IS210-Business Process Analysis & Solutioning

Business Process Re-Engineering Case Study – Easy Pace Logistic

G3T6

Bryan Tay Wei Teck

Chen Yibing

Jolene Teah Shi Han

Kelly Chan Yi Ting

Wei Minn

Zen Tan Hong Wee

Contents

1.EPL Company Introduction and purpose of the BPE Team

1.1. EPL Company Introduction

Easy Pace Logistics (EPL) is a leading local provider of third-party logistics services that include freight forwarding and warehousing ranging from picking, packaging, and shipping. EPL has several warehousing facilities and specializes in handling fast-moving consumer goods, and with their large customer base, daily replenishment of goods is required. They strive to provide high service standards and excellence for its customers and clients, while aiming to become the innovative leading third-party logistics company in Singapore.

However, there have been numerous complaints from customers regarding missing or wrong goods delivered to their clients recently and large quantities of outstanding backorders have been on the rise. EPL management has also observed that because of the inefficient management of warehousing operations, productivity has dropped.

1.2. Purpose of BPE Team

As such, the Business Process Engineering (BPE) team was set up to conduct a study of operational practices in the warehouse, specifically the Receiving & Putaway (RP) process and the Picking, Packaging, and Shipping (PPS) processes in the warehouse. The team is tasked to find viable solutions to improve the productivity of warehousing operations.

2. Process Redesign Goals, Management Decisions or Policies, Performance Target

2.1. Process Redesign Goals

S/No	Process Redesign Goals	Priority
1.	Improve RP and PPS Process efficiency	High
2.	Reduce labour-intensive activities	Medium
3.	Workforce Reduction	Medium

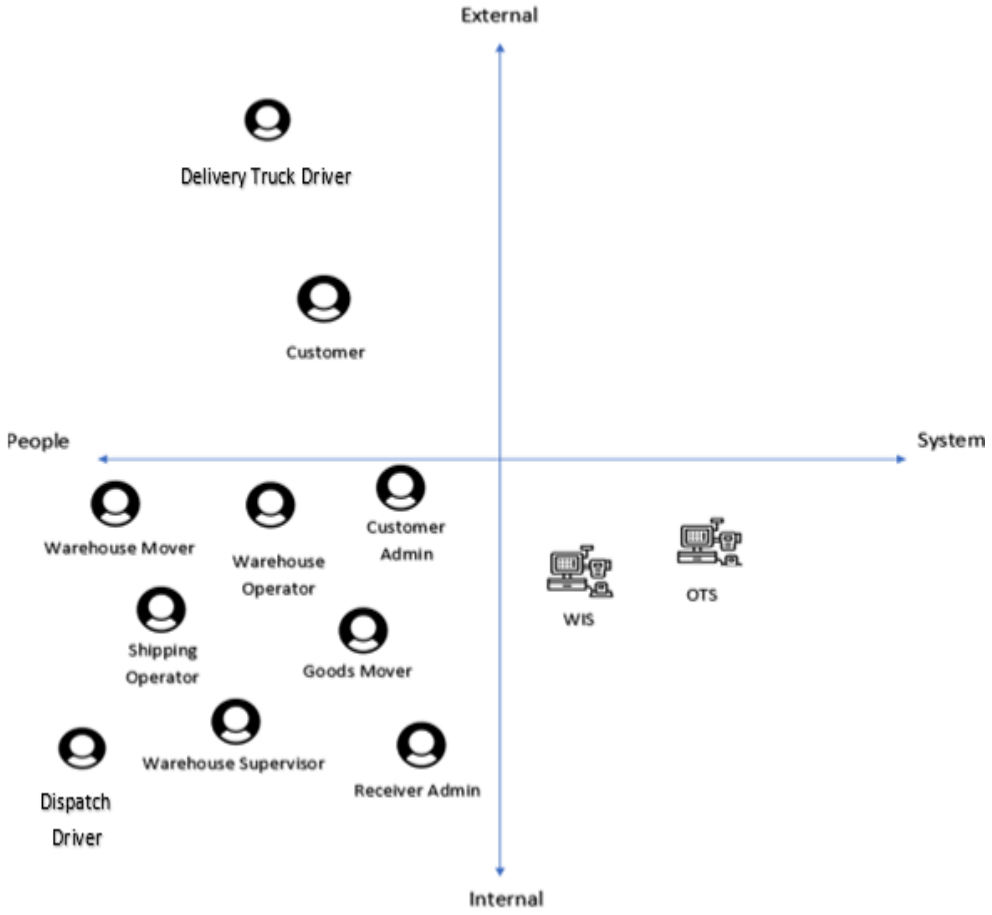
2.2. Management Decisions or Policies

S/No.	Details
1.	Deploy innovative technology
2.	Seamlessly integrate information across the various systems
3.	Provide high service standards and excellence for customers and clients

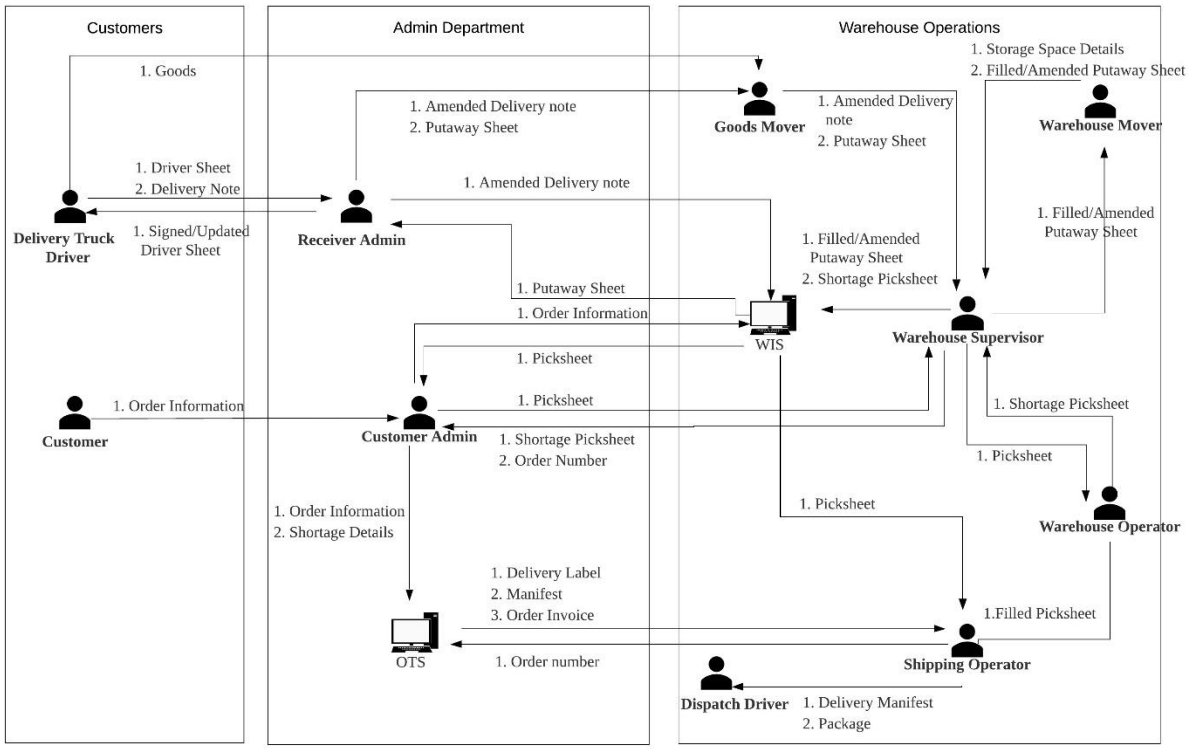
2.3. Performance Targets

S/No.	Targets	Metrics
1.	Reduce back orders by 10 %	1. Number of back orders
2.	Reduce time taken for RP process by 30% and PPS Process by 10%	1. Average time for RP 2. Average time for PPS
3.	Reduce cost for RP by 30% and PPS Process by 10%	1. Total Execution Cost for RP and PPS process
4.	Reduce labor-intensive tasks by 5	1. Number of labor-intensive tasks
5.	Reduce workforce by 10%	1. Number of workforce

