

Vehicle Inspection and Emissions-Testing Process

Business Process Management

Group 9

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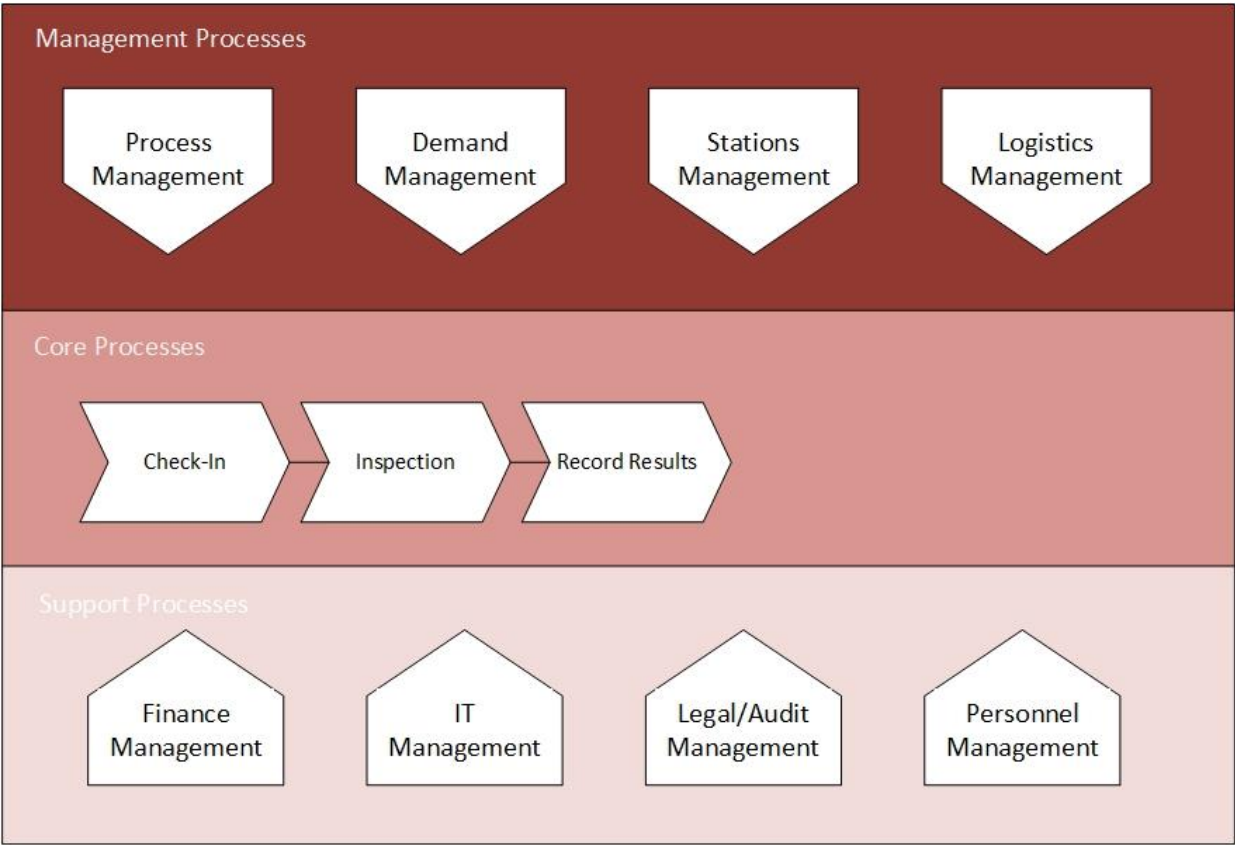
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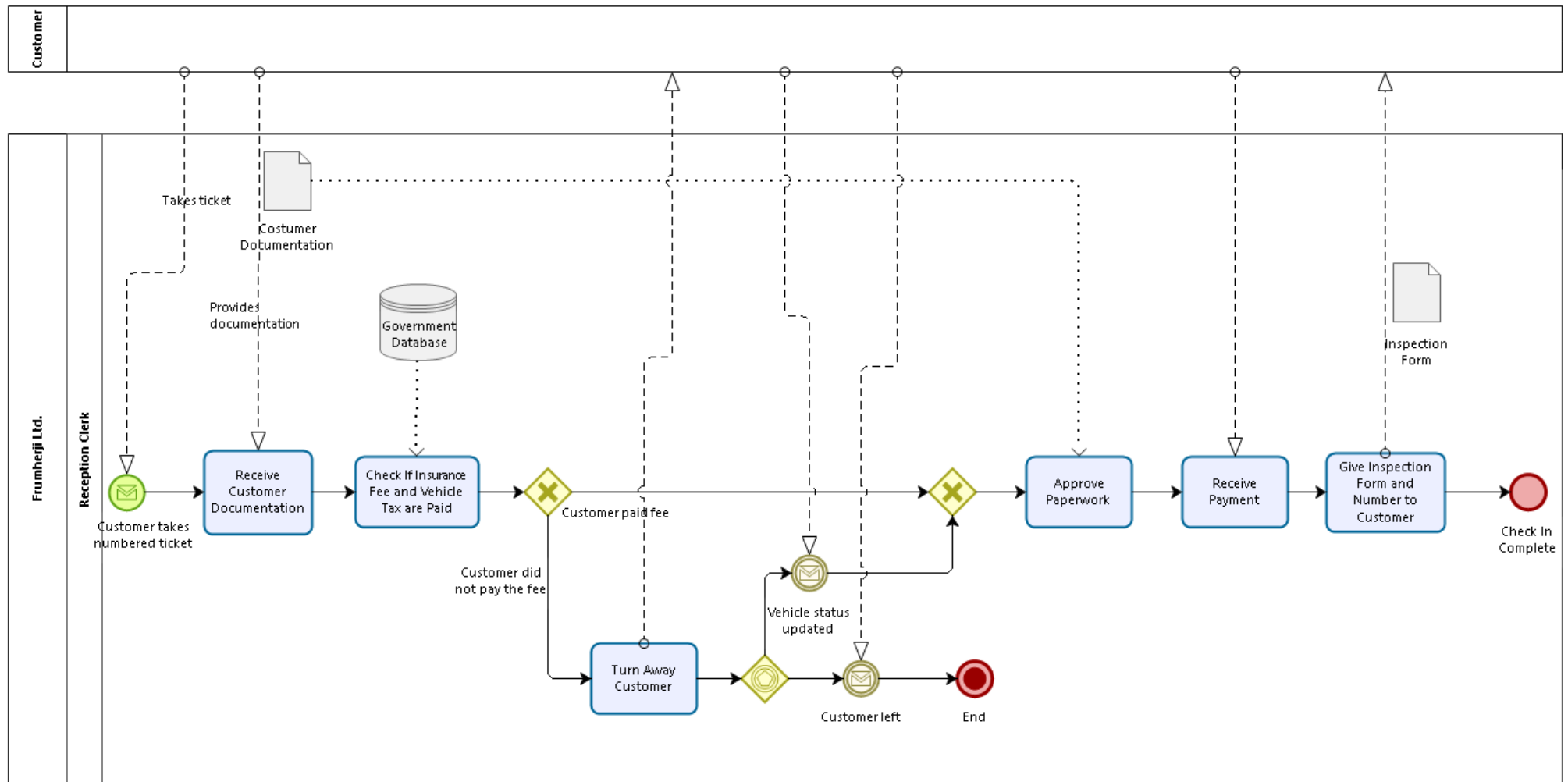
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Business Process Architecture

