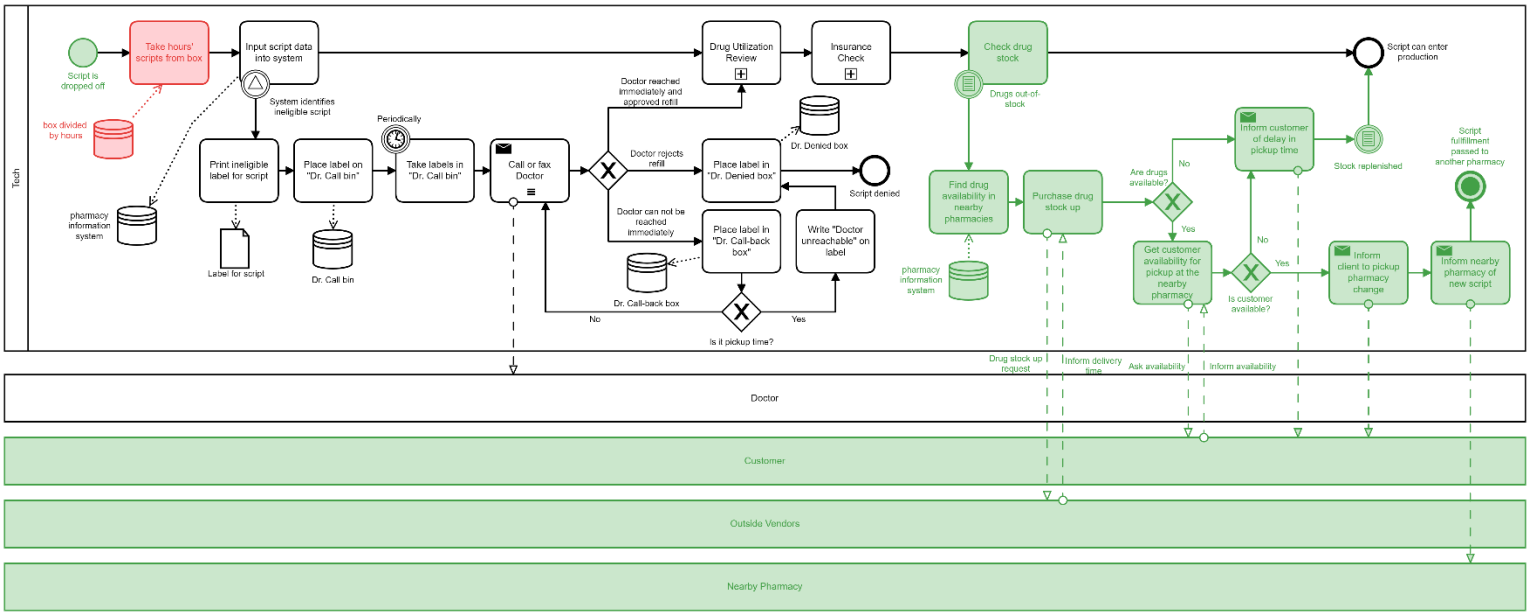
General High-level model



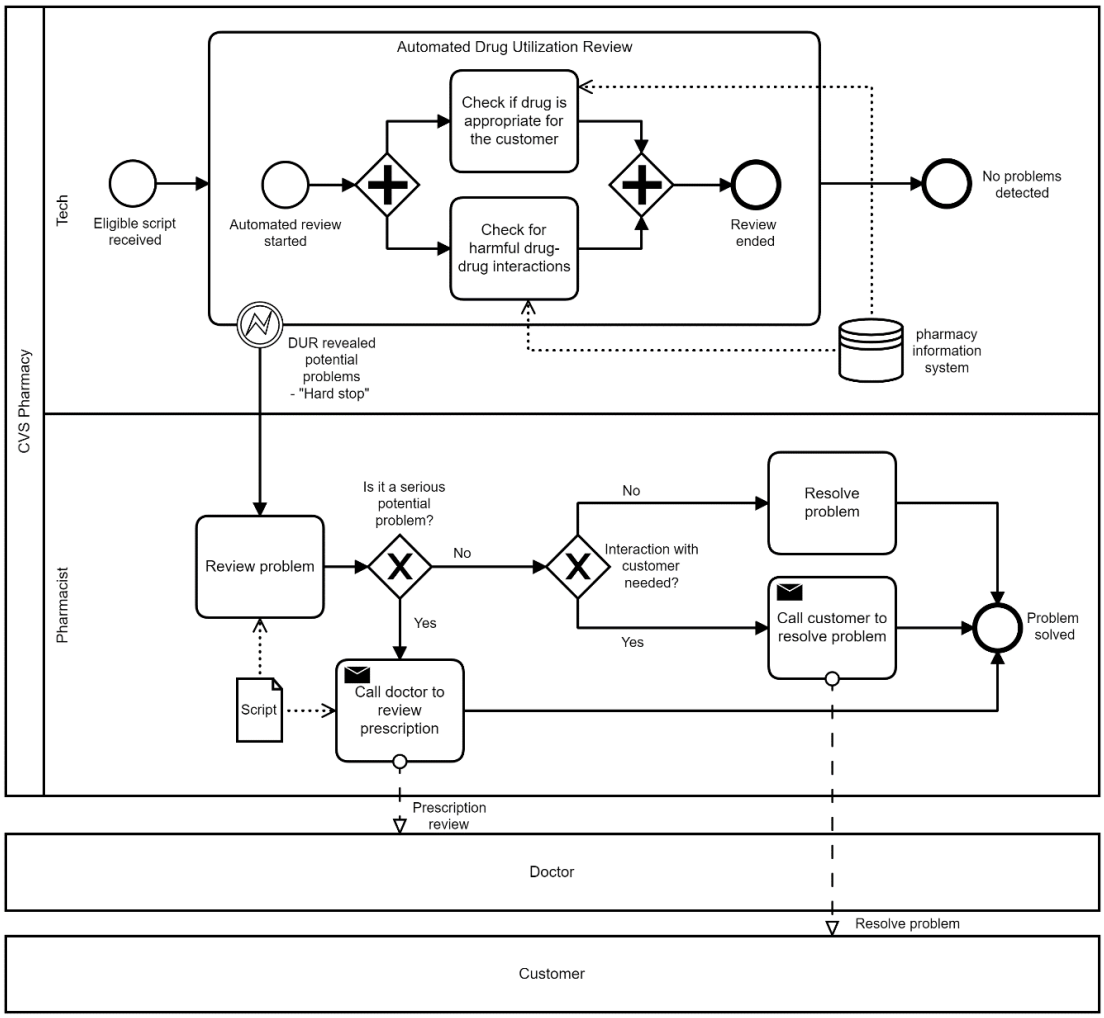
