



**FRESH** MARKET

## **BUSINESS PROCESS ANALYSIS**

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# 1. Introduction

The Fresh Market is a supermarket located in Lisbon, Portugal. This supermarket was founded in the year 1998, the purpose of this analysis is to compare and design a detailed Business Process Model and Notation of the current state of the process of preparing and delivering an order made through the supermarket website, understand their actual errors and exceptions that need to be handled, we will use quantitative and qualitative techniques (non-value adding steps, wastes, bottlenecks, what-if analysis, scenarios based on simulations) for produce a new efficiently Business Process Model and Notation, where we will identify and compare with the current process model their advantages and disadvantages that will solve the main problems of the processes, as customer dissatisfaction, their dissatisfaction about missing products, their dissatisfaction about lack of information about the delivery date, employees dissatisfaction about lack of in the process, and support Fresh Market becoming more sustainable.

## 2. Background

The FreshMarket is a supermarket that provides its products to its customers via an Online interface. The main objective of our work is to improve the process of picking and delivering all the orders made through the website. For that, we will design the actual business process model based on their description of the process, understanding of the problems and inefficiencies of the process, and which activities from the actual process could be improved or even deleted. After realizing the main problems and designing the As-Is business process model, we will apply a qualitative and quantitative analysis for understanding the origin of FreshMarket problems, which activities add value to the process, and which activities delay the process. After identifying the problems, we performed What-If Simulations, where we achieved an optimal result after some trials and tests. After achieving the optimal result, we decide to redesign the As-Is business process model in a way to create a To-Be business process model, the best and most efficient business process model, that will solve the actual problems from the current business process of FreshMarket. After creating a To-Be business process model, we compared the changes made in the process, as well the improvements and their cost of implementation, according to their limitations.

### 3. AS-IS Process Model

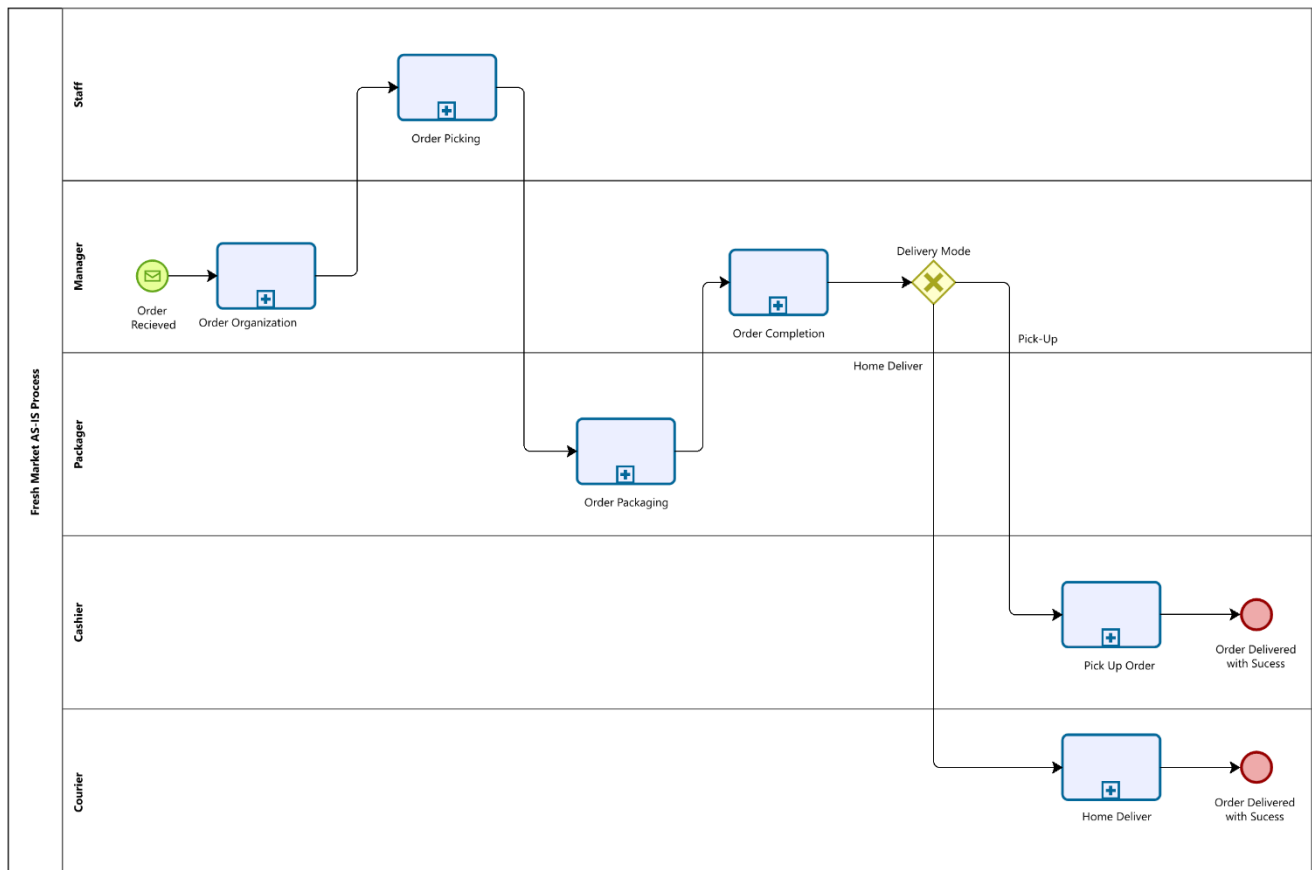
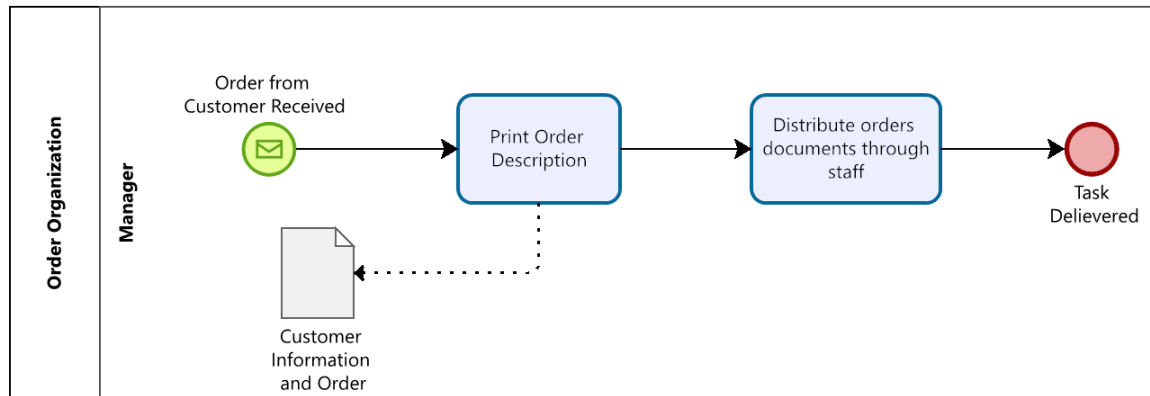


Figure 1: Fresh Market Overall Process - Level 1

The main process begins when the online website system receives a customer order, which triggers the process. So, the first sub-process we have is the order organization, performed by the manager, where he retrieves the order's information and distributes the task throughout the staff. Then, the process leads us to "Order Picking" where the staff (or better the staff employee chosen by the manager) will pick all the items necessary to fulfill the order. After having the shopping cart with the groceries, the staff gives the cart to the packager, who then will prepare, and bag the items of the order, and the order is ready for delivery. But before going to the delivery process, the manager will confirm the order, check missing or substituted products and do the necessary changes. After the preparation of the order is complete, the process can take two distinct paths, with a 20% chance a client can choose to pick up the order at the store, in this case, a cashier will be in charge of delivering the order to the client, the other option, with an 80% chance, a client can choose for the order to be delivered at his home, and in this

case, two cashiers will be in charge to deliver the order and the invoice. In both options, the process ends with the client receiving the order.

### 3.1 Order Organization



*Figure 2: Process Level 2 – Order Organization*

The order organization sub-process is very simple, the order starts when a client submits an order through the website. After receiving the order, the manager prints the order description, a unique document with the customer information, and the description of the order. After the order is printed, the manager gives the order to one of the staff, and in case of receiving multiple orders, he distributes the orders through the staff, this distribution happens with the delivery in the person of the paper document of the order description. The process of organization of the order ends when the task of preparing the order is delivered to the staff. And all the sub-process is performed by the manager, only having a connection with the client when this sends an order request through the website and initiates the process.