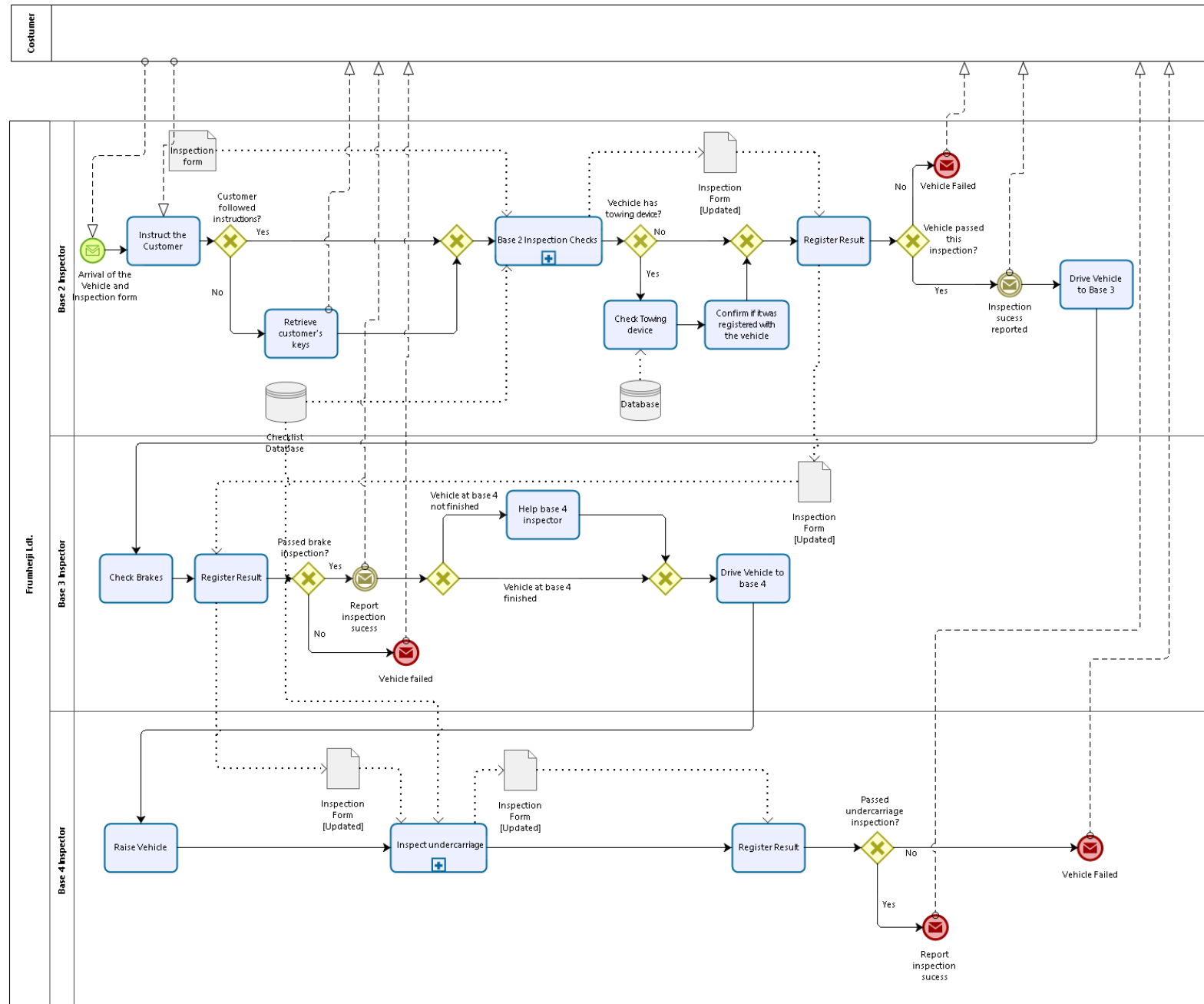


As-Is Business Process Model

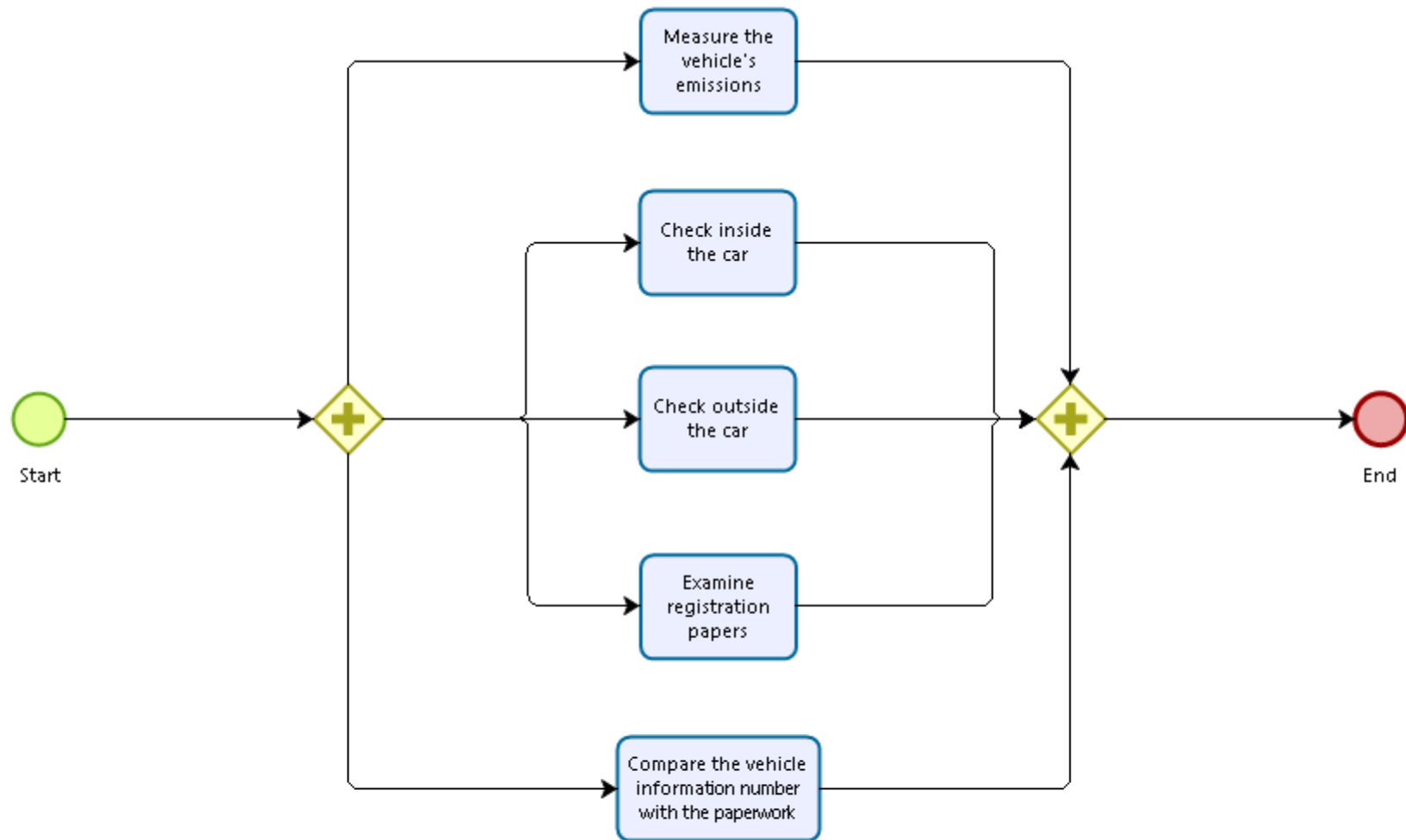
Customer Arrival and Check-In Process



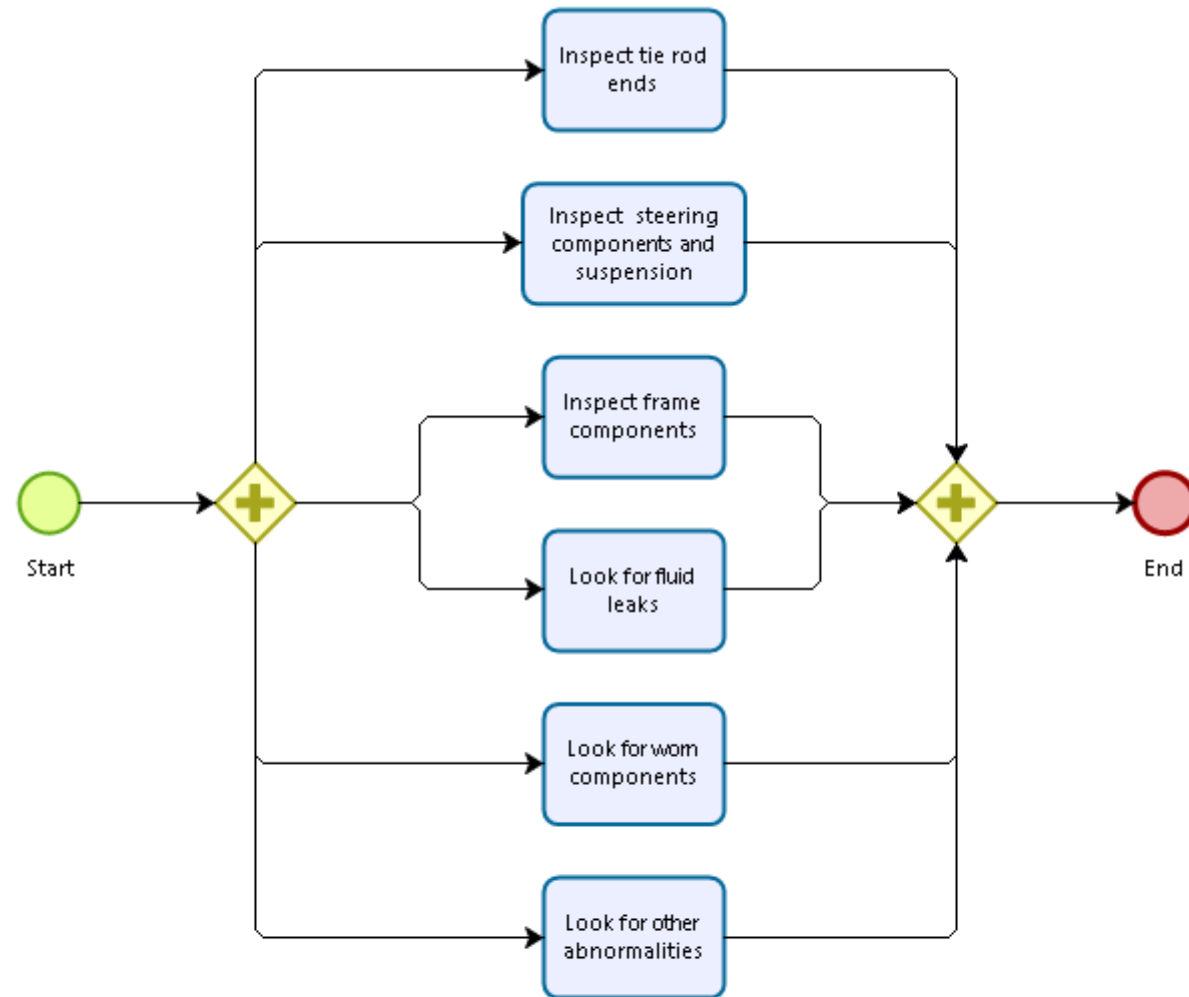
Inspection Process



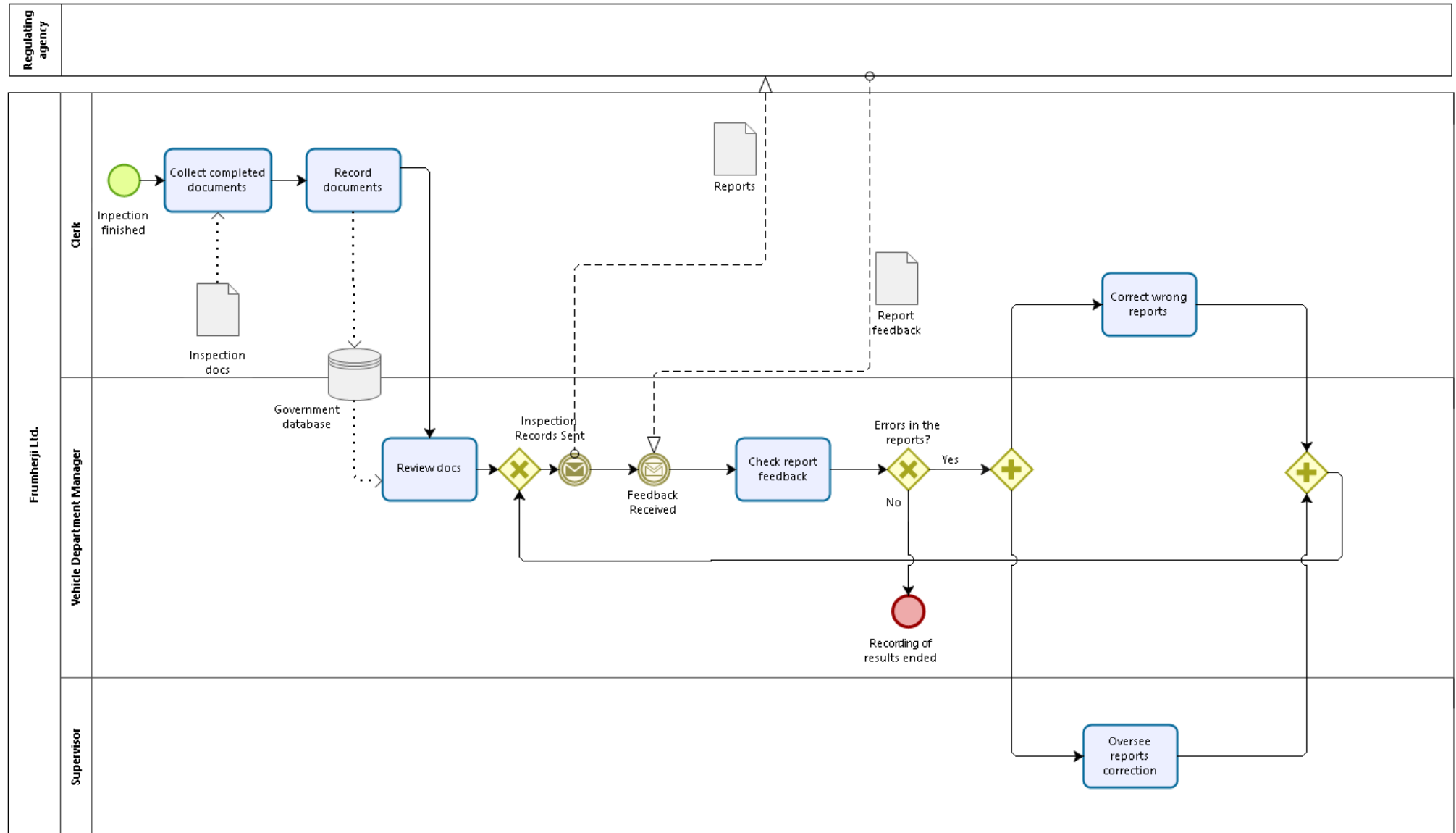
Base 2 Inspection Checks



Check Undercarriage



Recording Results into the Database Process



The “As is” Business Process Model Analysis

Qualitative Analysis

Waste Analysis

Process	Activity	Transportation	Motion	Inventory	Waiting	Defects	Over-Processing	Over-Production	Explanation
Check-In	Customer gives inspection form to inspector at base 2		X						When the customer picks an inspection form and has to give it to the inspector at base 2 introduces unnecessary motion inside the company.
	Customers give documentation to clerk		X						When the customers have to give their documentation to the clerk introduces unnecessary motion inside the company.
	When the customer is given the opportunity to pay the Insurance Fee and the Vehicle Tax and “returns” to the check-in.			X					When this happens, it causes a work-in-progress waste (of inventory).
	Client leaves or cancels inspection							X	If the client leaves or cancels the inspection, the work done on the Check-in is unnecessary.
Inspection	Move the car from the lane to base 2		X						Moving the car from lane to base 2 introduces unnecessary motion inside the company.
	Move the car from base 2 to base 4		X						Moving the car from base 2 to base 4 introduces unnecessary motion inside the company.
	Move the car from reception lot to inspection lot		X						Moving the car from reception lot to inspection lot introduces unnecessary motion inside the company.
	Customers proceed past base 2 directly to base 3				X				When customers proceed past base 2 directly to base 3 by mistake they create delays in the process.
	Inspector retrieves the customer’s keys					X			When the inspector has to retrieve the customer’s keys because he didn’t follow the instructions, consists in a compensating action.

Process	Activity	Transportation	Motion	Inventory	Waiting	Defects	Over-Processing	Over-Production	Explanation
Inspection	Customer fails inspection							X	If the client fails the inspection, the work done is unnecessary.
	Move the car from base 3 to base 4		X						Moving the car from base 3 to base 4 introduces unnecessary motion inside the company.
	When the inspector at base 3 goes to base 4		X						Inspector at base 3 going to base 4 introduces unnecessary motion inside the company.
	Vehicle in base 3 waits for vehicle in base 4 to finish				X				When base 4 is not ready to receive the vehicle from base 3, and so, the vehicle needs to wait in base 3 introduces delays in the process.
	Move the car from base 4		X						Move the car from base 4 introduces unnecessary motion inside the company.
Record Results	Clerk from reception area collects documents from inspection		X						When a clerk collects the inspections, forms introduces unnecessary motion inside the company.
	Clerk receives back wrong reports		X						When the clerk receives the reports back introduces unnecessary motion inside the company.
	Clerk records report in Government Database		X						When clerks have to switch of applications to report to the Government Database introduces unnecessary motion inside the company.
	Send/Receive reports to/from regulating agency	X							When the reports from vehicle development manager are sent to the regulating agency and vice-versa.
	Correct, record and review again wrong reports					X			When a report has errors, the clerk has to correct them, then the document has to be recorded and reviewed again. This is a compensating action.

Issue 1: Long Waiting Times for Check-In**Priority: 1**

Description: Delays in the reception area are caused, even when there were no cars in the inspection hall, because the receptionists also have to serve customers who were there for other services such as driver testing, picking up their license plates, and buying drinks and sweets.