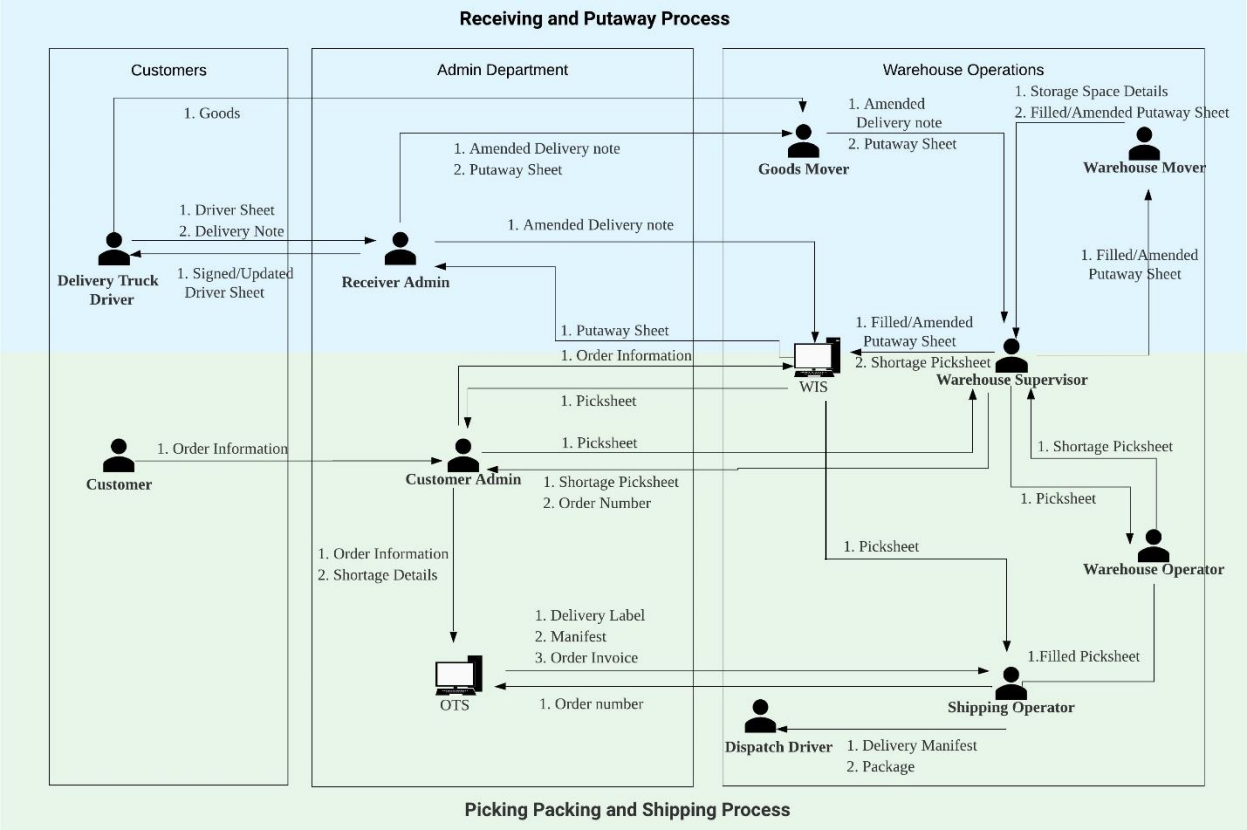
3. As-Is Resource Model



4.As-Is Collaboration Model

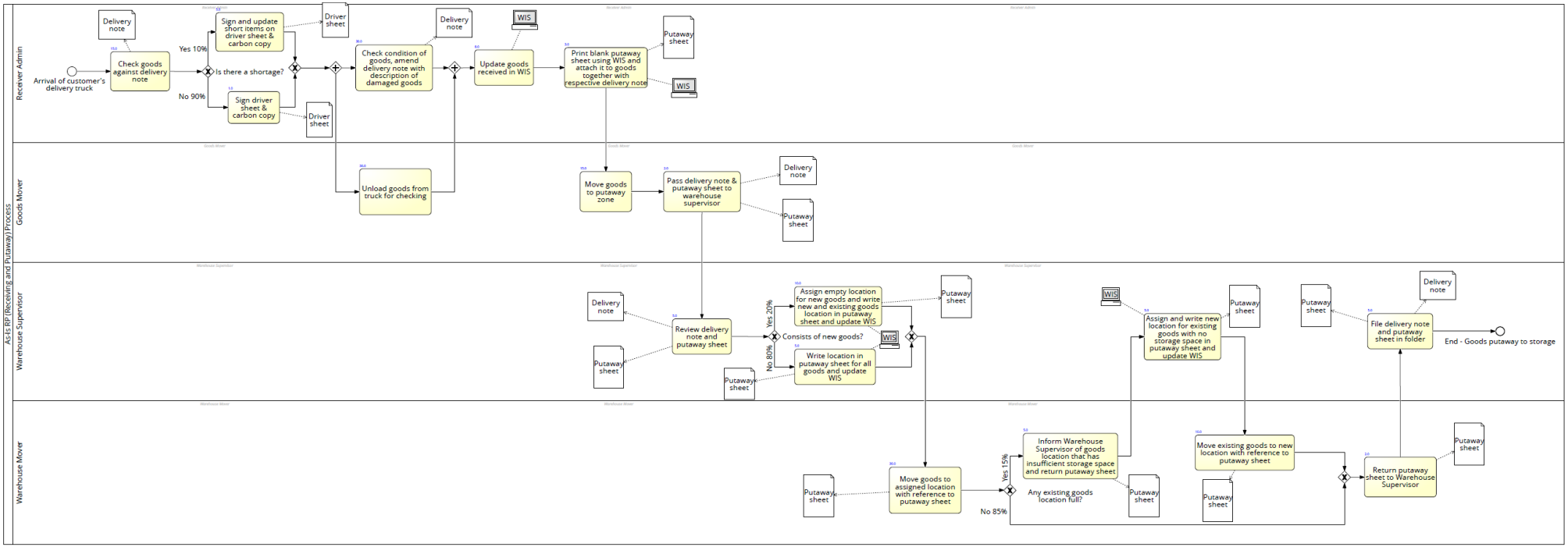


5. As-Is Process Package Model

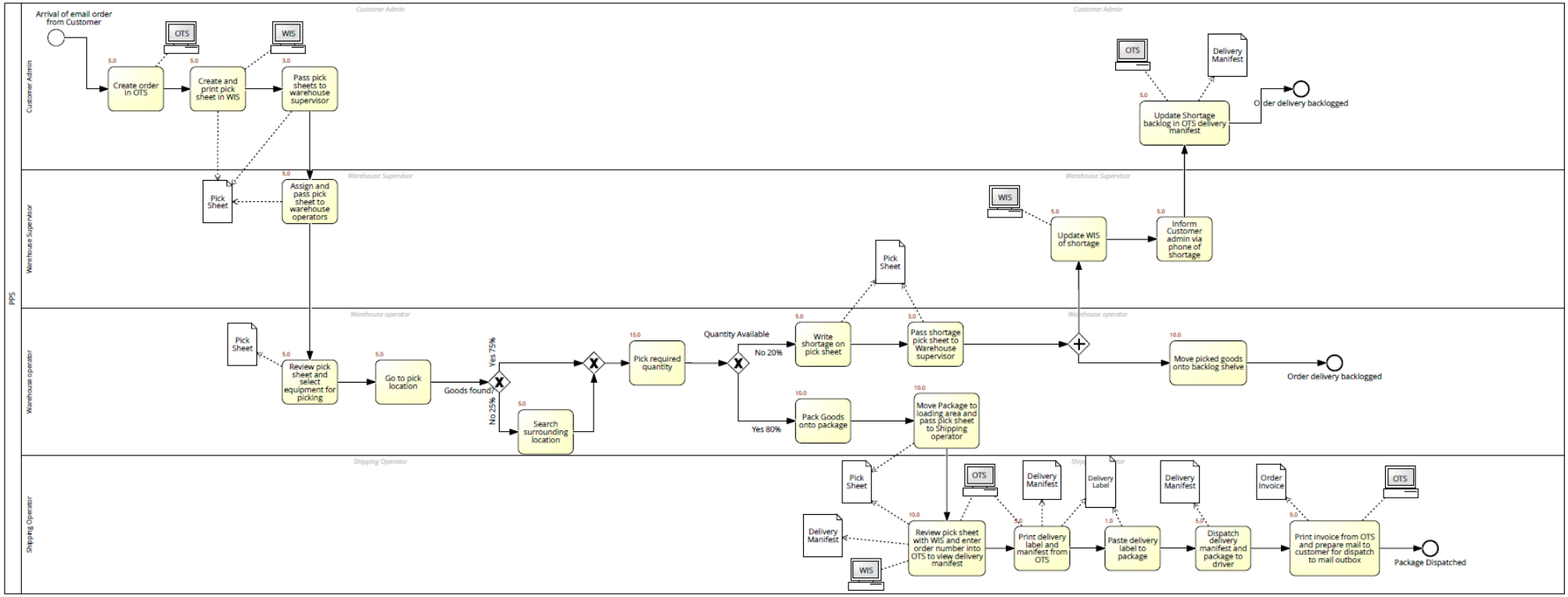


6. As-Is Workflow diagram

6.1. As-is Workflow diagram for RP process



6.2. As Is Workflow diagram for PPS



7. As-Is Static Analysis

a. RP Process

RP RCI Model

Issue No.	Issue Description	Cause Description	Root Cause	Issue Category	Business Performance Metric	Impact Level
1	Instances of multiple-entry and duplicate information in paper and system form, affecting productivity. Process time is also increased when transposing information from the paper into the system. Possibility of errant entries also increases.	Physical Putaway Sheet has to be passed to Warehouse Supervisor and on it, he needs to manually write the information for all goods on it. This same information will then be manually updated on WIS again.	Paper-based	Process	Measure 1: Total RP Process Time Measure 2: Number of Manual activities	Medium (3)
2	WIS is slow and hard to use. Features and functions are limited to support warehousing needs, leading to a tedious and time-consuming process.	No feature in WIS that is able to display the remaining storage capacity of locations based on goods that are already stored there.	Lack of System functionality	System	Measure 1: Total RP Process Time Measure 2: Number of times Warehouse Operators revisit location assigned to pick goods	High (4)

RP RCR Model

ROOT CAUSE	RECOMMENDATION	IMPACT SCORE	COMPLEXITY
Paper-based	1,Authorize good movers, warehouse movers and Warehouse Operator to access and update information on WIS directly by using portable handheld devices. Warehouse Supervisors will be able to access and edit the information on WIS. 2. Only Warehouse Supervisor will be authorised to update and write on the putaway sheet	High	Medium Complexity (3)
Lack of System functionality	1. Implement feature in WIS to display remaining storage capacity of the various locations. This information will ensure that location assigned by Warehouse Supervisor will have sufficient storage space. Information on goods capacity will be required. Information of location storage capacity is also needed. 2. Implement feature in WIS to allow automatic assignment of locations to goods depending on goods capacity as well as available capacity of the locations. Information on goods capacity will be required. Information of location storage capacity is also needed.	High	1. Medium Complexity (3) 2. High Complexity (4)

b. PPS Process

PPS RCI Model

Issue No.	Issue Description	Cause Description	Root Cause	Issue Category	Business Performance Metric	Impact Level
1	Instances of multiple-entry and duplicate information in various forms (paper and systems). Thus, contributing to higher elapsed time and cost.	WIS system does not talk to OTS system. Hence, same information on goods shortage has to be entered separately into the two systems.	Lack of system integration	System	Measure 1: Total PPS Process time Measure 2: Number of manual activities	Medium (3)
		Warehouse Operator updates shortage on pick sheet which he will then pass to Warehouse Supervisor to enter same information on WIS.	Paper-based	Process	Measure 1: Total PPS Process Time Measure 2: Number of manual activities	Medium (3)
2	Frequent mismatch of WIS and physical inventory status, many instances of goods being misplaced and gone missing in the warehouse. Warehouse operator's productivity is decreased as time and effort is wasted in searching for the goods.	Warehouse operator not given access to WIS, instead has to relay information using pick sheet to Warehouse Supervisor for him to update shortage information to WIS. Inaccuracies and human errors can easily arise from this unnecessary step.	Company policy	Policy	Measure 1: Total PPS Process Time Measure 2: Number of instances where information on WIS and physical inventory status do not match	High (4)

PPS RCR Model

ROOT CAUSE	RECOMMENDATION	IMPACT SCORE	COMPLEXITY OF IMPLEMENTING THE RECOMMENDATION
Lack of system integration	1. Integrate WIS & OTS. Thus, when WIS is updated with shortage, OTS can retrieve the shortage information from WIS, and shortage backlog in OTS delivery manifest can be updated directly. Customer admin no longer have to do it manually 2. Merge WIS and OTS into a single system	High (4)	1.Medium complexity (3) 2.Very High complexity (5)
Company Policy	1. Warehouse operator to be given the authority to access WIS update shortage information. 2. Modify current WIS system to accept details of paper-based forms eg. pick sheet, which can then be scanned into WIS directly	High (4)	Medium Complexity (3)

8. Tool Based Static Analysis of the As-Is process

8.1 Process Cost Analysis

8.1.1 Cost Calculation (RP)

Based on the static cost analysis, considering 5 workdays a week for 52 weeks. This leads to a total of 3900 trucks (15 trucks x 260 days). The cost to execute the entire RP process is $97,906.25 per year with a cost per execution of $25.10. The main activities, which constitutes a significant portion of the total cost (56%), are labour intensive tasks such as unloading goods from truck (18%), moving of goods to assigned location (18%) and checking goods conditions (20%).