## 3.2 Order Picking

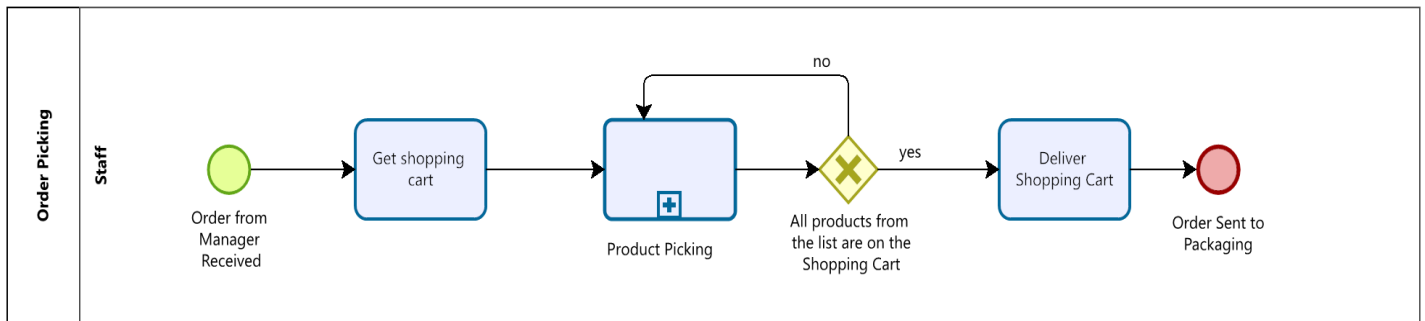


Figure 3: Process Level 2 – Order Picking

So, the order-picking process happens right after the manager gives the order description to the staff, then the staff starts the process of picking the products from the order. First, the staff picks a shopping cart, then for each product in the order's list, they have a subprocess they have to go through to complete the order correctly and successfully without any mistakes or the minimum number of mistakes possible. After going through every single item on the list and putting it in the shopping cart, they need to deliver the shopping cart to the packager, and the process ends when the order or the shopping cart is delivered to the packager. The staff fully performs the process, including the sub-process inside (of level 3).

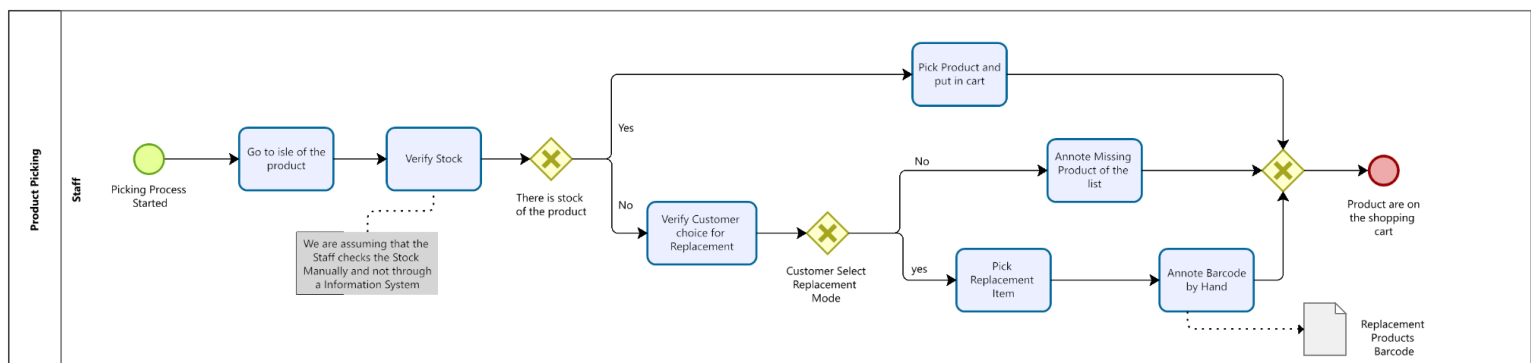
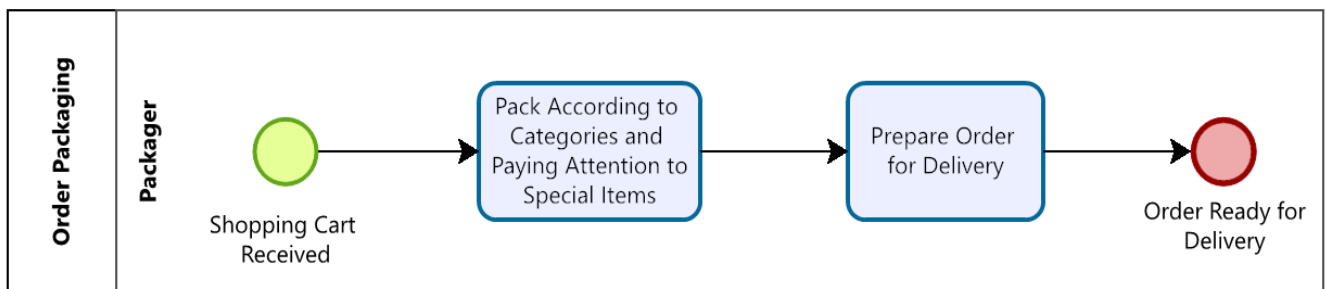


Figure 4: Process Level 3 – Product Picking

As said, the subprocess of picking each item on the list has to be performed individually, since the staff has to go to each product's aisle, check for items out of stock, and the solution for that problem. So, for each item, the staff goes to the isle with the shopping cart, then assumed that there can check the stock automatically, if the item is in stock, on the shelf, the employee either sees if the item is available on the storage and then picks the items, or if there is no system to verify the stock we go to check first. If there is an item, he picks the item and puts it on the

shopping cart, otherwise, we confirm that there is no stock in the storage (by walking there and then coming back to the isle or asking a co-worker), and then due to the lack of stock of the product required, the staff has to review the order description and check the customer's choice for replacement products, and from there, there are two options, if the customer opted for no replacement the employee marks the product on the list as missing and moves to the next item, if the customer accepted the replacement item the employee picks the new replaced product, puts it on the cart and annotates the barcode by hand in the order document. The order ends when the product is on the car (or the missing product is annotated).

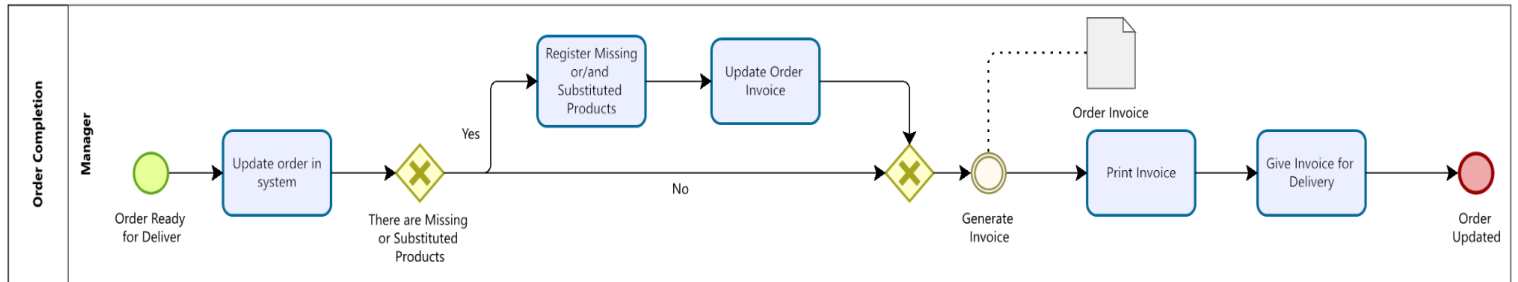
### 3.3 Order Packaging



*Figure 5: Process Level 2 – Order Packaging*

The process of packing the order's items is pretty simple, after receiving the shopping cart from the staff employee, the packager packs the items carefully in plastic bags, the activity can take some time depending on the size of the order and due to the fact the packager has to be careful with very specific items, for example, some frozen and fragile items should be handled and put on the bag carefully, the glass products should be bubbled wrapped before putting them in the bag, and liquid products should have adhesive tape on their lid in order not to spill. This process is very situational and depends a lot on each order and the products it contains. Due to that unpredictability, we cannot specify it fully in the process. After packing, the packager prepares the bags for delivery, and the order is finally ready for delivery.

### 3.4 Order Completion



*Figure 6: Process Level 2 – Order Completion*

The order completion (or order verification) is performed again by the manager and starts the moment the order is ready for delivery, the first thing the manager needs to do is to update the order in the system if there are no missing products or replacement products the update is pretty simple, updating only the time it took to prepare the order. If there are missing or replaced products, the manager has to register this situation, in case of missing products the manager has to discount the value of the product that is missing from the invoice, in the case of replacement products he has to update the barcode given in separated document by the staff and keep the same price as the one product that the customer chose. After making the necessary changes or not, the manager prints the invoice, this invoice will be delivered to the client, so it's given to the cashier for him to deliver to the client. And finally, the order is updated and the process continues to the delivery.



### 3.5 Pick-Up Order

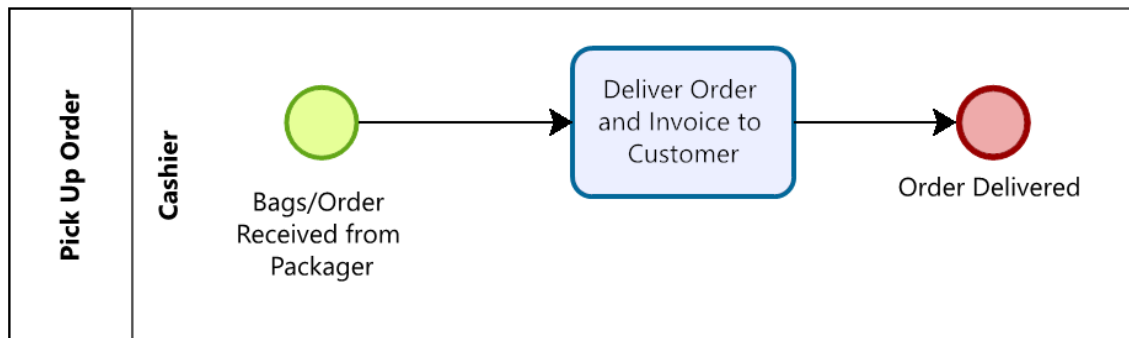


Figure 7: Process Level 2 – Pick-Up Order

Having only a 20% chance of a client choosing a pick-up order process is realized, this process starts with the delivery of the plastic bag order, from the packager to the cashier. Also receiving the invoice from the manager, the cashier then delivers both the order and the invoice to the client that arrived at the store. The process then ends when the order is successfully delivered to the client.