Data and assumptions:

- 1st inspection mean cost is 95\$
- 2nd inspection mean cost is 18.75\$
- 75 inspections a day are done
- 24.8% of vehicles don't pass 1st inspection
- There are 244 working days in a year (since 17 days are for holidays and 104 days are for weekends)
- 25% of customers are dissatisfied with this issue and within these 40% don't come back

Qualitative impact: Customer dissatisfaction for having to wait so long just to check-in. Therefore, the customers get annoyed and frustrated decreasing their satisfaction and consequentially the company's reputation declines.

Quantitative impact:

- Unsatisfied customers per year:
 $75 * 244 * 0.25 = 4575$
- Customers that don't come back per year:
 $4575 * 0.4 = 1830$
- Customers that fail 1st inspection per year:
 $1830 * 0.248 = 453,84$
- Money Loss per year:
 $1830 * 95 + 453.84 * 18.75 = 182259.5\$$

Issue 2: Minor problems make clients fail inspection**Priority: 2**

Description: Problems that could easily be fixed make customers fail inspection wasting inspector's time.

Data and assumptions:

- 1st inspection mean cost is 95\$
- 2nd inspection mean cost is 18.75\$
- 75 inspections a day are done
- 24.8% of vehicles don't pass 1st inspection
- 30% of the customers that don't pass 1st inspection are due to minor problems and within these 65% don't come back
- There are 244 working days in a year (since 17 days are for holidays and 104 days are for weekends)

Qualitative impact: Customers have to wait a long time for an inspection, and when their turn comes they rapidly fail the inspection because of problems that could easily be fixed before bringing the vehicle for inspection. Customers get annoyed and choose another company for the inspection. Therefore, the customers get annoyed and frustrated decreasing their satisfaction and consequentially the company's reputation declines.

Quantitative impact:

- Customers that fail 1st inspection per year:
 $75 * 244 * 0.248 = 4538.4$
 - Customers that fail 1st inspection due to minor problems per year:
 $4538.4 * 0.30 = 1361.52$
 - Customers that don't come back per year:
 $1361.52 * 0.65 = 884.988$
 - Customers that fail 1st inspection per year:
 $884.988 * 0.248 = 219.477$
 - Money Loss per year:
 $884.988 * 95 + 219.477 * 18.75 = 88189.053\$$
-

Issue 3: Long Waiting Times due to Employee Turnover**Priority: 3**

Description: Employee turnover is increasing and having to constantly recruit new employees, and them having less experience than those who left, makes inspections slower and more error prone. Therefore, the customers get annoyed and frustrated decreasing their satisfaction and consequentially the company's reputation declines.

Data and assumptions:

- 1st inspection mean cost is 95\$
- 2nd inspection mean cost is 18.75\$
- 75 inspections a day are done
- 24.8% of vehicles don't pass 1st inspection
- There are 244 working days in a year (since 17 days are for holidays and 104 days are for weekends)
- 15% of customers are dissatisfied with this issue and within these 20% don't come back

Qualitative impact: Customers have to wait more time in bases with inspectors with low experience because they're slower than the ones that are more experienced.

Quantitative impact:

- Unsatisfied customers per year:
 $75 * 244 * 0.15 = 2745$
- Customers that don't come back per year:
 $2745 * 0.2 = 549$
- Customers that fail 1st inspection per year:
 $549 * 0.248 = 136.152$
- Money Loss per year:
 $549 * 95 + 136.152 * 18.75 = 54707.85\$$

Issue 4: Fees and Taxes not Paid**Priority: 4**

Description: The owner has the option of calling the insurance company to arrange the payment of insurance fee and the vehicle tax. The customer then has to wait while the company change the status of the vehicle in the system.

Data and assumptions:

- 1st inspection mean cost is 95\$
- 2nd inspection mean cost is 18.75\$
- 75 inspections a day are done
- 24.8% of vehicles don't pass 1st inspection
- There are 244 working days in a year (since 17 days are for holidays and 104 days are for weekends)
- 5% of customers are dissatisfied with this issue and within these 20% don't come back

Qualitative impact: Customer dissatisfaction for having to wait so long just to check-in. Therefore, the customers get annoyed and frustrated decreasing their satisfaction and consequentially the company's reputation declines.

Quantitative impact:

- Unsatisfied customers per year:
 $75 * 244 * 0.05 = 915$
 - Customers that don't come back per year:
 $915 * 0.2 = 183$
 - Customers that fail 1st inspection per year:
 $183 * 0.248 = 45.384$
 - Money Loss per year:
 $183 * 95 + 45.384 * 18.75 = 18235.95\$$
-

Issue 5: Overtime Working Clerks**Priority: 5**

Description: Sometimes when inspectors work overtime, clerks have to stay until the end because they also have to work additional time to finish data entry of each report (that is produced by the inspectors).

Data and assumptions:

- 75 inspections a day are done
- 1 report is registered in 1 min
- Clerk earns 15\$/hour
- 65% of the working days, the clerk has to work additional time
- 2h additional for the inspectors

Qualitative impact: There are additional costs to pay the clerks for working overtime. The company spends money on overtime working hours that could be invested in another way.

Quantitative impact:

- Days that work additional time:
 $0.65 * 244 = 158.6$
- Additional hours spent:
2h (1 min per report and waiting time for the inspectors to finish the work – clerk inserts data as soon as the inspectors finish)
- Clerk cost in a year for additional hours:
 $2 * 158.6 * 15 = 4758\$$

Issue 6: Errors in Reports**Priority: 6**

Description: Inspection reports recorded by the clerks can contain a lot of errors. If the reports have errors, the clerk has to correct them and it's work is overseen by a supervisor.

Data and assumptions:

- 0.8% of the reports have errors
- 75 inspections a day are done
- 15 min to correct the errors
- Clerk earns 15\$/hour
- Supervisor earns 20\$/hour

Qualitative impact: Error correction consumes a lot of time from clerks and supervisors and that may be a cause for delaying the customers.

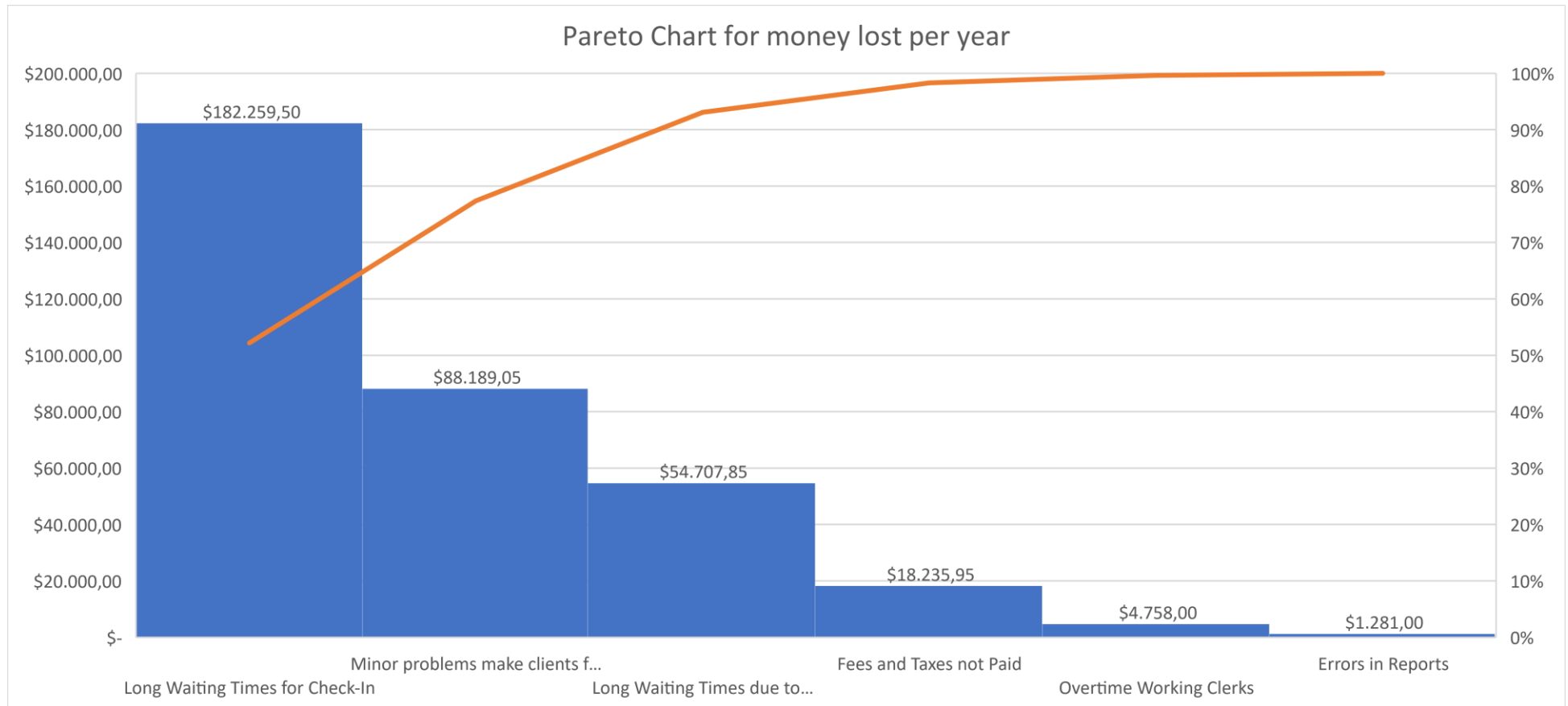
Quantitative impact:

- Reports with error per year:
 $0.008 * 75 * 244 = 146.4$
 - Hours correcting errors in a year:
 $15 / 60 * 146.4 = 36.6$
 - Clerk cost in a year due to errors:
 $36.6 * 15 = 549\$$
 - Supervisor cost in a year:
 $36.6 * 20 = 732\$$
 - Cost in a year:
 $549 + 732 = 1281\$$
-

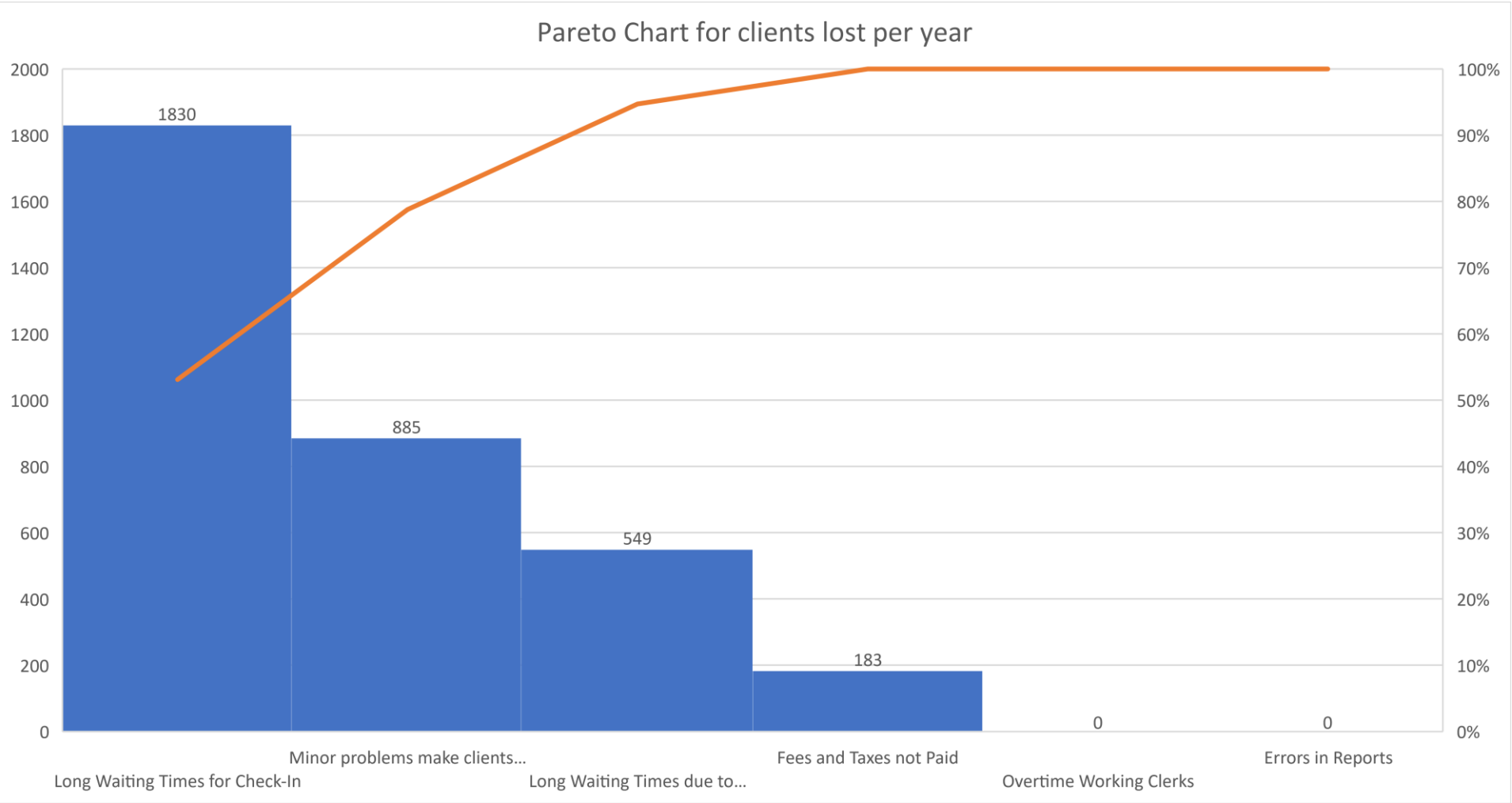
Pareto Analysis

We did two Pareto charts, one focused on the clients and the other on the money. The idea was to combine the results and derive an issue priority. As the impact of the issues is the same, the derivation of the issue priority was easy.