Analysis of the forecasted growth shows that there would be 30 trucks daily, resulting to a total of 7800 trucks (30 trucks x 260 days). The cost to execute the entire RP process would be $ 195,812.50 per year with a cost per execution of $25.10. Similarly, the main activities that constitutes a significant amount of the total cost (56%) are labour intensive tasks. Therefore, it would be in the team's interest to look for ways to reduce these costs while improving service standard.

Path Analysis RP

The total execution time of the 8 potential paths are illustrated in the table below.

Path	Total Cost per execution	Total Execution time (mins)
Path 1 (Shortage, new goods, location full)	**$29.27**	**180**
Path 2 (Shortage, new goods, location not full)	$26.02	160
Path 3 (Shortage, no new goods, location full)	**$ 28.27**	**175**
Path 4 (Shortage, no new goods, location not full)	$ 25.02	155
Path 5 (No Shortage, new goods, location full)	**$ 28.60**	**176**
Path 6 (No Shortage, new goods, location not full)	$ 25.35	156
Path 7 (No Shortage, no new goods, location full)	**$ 27.60**	**171**
Path 8 (No Shortage, no new goods, location not full)	$ 24.35	151

From the path analysis, it shows that when the location is full (Path 1,3,5,8), it costs the company significantly more in terms of execution time and cost per execution. Hence, a key area to investigate would be on how to minimise problems associated with having a full location.

The table also shows that path 1 amounts to the highest cost ($29.27) and execution time (180 minutes) whereby there are goods shortages, new goods and a full location. Hence, this would be another key area we will be looking today.

8.1.2 Cost Calculation (PPS)

Based on the static cost analysis, considering 5 workdays a week for 52 days. This leads to a total of 26,000 email orders (100 email orders x 260 days). The cost to execute the entire PPS process is $ 369,135.00 per year with a cost per execution of $14.20.

The activity, 'pick required quantity' amounted to the largest portion of the cost (15.85%), amounting to $ 58,500.00. It also has the highest activity time of 15 minutes. This is due to the nature of logistic companies as picking required quantity is a key activity for them. Further analysis into PPS shows that the second highest cost factor would be when

the Warehouse Operator packs goods onto package, moves package to loading area, reviews the pick sheet and enters order numbers into OTS. Each of these four activities cost $ 31,200.00. This is mainly due to these tasks being labor-intensive, thus costing higher as compared to other roles.
Analysis of the forecasted growth of EPL shows that the total cost of the PPS would increase from $ 369,135.00 to $ 738,270.00. Therefore, the BPE team would be looking for ways to reduce cost in this area while improving its standards.

Path Analysis PPS

Path	Total Cost Per execution	Total execution time (mins)
Path 1 (Goods found, Quantity not available, Update WIS of shortage, Order delivery backlogged)	$11.55	66
Path 2 (Goods found, Quantity not available, move picked goods onto backlog shelve, Order delivery backlogged)	$8.85	53
Path 3 (Goods found, Quantity available, Package dispatched)	$14.25	77
Path 4 (Goods not found, Quantity not available, Update WIS of shortage, Order delivery backlogged)	$12.30	71
Path 5 (Goods not found, Quantity not available, move picked goods onto backlog shelve, Order delivery backlogged)	$9.60	58
Path 6 (Goods not found, Quantity available, Package dispatched)	**$15.00**	**82**

From the path analysis, path 6 amounts to the highest cost ($15.00) and execution time (82 minutes) where goods are only found after searching surrounding location, and package is eventually dispatched. An additional cost of $0.75 per execution for path 6 is incurred as compared to the supposed path 3, where goods are found at once and no searching of surrounding locations is needed.

8.2 Resource utilization analysis

8.2.1 Resource Calculation (RP/PPS)

Current Process				
Roles	**Employee Numbers**	**Resource planning RP**	**Resource planning PPS**	**Total Number of workers needed**
Customer Admin	5	NA	3.38	4
Goods Mover	3	1.7	NA	2
Receiver Admin	2	2.08	NA	3
Shipping Operator	8	NA	5.03	6
Warehouse Mover	3	1.24	NA	2
Warehouse Operator	16	NA	11.08	12
Warehouse Supervisor	4	0.61	1.69	3
Forecasted Resources				
Roles	**Employee Numbers**	**Forecasted Resource planning RP**	**Forecasted Resource planning PPS**	**Total Number of workers needed**
Customer Admin	5	NA	6.77	7
Goods Mover	3	4.03	NA	5
Receiver Admin	2	4.92	NA	5
Shipping Operator	8	NA	10.5	11
Warehouse Mover	3	2.93	NA	3
Warehouse Operator	16	NA	22.16	23
Warehouse Supervisor	4	1.44	3.38	5

From the resource utilisation analysis, it shows that current resources are underutilized for all roles except receiver admin who has a workload of 2.08. However, there are only 2 receiver admins available, which means that the receiver admin is over-utilised. The existing human capital is unable to support business operations with future forecasted growth to double in the next 1 to 3 years. All roles except for Warehouse Movers will be overutilised with Warehouse Mover reaching close to its maximum utilization of 2.93 out of the 3 resources available.

9.Recommendations and proposed To-Be solution

9.1 Implementation of Portable Handheld Devices

To reduce multiple-entries of information and time taken to pass physical forms around, we recommend using portable handheld devices that allow employees to access and modify information on WIS when necessary. This will eliminate redundant activities such as entering the same information multiple times, reducing human errors and errant entries that could have far-reaching repercussions for logistic companies. This would be especially detrimental to EPL's reputation and their management to provide high service standards and excellence for customers and clients. Furthermore, Immediate and increased visibility and accessibility have also proven to be beneficial, alluring 75% of the respondents in the study to adopt optimized inventory management systems within 2 years (Sunol, 2019). Cost will be incurred to purchase these devices for employees and training them to use it.

9.2 Implement a New Order System (NOS)

Before the customer dispatches the truck to EPL, the customer will be required to register the impending delivery, specifying the items to be delivered on NOS. The system will then generate an e-delivery note along with a unique QR code associated with it for customers to print and paste on their goods. This system allows the customers to track delivery. Tracking of delivery status is already rampant in many logistics business processes and this recommendation keeps EPL up-to-date with the competition. Keeping customers in the loop is also an important aspect of maintaining high service standards, which part of EPL's mission. Goods information, namely goods condition and short items can also be view by customers on NOS. This can be done as NOS would be integrated with WIS. This allows customers to be aware much earlier as compared to the previous As-Is process, whereby made aware of the damaged goods only after it was being returned to them. This significantly impacts customers producing goods with long manufacturing lead time, as it can drastically reduce the waiting time for customers' clients.

The technology department will be tasked with implementing this new system and teaching customers how to pre-register their delivery. Cost will be also incurred as the Information Technology (IT) department will need to hire more employees such as system integration engineers as a result of increase in workload.

9.3 Integration of WIS and NOS

In the current process, Receiver Admin takes about 8 minutes to update goods received in WIS. However, once NOS and WIS is integrated, NOS would update information regarding delivery status on WIS. This reduces the process time and frees up Receiver Admin for other tasks, greatly benefiting the Receiver Admin, especially since they are overutilised. This also achieves EPL's high-level wants of seamless integration of information across systems. Cost will be incurred as the Information Technology (IT) department will need to hire more employees such as system integration engineers as a result of the increase in workload.

9.4 Digitilisation of paper-based processes (delivery note, driver sheet) through NOS

Once the goods are being delivered, Receiver admin would sign the driver sheet and scan the QR code pasted on the goods by using their portable handheld devices. Delivery status on NOS will be then be automatically updated. After checking for short items and goods condition, Receiver Admin will then update this information on WIS directly, eliminating the need for a physical delivery note or driver sheet. Digitization of the paper-based forms has proven its worth by improving process time of several business such as university application, insurance claiming, and utility billing ("The Benefits of Digitisation of Records", n.d.).Not only does it prevent wastage of physical paper resources and eradicate the problems arising from paper-based processes such as illegible handwriting. This

increases efficiency as seen in a study by McKinsey Global Institute, which found that switching to digital management typically increases productivity by up to 25%. IT department will be tasked to implement this feature in NOS. Receiver admin will also need to learn from company's IT personnel how to update information onto NOS.

9.5 Including forklifts

It currently takes 30 minutes for the Goods Mover to unload goods from truck and another 15 minutes to move goods to putaway zone manually. Using forklifts would make the unloading and moving of goods less labour intensive, increasing the productivity of Goods Mover. Aligning with EPL's process redesign goals, labour intensive tasks are reduced, freeing up Goods Mover for other tasks. This mitigates the problem of workforce shortage for moving, picking and packing tasks. RP efficiency is also increased with the decrease in total execution time. Additional cost will be incurred for the purchase of forklifts.

9.6 Authorise Warehouse Operator to access WIS to edit goods shortage information by scanning QR code

In the existing PPS process, if there is insufficient quantity, the Warehouse Operator will write shortage information on pick sheet and pass the pick sheet to Warehouse Supervisor to update the same information into WIS. We propose that the Warehouse Operator be granted with authority to update shortage in WIS directly for straightforward cases and only request for the supervisor to update for special cases. This would eliminate Instances of multiple-entry and duplicate shortage information in various forms. It also reduces the extra time taken for shortage pick sheet to be passed to Warehouse Supervisor to update in WIS. Warehouse Operator will need to scan QR, and only then will he have access to that specific goods information. He can then edit the goods shortage directly. This also ensures the other goods information cannot be tampered with as Warehouse Operator only has a limited role and cannot access to other goods information. Privilege Access Management is crucial in protecting data integrity and confidentiality (He, 2017). The department policy will have to be changed.

9.7 Implement Assignment function in WIS

Currently, the Warehouse Mover realises there is insufficient storage space as he is moving the goods to the assigned location with reference to putaway sheet 15% of the time. This inefficient process can be avoided by implementing an assignment function in WIS. Beforehand, the capacity of various locations will have to be entered first. When moving the goods using the forklift, Goods Mover uses the forklift fork as measurement for the capacity of goods. Goods Mover will then update Receiver Admin of goods capacity for him to input into WIS. Warehouse Supervisor then assign location of goods after cross-checking the remaining capacity of the location with the goods capacity on WIS. For existing goods, if there is sufficient space, Warehouse Supervisor will go ahead and assign same existing location. In the event that there is insufficient storage space, Warehouse Supervisor will need to reassign a new location. IT department will be tasked to implement new assignment feature in WIS.

This eliminates the outcome of Goods Mover being assigned a location with insufficient storage space, decreasing process time by 20 minutes, vastly increasing process efficiency. Lightening the workload of Goods Movers means they will be freed up for other tasks, and thus decreasing workforce shortage for moving, picking and packing tasks. It also resolves the issue faced by stakeholders, as innovative technology is deployed, increasing features in WIS to support warehousing needs.

