COMP CO835 – Object Oriented Systems
Final Project

Group 5
Vail Skiwear
Inventory Management System

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For
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Contents

Introduction

This document contains a completed systems analysis and design project based on the Vail Skiwear case. This team chose the inventory management subsystem to focus on as it was recognized that a stable base of operations for Finished Goods Inventory is a priority. The team identified problems with the current system and designed a solution to meet Vail Skiwear's needs. This document includes Use Case Models, Use Case Descriptions, Class Diagrams, Sequence Diagrams, and State Diagrams to model the team's proposed system which will undoubtedly increase the efficiency over the previous version of the system. In addition to a more robust system which takes on greater responsibility for storing paperwork, newly designed system output on screens will assuredly streamline much of the general inventory management process. It is believed that once this new system has been fully integrated into Vail Skiwear’s software infrastructure the overall quality of life of inventory system related employees will receive a significant increase. This in addition to the numerous other subtle changes made to the system should prove to offer the maximum amount of productivity, and efficiency possible for the inventory subsystem.

Narrative

Vail will receive orders for 80% of the products their customers think they will sell that season; if sales go well, the customers can place follow-up orders. Orders made by new customers will be flagged until their credit is validated, at which point they will receive a customer number. Orders made by customers who have exceeded their credit limit will be flagged, and they will be contacted to resolve this. All items in the system contain information about their raw material requirements, such that a full raw material list can easily be built from orders and sent to raw material suppliers. Vail will order an additional 20% of all raw materials to assist with follow-up orders and/or future sales.

Production electronically receives the full list of ordered items and can view this via a screen on their computers. All ordered items will be shown alongside the quantity ordered, with back-ordered items at the top of the list. Each item in the list can be marked as complete, to avoid producing more of an item than was required. All finished goods will be fitted with a barcode, which will be scanned by the Inventory department upon leaving Production. When an item's barcode is scanned, it will be removed from the list of items to produce and added to the inventory database.

Inventory can view the list of each individual order via a screen on their computers. The FGI foreman can view order details and print off picking forms as needed. A picker will take the picking form and gather the requested items from the Inventory warehouse. If the picker was able to successfully fill the order, the order is marked as complete on the computer and the quantity of items ordered will be automatically removed from the inventory database. If an order is not able to be filled due to lack of inventory, the picker will mark on the picking form how many of each item they were unable to find. The FGI foreman will indicate on the computer that the order was not filled completely, at which point a new screen will appear where they can enter how many of each item to back-order. At this point, whether complete or not, the order will be sent to Shipping. The picking form will be sent electronically to the Shipping department computers.

Vail has a small truck that is loaded each morning to make deliveries for local customers. Non-local customers will be given the option for fast shipping, or single shipment. If the fast shipping option was chosen, incomplete orders will be shipped as soon as they are received. The remainder of the order will arrive in Shipping the following week as a back-order and will be shipped separately. If the single shipment option was chosen, incomplete orders will be held in Shipping until the following week, at which point they will be merged with their corresponding back-order to create a single shipment. When Shipping marks an order as "shipped" an invoice will be automatically created and emailed to the customer, and that customer will have their amounts owing updated in the customer database.

If a customer claims they did not receive the correct order, their order will be compared to the picking order from Inventory and Shipping. If the three lists do not match, a picker in the Inventory warehouse will visit all bins containing items where discrepancies were found, noting their quantity on hand. The FGI foreman will then update the inventory accordingly. Finally, the remainder of the customer's proper order will be added to back-order for the following week.

Use Case Descriptions

Use Case Name:	**Managing Raw Materials**	
Scenario:	Vail receives sales orders, so that Vail needs to find suitable suppliers and ensure that the raw materials will be available and place the orders.	
Triggering Event:	Vail received sales orders and the system checked the orders	
Brief Description:	Vail employee receives sales orders, then the employee enters the order into system, the system will print figure of all ordered items and sent it to the raw materials personnel, then the raw materials personnel calculates the materials, finds a raw material supplier, and place the order.	
Actors:	Vail Order Receiving Employee, Raw Materials Personnel, Raw Materials Supplier	
Related Use Cases:	Excludes: Get Sales Order's Summary Report Extends: Require more data for calculate special raw materials Includes: Update Inventory File Includes: Look up raw materials availability Excludes: Create Raw Material Orders Excludes: Update Raw Materials Orders	
Stakeholders:	Vail Company's Employee: To receive orders from customers, save orders into system. Vail's Raw Materials Personnel: To calculate the amount of each kind of material by inventory item, find suitable suppliers, and place orders. Raw Materials Supplier: To provide raw materials for Vail Skiwear	
Preconditions:	Vail received a new sales order. The orders are checked and correct. The customer must exist. The goods ordered have valid product codes. Vail determines to place the order.	
Postconditions:	The orders are summed by inventory item. The raw material requirements for each product item are calculated. The raw materials are expected in stock. The Raw materials are ready to start manufacturing process.	
Flow of Events:	Actor	System
	1. Employee from Vail company receives a sales order. 2. The employee enters the order into a microcomputer and save it into a file of inventory items.	2.1 The system checks the order is correct, the customer exists, and the goods ordered have valid product. 2.2 The system summarizes the order by inventory items and gives figures of a total of all quantity ordered of each item. 2.3 The system sends the figures to the raw materials personnel.