Pareto Chart for money lost per year

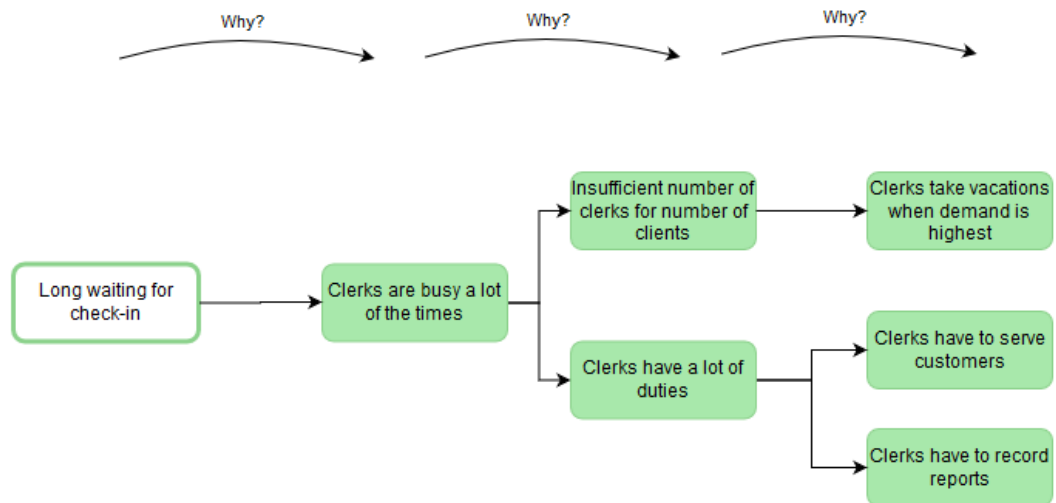


Pareto Chart for clients lost per year



Why-Why Diagrams

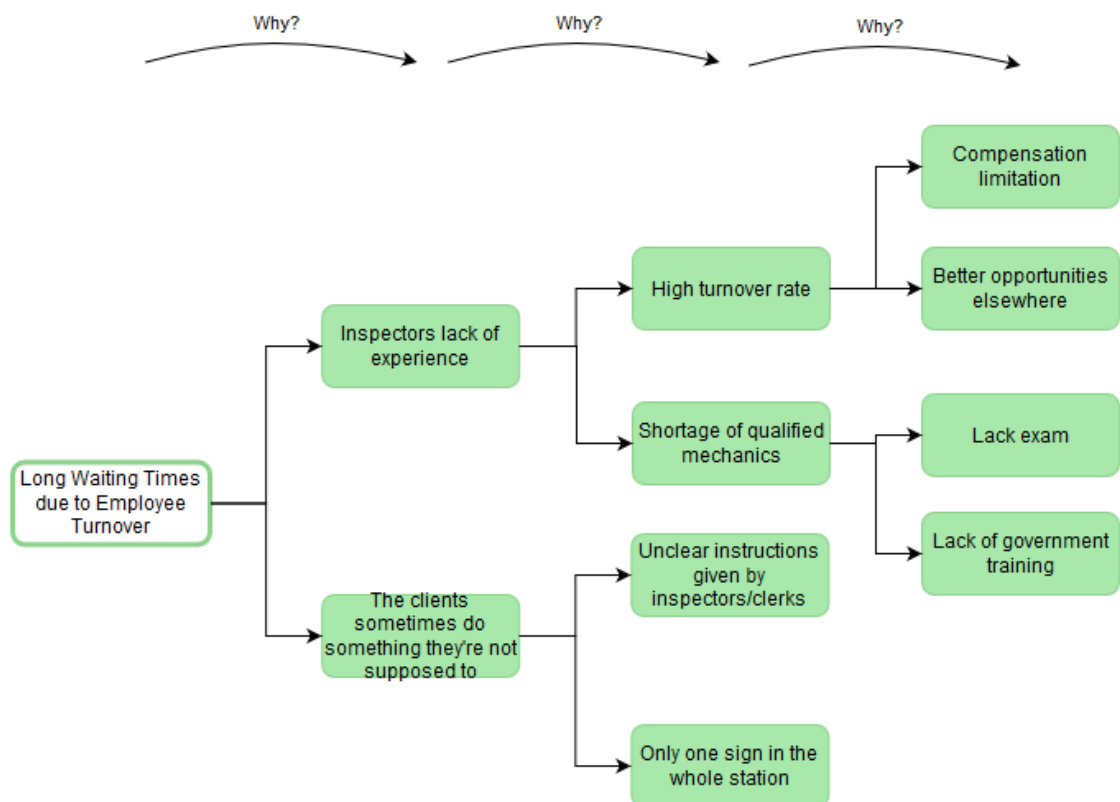
Long Waiting Times for Check-In



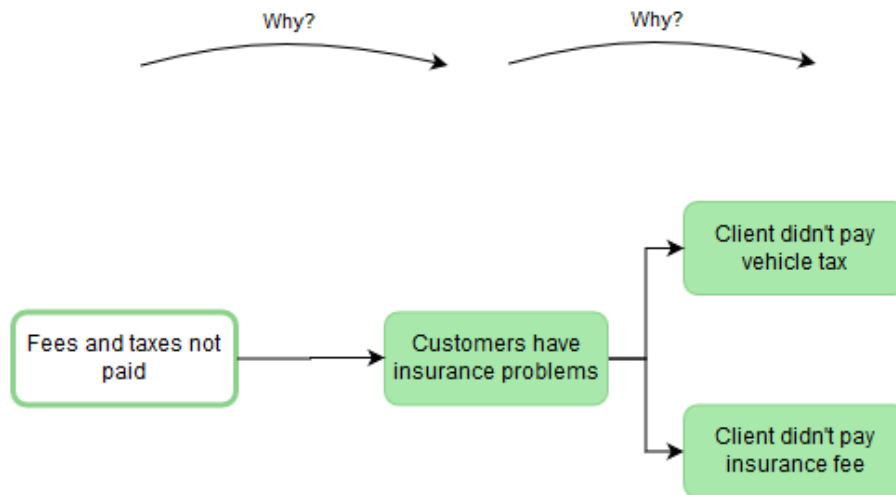
Minor problems make clients fail inspection



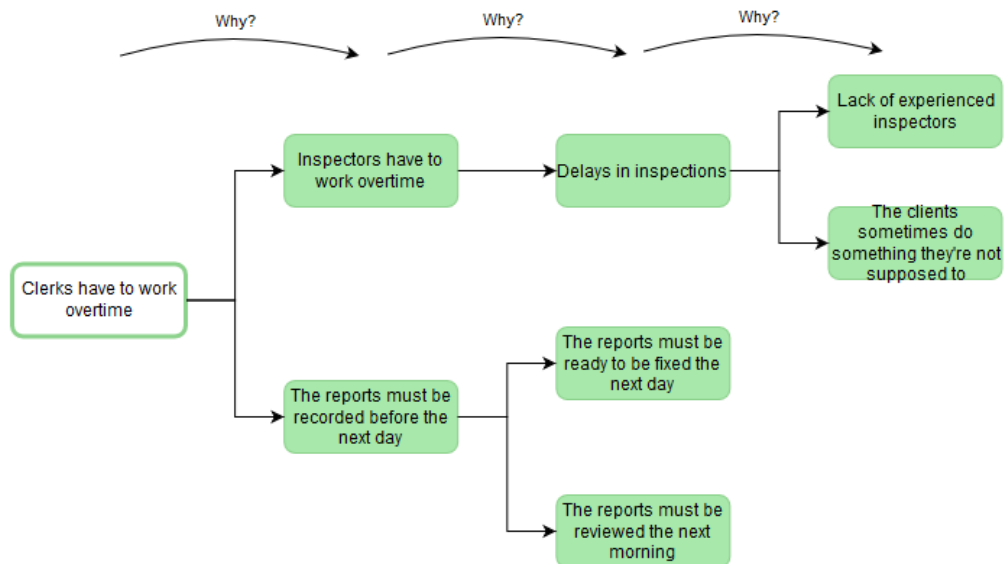
Long Waiting Times due to Employee Turnover



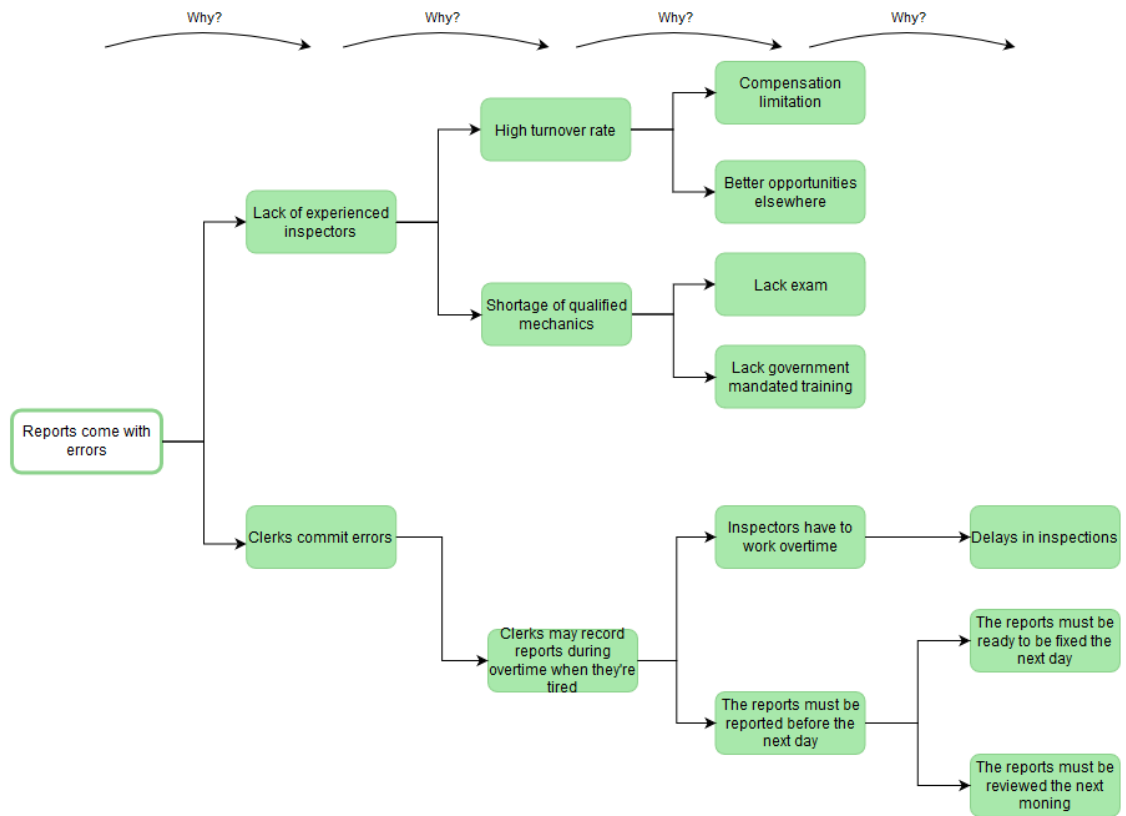
Fees and Taxes not Paid



Overtime Working Clerks



Errors in Reports



Simulation As-Is Process

Check-In Process

Parameters

Start Events	Max. arrival count	Poisson Distribution
Customer takes numbered ticket	75	Mean=7.2
Tasks	Processing Time	Waiting Time
Receive Customer Documentation	5 secs	Poisson Distribution: Mean=8 mins
Check If Insurance Fee and Vehicle Tax are Paid	10 secs	
Turn Away Customer	15 secs	
Approve Paperwork	30 secs	
Receive Payment	10 secs	
Give Inspection Form and Number to Customer	5 secs	
Gateways	Probability	
Exclusive Gateway	Paid=98% Did not pay=2%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Clerk	0,79 %	0	170,88	170,88
Inspector_B2	0,00 %	0	0	0
Inspector_B3	0,00 %	0	0	0
Inspector_B4	0,00 %	0	0	0
Manager	0,00 %	0	0	0
Supervisor	0,00 %	0	0	0
Total		0	170,88	170,88

Process

Frumherji Ltd.													
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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	3m	20m 55s	9m 32s	11h 56m 5s					32m 35s	0
ExclusiveGateway	Gateway	75	75										
Check In Complete	End event	75											
Check If Insurance Fee and Vehicle Tax are Paid	Task	75	75	10s	6m 15s	23s	29m 45s	0	6m 5s	13s	56s	17m 15s	0
Turn Away Customer	Task	2	2	15s	30s	22s	45s	0	15s	7s	7s	15s	0
ExclusiveGateway	Gateway	75	75										
Give Inspection Form and Number to Customer	Task	75	75	5s	35s	6s	7m 45s	0	30s	1s	4s	1m 30s	0
Receive Payment	Task	75	75	10s	40s	11s	14m 45s	0	30s	1s	6s	2m 15s	0
Approve Paperwork	Task	75	75	30s	6m 35s	37s	46m 15s	0	6m 5s	7s	42s	8m 45s	0
Customer takes numbered ticket	Start event	75											
Receive Customer Documentation	Task	75	75	2m 5s	17m 5s	8m 13s	10h 16m 50s	0	1m 15s	2s	11s	2m 35s	0
End	End event	0											
EventBasedGateway	Gateway	2	2										
Customer left	Intermediate event	0	0										
Vehicle status updated	Intermediate event	2	2										

We intend to decrease the average time of this process because customers complain about the long waiting times.