9.8 Format of location records standardised

As a result of the inaccuracy of the putaway location records currently, Warehouse Operator have trouble searching for the goods. This results in the labour-intensive task of Warehouse Operator searching surrounding location for the good, contributing to the high process time. Without data standardisation, EPL will certainly have more trouble sending the right goods and quantity to customers when the number of customer's delivery trucks arriving and email orders received double. It may even cause them to lose customers altogether if customers grow frustrated with the low service standards and decide to stop using their services. A comprehensive back end process will be required to eliminate any inconsistencies in the current location records and standarise it. This ensures that goods locations are extremely accurate, with least amount of time wasted.

9.9 OTS will be revamped to become a web-based application

Currently, OTS is a macro visual basic system built in house using Excel Spreadsheet. Being offline, it would be difficult to integrate with other systems. Thus, OTS will be revamped to become a web-based application. This would also allow for OTS to be integrated with WIS.

9.10 Integration of WIS and OTS

Due to WIS and OTS being completely separate systems, shortage information has to be entered into WIS and OTS delivery manifest separately, resulting in instances of multiple entry and duplicate information. Also, Customer Admin must first create order in OTS and then subsequently take 5 minutes to create a pick sheet in WTS.

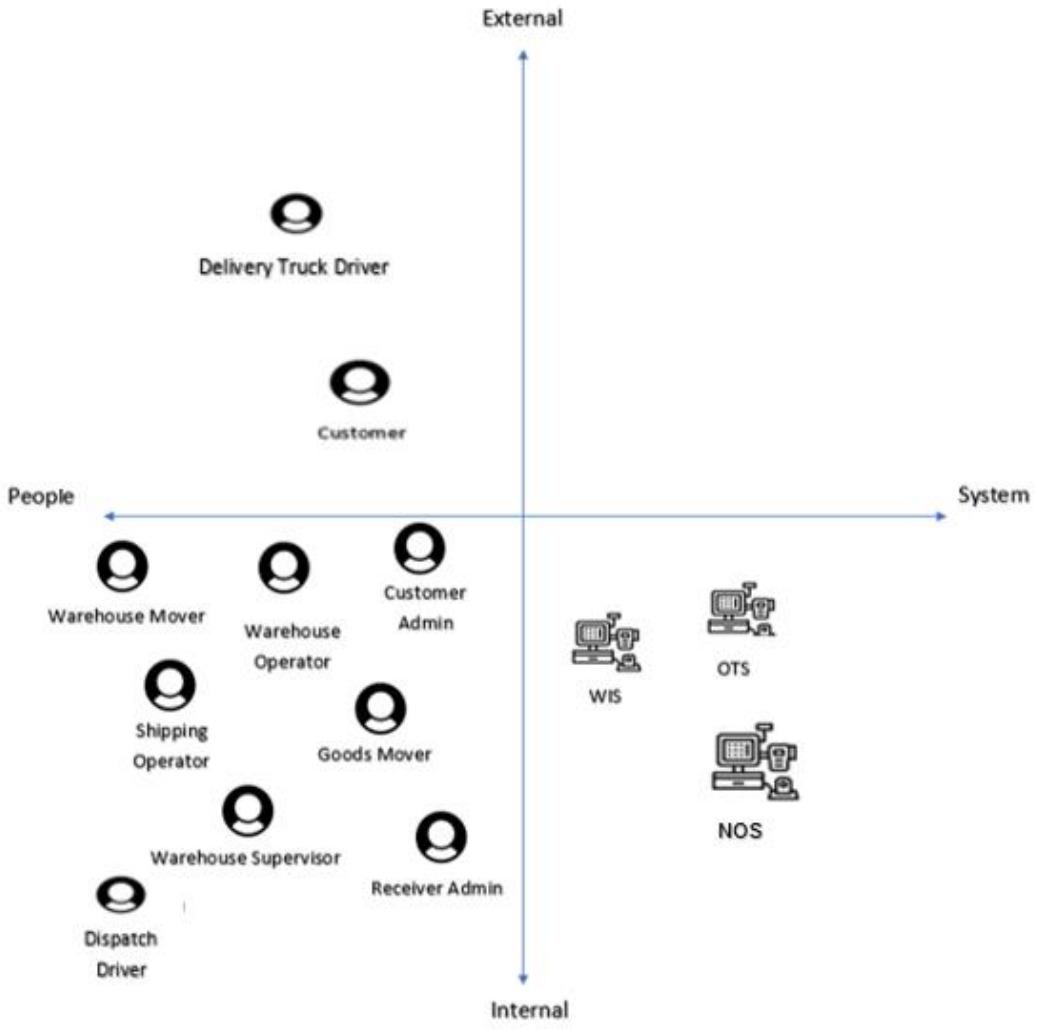
With the system integration, once an order is created in OTS, WIS can retrieve order information from OTS automatically. Manual task of creating, printing and passing pick sheet to Warehouse Operators can be removed as process time decreases, Similarly, once shortage information is entered into WIS, WIS will update shortage in shortage backlog on OTS delivery manifest. Moreover, Warehouse Supervisor no longer needs to convey shortage information to Customer Admin in order for them to update into OTS delivery manifest. With the automation of these labour-intensive tasks, efficiency of the processes are improved.

9.11 Quality Control Activity

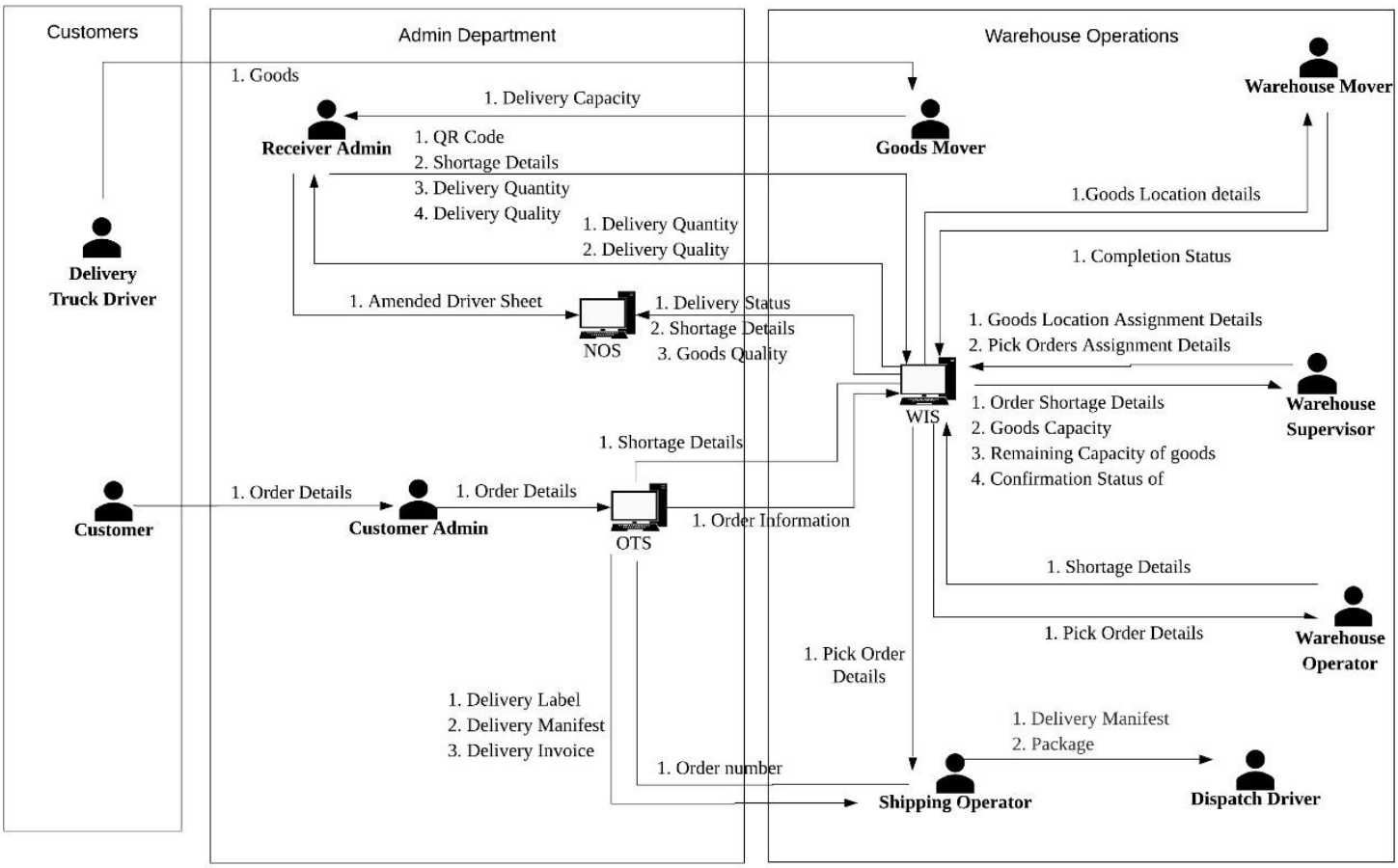
Currently, customers are complaining that their clients are not receiving the correct goods and quantity order as well as damaged goods received due to improper packaging.

Thus, we have decided to include a new activity, quality control. This is key to building a successful business that delivers products that meet or exceed customers' expectations (Shukla, 2016), EPL's management deicison. It also forms the basis of an efficient business that minimises waste and operates at high levels of productivity. This increases process time by 5 mins and increases a manual task for Shipping Operation. However, we believe that the benefits of this manual activity would greatly outweigh the cost in the long run, maintaining EPL's credible reputation.