	3. The raw materials personnel receives the figures. 4. The raw materials personnel starts to manually calculate the amount of each kind of material by inventory item. 5. The raw materials personnel assembles a raw materials requirements list. 6. The raw materials personnel finds suitable suppliers and ensure that the raw materials will be available and place the orders 7. The raw materials supplier receives the order from Vail. 8. The raw materials supplier transports the required materials to the raw materials personnel from Vail. 9. The raw materials personnel receives the ordered raw materials. 10. Finally, the ordered raw materials are in stock before the beginning of June.	
Exception Conditions:	2.1.1 If the system checks the order is not correct, or the customer does not exist, or the goods ordered have invalid product. The system will notice the Vail's employee to check the input information is correct or cancel the order. 3.1 If the raw materials personnel cannot receive the figures or the figures have wrong message in it, the raw materials personnel will tell the maintenance department to repair the system. 6.1 If the raw materials personnel cannot find a suitable supplier, he/she will tell the Vail's employee to cancel the order.	

Use Case Name:	**Perform Production Transfer**	
Scenario:	Create and use Production Transfer form to move finished goods into inventory	
Triggering Event:	New stock is produced	
Brief Description:	When new stock has been produced, the Production Department fills in a Production Transfer form electronically. A copy of this form goes with the goods to the FGI (Finished Goods Inventory) department.	
Actors:	Production Department Personnel, FGI Foreman, FGI Worker	
Related Use Cases:	Includes: Update Inventory File Includes: Move Items Extends: Create item bin location	
Stakeholders:	Production department: to provide goods and Production Transfer form FGI department: to physically move goods to bin location	
Preconditions:	Goods are finished and ready to move into inventory. Inventory item exists in inventory file.	
Postconditions:	Inventory file is updated. Production schedule is updated. Goods are in bin location.	
Flow of Events:	Actor	System
	1. Production Personnel verifies finished items are ready. 2. Personnel creates and fills in Production Transfer form electronically. 3. Personnel moves items to FGI department area. 4. FGI Foreman verifies physical item matches description on the form and approves form electronically. 5. FGI Foreman scans items (*Update Inventory File* use case). 6. FGI Foreman verifies inventory item has bin location. 7. FGI Foreman or FGI worker moves item to bin location (*Move items* use case).	2.1 Create Production Transfer form record. 4.1 Production Transfer record approved. 5.1 Update QTY in Inventory file. 5.2 Update QTY in Production schedule.
Exception Conditions:	1.1 If items are not ready, do not proceed, go back to Production process. 4.1 If items do not match form description, do not proceed. Notify Production department. 5.1 If bin location does not exist, FGI must create physical bin location in warehouse and add bin location to inventory file record (*Create item bin location* use case).	