Inspection Process

Parameters

Start Events	Max. arrival count	Poisson Distribution
Arrival of the Vehicle and Inspections Form	75	Mean=7.2
Tasks	Processing Time	Waiting Time
Instruct the Customer	1 min	
Retrieve customer's keys	1 min 30 secs	
Measure the vehicle's emissions	1 min	
Check inside the car	1 min	
Check outside the car	1 min	
Examine registration papers	10 secs	
Compare the vehicle information number with the paperwork	10 secs	
Check Towing device	1 min	
Confirm if it was registered with the vehicle	20 secs	
Register Result	20 secs	
Drive Vehicle to Base 3	30 secs	
Check Brakes	40 secs	Poisson Distribution: Mean=2 mins
Register Results	20 secs	
Help base 4 inspector	1 min	
Drive Vehicle to base 4	30 secs	
Raise Vehicle	1 min	Poisson Distribution: Mean=2 mins
Inspect tie rod ends	1 min	
Inspect steering components and suspension	1 min 10 secs	
Inspect frame components	1 min	
Look for fluid leaks	1 min 10 secs	
Look for worn components	1 min	
Look for other abnormalities	1 min 20 secs	
Register Results	20 secs	
Gateways	Probability	
Customer followed instructions?	Yes=50% No=50%	
Vehicle has towing device?	Yes=50% No=50%	
Vehicle passed this inspection?	Yes=85% No=15%	
Passed brake inspection?	Yes=98% No=2%	
Exclusive Gateway	Finished=70% Not finished=30%	
Passed undercarriage inspection?	Yes=92% No=8%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Clerk	0,00 %	0	0	0
Inspector_B2	1,14 %	0	164,83	164,83
Inspector_B3	0,52 %	0	74,67	74,67
Inspector_B4	1,38 %	0	198,33	198,33
Manager	0,00 %	0	0	0
Supervisor	0,00 %	0	0	0
	Total	0	437,83	437,83

Process

Frumherji Ltd.													
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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	8m 20s	2h 53m 20s	1h 18m 40s	2d 18h 14m 20s					2d 6h 53m 50s	0
Vehicle has towing device?	Gateway	75	75										
Customer followed instructions?	Gateway	75	75										
Inspection success reported	Intermediate event	63	63										
ExclusiveGateway	Gateway	75	75										
Retrieve customer's keys	Task	38	38	1m 30s	8m 50s	3m 34s	2h 15m 50s	0	7m 20s	2m 4s	1m 47s	1h 18m 50s	0
Instruct the Customer	Task	75	75	1m	8m 20s	3m 22s	4h 13m 40s	0	7m 20s	2m 22s	2m 5s	2h 58m 40s	0
Vehicle passed this inspection?	Gateway	75	75										
Confirm if it was registered with the vehicle	Task	42	42	20s	8m 30s	3m 12s	2h 14m 50s	0	8m 10s	2m 52s	1m 59s	2h 50s	0
Check Towing device	Task	42	42	1m	8m 40s	3m 9s	2h 12m 50s	0	7m 40s	2m 9s	1m 50s	1h 30m 50s	0
Drive Vehicle to Base 3	Task	63	63	30s	7m 40s	3m 18s	3h 28m 10s	0	7m 10s	2m 48s	2m 6s	2h 56m 40s	0

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Check Brakes	Task	63	63	40s	9m	3m 16s	3h 25m 50s	0	5m 20s	31s	1m 6s	32m 50s	0
ExclusiveGateway	Gateway	60	60										
Help base 4 inspector	Task	17	17	1m	1m	1m	17m	0	0	0	0	0	0
ExclusiveGateway	Gateway	60	60										
Drive Vehicle to base 4	Task	60	60	30s	7m	50s	50m 50s	0	6m 30s	20s	55s	20m 50s	0
Passed brake inspection?	Gateway	63	63										
Vehicle failed	End event	3											
Vehicle Failed	End event	12											
Raise Vehicle	Task	60	60	1m	48m 20s	21m 58s	21h 58m	0	44m 20s	19m 3s	12m 49s	19h 3m	0
Passed undercarriage inspection?	Gateway	60	60										
Report inspection sucess	End event	53											
Vehicle Failed	End event	7											
Report inspection sucess	Intermediate event	60	60										
Register Result	Task	60	60	20s	47m	20m 16s	20h 16m	0	46m 40s	19m 56s	12m 47s	19h 56m	0
Register Result	Task	63	63	20s	7m 40s	1m 17s	1h 21m 30s	0	7m 20s	57s	1m 48s	1h 30s	0
Register Result	Task	75	75	20s	8m 20s	2m 55s	3h 39m 50s	0	8m	2m 35s	1m 58s	3h 14m 50s	0
Arrival of the Vehicle and Inspection form	Start event	75											
ExclusiveGateway	Gateway	75	75										
Base 2 Inspection Checks	Process	75	75	3m 20s	10m	5m 7s	1d 2h 48m 20s					22h 38m 20s	0
Inspect undercarriage	Process	60	60	6m 40s	53m 40s	25m 42s	5d 17h 56m					5d 11h 16m	0

Base 2 Inspection Checks													
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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Base 2 Inspection Checks	Process	75	75	3m 20s	10m	5m 7s	1d 2h 48m 20s					22h 38m 20s	0
Check inside the car	Task	75	75	3m	9m 40s	4m 47s	5h 59m 10s	2m	8m 40s	3m 47s	1m 39s	4h 44m 10s	0
Examine registration papers	Task	75	75	3m 20s	10m	5m 7s	6h 24m 10s	3m 10s	9m 50s	4m 57s	1m 39s	6h 11m 40s	0
Measure the vehicle's emissions	Task	75	75	2m	8m 40s	3m 47s	4h 44m 10s	1m	7m 40s	2m 47s	1m 39s	3h 29m 10s	0
Check outside the car	Task	75	75	1m	7m 40s	2m 47s	3h 29m 10s	0	6m 40s	1m 47s	1m 39s	2h 14m 10s	0
Compare the vehicle information number with the paperwork	Task	75	75	3m 10s	9m 50s	4m 57s	6h 11m 40s	3m	9m 40s	4m 47s	1m 39s	5h 59m 10s	0
ParallelGateway	Gateway	75	75										
ParallelGateway	Gateway	75	75										
Start	Start event	75											
End	End event	75											

Inspect undercarriage

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Inspect undercarriage	Process	60	60	6m 40s	53m 40s	25m 42s	5d 17h 56m					5d 11h 16m	0
End	End event	60											
ParallelGateway	Gateway	60	60										
ParallelGateway	Gateway	60	60										
Look for other abnormalities	Task	60	60	1m 20s	48m 20s	20m 22s	20h 22m 40s	0	47m	19m 2s	13m 16s	19h 2m 40s	0
Inspect tie rod ends	Task	60	60	2m 20s	49m 20s	21m 22s	21h 22m 40s	1m 20s	48m 20s	20m 22s	13m 16s	20h 22m 40s	0
Start	Start event	60											
Inspect frame components	Task	60	60	5m 30s	52m 30s	24m 32s	1d 32m 40s	4m 30s	51m 30s	23m 32s	13m 16s	23h 32m 40s	0
Look for fluid leaks	Task	60	60	4m 30s	51m 30s	23m 32s	23h 32m 40s	3m 20s	50m 20s	22m 22s	13m 16s	22h 22m 40s	0
Look for worn components	Task	60	60	3m 20s	50m 20s	22m 22s	22h 22m 40s	2m 20s	49m 20s	21m 22s	13m 16s	21h 22m 40s	0
Inspect steering components and suspension	Task	60	60	6m 40s	53m 40s	25m 42s	1d 1h 42m 40s	5m 30s	52m 30s	24m 32s	13m 16s	1d 32m 40s	0

A considerable number of vehicles are failing the inspection at base 2 (22), we should try to avoid failures by minor problems in order to don't waste resources inspecting these cars. In addition, we should try to decrease the average time of this process because it is suffering from avoidable delays like the clients falling asleep.

Recording Results into the Database Process

Parameters

Start Events	Max. arrival count	Uniform Distribution
Inspection finished	75	Min=2 Max=4
Tasks	Processing Time	
Collect completed documents	1 min	
Record documents	1 min	
Review docs	30 secs	
Check report feedback	30 secs	
Correct wrong reports	15 mins	
Oversee reports correction	15 mins	
Gateways	Probability	
Errors in the reports?	Yes=1% No=99%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Clerk	0,45 %	0	48,75	48,75
Inspector_B2	0,00 %	0	0	0
Inspector_B3	0,00 %	0	0	0
Inspector_B4	0,00 %	0	0	0
Manager	0,18 %	0	38,25	38,25
Supervisor	0,10 %	0	15	15
Total		0	102	102

We intend to decrease the clerk utilization in this process because the clerk already has several tasks to perform in the reception area, which is causing delays in the check in process.

Process

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	3m	22m 15s	7m 33s	10h 11m 27s					4h 54m 57s	0
ParallelGateway	Gateway	3	3										
Correct wrong reports	Task	3	3	15m	15m 56s	15m 18s	45m 56s	0	56s	18s	26s	56s	0
Inspection Records Sent	Intermediate event	78	78										
Feedback Received	Intermediate event	78	78										
Oversee reports correction	Task	3	3	15m	15m	15m	45m	0	0	0	0	0	0
Collect completed documents	Task	75	75	1m	15m 15s	3m 18s	4h 8m	0	14m 15s	2m 18s	3m 48s	2h 53m	0
ExclusiveGateway	Gateway	78	78										
Record documents	Task	75	75	1m	16m	2m 36s	3h 16m	0	15m	1m 36s	2m 43s	2h 1m	0
Check report feedback	Task	78	78	30s	30s	30s	39m	0	0	0	0	0	0
Errors in the reports?	Gateway	78	78										
ParallelGateway	Gateway	3	3										
Inspection finished	Start event	75											
Recording of results ended	End event	75											
Review docs	Task	75	75	30s	30s	30s	37m 30s	0	0	0	0	0	0

Most of the time spent in this process is used to perform the two initial tasks done by the clerks: Collect completed documents and Record Documents. We should avoid doing these tasks in this process by assigning them to the inspectors, which would result in the distribution of effort. This would decrease a lot the average time of the process.

The Process Redesign

BPR Principles

- 1 - ...make sure that information is captured fresh...
- 2 - ... information processing work ... is to be integrated with the real work ...
- 3 - ... Those who have an interest in the output of a process should ... drive it all the way....

Proposed Process Changes and Discussion of its Expected Benefits

For “Long Waiting Times for Check-In” we think that we can solve this issue by having a partial part of the check-in done in a self-service mode (maintaining also the option of being the clerk that does all the check-in). In the self-service, the customer would have access to machines that would have connection to the Government Database. In this way, the customer would insert all the required details and the machine would automatically check if the Insurance Fee and the Vehicle Tax were paid. If so, they could pay and the machine would give a beeper to the client. If not, the machine would print a QR code if they decided to call the insurance company and the client could go and deal with it. The QR code with give the machine and the clerk all the details already inserted. With these changes, we expect to reduce the waiting times in the Check-In and give the Clerk time for other tasks that they need to do (for example, correct wrong records).

For “Minor problems make clients fail inspection” there could be a mechanic responsible for doing a quick check for minor problems when the customers are waiting for inspection. The mechanic could do a quick check and could fix the problems right away if the customers were willing to pay extra for that service. Otherwise, the vehicles would fail the inspection and would not waste inspector’s time. With this service we expect to maintain or improve customer satisfaction by not making them waste their time with minor problems, decrease failing rate and waste less resources.