### 3.6 Home Delivery

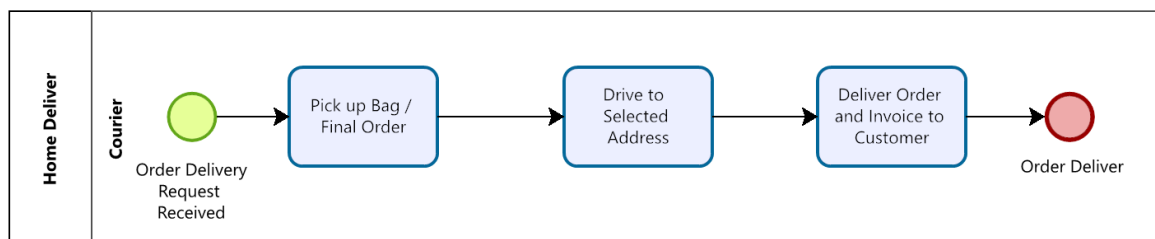


Figure 8: Process Level 2 – Home Delivery

The other option for delivery is home delivery; on average, 80% of the clients choose this option. So, after the courier receives the request to do home delivery, two couriers pick up the bag and drive to the address selected by the customer. This activity can be affected by multiple factors, like weather, traffic, vehicle problems, or unexpected problems. They then deliver the bags and the invoice to the customer. And finally, after the order is delivered and the process is finished.

## 4. Qualitative Analysis

So, after designing the AS-IS process, we started applying the Qualitative Analysis, to: have a better perception and recognition of both activities that are unnecessary and that are needed; reveal the most irrelevant activities, to eliminate them, and most important ones; clarify what activities to keep, showing the activities that do not bring additional value and the ones that bring value to the process; recognize the desired solutions to the respective issues.

This analysis will have the advantage of gathering, structuring, and reorganizing the qualitative data from the process with great clarification. In this analysis, we applied the methods of Value-Added Analysis, Waste Analysis, Issue Register, and Root Cause Analysis, with the help of Why-Why Diagrams.

### 4.2 Value-Adding Analysis

We will apply firstly the Value-Added Analysis, which will allow an understanding of the steps from the Freshmarket process, that contribute positively and the steps that are irrelevant, and do not provide an adding value to the process. After removing them. In terms of outcomes, the **Value-Added Analysis can be divided into 3 distinct groups:**

- **Value Adding (VA)** – When the activities are classified as **Value Adding** to the customer, means we are producing value or higher satisfaction to the customer, he agrees to pay for that respective step, if the customer values this step to conducting the business, or if we remove this step the customer will feel the outcome from the process is less valuable, the step contributes to positive outcomes.
- **Business Value Adding (BVA)** – When the activities are classified as **Business Value Adding**, they do not add direct value for customers when these activities are necessary for rolling the business efficiently. They are important for collecting revenue, to improve and growing the business, they represent steps that reduce the risk of business losses.

- **Non-Value Adding (NVA)** – When the activities are classified as **Non-Value Adding**, means the steps are irrelevant to the business, they don't give any value to our business. They should be removed; the steps are **Non-Value Adding** when they don't follow any from the previous categories.

Steps	Classification
Receive Order from Customer	VA
Print Customer Information Order Description	BVA
Distribute Orders documents through staff	BVA

Table 1: Value-Adding Analysis – Order Organization

Steps	Classification
Update Order in System	BVA
Register Missing or/and Substituted Products	NVA
Update Order Invoice	NVA
Generate Order Invoice	BVA
Print Invoice	BVA
Give Invoice for Deliver	VA

Table 5: Value-Adding Analysis – Order Completion

Steps	Classification
Receiving Shopping Cart from Staff	BVA
Pack According to Categories	VA
Prepare Order to Delivery	VA

Table 4: Value-Adding Analysis – Order Packing

Steps	Classification
Receive Order from Manager	BVA
Get Shopping Cart	NVA
Deliver Shopping Cart	NVA

Table 2: Value-Adding Analysis – Order Picking

Steps	Classification
Go to isle of Product	NVA
Verify the Stock	BVA
Pick Product and put in cart	VA
Verify the Customer choice Replacement	BVA
Annote Missing Product of the list	NVA
Pick Replacement Item	VA
Annote the Replacement Products Barcode by hand	BVA

Table 3: Value-Adding Analysis – Product Picking

Sub-Process	Steps	Classification
Pick-Up	Receive Order from Packager	BVA
Home Deliver	Receive Order Request	VA
Home Deliver	Pick-up Final Order	BVA
Home Deliver	Drive to Selected Address	VA
Both	Deliver Order & Invoice to Customer	VA

Table 6: Value-Adding Analysis – Pick-up Order &amp; Home Delivery

## 4.3 Issue Register

After realizing a deep analysis of the business process of FreshMarket, we can conclude that we have a few problems that can contribute to a negatively significant and direct impact on business performance, which will lead to dissatisfaction among the customers and employees. The objective of the Issue Register method is to understand the gravity of the issues, the respective issues that exist in the business model, the assumptions from our issues, and the qualitative and quantitative issues impact.

Issue	Priority	Description	Data and Assumptions	Qualitative Impact
Waste of Environmental Resources	5	Fresh Market process works using both papers to print invoices and order distribution, and plastic to package the Items and then do the delivery	By using plastic and paper resources, they are wasting money and environmental resources	Decreased Sustainability of the company, Costs (plastic & paper) increase.
Customers are not Informed of the Time of Delivery	4	Customers would like to be informed about the exact delivery date	Not having the exact time of delivery, customers don't know when to pick up the order or when to expected to be delivered	Unsatisfaction of Customers
Non-Compliant with Home Delivery Schedule	1	Customer complain that home delivery schedule is not followed, some deliveries are made with more than 30 minutes of delay, and at that time the customer is not available anymore	By not complying to the delivery schedule the customer might not order from the store again or rate badly the company.	Inefficiency of Order Distribution, Unsatisfied Customers
Staff is Dissatisfied with the Lack of Efficiency in Order Picking	3	The process of collecting items is very manual and prone to errors. For example, when the staff has to substitute a product the new product's barcode is annotated by hand in some order document. Or the fact that the staff has to check the stock manually. Or the staff has to check multiple aisle to find their items, even if the next item is in the same aisle they have no way to know	Poor processes to collect items leads to inefficiency in the distribution of the orders	Loss of Efficiency, Unsatisfied Employees, Waste of Time
Customer Complains of Missing Products	2	Customers, when choosing not to replace an out-of-stock product, will not receive one of their products. And sometimes, it happens that the customer doesn't receive a product from the order (by mistake)	Some clients opt not to replace a missign product. Staff may not fulfill the order correctly and miss products	Loss of Efficiency, Unsatisfied Clients
Each Order has to be Delivery by 2 Courtiers	6	Two courtiers have to deliver the order because one is not able to perform the home delivery by himself, too many plastic bags	One courtier is not enough in every order. The need to have two courtiers available for each order delivery is a problem	Poor Resource Allocation
Manually Update Missing and Substituted Products	7	The manager has to update manually the substituted products and update the new barcode, given in a note by the staff, and then discount the price for same price the product is replacing. If the manager updates a missing product he has to discount the value	Manager does this process manually. He might get some number wrong	Loss of Efficiency, Waste of Time

Table 7: Issue Register

## 4.4 Wastes

After understanding the issues and the activities that are necessary for performing our model efficiently, now we need to identify which activities from our process do not add value. The waste analysis could be the steps, or actions between the steps. The Waste Analysis is grouped into 3 categories, which could be wastes associated with movement (transportation or motion) or could be wastes associated with holding (inventory or waiting), and wastes could be associated with over-do (defects, over-processing, and over-production).

In the AS-IS model, we identified 6 steps that do not bring any value, and these are: when the staff gets the shopping cart, then delivers the shopping cart, when the staff goes to the aisle of the product when the staff has to verify the stock in the storage (having to move and “wasting time” not producing), and finally when the manager has to put to give the order description to the staff and put the printed order in the order bag.

We can conclude that all the steps we identified belong to the type of waste of moving, both in transportation type when the employees exchange the order bag and the invoices, and in motion type when the employees have to move to go to the aisle or go to the storage.

A few steps we were considering putting as a waste, was the process of updating the system and replacing or removing the specific item(s) from the list, because at a first glance it seems that the manager is trying to fix the problem of not having the item available. But as the last consideration, we didn't consider it as overdo waste, because we are not compensating for a mistake or reworking something, we are just changing the order to ensure the client doesn't receive the order with missing products or products that are not well charged.

## 4.5 Root Cause Analysis

Now, we will apply the Root Cause Analysis (Why-Why Diagram), with Root Cause Analysis will allow us to analyze, identify and understand deeper the cause of the specific negative issues from our current model, applying Why-Why Diagram (also known as tree diagrams) we will apply the question ‘Why’ multiple times until recognizing the root cause of our business process problems, this way, we will have a better understanding of what solutions to apply to solve the problem of the process of preparing and delivering the orders of FreshMarket.