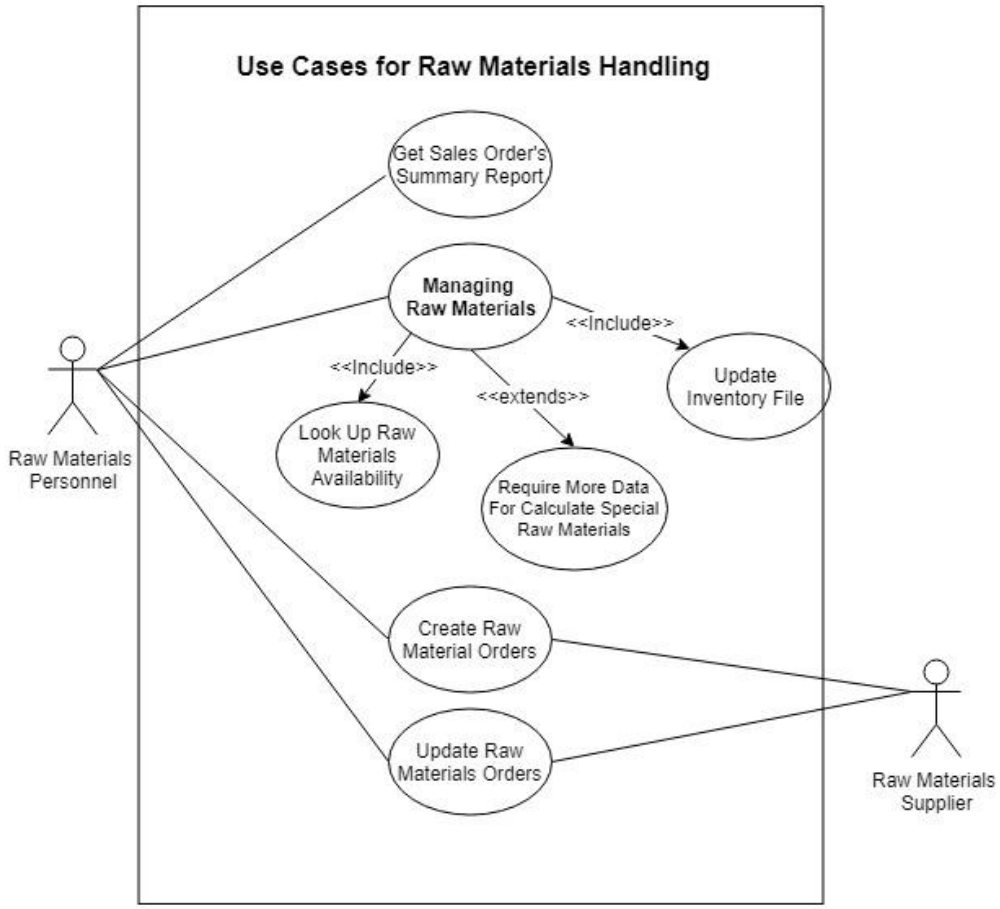
Use Case Name:	**Picking Order**	
Scenario:	Picking order items from warehouse with generated picking form.	
Triggering Event:	Finalized shipping order is sent to Finished Goods Inventory (FGI) Department.	
Brief Description:	Once a shipping order is finalized the final shipping order form is sent to the Finished Goods Inventory (FGI) Department for a picking list to be generated when a "Picker" employee is available. The "Picker" employee is then in charge of assembling all the items on the picking form in the warehouse. The responsibility of the final picked order is then given over to the shipping employees.	
Actors:	Shipping Employee, Picker, Warehouse Foreman	
Related Use Cases:	Includes: Checking Total Quantity on Hand Includes: Get Bin Location Includes: Update Inventory File Includes: Sort Picking Items by Bin Location Includes: Print the Picking form Excludes: Error Fixing in Inventory File Excludes: Create Inventory Backorder	
Stakeholders:	Shipping Department: to provide finalized shipping form which will be used to create a list of items which need to be on picking form. Also takes responsibility for finished picked order at the end of the use case. Finished Goods Inventory (FGI) Department: Responsible for generating/printing out the Picking form.	
Preconditions:	Shipping Order must exist for Picking form to be made. Picker must be present to pick the items in the warehouse. Picker or Warehouse foreman must be present to print the Picking form.	
Postconditions:	Picking Form will be generated from finalized Shipping Form. Items in Picking Form will be ordered by bin location. Picking Form will be Printed. Total Quantity on Hand will be updated to reflect the items which have been picked and removed from the warehouse. Finalized and fully picked order will be handed off to shipping department.	
Flow of Events:	Actor	System
	1. Employee from Shipping Department finalizes the Shipping form and sends it to the FGI Department through the system. 2. Warehouse Foreman verifies the information on the Shipping form. 3. Warehouse Foreman initiates the creation of a new Picking form.	1.1 Deliver final Shipping Form 3.1 Create new Picking form 3.2 Retrieve and add all information on the items in the Shipping form to