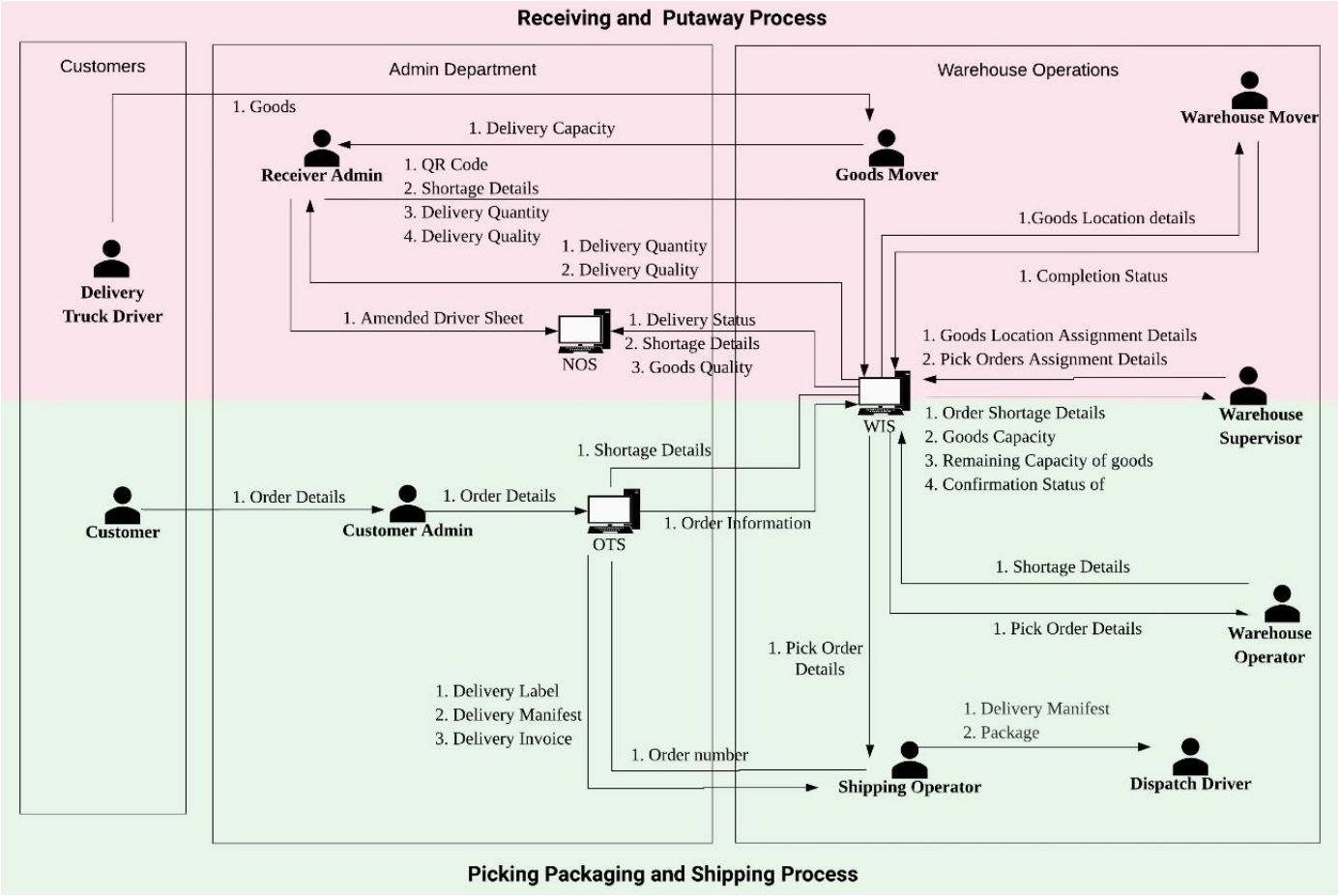
10. To-Be Resource Model



11. To-Be Collaboration Model



12. To-Be Process Package Model



13. RP process and PPS process To-Be scenario

a. Roles information

Role	Cost (SGD)	Work Hours	Number
Customer Admin	$12 per hour	8.30am - 6pm	5
Goods Mover	$9 per hour	9am – 7pm	3
Receiver Admin	$10 per hour	8.30am - 6pm	2
Shipping Operator	$9 per hour	10pm – 8pm	8
Warehouse Mover	$9 per hour	9am – 7pm	3
Warehouse Operator	$9 per hour	9am – 7pm	16
Warehouse Supervisor	$12 per hour	8.30am - 8pm	4

b. RP process and PPS process trigger information

RP process: Triggered by Arrival of customer's delivery truck

PPS process: Triggered by Arrival of email order from customer

c. Existing and new IT applications descriptions

Following are the core IT application that are used at EPL for the **RP process** and the **PPS process**.

Application	Existing - Description	New - Description
Warehouse Inventory System (WIS)	Controls the storage of materials within the warehouse and processed the associated transactions, including receiving, putaway and picking. System was developed in-house some years ago with limited functionalities and documentation.	Displays the remaining capacity of storage locations in warehouse and processes transactions, including receiving, putaway and picking. Information of these transactions can be conveniently accessed and updated through scanning of unique QR code pasted on the goods. In addition, WIS stores the capacity of goods that are brought in and out of the warehouse through the processes mentioned above and is able to allow the receiver admin to cross check and verify goods received Additionally, it integrates seamlessly with NOS and OTS, on goods condition, shortage and order information.
Order Taking System (OTS)	Maintains customers' order information. This is a macro visual basic system built in-house using Excel spreadsheet.	Web-based system which maintains customers' order information. Shortage backlog in OTS delivery manifest is automatically updated.
New Order System (NOS)	NIL	Allows customers to register their impending delivery and this system will generate a unique QR code for goods belonging to that specific delivery which customers will paste on their goods. It will also include a digitalized driver sheet for Receiver Admin to sign upon the delivery of goods. System is also accessible by customers to track delivery, quantity of goods and goods condition.

d. Step by step activity tables

Step by Step Sequence for To-Be RP Process

Triggered by Arrival of customer's delivery truck

Current Step	Previous Step	Task Description	Actor	Execution Time (Mins)
1	-	Sign driver sheet on NOS	Receiver Admin	1
2	1	Scan QR code, update quantity and goods condition on WIS	Receiver Admin	35
3	2	Update Shortage on WIS (10%)	Receiver Admin	5
4	-	Unload goods from truck for checking	Goods Mover	15
5	4	Update Receiver Admin on the capacity of the delivery goods	Goods Mover	5
6	2,3,5	Update WIS on the capacity of delivery goods	Receiver Admin	5
7	6	Move goods to holding location	Goods Mover	8
8	6	Updates delivery status, information on short items and good conditions on NOS	WIS	1
9	7	Assign empty location for new goods after cross checking capacity of goods with remaining capacity of locations using WIS and update WIS (consist of new goods – Yes 20%)	Warehouse Supervisor	5
10	7	Assign location for existing goods after cross checking capacity of goods with remaining capacity of locations using WIS and update WIS (consist of new goods – No 80%)	Warehouse Supervisor	5
11	10	Get goods location from WIS	Warehouse Mover	1
12	11	Move goods from holding location to assigned location	Warehouse Mover	15
13	12	Update completion status on WIS	Warehouse Mover	5
14	13	Warehouse Supervisor confirms completion of Putaway process on WIS	Warehouse Supervisor	5