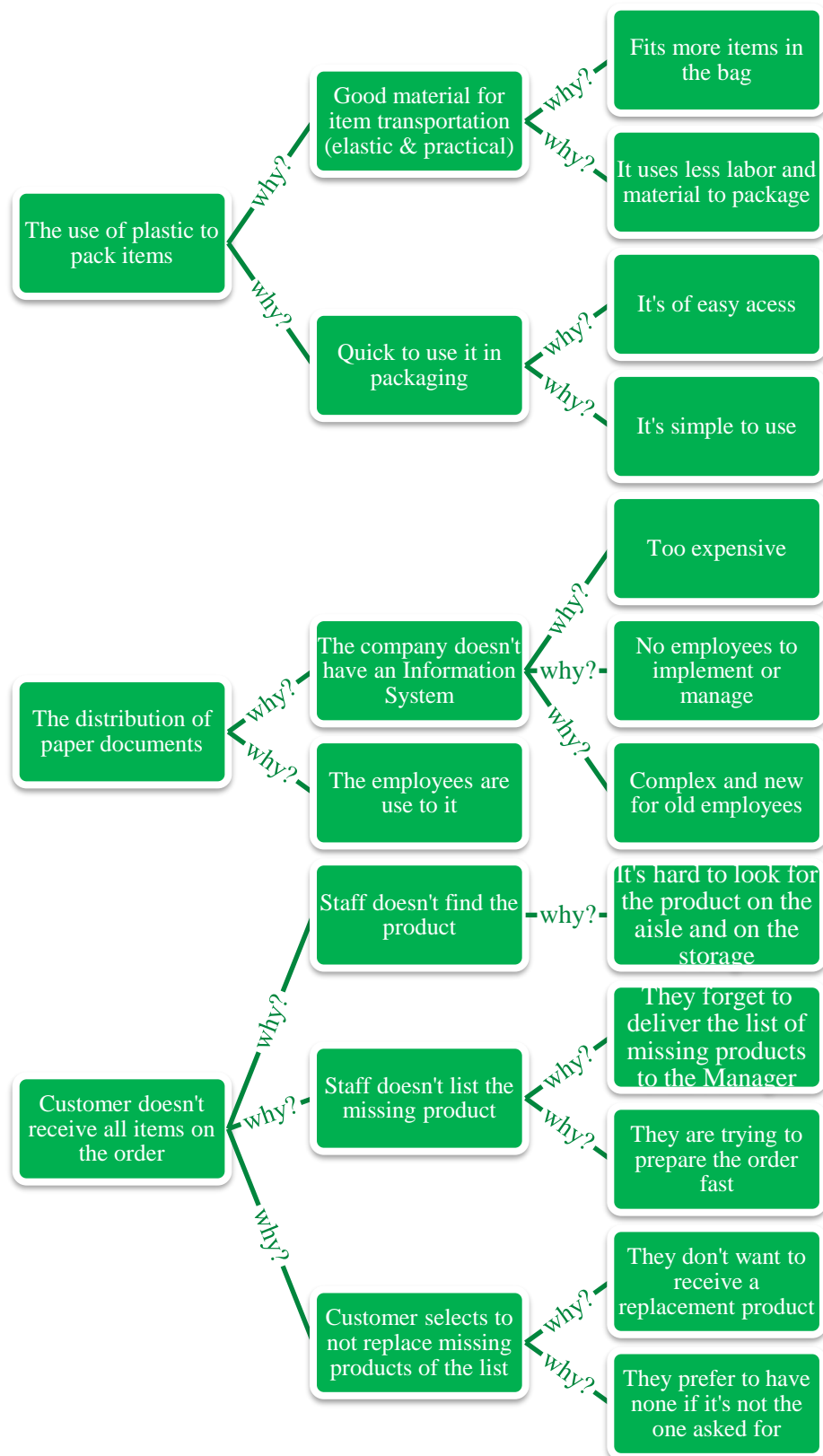


Figure 9: Why-why Diagram 1

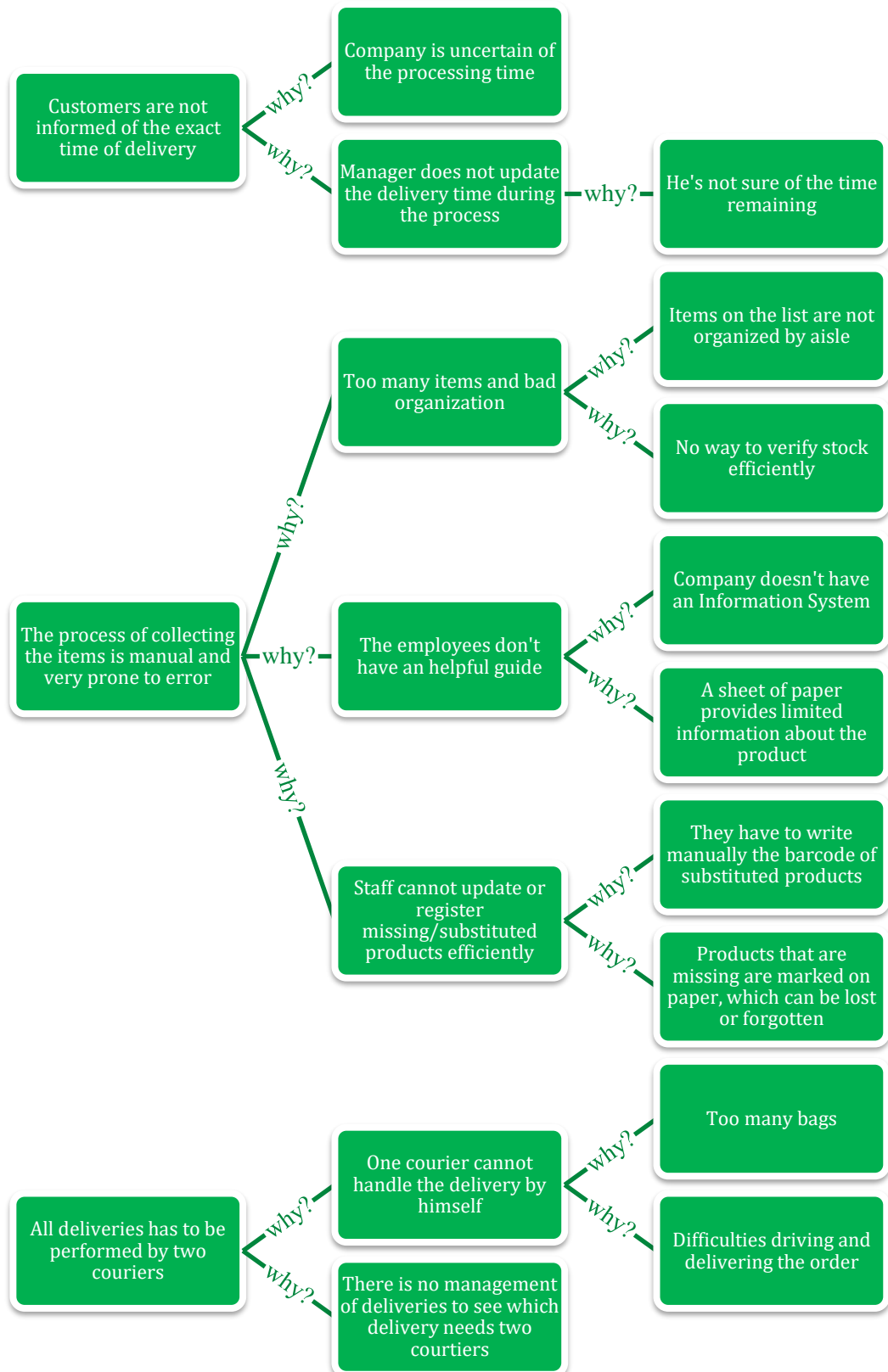


Figure 10: Why-why Diagram 2

## 5. Quantitative Analysis

Now, quantitative analysis is a technique that uses quantitative data (numerical measures), which is composed of Process Performance Measures, Flow Analysis, Queuing Analysis, and Simulation on Process Performance Measures their purpose is to allow recognize the time, cost, flexibility, and quality of the respective process, on Flow Analysis concede the recognition of techniques that allow us to assess the global performance, in Queuing Analysis leads with problems which involve waiting and Simulation generates and executes every step of a wide number of imaginary instances and records it.

So, to perform quantitative analysis, we will work with the information that the supermarket website processes works from 10 am to 6 pm every day of the month. This will give a total of 8 hours of work daily, assuming a month of 30 days in total. Finally, we also have the information that the website receives around 45 orders per day.

### 5.1 Performance Measure

The Performance Measure Process is a technique from Quantitative Process Analysis to recognize how is the performance by looking at each activity across the process model. The Process Performance is composed of Time (Processing Time, Waiting Time, Cycle Time, Cycle Time Efficiency), Cost (Processing Cost, Cost of Waste, Per-Instance Cost, Material Costs, Resources costs, Resource Utilization), Quality (Product Quality, Delivery Quality, Customer Satisfaction) and Flexibility.

#### 5.1.1 Resources Cost Analysis

Since we are not able to analyze the Material Costs (the cost of materials like paper; ink for the printer; plastic; gasoline/diesel; vehicle/car/motorcycle/truck; system; and website) during the process of preparing and delivering, we will perform a Resources Cost analysis.