Drop off



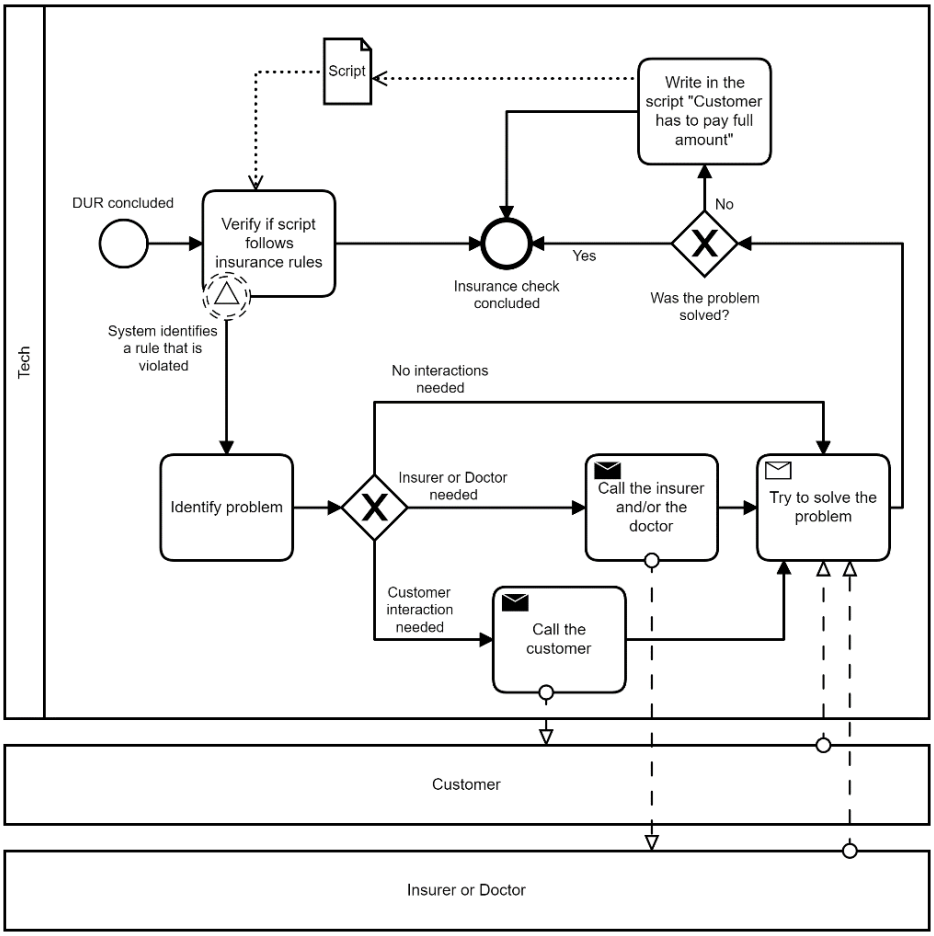
Data Entry



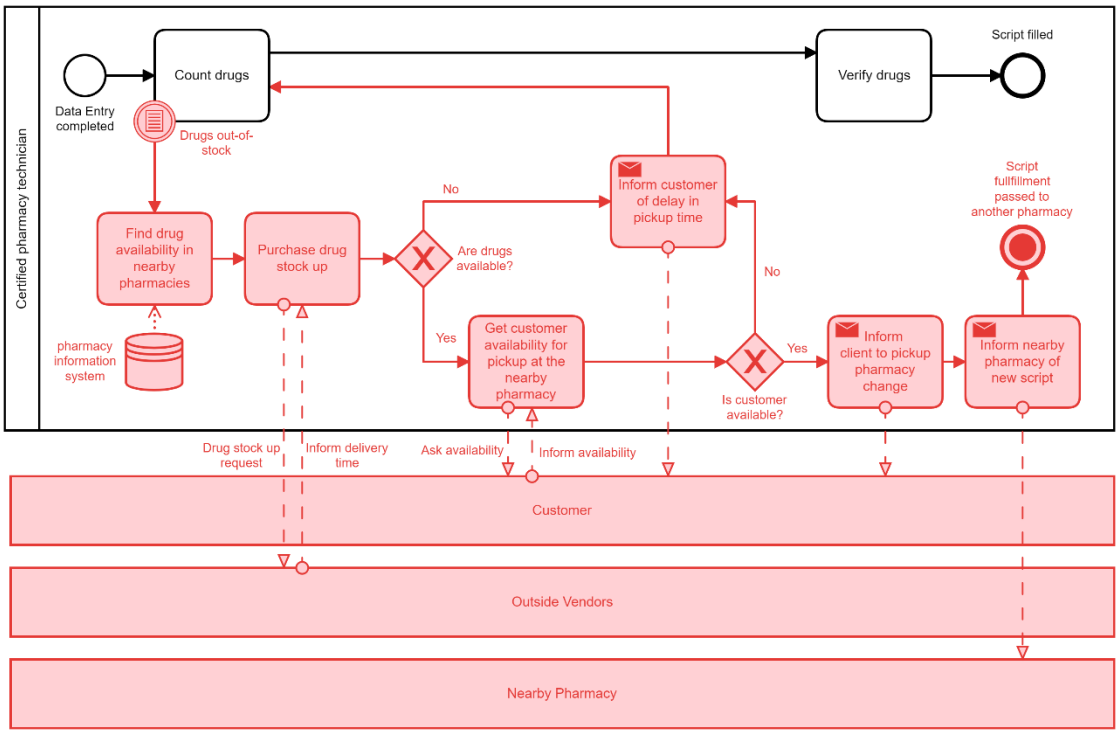