For “Long Waiting Times due to Employee Turnover”, in the inspection processes at all the bases the inspectors should now directly record their own documents into the database to make the process more transparent (2nd BPM principle) and to make the task of gathering the documents later by a clerk obsolete. We would also define a time limit to the customer to arrive at Base 2 with their car so that if the clients do things that were not supposed to do, like taking the keys with them or fall asleep in the car, the inspectors could take care of the next customer and not have to wait for that one. This is done with the help of the beeper delivered in Check-In. The beeper alerts the customers that it is their turn. With the beeper, the customers show up in time. The company could also reward the experienced inspectors so that they feel motivated to maintain their work in the company and not leave them for their competitors. The stations could also be improved by having more signals to direct the customers through the building. With these changes, we expect that the clerk has more time to dedicate to the check-in and don’t have the need to work extra hours; the waiting times for the inspection would decrease because of the new time limit and the addition of signals; the inspectors would work faster and be less error prone.

For “Fees and Taxes not Paid” the self-service machine gives the option to call the insurance company. Here, if the status is still not updated, the client could give the clerk a probative that they have already paid, and all would carry on as normal. With this, the client doesn’t need to wait until the government database is updated, improving the satisfaction of the client and avoiding frustrations.

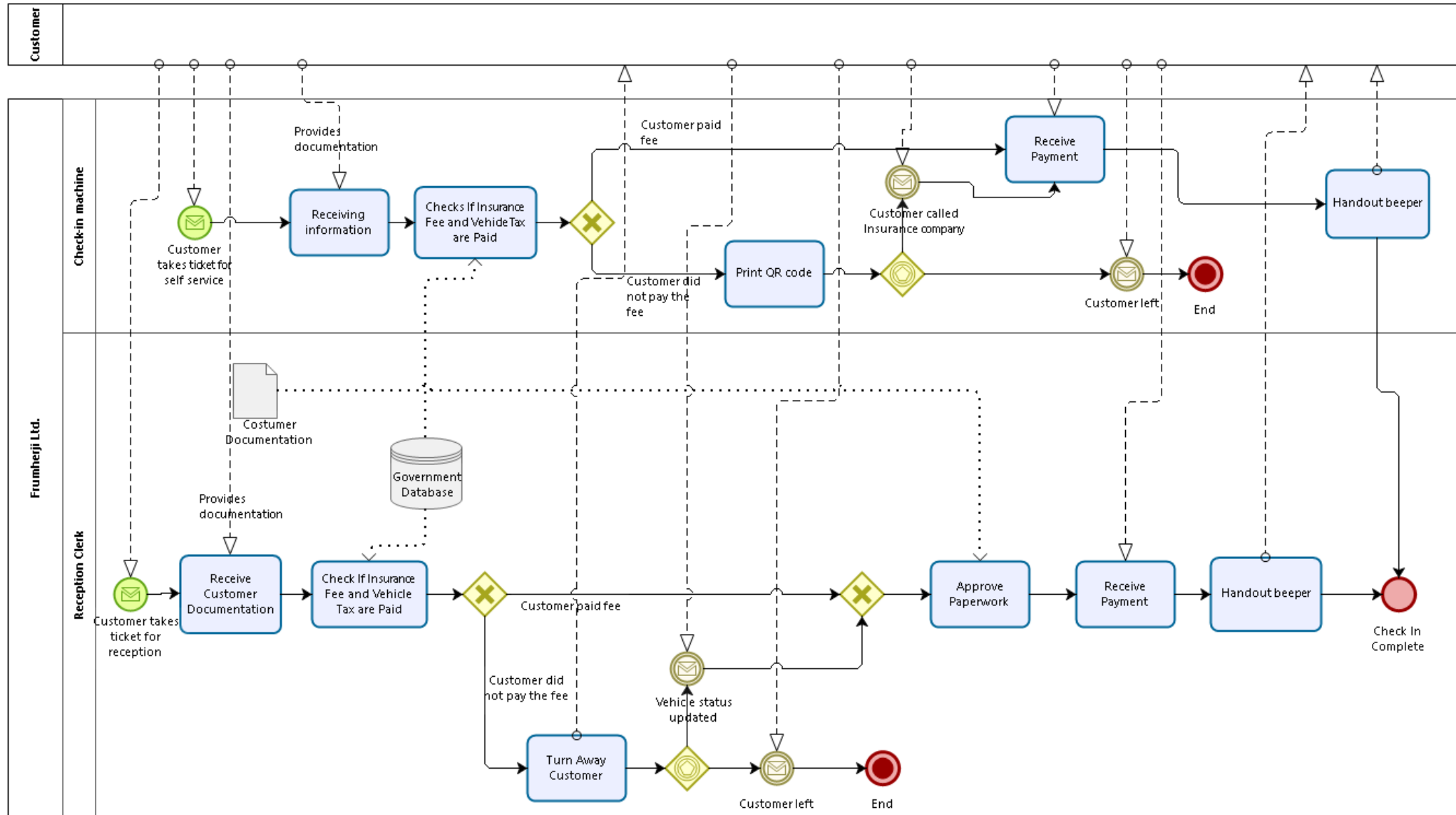
For “Overtime Working Clerks” and “Errors in Reports”, the issues are improved by the solutions given previously.

Discarded Ideas for Improvement

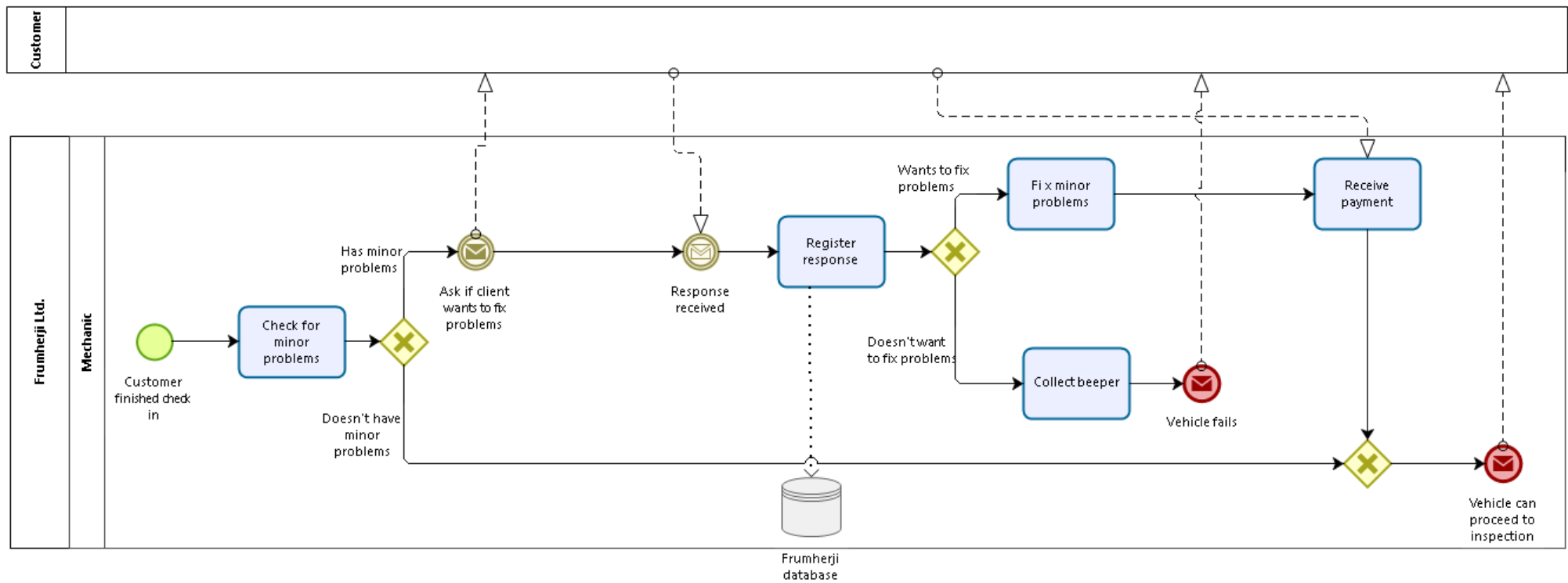
- Customers should drive their cars on their own from base to base in order to make them more involved in the processes (3rd BPM principle). Downside is that the amount of human errors could dramatically increase and involving the customer more in the inspection process could provoke more delays. Because of the possible higher rate of human errors this idea as dismissed.
- Inspection should not be part of the company's tasks, so that the company could directly start with charging the fee for inspection. It should not be illegal to inspect an illegal car. But as this is an issue of legislation it is not within the reach of this task.
- The customer does not drive the car anymore within the inspection, so it's subjective waiting time would increase. Having a customer waiting during the inspection could offer many opportunities for the company to run a more lucrative business. Customers could be charged for food and also commercials on e.g. TV screens can be run more efficiently. This idea was dismissed because it has nothing to do with the inspection itself.