The only resources cost information we have available from the Fresh Market is the salary of each employee and the number of employees in each process. So, per month, the manager receives 1100 euros, the three staff employees receive 850 euros each, the two packages gain



700 euros each, the two cashiers have a salary of 750 euros and all the seven couriers receive also 750 euros. So, per month Fresh Market has to pay its employees a total of:

$$\begin{aligned} \text{Employees Cost per month} &= (\# \text{ of Employee per Process} \times \text{Salary per Month}) = \\ &= (1 \times 100) + (3 \times 850) + (2 \times 700) + (2 \times 750) + (7 \times 750) = 11800 \text{ € p/ month} \end{aligned}$$

And for an hour the cost of each employee is:

$$\text{Manager Hourly Cost} = \frac{\text{Monthly Salary}}{\text{Days p/ Month} \times \text{Hours Worked p/ Day}} = \frac{850}{30 \times 8} \approx 4.58 \text{ € p/ hour}$$

$$\text{Staff Hourly Cost} = \frac{\text{Monthly Salary}}{\text{Days p/ Month} \times \text{Hours Worked p/ Day}} = \frac{1100}{30 \times 8} \approx 3.54 \text{ € p/ hour p/ manager}$$

$$\text{Packager Hourly Cost} = \frac{\text{Monthly Salary}}{\text{Days p/ Month} \times \text{Hours Worked p/ Day}} = \frac{700}{30 \times 8} \approx 2.92 \text{ € p/ hour p/ packager}$$

$$\text{Cashier Hourly Cost} = \frac{\text{Monthly Salary}}{\text{Days p/ Month} \times \text{Hours Worked p/ Day}} = \frac{750}{30 \times 8} \approx 3.13 \text{ € p/ hour p/ cashier}$$

$$\text{Courier Hourly Cost} = \frac{\text{Monthly Salary}}{\text{Days p/ Month} \times \text{Hours Worked p/ Day}} = \frac{750}{30 \times 8} \approx 3.13 \text{ € p/ hour p/ courier}$$

### 5.1.2 Flow Analysis

Flow Analysis is a technique from Quantitative Process Analysis, to evaluate the overall performance of a given process, according to its activities performance for that we estimate the cycle time (the average time it takes between the moment when a process starts and then when it ends) and we apply the efficiency (Process Time/Cycle Time) and we will understand if we must improve our not our cycle, depending of the final ratio.

So first to start the flow analysis we will start with two simple measures: the Total Cycle Time and the Arrival Time.

$$\text{Total Cycle Time} = 5 + 15 + 7 + 2 + 0.2 \times 7 + 0.8 \times 25 = 49.14 \text{ or } \approx 49 \text{ mins and 8 seconds}$$

$$\text{Arrival Time} = \frac{1}{\text{Mean Arrival Rate}} = \frac{1}{\frac{\text{Order p/ Day}}{\text{Hours Open} \times \text{Minutes in an Hour}}} = \frac{1}{\frac{45}{8 \times 60}} = 10.6667 \approx 10 \text{ minutes and 40 seconds}$$

Due to the fact of the AS-IS model is not being structured we cannot apply the Little Formula and add some extra measures to analyze the performance of the AS-IS process of preparing

and delivering orders. And due to the numerous limitations of the queuing analysis (both the basic theory models  $m/m/1$  and  $m/m/c$ ), we are not going to apply this analysis.

## 5.2 Simulation

The Simulation is a technique from Quantitative Process Analysis, to improve the current process model (AS-IS), applying several What-If scenarios until identifying an optimum state of one of the What-If processes, for then building a future model (TO-BE).

### 5.2.1 Parameters

After all the analysis was done, all that was left to do was the simulation of the AS-IS process, for this we defined some parameters, namely for the time and cost of the overall process. As mentioned before, Fresh Market receives around 45 orders per day, and they are open from 10h

Start Events / Sub-Process	Distribution	Mean	Standard Deviation	Minimum	Maximum
Order Received	Poisson	10.667	..	..	45
Order Organization	Truncated Normal	5	2	0.5	8
Order Picking	Negative Exponential	15	..	..	..
Order Packaging	Negative Exponential	7	..	..	..
Order Completion	Truncated Normal	2	0.5	0.5	4
Pick-Up Order	Truncated Normal	7	3	0.5	13
Home Deliver	Negative Exponential	25	..	..	..

*Table 8: Distribution of Subprocess and Start Event*

am to 18h pm, and as calculated before this gives an arrival time of 10.6678. So, on average, the interval between each order is around 10 minutes and 40 seconds.

Now moving to the parameters of each Sub-process we re-organize it in a simple table for better visualization:

So, the overall process starts when the order is received through the system, during a total of 8 hours is expected around 45 orders (average number of orders per day), which gives an arrival time of 10.667 minutes, the event follows a Poisson distribution since the probability of a customer arriving at a certain moment doesn't depend on the arrival of the previous customer.

For each sub-process, we based their distribution according to their complexity or possible variation. With this said, we assign a Truncated Normal Distribution to Order Organization, Order Completion, and Pick-up Order, since they are pretty repetitive and simple tasks. The rest of the sub-processes we assign as having a Negative Exponential Distribution, due to their complexity and duration varying depending on the size of the order or external factors (in the case of the Home Delivery Process). From this, we assign a standard deviation, a minimum, and a maximum according to the mean that was given and the idea we have of the process.

## 5.2.2 Output

The output of the process time results is given by resource and per-process. With these results, we want to analyze each resource's utilization, the time it takes for the process to be complete, and the time waiting for resources.

Resource	Utilization (%)
Manager	58.23
Staff	32.23
Packager	32.79
Cashiers	4.11
Couriers	51.46

Table 9: As-Is Process  
Resource Utilization

Process	Instances completed	Avg. Time	Total time	Avg. time waiting for resource	Total time waiting resource
Overall AS-IS Process	45	52m 41s	1d 15h 31m 15s		2h 56m 54s
Order Picking	45	11m 31s	8h 38m 58s	0	0
Order Completion	45	3m 47s	2h 50m 17s	1m 57s	1h 17m 43s
Home Deliver	37	27m 56s	17h 13m 53s	3m 50s	1h 7m 11s
Pick Up Order	8	5m 30s	44m 7s	0	0
Order Packaging	45	7m 52s	5h 54m	17s	1m 59s
Order Organization	45	5m 33s	4h 9m 58s	1m 10s	29m 59s

Table 10: As-Is Process Time & Waiting Time

## 5.2.3 Final Ideas

So first analyzing the resource utilization we notice a very small utilization of the cashiers, being utilized only 4.11% during the process, these give us two options, attribute more work

or tasks to cashiers or remove them from the process. We also notice a bit of overutilization of the manager, so a unique manager may not handle 2 sub-processes.

Secondly, we see the processing time, we see that the sub-process that takes more time to complete is the Home Delivery with around 17h13m, and in each order, the Home Delivery takes 28m to be complete, around half of the average process time per order. A positive note is that even with a high total process time, the process can still process all 45 orders it receives.

Lastly, we can see a big problem in the total time waiting for resources, in the overall process, the process waits around a total of 2h57m for resources, and the two that most contribute to this are the Home Delivery (or courier) and the Order Completion (or manager). So, we can infer two things, the manager cannot handle two processes and there are not enough couriers to work on the Home Delivery.

## 5.3 What-If Analysis

After analyzing the outputs for some time, we arrived at the question of “How useful or necessary are the cashiers” since their utilization rate is only 4.11%, and the pick-up order doesn’t present any complication with total time processing or waiting for resources.

Therefore, in our **first scenario** in the What-If Analysis, we **removed both cashiers** from the process, giving the pick-up process job to the staff or the cashier, since it’s a pretty simple and direct job of delivering the bags to the client, we believed that removing the cashiers will not affect negatively the process.

Resource	Utilization (%)
Manager	58.23
Staff	34.97
Packager	32.79
Cashiers	0
Couriers	51.46

*Table 11: What-If Scenario 1 – Resource Utilization*

The results were a bit surprising, the processing time and the time waiting for resources did not suffer any change with the removal of the cashiers and the attribution of their job to the staff or the packager. The only changes that occur, were in the utilization of the resources, the staff got a little more utilization and the cashiers as expected went to 0%.

Continuing, in our **second scenario**, we propose **hiring the eighth courier**, so with two cashiers dismissed we have a total of 1500 euros per month free to spend on new and better-allocated resources. So, one thing we notice is the waiting time in the Home Deliver process, and since the delivery has to be made by two couriers, we decided that hiring one more courier would be the best option to decrease the time waiting for resources, and it makes sense if we have deliveries in pairs have a pair number of couriers available to do the delivery.

Resource Utilization (%)	
Manager	59.27
Staff	35.59
Packager	33.38
Cashiers	0
Couriers	45.83

Table 12: What-If Scenario 2 – Resource Utilization

Process	Instances completed	Avg. Time	Total time	Avg. time waiting for resource	Total time waiting resource
Overall AS-IS Process	45	51m 19s	1d 14h 29m 25s		1h 55m 5s
Order Picking	45	11m 31s	8h 38m 58s	0	0
Order Completion	45	3m 47s	2h 50m 17s	1m 57s	1h 17m 43s
Home Deliver	37	26m 16s	16h 12m 3s	49s	5m 22s
Pick Up Order	8	5m 30s	44m 7s	0	0
Order Packaging	45	7m 52s	5h 54m	17s	1m 59s
Order Organization	45	5m 33s	4h 9m 58s	1m 10s	29m 59s

Table 13: What-If Scenario 2 – Process Time & Waiting Time

The major difference now in the process is in the Home Delivery and its resources, other resources also increased slightly their utilization. First, the utilization of the couriers decreases since we have one more to rely on. Secondly, the process total time decreases due to the waiting time for resources. And talking about that, the biggest change is the time waiting for resources, it went from 1h7m to only 5m, a huge difference, and improvement, also the average waiting time suffer a decrease going from 3m50s to only 49s per order. As expected, these changes impacted the overall process in the same measure.