Drug Utilization Review



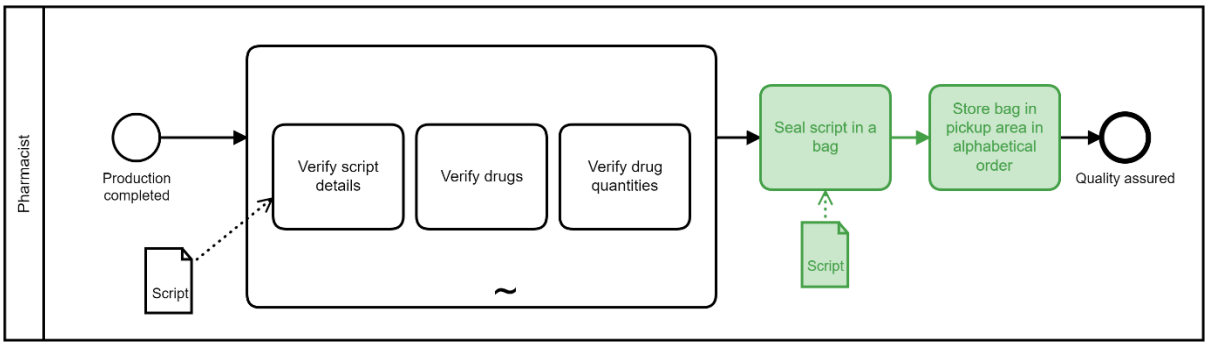
Insurance Check



Production



Quality Assurance



Pick up