As-Is Business Process Model Redesigned

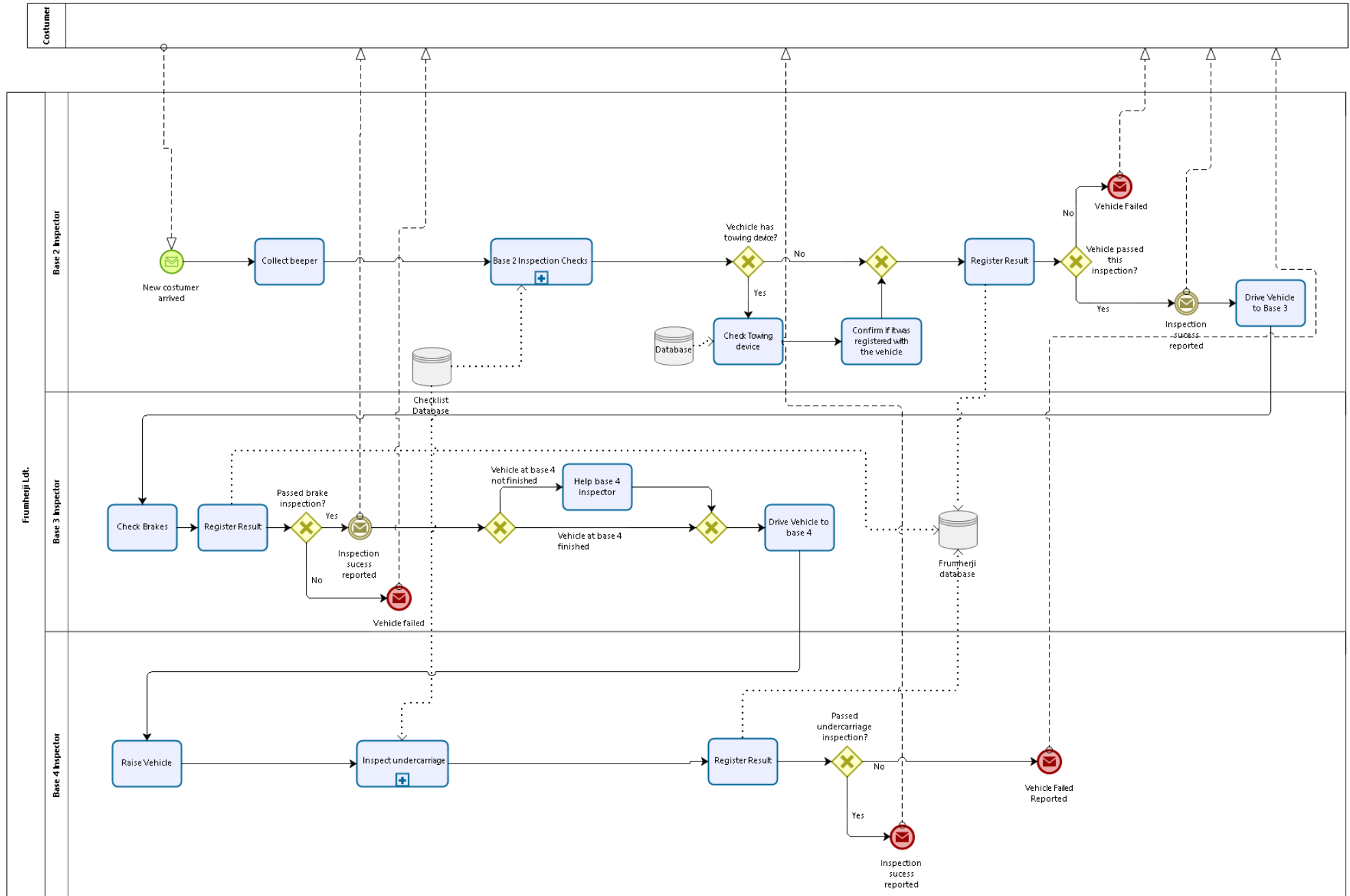
Customer Arrival and Check-In Process

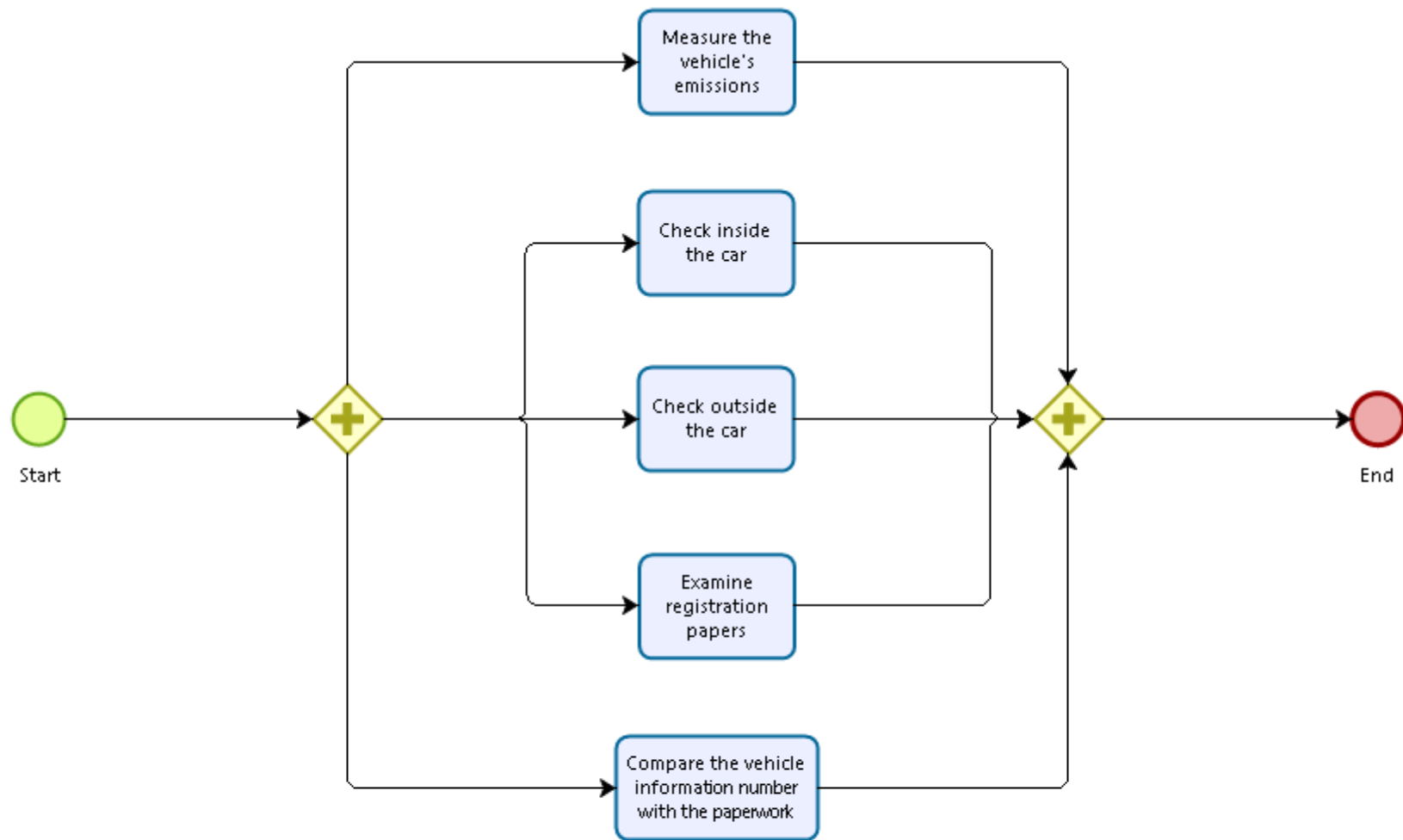


Minor Problems Check Process

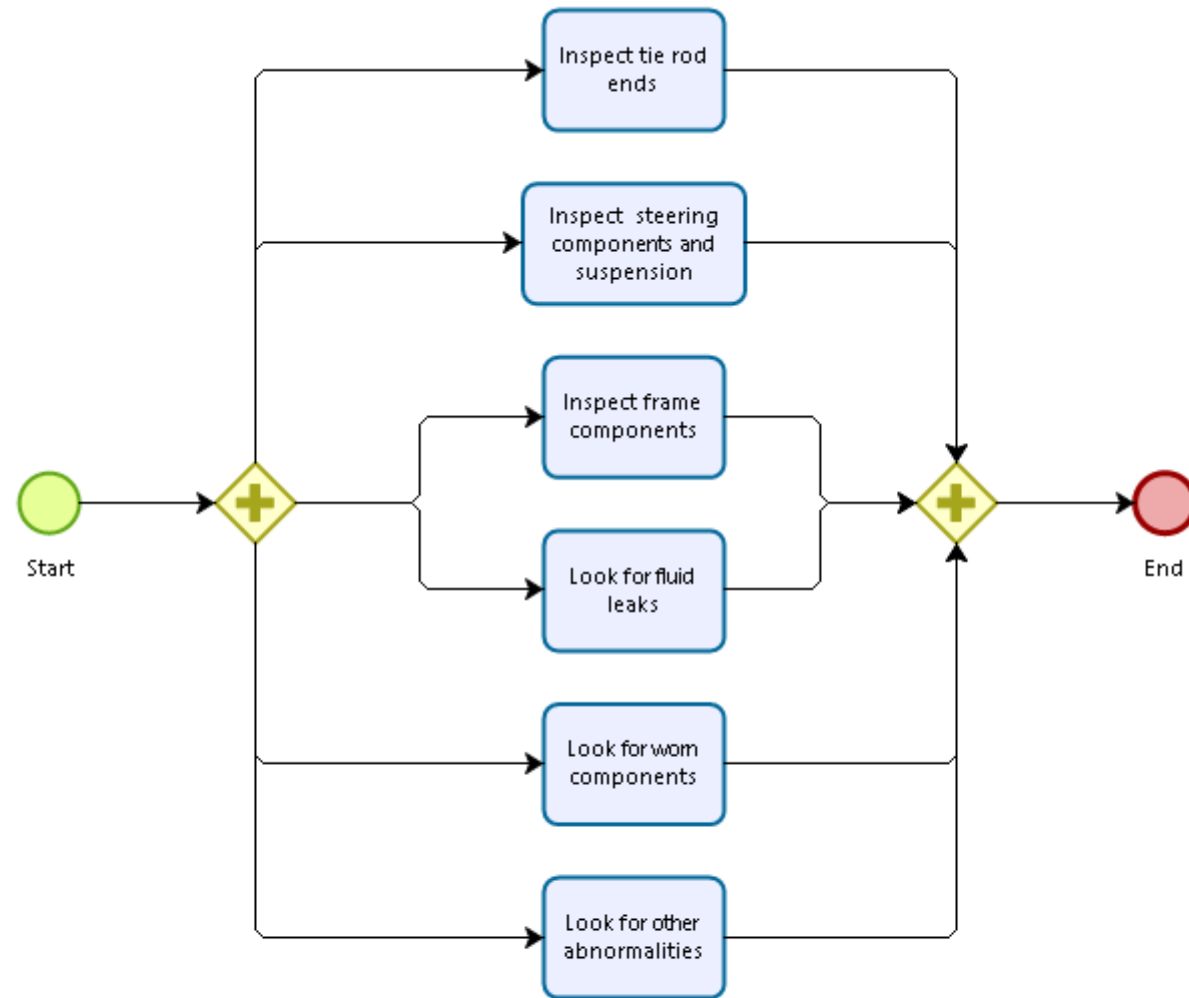


Inspection Process

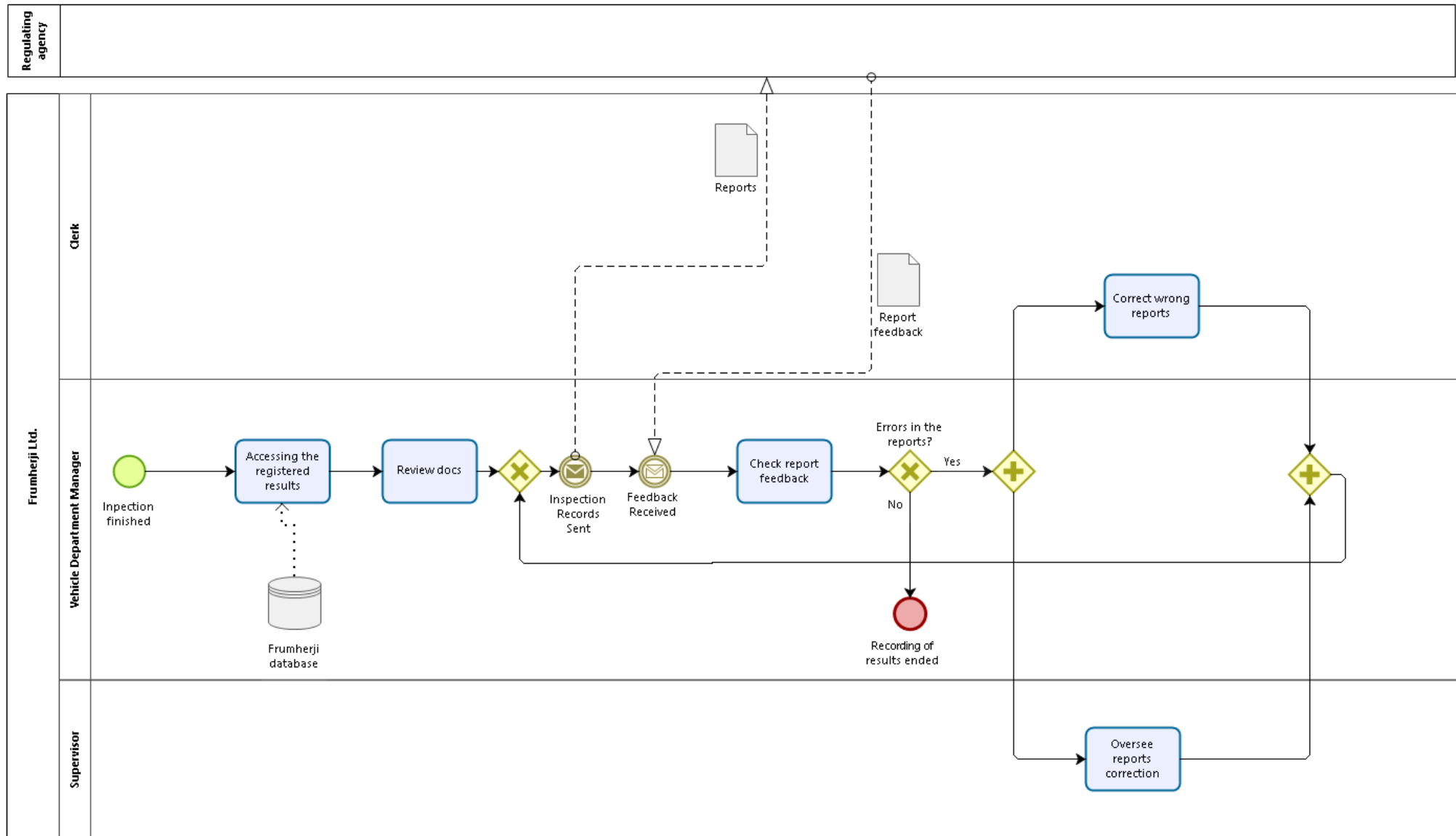




Check Undercarriage



Recording Results into the Database Process



Simulation To-Be Process

Check-In Process

Parameters

Start Events	Max. arrival count	Poisson Distribution
Customer takes ticket for self service	45	Mean=7.2
Customer takes ticket for reception	30	Mean=7.2
Tasks	Processing Time	Waiting Time
Receive Customer Documentation	5 secs	Poisson Distribution: Mean=3 mins
Check If Insurance Fee and Vehicle Tax are Paid	10 secs	
Turn Away Customer	15 secs	
Approve Paperwork	30 secs	
Receive Payment	10 secs	
Handout beeper	5 secs	
Receiving Information	5 secs	
Checks If Insurance Fee and Vehicle Tax are Paid	10 secs	
Print QR code	2 secs	
Receive Payment	10 secs	
Handout beeper	5 secs	
Gateways	Probability	
Exclusive Gateway	Paid=99% Did not pay=1%	
Exclusive Gateway	Paid=99% Did not pay=1%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Machine_CheckIn	0,02 %	0	0	0
Clerk	0,29 %	0	31,81	31,81
Inspector_B2	0,00 %	0	0	0
Inspector_B3	0,00 %	0	0	0
Inspector_B4	0,00 %	0	0	0
Supervisor	0,00 %	0	0	0
Manager	0,00 %	0	0	0
	Total	0	31,81	31,81

Process

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	30s	20m 55s	2m 45s	3h 27m 25s					57m 40s	0
ExclusiveGateway	Gateway	30	30										
Check In Complete	End event	75											
Check If Insurance Fee and Vehicle Tax are Paid	Task	30	30	10s	7m 25s	51s	25m 40s	0	7m 15s	41s	1m 35s	20m 40s	0
Turn Away Customer	Task	1	1	15s	15s	15s	15s	0	0	0	0	0	0
Vehicle status updated	Intermediate event	1	1										
ExclusiveGateway	Gateway	30	30										
Handout beeper	Task	30	30	5s	4m 25s	18s	9m 10s	0	4m 20s	13s	47s	6m 40s	0
Receive Payment	Task	30	30	10s	4m 30s	30s	15m	0	4m 20s	20s	54s	10m	0
Approve Paperwork	Task	30	30	30s	7m 45s	56s	28m	0	7m 15s	26s	1m 22s	13m	0
Customer takes ticket for reception	Start event	30											
Receive Customer Documentation	Task	30	30	5s	9m 25s	3m 33s	1h 46m 50s	0	4m 5s	14s	49s	7m 20s	0
End	End event	0											

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
EventBasedGateway	Gateway	1	1										
Customer left	Intermediate event	0	0										
Checks If Insurance Fee and Vehicle Tax are Paid	Task	45	45	10s	10s	10s	7m 30s	0	0	0	0	0	0
ExclusiveGateway	Gateway	45	45										
Receiving information	Task	45	45	5s	5s	5s	3m 45s	0	0	0	0	0	0
Receive Payment	Task	45	45	10s	10s	10s	7m 30s	0	0	0	0	0	0
Handout beeper	Task	45	45	5s	5s	5s	3m 45s	0	0	0	0	0	0
Print QR code	Task	0	0	0	0	0	0	0	0	0	0	0	0
EventBasedGateway	Gateway	0	0										
Customer left	Intermediate event	0	0										
Customer called Insurance company	Intermediate event	0	0										
Customer takes ticket for self service	Start event	45											
End	End event	0											

Note: In red is the self-service machine data

By adding a self-service machine, the average time of the process decreased a lot also result in a significant reduction of the clerk resource utilization.