In the **third scenario**, we focus on the problem of order completion, since the time waiting for resources is still very high. Then, after some consideration, we **gave the task of completing the order to the packager**, ideally, since he is the one finishing preparing the order and he can verify missing and/or substitute products, and a plus, this scenario would decrease handovers or wait between activities, since the moment the packager finishes preparing the order, the process has to go the manager for him to complete the order and then move to the deliver.

Resource	Utilization (%)
Manager	41.9
Staff	35.75
Packager	42.34
Cashiers	0
Couriers	46.03

Table 14: What-If Scenario 3 – Resource Utilization

Process	Instances completed	Avg. Time	Total time	Avg. time waiting for resource	Total time waiting resource
Overall AS-IS Process	45	49m 4s	1d 12h 48m 4s		13m 44s
Order Picking	45	11m 31s	8h 38m 58s	0	0
Order Completion	45	2m 6s	1h 34m 44s	14s	2m 10s
Home Deliver	37	26m 15s	16h 11m 45s	49s	5m 4s
Pick Up Order	8	5m 30s	44m 7s	0	0
Order Packaging	45	7m 55s	5h 56m 40s	22s	4m 40s
Order Organization	45	4m 55s	3h 41m 47s	10s	1m 48s

Table 15: What-If Scenario 3 – Process Time & Waiting Time

After attributing the task of order completion to the packager, the utilization of the manager decreased and the utilization of the packager increased, this was expected so it was a good sign. Then the main improvement, of this change was the decrease in the waiting time for resources of all sub-processes, but especially of the order completion which went from 1h17m to only 2m. The order organization also suffers a big decrease in the total time waiting, since the process doesn't have to wait for the manager to finish the order completion, also the increase in the total time waiting for resources of the order packaging is expected due to the attribution of the extra activity to the packager. The total process time also got reduced, with the main differences being the order organization which decreased by 1 hour, and the order packaging which increased a bit.

To solve the overutilization of the packager, we introduced an optional scenario, the fourth scenario, and we thought of **hiring one more packager**. Since we 2 packagers were dismissed, we still had one more salary extra to give, and after some consideration and testing an extra packager was the one that deliver the best results. Some notes are: although optional, we believe that this scenario could be an improvement for FreshMarket, and depends on whether the company wants to spend the money to hire one more packager to improve the performance of the process; we tried to hire extra staff, and the results improved, but on a smaller scale, but it's still an option if the company believes an extra staff employee would benefit more the

Resource	Utilization (%)
Manager	41.96
Staff	35.8
Packager	28.26
Cashiers	0
Couriers	46.09

Table 16: What-If Scenario 4 – Resource Utilization

Process	Instances completed	Avg. Time	Total time	Avg. time waiting for resource	Total time waiting resource
Overall AS-IS Process	45	48m 54s	1d 12h 41m 13s		6m 53s
Order Picking	45	11m 31s	8h 38m 58s	0	0
Order Completion	45	2m 3s	1h 32m 33s	0	0
Home Deliver	37	26m 15s	16h 11m 45s	49s	5m 4s
Pick Up Order	8	5m 30s	44m 7s	0	0
Order Packaging	45	7m 49s	5h 52m	0	0
Order Organization	45	4m 55s	3h 41m 47s	10s	1m 48s

Table 17: What-If Scenario 4 – Process Time & Waiting Time

company; we also tried one extra courtier, but the waiting time didn't change at all since it's necessary two to do a delivery, so an extra courier is not the answer.

In the final scene we arrived at really good results, with a total time waiting for resources of only 7m, with the Home Deliver responsible for most of it, we believe that the results were good enough to try and implement them in a TO-BE process. This was the line of scenarios we chose as the best what-if scenarios. But we did try some options to solve the problems of the process. Some options we tried were:

In an extra scenario, we tried that after the first one the home deliveries were made by a single courier, this change pretty much solve most problems with waiting times. Since the orders have to be delivered by two couriers, we cannot implement this change, but we kept it as a test to see how impactful is this constraint, and then think of ideas to try to solve it.

In a different line, we tried not to dismiss both cashiers, then we attributed the job of performing the order completion to these cashiers and we ended up hiring an extra courier. The results were good, but we had now an extra salary to pay and the time waiting for resources was worse than our final option (presented before).

Another option we thought about, was to start by hiring one more manager, since a single one wasn't handling performing the order organization and the order completion, after that we had still to hire an extra courier to improve the waiting time for resources of the home delivery sub-process. The results weren't so great, and we had two more salaries to pay in this what-if line, so we rejected them.

## 6. Process Redesign

### 6.1 Solutions & Heuristics

In the overall process, one thing we notice during the exploration and analysis of the preparing and delivering process of FreshMarket is the consequences of the lack of a functional Information System, so most of the solutions will involve the implementation of an Information System, so “**Automation**” will be one big solution to improve the process, and although it will increase the costs of the company we believe it will decrease the processing time of each order, allowing the market to receives and handle more orders per day. Another problem we will mention a lot is that the customer complains of not knowing the date/time of delivery and missing products, so we pretend to implement the heuristics of “**Communication optimization**” putting the customer in the first place, and interact more with the client, with notifications of delivery times and shortage warmings. We also use the “Decomposition of tasks to include more of the resolution of problems within each sub-process.

Focusing on each subprocess, we start by analyzing the order organization. The first problem is that the manager always prints the descriptions of the orders from the supermarket website,



wasting paper, ink, and time printing, and then not very sustainable or “green”, so we will use **“Task elimination”** in printing the orders and distributing them. Being one of the main goals to reduce the amount of paper spent in the company, we can solve this issue by implementing business process software. The software would solve this issue since, when the customers purchase and pay for any item from the supermarket website, it will record the specific order descriptions from the customer, then the system itself can decide how the order will be distributed by the employees, according with the size and previous similar orders. This distribution would be made using the software, and each employee would receive the order they are in charge of, so we will take advantage of **“Resource optimization”**, removing the manager from this sub-process and fully automating it (**“Automation”**). When solving the problem of informing the customer of the date of delivery, this has to be solved in stages, at the moment the system should notify the customer of an estimated delivery time, based on previous similar deliveries and the delivery process, increase the communication with the client **“Communication optimization”**.

Following, we have the order-picking process and summing up, the products in the order description are not organized by aisle, which could decrease the time efficiency of the employees. A solution to this problem is to use the same software/system mentioned before and input the organization of the items into the system, this way each product would have the corresponding corridor, and this way, the staff would be able to filter the list by corridor if necessary and saving the trouble of going to the store to verify stock. In addition to this system is to add a plug-in of “Pick-by-voice” where employees from warehouses use AI apps like Alexa, Siri & Co. and others as a system to provide step-by-step guidance, the app would be logged into the system of FreshMarket knowing how to localize the product and the employee and guide him to the product, then using some “magic word” or pushing a button move on to the next product of the list (saving most trouble with the manual and prone to error process). Consequently, the complaints of missing products would decrease exponentially, but we added a real-time connection between the stock and the website, this way if a product is in shortage the website should warn the customer, and even if the client picks to not substitute a product notify the client of the missing product. Finally, the use of an Information System would help to substitute the bar code of substituted products, with a simple barcode reader or a menu. After substituting or selecting as missing, the staff should warn the manager that the item suffered some kind of alteration. Again, we would use **“Task elimination”** since some tasks would

become obsolete (e.g., the manual verification of the stock), **“Communication Optimization”** between the staff and the manager, and especially **“Automation”**.

After picking up the order it comes, to the order packing process, the major problem of this process is the excessive use of plastic to pack the order. Our first solution is to give the option to the customer to buy an extra big bag (to use fewer bags in the delivery) for an extra small amount of money. And secondly, give the customer the choice of using plastic or paper bags for the delivery, applying a small tax if the customer chooses plastic bags, as expected the packager should leave plastic bags or resistant bags for frozen, meat and fish products. This **“Decomposition”** is expected to decrease the use of plastic bags, even though the time for the task will increase (very little), as well as its flexibility, we believe it’s a good trade-off.

Now in order completion, we can finally give the customer an exact date of delivery, so the system should send a notification. Another resource highly used in the overall process is paper, and this subprocess is no exception, so to solve or improve the paper excessive use, we use the system to save paper, the system should save the order in a database. The system should also retrieve the choice of the customer of whether they prefer an electronic invoice or a physical one, in case of a physical the store should send a message with the invoice, and in case of a physical invoice, the employee should print and put on the bag (as they do now). The point of this change is to decrease the use of paper, giving the choice to the customer to save paper during the process. So, the use of **“Communication optimization”** will help a lot the process, firstly communicating with the client will result in a more satisfied client, since its need is met, secondly giving the option of the customer to choose between electronic and physical invoice is a good way to increase sustainability, and finally, the communication between the manager and the staff can save a lot of time and wastes checking all changes twice.

The biggest alteration we did on the Pick-up order was to give the job to a staff member or the packager to do it, dismissing in the process both cashiers that were allocated on the process. And then confirm the order delivery in the system.

This process was one of the hardest to improve the processing time, we understand the use of two couriers in each order delivery, but we believe that implementing a checkpoint to verify if the order needs to be performed by two couriers or if it’s possible to do with a single one (so we did it in the order organization). Besides that, to solve the non-compliant with home delivery

schedules, the couriers should send a message to the headquarter in any case of delay, then the manager or the person in charge of receiving the courier’s message should message or call the customer and apologize for the delay, ask if the courier can continue the delivery as it might not have anyone at home to receive the package, and if the customer cannot receive the bags anymore, reschedule the delivery for another time or find some other agreement with the customer. The principal heuristic here is “**Communication optimization**” since FreshMarket didn’t have any solution for the problem of non-compliant delivery times, so communicating with the client and finding a solution that satisfies both sides, should solve that.