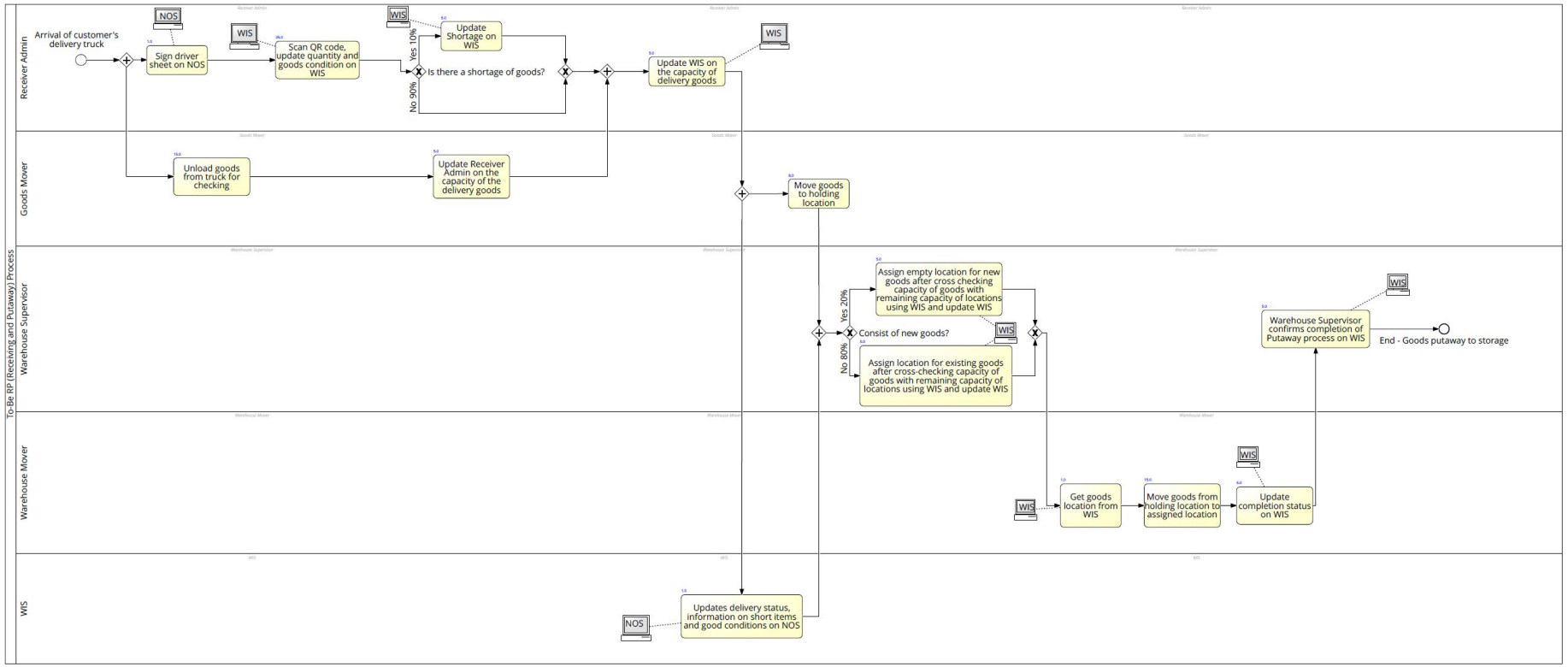
Step by Step Sequence for To-Be PPS

Triggered by Arrival of email order from customer

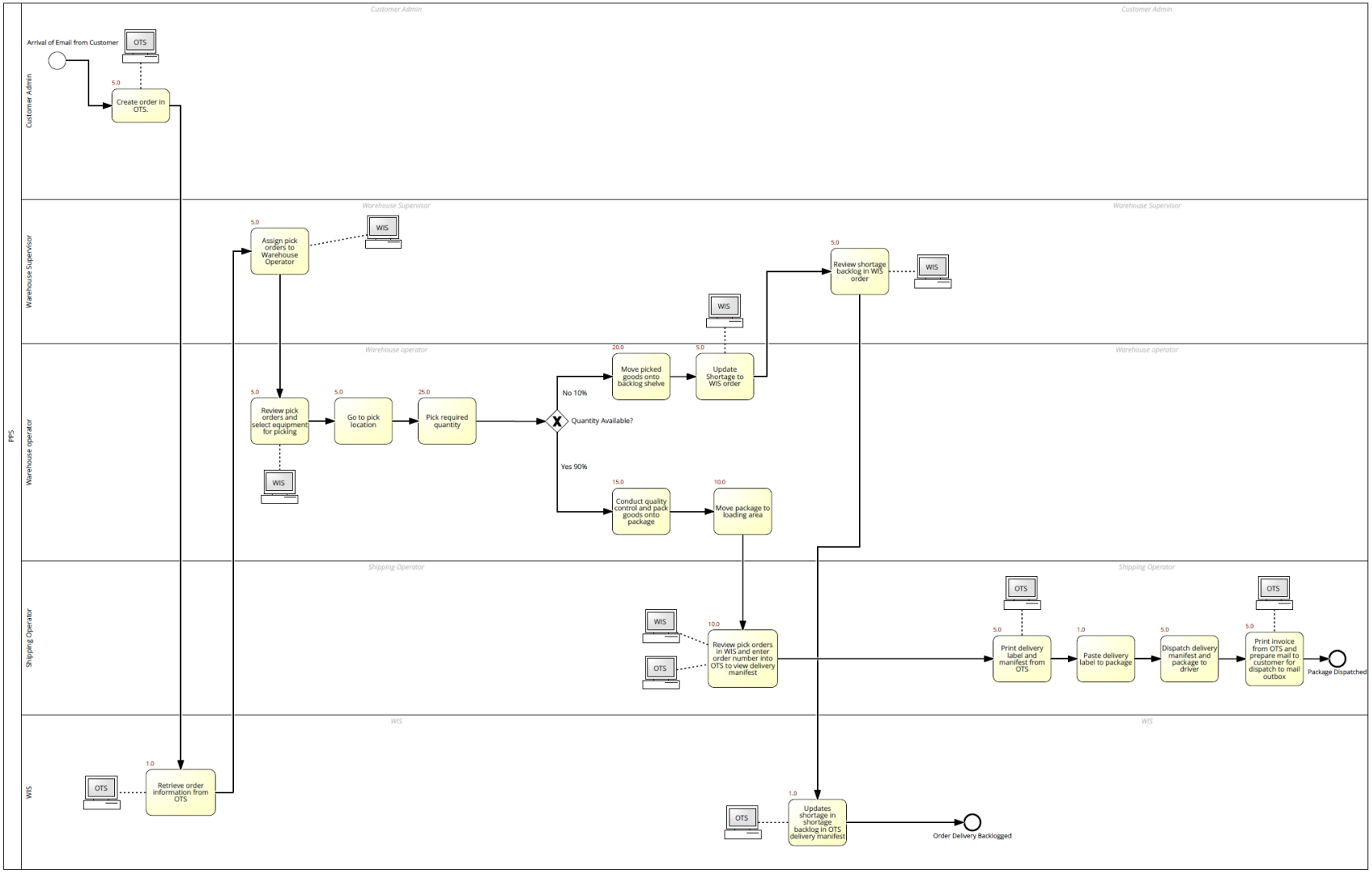
Current Step	Previous Step	Task Description	Actor	Execution Time (Mins)
1	-	Create order in OTS.	Customer Admin	5
2	1	Retrieve order information from OTS.	WIS	1
3	2	Assign pick orders to Warehouse Operator on WIS	Warehouse Supervisor	3
4	3	Review pick orders on WIS and select equipment for picking	Warehouse Operator	5
5	4	Go to pick location	Warehouse Operator	5
6	5	Pick required quantity	Warehouse Operator	15
7	6	Move picked goods onto backlog shelve (Quantity available – No 10%)	Warehouse Operator	10
8	7	Update Shortage on WIS	Warehouse Operator	5
9	8	Review Shortage on WIS	Warehouse Supervisor	2
10	9	Updates shortage in shortage backlog in OTS delivery manifest [End – Order delivery backlogged]	WIS	1
11	6	Conduct quality control and pack goods onto package (Quantity available – Yes 90%)	Warehouse Operator	15
12	11	Move package to loading area	Warehouse Operator	10
13	12	Review pick orders in WIS and enter order number into OTS to view delivery manifest	Shipping Operator	10
14	13	Print delivery label and manifest from OTS	Shipping Operator	5
15	14	Paste delivery label to package	Shipping Operator	1
16	15	Dispatch delivery manifest and package to driver	Shipping Operator	5
17	16	Print invoice from OTS and prepare mail to customer for dispatch to mail outbox [End – Package Dispatched]	Shipping Operator	5

14. Two To-Be As-Is workflow diagrams,

14.1 To-Be RP



14.2 To-Be PPS


PPS
Customer Admin
Warehouse Supervisor
Warehouse operator
Shipping Operator
WIS
Arrival of Email from Customer
OTS
5.0
Create order in OTS.
5.0
Assign pick orders to Warehouse Operator
WIS
5.0
Review shortage backlog in WIS order
WIS
5.0
Review pick orders and select equipment for picking
WIS
5.0
Go to pick location
25.0
Pick required quantity
Quantity Available?
No 10%
20.0
Move picked goods onto backlog shelve
5.0
Update Shortage to WIS order
Yes 90%
15.0
Conduct quality control and pack goods onto package
10.0
Move package to loading area
WIS
OTS
10.0
Review pick orders in WIS and enter order number into OTS to view delivery manifest
OTS
5.0
Print delivery label and manifest from OTS
1.0
Paste delivery label to package
5.0
Dispatch delivery manifest and package to driver
OTS
5.0
Print invoice from OTS and prepare mail to customer for dispatch to mail outbox
Package Dispatched
OTS
1.0
Retrieve order information from OTS
OTS
1.0
Updates shortage in shortage backlog in OTS delivery manifest
Order Delivery Backlogged

15. Tool Based Static Analysis of the To-Be processes

15.1 Cost Calculation (RP)

With the changes made in the To-Be model, the cost of the entire RP process is $63,440 per year considering 5 workdays a week for 52 weeks. The cost of each execution for RP amounted to $16.27.

Analysis of the forecasted growth shows that there would be 30 trucks daily, thus 7800 trucks per year (30 trucks x 260 days). The cost to execute the entire RP process amounts $ 126,880.00 per year with a cost per execution of $16.27. The main activities that take up significant amount of the total cost (36%) are the scanning of QR code and checking of the conditions of the goods.

The total execution time of the 4 potential paths are illustrated in the table below.

Path	Total Cost	Total Execution time (mins)
Path 1 (Shortage, new goods)	$17.02	106
Path 2 (Shortage, no new goods)	$17.02	106
Path 3 (No Shortage, new goods)	$ 16.18	101
Path 4 (No Shortage, no new goods)	$ 16.18	101

15.2 Cost Calculation (PPS)

With the changes made in the To-Be model, the cost of the entire PPS process is $ 325,860.00 per year considering 5 workdays a week for 52 weeks. The cost of each execution for PPS amounted to $ 12.50.

Looking into the cost breakdown, the activity ‘pick required quantity’ amounted to the largest portion of the cost at $ 58,500.00 and 18% of the total cost. It also has the highest activity time of 15min. The activity ‘conduct quality control and pack goods onto package’, contributed to next highest cost at $52,650.00 and 16% of the total cost.

Analysis of the forecasted growth shows that total cost of the PPS would increase from $ 325,860.00 to $ 650,000.00,

The total execution time of the 2 potential paths for PPS per execution are illustrated in the table below.

Path	Total Cost	Total Execution time (mins)
Path 1 (Quantity available, Package dispatched)	$11.50	82
Path 2 (Quantity not available, Package not dispatched)	$11.75	65

15.3 Resource Utilization Analysis

To-Be Current Resources				
Roles	**Employee Numbers**	**Resource planning RP**	**Resource planning PPS**	**Total Number of workers needed**
Customer Admin	5	NA	1.21	2
Goods Mover	3	1.02	NA	2
Receiver Admin	2	1.50	NA	2
Shipping Operator	8	NA	5.66	6
Warehouse Mover	3	0.76	NA	1
Warehouse Operator	16	NA	11.84	12
Warehouse Supervisor	4	0.36	0.77	2

To-Be Forecasted Resources				
Roles	**Employee Numbers**	**Forecasted Resource planning RP**	**Forecasted Resource planning PPS**	**Total Number of workers needed**
Customer Admin	5	NA	2.42	3
Goods Mover	3	2.03	NA	3
Receiver Admin	2	3.01	NA	4
Shipping Operator	8	NA	11.31	12
Warehouse Mover	3	1.52	NA	2
Warehouse Operator	16	NA	23.68	24
Warehouse Supervisor	4	0.73	1.55	3

After the adoption of the To-Be model, employees in all roles will be underutilized for the current demand. With the projected growth to be doubled, there is a need to increase the number of employees for 3 roles: Receiver Admin, Shipping Operator and Warehouse Operator.

16. Summary analysis of the To-Be processes in comparison with the As-Is business processes.

16.1 Resource Utilization

Roles	Total Number of workers needed in As-Is	Total Number of workers needed in To-Be	Improvement %
Customer Admin	4	2	50%
Goods Mover	2	2	0%
Receiver Admin	3	2	33%
Shipping Operator	6	6	0%
Warehouse Mover	2	1	50%
Warehouse Operator	12	12	0%
Warehouse Supervisor	3	2	33%
Total number	32	27	19%

Comparing the As-Is and the To-Be processes, we can see all employees including the Receiver Admin would no longer be overutilised. Further analysis into the To-Be Model also shows that existing human capital has the capacity to support future forecasted growth which is expected to double in the next 1 to 3 years. For the current To-Be process, 4 out of 7 roles can support the future growth of EPS, namely the Customer Admin, Goods Mover Warehouse Mover and Warehouse Supervisor as compared to the previous As-Is model where only Warehouse Mover could. The total number of employees needed for As-Is process was 32 employees as compared to 27 in the To-Be process. In the forecasted model, the As-Is process requires 59 employees compared to the 51 employees in the To-Be process. Overall, workforce will be reduced by at least 15%, therefore achieving the 10% reduction in workforce set out by EPL.

16.2 Cost Calculation

Comparing the cost calculations from the respective static analyses, the total cost for both RP and PPS processes has decreased by 16% from $467,041.25 to $389,300. Individually, cost of RP process has decreased by 7.38% from $97,906.25 to $63,440.00. Similarly, cost of PPS process has decreased by 11.72% from $369,135 to $325,860. This has been done by improving the efficiency of both RP and PPS processes.

16.3 Process time comparison

Comparing the path analysis, there have been improvements made in terms of cost and process time. These findings will be illustrated in the table below.

Path Analysis	AS IS		TO BE		Comparison	
Description	Cost	Duration	Cost	Duration	Cost improvement	Duration Improvement
RP						
Path 1 (Shortage, new goods, location not full)	$26.02	160	$17.02	106	34.59%	33.75%
Path 2 (Shortage, no new goods, location not full)	$ 25.02	155	$17.02	106	31.97%	31.61%
Path 3 (No Shortage, new goods, location not full)	$ 25.35	156	$ 16.18	101	36.17%	35.26%
Path 4 (No Shortage, no new goods, location not full)	$ 24.35	151	$ 16.18	101	33.55%	33.11%
Path 5 (Merged the 4 paths with location full)	$28.44 (Average)	175.5 (Average)	0	0	100%	100%
PPS						
Path 1 (Goods found, Quantity not available, Update WIS of shortage, Order delivery backlogged)	$11.55	66	0	0	100%	100%
Path 2 (Goods found, Quantity not available, move picked goods onto backlog shelve, Order delivery backlogged)	$8.85	53	0	0	100%	100%
Path 3 (Goods found, Quantity available, Package dispatched)	$14.25	77	$11.50	82	19.2%	-6%
Path 4 (Goods not found, Quantity not available, Update WIS of shortage, Order delivery backlogged)	$12.30	71	$11.75	65	4.5%	8.5%
Path 5 (Goods not found, Quantity not available, move picked goods onto backlog shelve, Order delivery backlogged)	$9.60	58	0	0	100%	100%
Path 6 (Goods not found, Quantity available, Package dispatched)	$15.00	82	0	0	100%	100%

Path Comparison RP

The To-Be model eradicated 4 paths that had locations that were full. This optimisation has allowed for a 100% improvement in terms of both cost and time for these paths. As such, paths have been reduced from 8 to 4. As compared to the initial paths in the As-Is processes, there is over 30% improvement in process time and cost. By streamlining inefficient work processes and eliminating repetitive tasks, goals of time and cost reduction have been achieved. Though automation and use of forklifts, there are also fewer labour-intensive tasks left.