Minor Problems Check Process

Parameters

Start Events	Max. arrival count	Poisson Distribution
New customer arrived	75	Mean=7.2
Tasks	Processing Time	Waiting Time
Check for minor problems	3 min	
Register response	3 secs	
Fix minor problems	10 min	
Collect beeper	5 secs	
Receive payment	10 secs	
Gateways	Probability	
Exclusive Gateway	Have minor problems=92% Doesn't have minor problems=8%	
Exclusive Gateway	Wants to fix problems=85% Doesn't want to fix problems=15%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Machine_CheckIn	0,00 %	0	0	0
Clerk	0,00 %	0	0	0
Inspector_B2	0,00 %	0	0	0
Inspector_B3	0,00 %	0	0	0
Inspector_B4	0,00 %	0	0	0
Supervisor	0,00 %	0	0	0
Manager	0,00 %	0	0	0
Mechanic	0,00 %	0	0	0
Total		0	0	0

Process

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	3m	13m 13s	3m 40s	4h 36m 5s					0	0
Customer finished check in	Start event	75											
Check for minor problems	Task	75	75	3m	3m	3m	3h 45m	0	0	0	0	0	0
Doesn't have minor problems	Gateway	75	75										
Ask if client wants to fix problems	Intermediate event	5	5										
Response received	Intermediate event	5	5										
Register response	Task	5	5	3s	3s	3s	15s	0	0	0	0	0	0
ExclusiveGateway	Gateway	5	5										
Receive payment	Task	5	5	10s	10s	10s	50s	0	0	0	0	0	0
Collect beeper	Task	0	0	0	0	0	0	0	0	0	0	0	0
Fix minor problems	Task	5	5	10m	10m	10m	50m	0	0	0	0	0	0
Vehicle fails	End event	0											
Vehicle can proceed to inspection	End event	75											
ExclusiveGateway	Gateway	75	75										

Inspection Process

Parameters

Start Events	Max. arrival count	Poisson Distribution
New customer arrived	75	Mean=7.2
Tasks	Processing Time	Waiting Time
Collect beeper	1 sec	
Measure the vehicle's emissions	58 secs	
Check inside the car	50 secs	
Check outside the car	50 secs	
Examine registration papers	8 secs	
Compare the vehicle information number with the paperwork	8 secs	
Check Towing device	50 secs	
Confirm if it was registered with the vehicle	18 secs	
Register Result	20 secs	
Drive Vehicle to Base 3	30 secs	
Check Brakes	36 secs	Poisson Distribution: Mean=1,8 mins
Register Results	20 secs	
Help base 4 inspector	58 secs	
Drive Vehicle to base 4	30 secs	
Raise Vehicle	58 secs	Poisson Distribution: Mean=1,8 mins
Inspect tie rod ends	50 secs	
Inspect steering components and suspension	1 min	
Inspect frame components	50 secs	
Look for fluid leaks	1 min	
Look for worn components	50 secs	
Look for other abnormalities	1 min 10 secs	
Register Result	20 secs	
Gateways	Probability	
Vehicle has towing device?	Yes=50% No=50%	
Vehicle passed this inspection?	Yes=86% No=14%	
Passed brake inspection?	Yes=99% No=1%	
Exclusive Gateway	Finished=75% Not finished=25%	
Passed undercarriage inspection?	Yes=93% No=7%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Machine_CheckIn	0,00 %	0	0	0
Clerk	0,00 %	0	0	0
Inspector_B2	0,68 %	0	97,27	97,27
Inspector_B3	0,50 %	0	71,62	71,62
Inspector_B4	1,30 %	0	186,6	186,6
Supervisor	0,00 %	0	0	0
Manager	0,00 %	0	0	0
Mechanic	0,00 %	0	0	0
Total		0	355,49	355,49

Process

Frumherji Ltd.													
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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	3m 15s	1h 8m 43s	31m 42s	20h 11m 23s					10h 55m 10s	0
Vehicle has towing device?	Gateway	75	75										
Inspection sucess reported	Intermediate event	67	67										
ExclusiveGateway	Gateway	75	75										
Vehicle passed this inspection?	Gateway	75	75										
Confirm if it was registered with the vehicle	Task	36	36	18s	3m 12s	35s	21m 8s	0	2m 54s	17s	48s	10m 20s	0
Check Towing device	Task	36	36	50s	3m 44s	1m 3s	37m 56s	0	2m 54s	13s	40s	7m 56s	0
Drive Vehicle to Base 3	Task	67	67	30s	3m 10s	42s	47m 56s	0	2m 40s	12s	41s	14m 26s	0

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Check Brakes	Task	67	67	36s	8m 42s	2m 47s	3h 7m 20s	0	4m 6s	12s	44s	14m 8s	0
ExclusiveGateway	Gateway	66	66										
Help base 4 inspector	Task	20	20	58s	1m 56s	1m 5s	21m 56s	0	58s	7s	17s	2m 36s	0
ExclusiveGateway	Gateway	66	66										
Drive Vehicle to base 4	Task	66	66	30s	30s	30s	33m	0	0	0	0	0	0
Passed brake inspection?	Gateway	67	67										
Vehicle failed	End event	1											
Vehicle Failed	End event	8											
Raise Vehicle	Task	66	66	1m 24s	34m 36s	11m 37s	12h 47m 4s	0	29m 38s	8m 48s	7m 23s	9h 41m 16s	0
Passed undercarriage inspection?	Gateway	66	66										
Inspection sucess reported	End event	61											
Vehicle Failed Reported	End event	5											
Inspection sucess reported	Intermediate event	66	66										
Register Result	Task	66	66	20s	20s	20s	22m	0	0	0	0	0	0
Register Result	Task	67	67	20s	7m 56s	41s	46m 48s	0	7m 36s	21s	1m 9s	24m 28s	0
Register Result	Task	75	75	20s	20s	20s	25m	0	0	0	0	0	0
New costumer arrived	Start event	75											
Collect beeper	Task	75	75	1s	1s	1s	1m 15s	0	0	0	0	0	0
Base 2 Inspection Checks	Process	75	75	2m 54s	4m 48s	2m 58s	13h 59m 30s					10h 22m	0
Inspect undercarriage	Process	66	66	5m 40s	33m 34s	14m 18s	3d 7h 9m 48s					3d 55m 48s	0

Base 2 Inspection Checks

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Base 2 Inspection Checks	Process	75	75	2m 54s	4m 48s	2m 58s	13h 59m 30s					10h 22m	0
Check inside the car	Task	75	75	1m 40s	3m 34s	1m 44s	2h 10m 54s	50s	2m 44s	54s	17s	1h 8m 24s	0
Examine registration papers	Task	75	75	2m 54s	4m 48s	2m 58s	3h 43m 24s	2m 46s	4m 40s	2m 50s	17s	3h 33m 24s	0
Measure the vehicle's emissions	Task	75	75	2m 38s	4m 32s	2m 42s	3h 23m 24s	1m 40s	3m 34s	1m 44s	17s	2h 10m 54s	0
Check outside the car	Task	75	75	50s	2m 44s	54s	1h 8m 24s	0	1m 54s	4s	17s	5m 54s	0
Compare the vehicle information number with the paperwork	Task	75	75	2m 46s	4m 40s	2m 50s	3h 33m 24s	2m 38s	4m 32s	2m 42s	17s	3h 23m 24s	0
ParallelGateway	Gateway	75	75										
ParallelGateway	Gateway	75	75										
Start	Start event	75											
End	End event	75											

Inspect undercarriage

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Inspect undercarriage	Process	66	66	5m 40s	33m 34s	14m 18s	3d 7h 9m 48s					3d 55m 48s	0
End	End event	66											
ParallelGateway	Gateway	66	66										
ParallelGateway	Gateway	66	66										
Look for other abnormalities	Task	66	66	1m 10s	29m 4s	9m 48s	10h 46m 48s	0	27m 54s	8m 38s	7m 18s	9h 29m 48s	0
Inspect tie rod ends	Task	66	66	2m	29m 54s	10m 38s	11h 41m 48s	1m 10s	29m 4s	9m 48s	7m 18s	10h 46m 48s	0
Start	Start event	66											
Inspect frame components	Task	66	66	4m 40s	32m 34s	13m 18s	14h 37m 48s	3m 50s	31m 44s	12m 28s	7m 18s	13h 42m 48s	0
Look for fluid leaks	Task	66	66	3m 50s	31m 44s	12m 28s	13h 42m 48s	2m 50s	30m 44s	11m 28s	7m 18s	12h 36m 48s	0
Look for worn components	Task	66	66	2m 50s	30m 44s	11m 28s	12h 36m 48s	2m	29m 54s	10m 38s	7m 18s	11h 41m 48s	0
Inspect steering components and suspension	Task	66	66	5m 40s	33m 34s	14m 18s	15h 43m 48s	4m 40s	32m 34s	13m 18s	7m 18s	14h 37m 48s	0

By giving the opportunity to the customers to correct minor problems, we decreased the vehicle failure at base 2. We were able to decrease a lot the average time of the process as well by adding a time limit for the customers at base 2.

Recording Results into the Database Process

Parameters

Start Events	Max. arrival count	Uniform Distribution
Inspection finished	75	Min=2 Max=4
Tasks	Processing Time	
Assessing the registered results	20 secs	
Review docs	1 min	
Check report feedback	30 secs	
Correct wrong reports	15 mins	
Oversee reports correction	15 mins	
Gateways	Probability	
Errors in the reports?	Yes=1% No=99%	

Resources

Resources				
Resource	Utilization	Total fixed cost	Total unit cost	Total cost
Machine_Checkin	0,00 %	0	0	0
Clerk	0,03 %	0	3,75	3,75
Inspector_B2	0,00 %	0	0	0
Inspector_B3	0,00 %	0	0	0
Inspector_B4	0,00 %	0	0	0
Supervisor	0,03 %	0	5	5
Manager	0,32 %	0	69	69
Total		0	77,75	77,75

Process

Frumherji Ltd.

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	Standard deviation waiting resources	Total time waiting resource	Total fixed cost
Frumherji Ltd.	Process	75	75	1m 50s	17m 20s	2m 2s	2h 48m 28s					28s	0
Errors in the reports?	Gateway	76	76										
Recording of results ended	End event	75											
Inspection finished	Start event	75											
Review docs	Task	75	75	1m	1m	1m	1h 15m	0	0	0	0	0	0
Feedback Received	Intermediate event	76	76										
Inspection Records Sent	Intermediate event	76	76										
Check report feedback	Task	76	76	30s	30s	30s	38m	0	0	0	0	0	0
Correct wrong reports	Task	1	1	15m	15m	15m	15m	0	0	0	0	0	0
Oversee reports correction	Task	1	1	15m	15m	15m	15m	0	0	0	0	0	0
ParallelGateway	Gateway	1	1										
ParallelGateway	Gateway	1	1										
ExclusiveGateway	Gateway	76	76										
Accessing the registered results	Task	75	75	20s	47s	20s	25m 28s	0	27s	0 s	3s	28s	0

The average time of the process and the clerk resource utilization decreased significantly by making the inspectors record their inspection forms in the database.

Process Model in OutSystems

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Password: 12345678

Public URL: <https://personal-cx8mdgvd.outsystemscloud.com/ETPNProjectG9/>