## 6.2 TO-BE Process

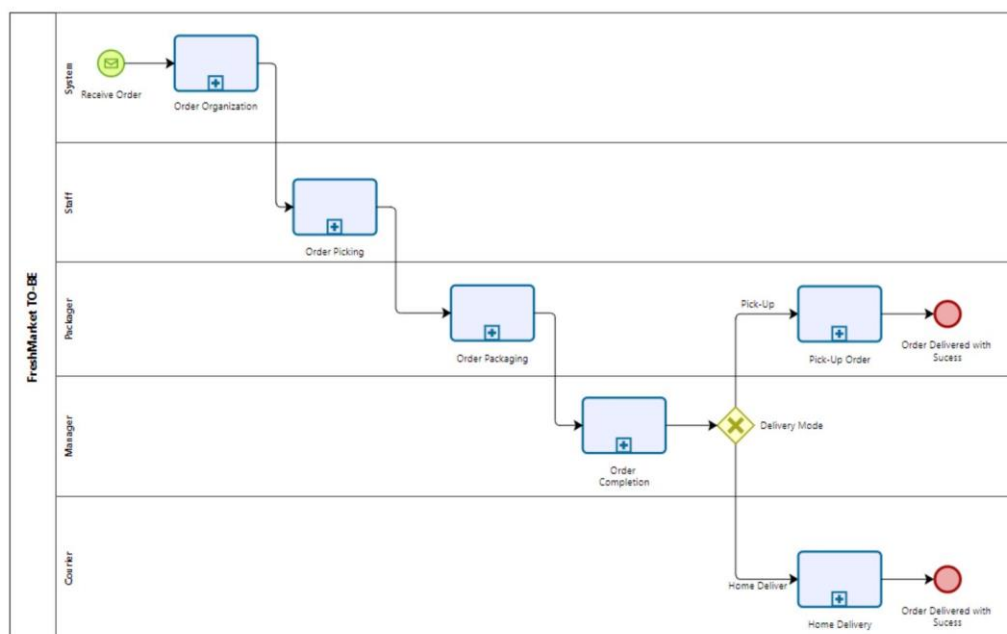


Figure 10: Fresh Market Overall TO-BE Process - Level 1

In our conceptualization of the TO-BE model, the process starts with the system receiving the order, we believe that an implementation of a system that can automatize the order organization process will be worth the cost of implementation. After the system organizes and distributes the order, the order picking will still be realized by the order picking, and afterward, the order packaging is realized by the packagers. After this we have the order completion, where the manager’s focus will be on the process, we will later explain the changes we made and why we think the manager should only be in charge of one unique task. After the order is ready for delivery, the order has two ways to go, either the customer picks up the order in the store,

delivered by the packager, or the couriers deliver the order to the customer's house. In both deliveries, the process ends when the order is successfully delivered.

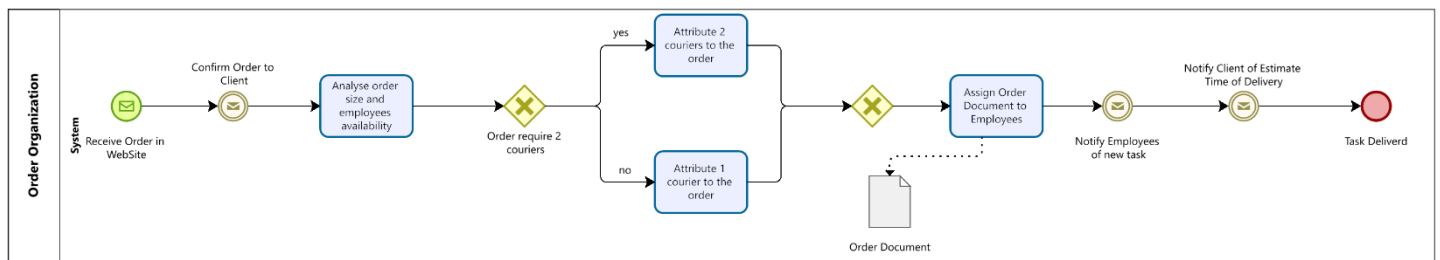


Figure 11: TO-BE Process Level 2 – Order Organization

The first we notice differences in the process is that is now performed solely by the system, this is the main goal of improving the processing time of this activity and freeing the manager for more important tasks. So, the process starts when a client sends an order request through the website, then when the system starts processing the order it should send a confirmation of the received order. To optimize resource utilization, the system analyses the order size and the availability of the employees and distributes the orders accordingly. Additionally, to decrease future constraints on in-home delivery, the system will attribute one or two couriers to the order depending on the order size. After this, the system sends the order document to the employees and notifies them of a new order. Before it finishes, the system notifies the client of an estimated time of delivery.

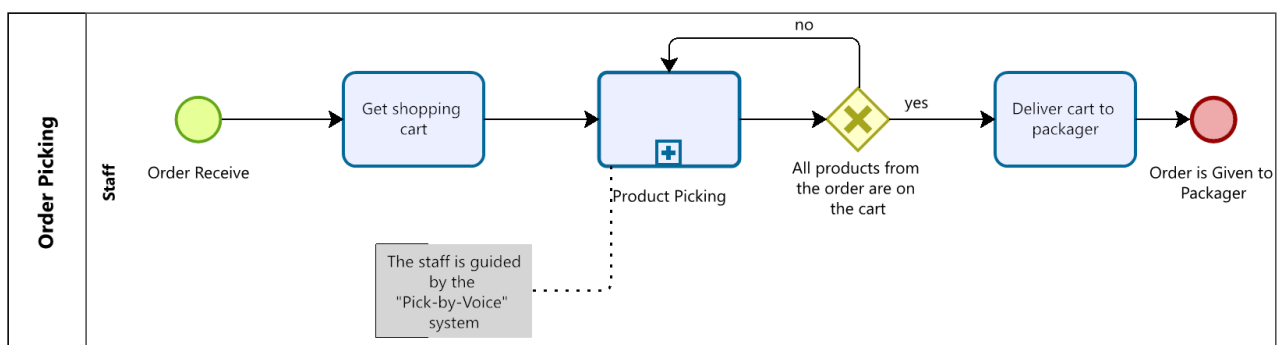
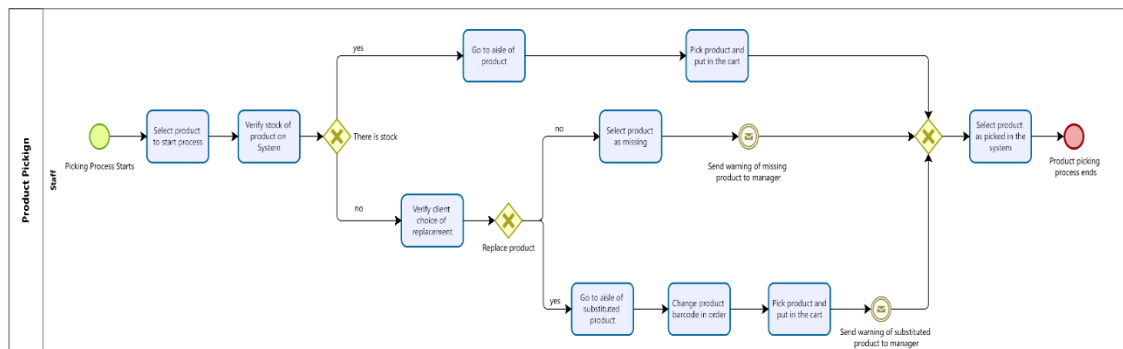


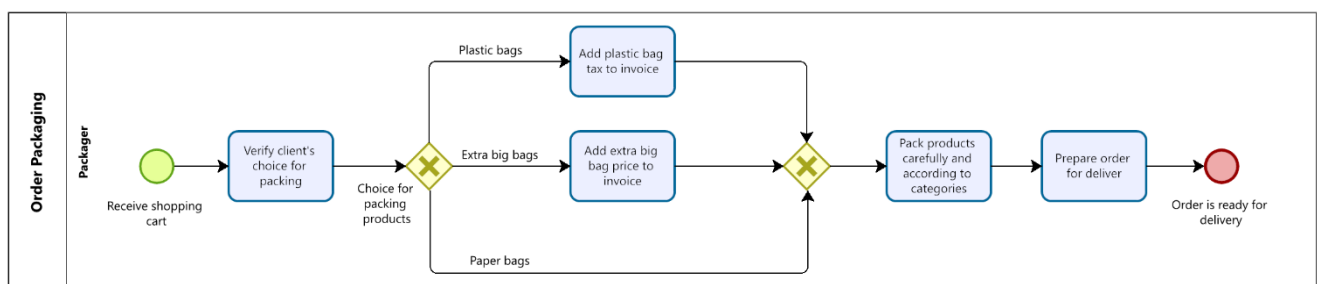
Figure 12: TO-BE Process Level 2 – Order Picking

This subprocess is similar to the original one, with the only changes in the way the product picking is done and organized. As we will see.



*Figure 13: TO-BE Process Level 3 – Product Picking*

After getting the shopping cart, the staff employee will select the product he is looking for in the system, then we will verify the stock of that product. If there is stock available, the “Pick-by-Voice” will guide the staff to the selected product and its aisle. If there is no stock available of the product, the employee has to see if the customer chose to replace the missing products, if he wants to replace, the staff should pick an available substitute product, then change the barcode in the system, select manually in the menu or using a barcode reader, after picking the product and putting in the cart, a message should be sent to the manager warning that a product was substituted during the process. The final possibility is that the customer doesn’t want to replace the missing products, in these cases, the staff should select the product as missing in the system and send a message to the manager with that information. After the product is picked or the process is done, the staff should select the product that has been done or picked to make sure no items are ignored in the final.