Path Comparison PPS

Looking at the comparison of the path analyses from As-Is and To-Be, the number of paths has reduced from 6 to 2 due to a streamlining of the PPS process resulting in only two outcomes; either package is dispatched, or order delivery backlogged. This is the result of optimising path 1, 2, 5, 6 in the To-Be model, resulting in a 100% improvement in both the cost and duration for these 4 paths.

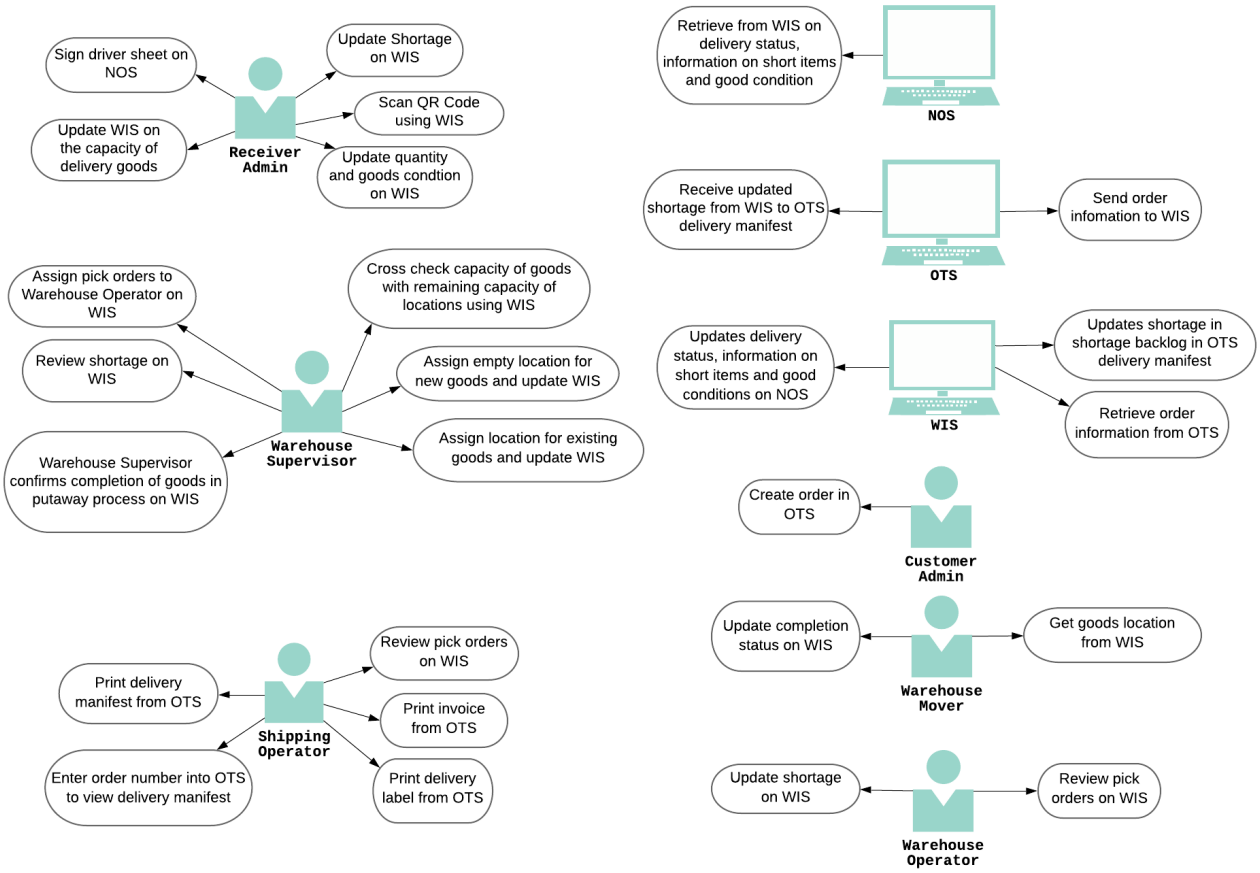
A closer look into path 3 indicates that cost has reduced by 19.2% with the removal of multiple entry and duplicate information in paper and system form. This is made possible by authorising other employees besides the Warehouse Supervisor to access WIS and update the shortages on it directly. In doing so, inaccuracies and human errors are reduced, resulting in fewer mismatches between WIS and the physical inventory status. Ultimately, this reduces the cost of PPS.

The duration for path 3 increased by 6% due to an additional activity to conduct quality checks on the package before shipping. This would reduce complaints from customers due to incorrect or damaged goods. In line with management decisions, the team feels that this is a necessary addition to the process.

For path 4, the cost and duration will improve by 4.5% and 8.5% respectively. As a result of the improvements made to the RP process where location of goods storage has become more accurate, Warehouse Operator are now able to pick the required quantity without spending unnecessary time to look at surrounding locations, which is a labour-intensive task. With better warehouse organisation, back orders will also be reduced by 50% as goods which was previously not found in the As Is process is eradicated as the current RP process stores the location of the goods accurately. Previously, goods not available was mainly due to two reasons: goods not being found even though they could be in the warehouse, and quantity not being available. With better warehouse organisation due to more accurate location information, cases where goods are not found even though they are in the warehouse are eliminated. Thus, quantity of goods not being found is reduced from 20% to 10%.

17. The Concept Solution Blueprint for the proposed To-Be processes.

(i) Use Case Model

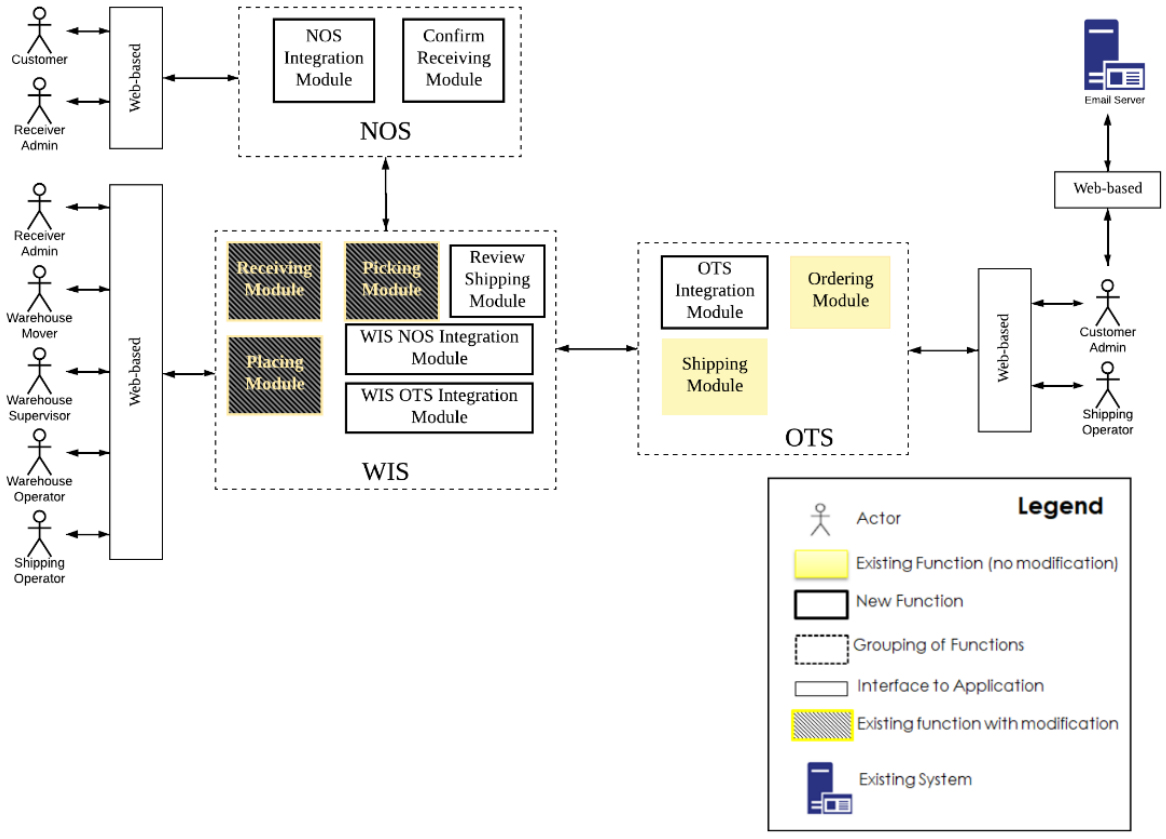


(ii) Function Model

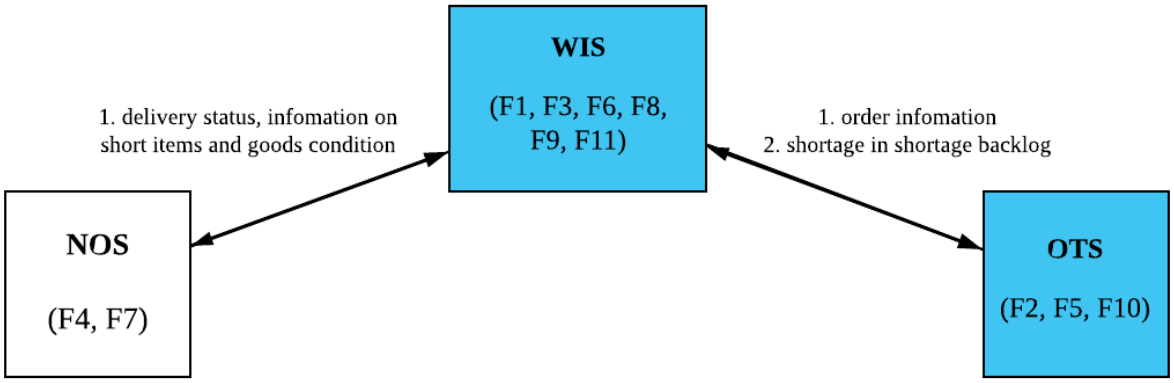
Function	Use Case	New / Existing / To be Modified	Systems / Comments
WIS OTS Integration Module	Retrieve order information from OTS	New	WIS – System integration
	Update shortage in shortage backlog on OTS delivery manifest	New	WIS – System integration
OTS Integration module	Send order information to WIS	New	OTS – System integration
	Receive updated shortage from WIS to OTS delivery manifest	New	OTS – System integration
WIS NOS Integration Module	Updates delivery status, information on short items and good conditions on NOS	New	WIS – System integration
NOS Integration Module	Retrieve from WIS on delivery status, information on short items and good condition	New	NOS – System integration
Ordering Module	Create order in OTS	Existing	OTS – Fully supported
Receiving Module	Scan QR code using WIS	New	WIS – New use case
	Update quantity and goods condition on WIS	To be modified	WIS – Currently done manually
	Update shortage on WIS	New	WIS – Currently done manually
	Update WIS on the capacity of delivery goods	New	WIS – New use case
Confirm Receiving Module	Sign driver sheet on NOS	New	NOS – Currently done manually
Placing Module	Assign empty location for new goods and update WIS	To be modified	WIS - Requires cross check information
	Cross check capacity of delivery with remaining capacity of locations using WIS	New	WIS – New use case
	Assign location for existing goods and update WIS	To be modified	WIS – Requires cross check information
	Warehouse Supervisor confirms completion of goods in putaway process on WIS	New	WIS - New use case