*Figure 14: TO-BE Process Level 2 – Order Packaging*

After the order is picked, the packager receives the shopping cart with the products, we then verify the customer’s packing choice, a feature we add to save money and turn FreshMarket into a more sustainable company. The customer has three choices, plastic bags, extra big bags, and paper bags, the paper bags are the regular ones, and don’t add an extra tax in the invoice, the others option have a specific tax associated. After having the bags decided, the process is the same as it is in the real process.

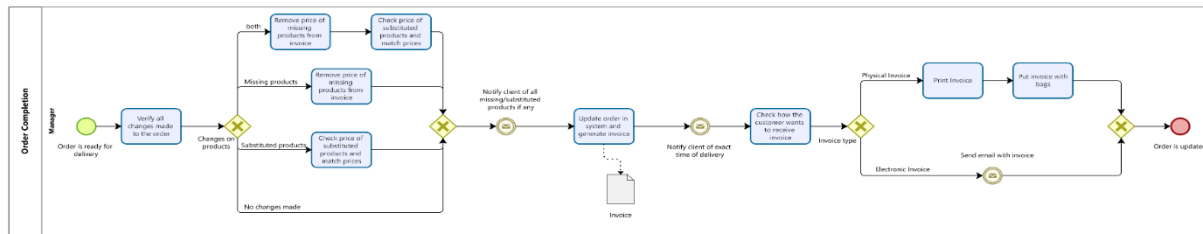


Figure 15: TO-BE Process Level 2 – Order Completion

The process of completing is still similar to the original one, but with more contact with the client and the other employees of the market. First, the manager should verify all changes made in the order, missing products, substitute products, and bag taxes. In case of missing products, the manager should verify the prices of the products that were removed from the invoice and remove them, if necessary, in case of substituted products the manager will check if the price is correct (the price should be the same of the original product), in case of both alterations were made, the manager will do both tasks. After checking the invoice, the manager will notify the customer of the alterations made, in case of no alteration the manager sends a message of order with no alterations. Then we update the order and the system generates the invoice. At this moment, a notification is sent to the client with the exact time of delivery. For the invoice, the manager checks if the customer wants an electronic invoice, and if so an email is sent to the client with the invoice, if the customer wants a physical invoice the manager prints the invoice and puts it with the bags.

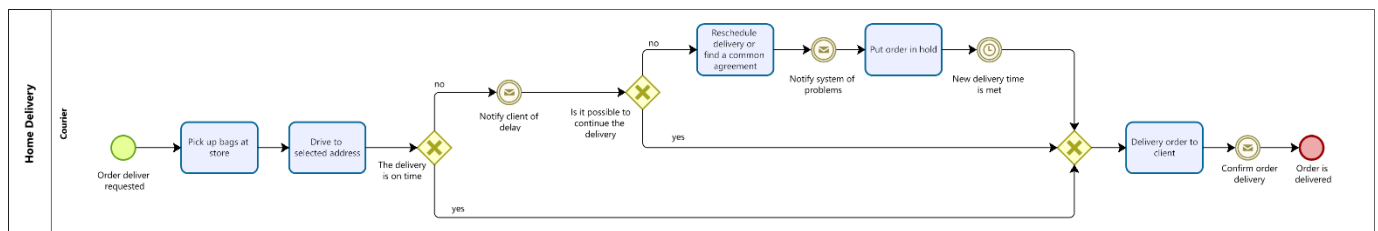
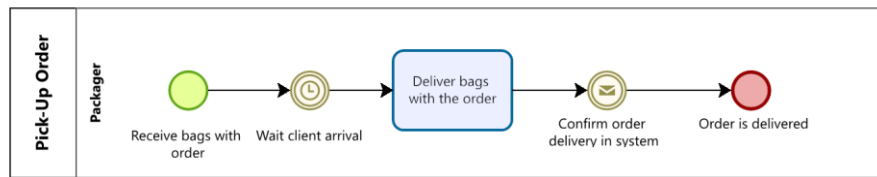


Figure 16: TO-BE Process Level 2 – Home Delivery

With an 80% chance of being performed, the process starts when the courier receives a request to make a delivery, he or they then picks up the bags at the store and drives to the selected address. Since the original model didn't have in-count delay problems, we had to introduce options in to continue and react to those problems. In case of delay, the courier should notify the client of the delay, and ask if the order can still be delivered, if yes, the courier continues the delivery, if not, the courier should reschedule or find a common agreement with the client, then notify the system of the current problem, and the order is put in hold until it can be

delivered. If the delivery is on time, the process runs normally. In any case, the order is then delivered to the client, and the courier confirms the delivery.



*Figure 17: TO-BE Process Level 2 – Pick-Up Order*

With a 20% chance of being picked, the pick-up process starts with the packager having the bags with the order, then he must wait until the arrival of the customer, then the delivery is made, and a confirmation is sent to the system.

## 6.3 AS-IS vs TO-BE

With the changes made in the process, we believe that will turn the process more efficient and although these changes are expensive, in the long term they will provide the possibility to increase the number of orders processed and return the expenses made in its implementation. Some of the major improvements were:

Turning the process more automatic, the implementing the system the idea to: decrease the human errors in the process (the picking process was very prone to error), and although we didn't eliminate that problem, we decreased the chance of it happening; diminish the pressure of some resources, especially the manager that was not able to perform both tasks efficiently; and improve the processing time of the overall process.

Communicating more with the customers and communication between departments, during the analysis of the process we notice that most problems could be solved, with the improvement of the communication between process actors. This includes messages that notify delays, time notes, missing or substitute products, and other small details that are essential to provide an efficient process.

Removing the cashier and optimizing the allocation of the resources, in the analysis of the process we noted that the cashiers only had one simple task and their utilization of the process was minimum, so in the TO-BE process, we removed them from the process and attributed the

task of giving the order to the customer in the store to the packagers, since they were the most available, and this way we could reduce the handover occurred in the process.

Reduce the utilization of paper and plastic within the company. Of the major complaints of the company was the excessive use of plastic and paper in the process. As said in the modeling of the TO-BE process, we eliminated the task of distributing the paper order task through the staff, substituting it with a system distribution. Then on the plastic bags, the customer could choose between plastic bags, paper ones, and extra-large ones.

Finally, on the invoice printing, we gave the option to the customer to choose between paper or electronic. Both these changes have the intuition of decreasing the use of these materials and turning FreshMarket into a sustainable business, giving the customer the choice.

## 7. Financial Analysis

Alteration	Expected Effect	Cost/Gain
System Implementation (IMS - Lightspeed)**	Increase Cost in short term, but decrease in the long term	\$69 - \$229 per month
System Implementation (OMS - Webgibility)	Increase Cost in short term, but decrease in the long term	\$109 per month
Hiring 1 Courier	---	\$750 per month
Hiring 1 Packager	---	\$700 per month
Dismissing 2 Cashiers	----	\$1500 per month
Reduction of Prints	Decrease Costs	---
Substitution of plastic to paper	Increase Costs Slightly	---

Table 18: Financial Analysis

The implementation of an Inventory Management System has the purpose of serving as the system to solve the problems of bad efficiency in process of picking the order of FreshMarket, the plug of a Pick-by-Voice software can be made, but we only found solutions with this plugin using a Warehouse Management Software (WMS). The Lightspeed program might not be the best to solve all problems of FreshMarket, maybe it's necessary more than one software, so we suggested the addition of Webgility (an Order Management Software), to manage the process of receiving orders and automatically distribute the work throughout the employees. Even though these changes are costly we expect that they will bring great value to the process, turning these expenses into future profit, being a great investment. These other changes are



neutral in cost, since the changes in the hiring process cancel each other and FreshMarket doesn't spend more than it was before, a note that hiring an additional packager is optional just to improve a bit the efficiency of the process. Plus, the change in plastic and paper are expected to neuter themselves, reduce prints reduce the cost of paper and ink, and substitute plastic for paper, increasing the cost.

## 8. Conclusion

After finishing the analysis of the current process of preparing and delivering of FreshMarket, we can conclude that the company must improve its actual process, and although it can be costly, we strongly believe that it will be a great investment. To solve the main problems of the processes, of the customer and employee dissatisfaction and excessive use of paper and plastic, we suggested better allocation of resources, improved communication between employees and with the customer, and the implementation of one or two software, one for the process of receiving the orders and managing its distribution through the employees, and other help and improve the efficiency of picking the order. With these changes, FreshMarket will be capable of automating the process, decreasing human errors, improving communication, turning FreshMarket into a more sustainable company, turning the process more efficient and therefore faster, and finally is expected that with these changes the satisfaction of the customer increases, leading possibly to an increase of sales. The implementation of the new process has the purpose of solving these problems of the actual model, and modeling all possible ways an order can go.

## 9. Limitations

Some limitations we found in the realization of the new business process were essentially in the limited information we had on the process, which led to assumptions that might not be fully correct in time or cost. Also, the restrains that exist when trying to implement our new ideas are a limitation to the success of the implementation of our process, these include all the time of the new activities, the time difference of the ones we removed, the new duration of the ones that were changed, the cost associated with each one and then finally, the correct implementation of the software, might need more exploration because it depends on what the company wants and believes is the best software, and of course, a lot of limitation when testing since we had only simulations.

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