	Update completion status on WIS	New	WIS – Currently done manually
	Get goods location from WIS	New	WIS – Currently done manually
Picking Module	Assign pick orders to Warehouse Operator on WIS	New	WIS – Currently done manually
	Review pick orders on WIS	New	WIS – Currently done manually
	Update shortage on WIS	Existing	WIS – Fully supported
	Review shortage on WIS	New	WIS - New use case
Shipping Module	Print delivery manifest from OTS	Existing	OTS – Fully supported
	Enter order number into OTS to view delivery manifest	Existing	OTS – Fully supported
	Print delivery label from OTS	Existing	OTS – Fully supported
	Print invoice from OTS	Existing	OTS – Fully supported
Review Shipping Module	Review pick orders on WIS	New	WIS - Currently done manually

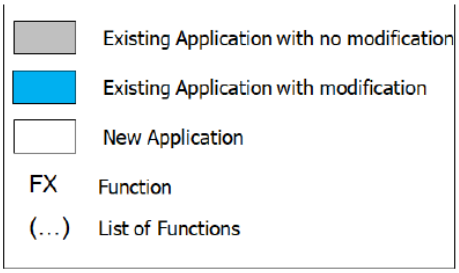
(iii) Solution Overview Model



(iv) Application Model.



Function Symbol	Function Name
F1	WIS OTS Integration Module
F2	OTS Integration module
F3	WIS NOS Integration Module
F4	NOS Integration Module
F5	Ordering Module
F6	Receiving Module
F7	Confirm Receiving Module
F8	Placing Module
F9	Picking Module
F10	Shipping Module
F11	Review Shipping Module



18. Justification and Conclusion

As demonstrated by the analyses in the previous sections, it is indisputable that the proposed solution will solve several pressing issues faced by EPL in the RP and PPS processes and will propel EPL towards attaining the high-level "wants" of their various stakeholders. In doing so, we adhered to the statements of the problems faced by the stakeholders and ascertained a set of performance targets around which all our proposed solutions revolve. Apart from the alleviation of those issues, the team also takes into account the less tangible aspects of the solution pertaining to EPL having the competitive advantage of having innovative and cutting-edge systems that powers the processes. This is achieved by a combination of creation of a new system (NOS), revamping of OTS and integrating these systems with the existing WIS that is reinforced with new functionalities to support our new and more efficient processes.

The team also delved into the respective market research in contemporary warehouse processes as prerequisite for any part of our solution. The research covers the standard practices in the industry, and the future trends worth noticing – and probably anticipating – in the areas of warehouse management processes, systems and policies. The first key finding is interfering activities that needlessly use paper-based forms which takes up time to be filled up which potentially gives rise to errant entries. By digitalizing forms, EPL can achieve numerous advantages including better quality control of documents as well as easy collaboration where different users of the system are able to create, modify as well as manage the same documents. This is especially important for EPL as information needs to be retrieved and modified by different parties throughout the process and the digitalization of the forms would enable a greater efficiency of the process.

Through the recommendation provided, EPL would achieve the goal with savings of over 30% in process time and cost for the RP process. Similarly, PPS would be able to achieve the goal of a reduction in cost by at least 10%. As for time savings, the model did not achieve the goal of a 10% improvement due to the inclusion of the quality checks on the package before shipping which the team felt that was important as it achieves the goal of proving high service standards and excellence for customers and clients. As such, the team is confident that the recommendations are never behind its industry counterpart, and will in fact, propel EPL forward to be a leading third-party logistic provider in Singapore.

After implementing the recommendations, back orders will also be halved, effectively reducing the backlog from 20% to 10% would achieve the goal of reducing backlog by 10%. Through the recommendation of digitalising of paper processes and the introduction of the forklift, it has both reduced the labour required per task as well as removed 6 tasks that are labour intensive in the form of filling up the paper processes that were found in the initial As-Is process but not in the To-Be process. This fulfills the goal of reducing the number of labour intensive tasks by 5. Furthermore, mentioned under resource utilization in summary analysis, workforce required reduces by 19% from 32 to 27. This also fulfills the goal of reducing workforce by 10%.

All in all, the team is more than confident that the new and modified functionalities in our proposed solution will effectively nullify EPL's issues like the labor-intensiveness of picking and packing tasks. The integration of WIS and OTS systems will also streamline the process of data-entry and thus solving a multitude of issues such as duplicate and errant data, mismatch of inventory status and missing and misplaced goods. An improvement in the total process time has also been observed, allowing more resources to be allocated to Quality Assurance aspect of the process and improving relationship with and reducing complaints from the customer. Thus, the proposed solution will help put EPL at an advantageous position in the warehousing industry with the help of innovative efficient processes.

19.Appendix

Appendix A: RP Cost Analysis ASIS Current

Task	Input factor	Costs per execution	Total Costs	Percentage of total cost
Check goods against delivery note	1.00	$ 2.50	$ 9,750.00	9.96%
Sign driver sheet & carbon copy	0.90	$ 0.17	$ 585.00	0.60%
Sign and update short items on driver sheet & carbon copy	0.10	$ 0.83	$ 325.00	0.33%
Check condition of goods, amend delivery note with description of damaged goods	1.00	$ 5.00	$ 19,500.00	19.92%
Unload goods from truck for checking	1.00	$ 4.50	$ 17,550.00	17.93%
Update goods received in WIS	1.00	$ 1.33	$ 5,200.00	5.31%
Print blank putaway sheet using WIS and attach it to goods together with respective delivery note	1.00	$ 0.50	$ 1,950.00	1.99%
Move goods to putaway zone	1.00	$ 2.25	$ 8,775.00	8.96%
Pass delivery note & putaway sheet to Warehouse Supervisor	1.00	$ 0.30	$ 1,170.00	1.20%
Review delivery note and putaway sheet	1.00	$ 1.00	$ 3,900.00	3.98%
Write location in putaway sheet for all goods and update WIS	0.80	$ 1.00	$ 3,120.00	3.19%
Assign empty location for new goods and write new and existing goods location in putaway sheet and update WIS	0.20	$ 2.00	$ 1,560.00	1.59%
Move goods to assigned location with reference to putaway sheet	1.00	$ 4.50	$ 17,550.00	17.93%
Inform Warehouse Supervisor of goods location that has insufficient storage space and return putaway sheet	0.15	$ 0.75	$ 438.75	0.45%
Assign and write new location for existing goods with no storage space in putaway sheet and update WIS	0.15	$ 1.00	$ 585.00	0.60%
Move existing goods to new location with reference to putaway sheet	0.15	$ 1.50	$ 877.50	0.90%
Return putaway sheet to Warehouse Supervisor	1.00	$ 0.30	$ 1,170.00	1.20%
File delivery note and putaway sheet in folder	1.00	$ 1.00	$ 3,900.00	3.98%
Sums		**$ 25.10**	**$ 97,906.25**	100.00%

Appendix B: PPS Cost Analysis ASIS Current

Task	Input factor	Costs per execution	Total Costs	Percentage of total cost
Create order in OTS	1.00	$ 1.00	$ 26,000.00	7.04%
Create and print pick sheet in WIS	1.00	$ 1.00	$ 26,000.00	7.04%
Pass pick sheets to warehouse supervisor	1.00	$ 0.60	$ 15,600.00	4.23%
Assign and pass pick sheet to warehouse operators	1.00	$ 1.00	$ 26,000.00	7.04%
Review pick sheet and select equipment for picking	1.00	$ 0.75	$ 19,500.00	5.28%
Go to pick location	1.00	$ 0.75	$ 19,500.00	5.28%
Search surrounding location	0.25	$ 0.75	$ 4,875.00	1.32%
Pick required quantity	1.00	$ 2.25	$ 58,500.00	15.85%
Pack Goods onto package	0.80	$ 1.50	$ 31,200.00	8.45%
Move Package to loading area and pass pick sheet to Shipping operator	0.80	$ 1.50	$ 31,200.00	8.45%
Review pick sheet with WIS and enter order number into OTS to view delivery manifest	0.80	$ 1.50	$ 31,200.00	8.45%
Print delivery label and manifest from OTS	0.80	$ 0.75	$ 15,600.00	4.23%
Paste delivery label to package	0.80	$ 0.15	$ 3,120.00	0.85%
Dispatch delivery manifest and package to driver	0.80	$ 0.75	$ 15,600.00	4.23%
Print invoice from OTS and prepare mail to customer for dispatch to mail outbox	0.80	$ 0.75	$ 15,600.00	4.23%
Write shortage on pick sheet	0.20	$ 0.75	$ 3,900.00	1.06%
Pass shortage pick sheet to Warehouse supervisor	0.20	$ 0.45	$ 2,340.00	0.63%
Update WIS of shortage	0.20	$ 1.00	$ 5,200.00	1.41%
Inform Customer admin via phone of shortage	0.20	$ 1.00	$ 5,200.00	1.41%
Update Shortage backlog in OTS delivery manifest	0.20	$ 1.00	$ 5,200.00	1.41%
Move picked goods onto backlog shelve	0.20	$ 1.50	$ 7,800.00	2.11%
Sums		**$ 14.20**	**$ 369,135.00**	**100%**

Appendix C: Market Research Findings

[1] Benefits of Digitalization

Examples of financial benefits: https://www.changefactory.com.au/our-thinking/articles/benefits-digitisation/

20 References

He, Q. (2017). Maintaining Data Integrity with Privileged Access Management. [online] Blog.wallix.com. Available at: http://blog.wallix.com/data-integrity-and-privileged-access-management/

Shukla, V. (2016). Importance of Quality Control and Quality Assurance - Parekhplast India Limited. [online] Parekhplast India Limited. Available at: https://www.parekhplast.com/blog/importance-of-quality-control-and-quality-assurance/

Sunol, H. (2019, April 25). Warehouse Digitalization: The Future of Warehousing. Retrieved from https://articles.cyzerg.com/warehouse-digitalization-the-future-of-warehousing.

The Benefits of Digitisation of Records. (n.d.). Retrieved October 26, 2019, from https://www.changefactory.com.au/our-thinking/articles/benefits-digitisation/.