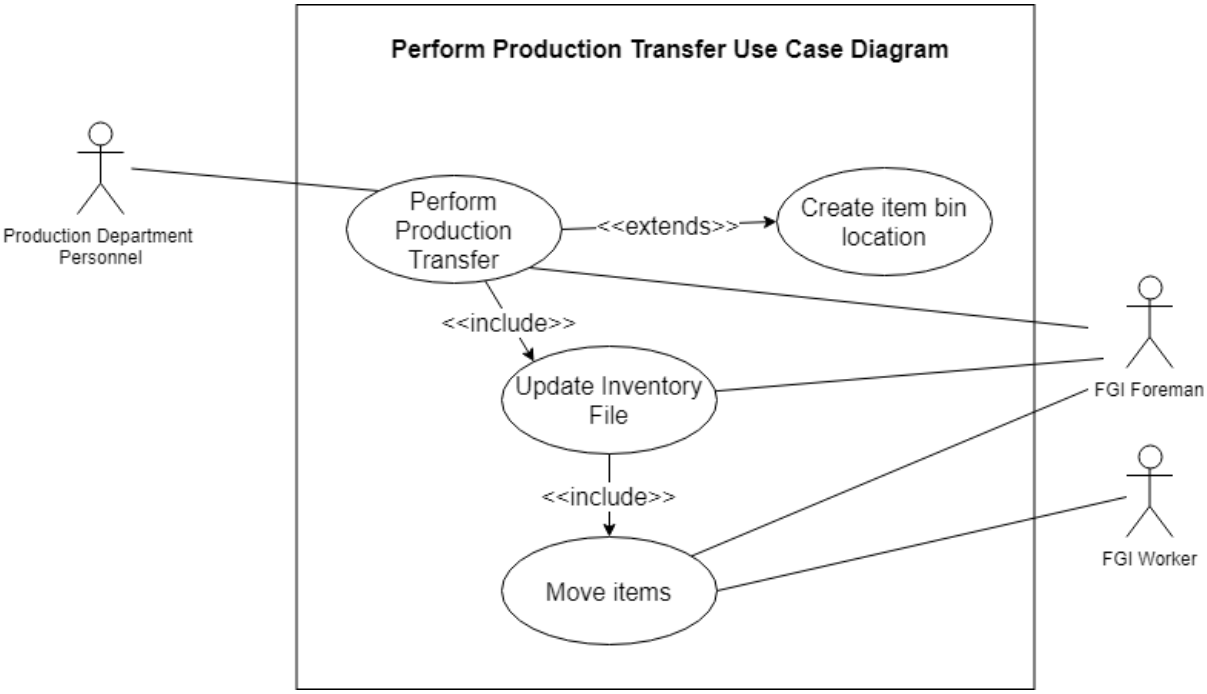
		the Picking form (Qty on hand, Bin location etc.) 3.3 Sort Items on form by Bin location in warehouse
	4. Warehouse Foreman verifies the newly generated Picking form and places item on backorder if there isn't enough inventory	4.1 Display Picking Form and all information (Qty on hand, bin location) on screen
	5. The generated Picking form is then printed when there is a "Picker" employee present to pick the order.	5.1 Print Picking Form
	6. Picker employee then selects the items closest to the top of the list and picks it for the order.	
	7. When the item is picked for the shipment, the Picker marks it as complete.	
	8. Picker repeats step 6 for every item on the list until the order is completely picked.	
	9. Once all the items on the Picking form are picked, the Picker signs the form and leaves a copy of it with the Pallet for the Shipping department to take over.	
	10. Finally, the Warehouse Foreman then uses the original copy of the Picking form to update the total quantities on hand.	10.1 Update total quantity on hand
Exception Conditions:	4.1 If an Item is not in stock, the Warehouse Foreman places the item on backorder in the Inventory file. 8.1 If one of the items on the Picking form is not where it is supposed to be, the Picker marks this on the form so the Warehouse Foreman can update the Inventory file (Bin location) at a later time. 8.2 If the Picking form says there should be an item present, but none is found (or the full amount isn't found), the Picker also indicates this on the form. The partial inventory is picked to be shipped. The Warehouse Foreman then marks the Item as backordered in the Inventory file. 10.1 If total quantity on hand reaches zero, inventory file is marked appropriately to show more are needed.	

Use Case Name:	**Inventory Corrections Management**	
Scenario:	Correcting inventory files to match total quantity on-hand	
Triggering Event:	Customer indicates that an error has occurred with the goods they had ordered	
Brief Description:	Once the FGI Department receives notice that an error has occurred with a shipment. The FGI Department verifies the customer information and compares the customer's order to the shipment information for that order ID. The FGI Foreman tasks a "picker" to check the total quantity on hand of the goods where discrepancies were claimed. The FGI Foreman updates the Inventory files to match the warehouse inventory. A new shipment is created to match the goods they had ordered.	
Actors:	Customer, FGI Foreman, Picker	
Related Use Cases:	Includes: Customer Authentication Includes: Check Order Authenticity Includes: Process Exchange Includes: Process Return Includes: Process Replace Extends: Confirm Product & Inventory Extends: Ship Exchange/Replace Order Extends: Return Refund Amount	
Stakeholders:	General Office: To receive complaint that an error has occurred with a customer's order. FGI Department: Verification of customer order and comparing shipment information with order ID and product number. FGI Foreman: Notifies a Warehouse Foreman to check product location, and quantity on hand. Also takes responsibility for creating a new shipment order Shipping Department: To deliver proper goods to the customer	
Preconditions:	Customer must exist. FGI Department be present to verify order information. Product number of shipped items must differ from the details on the order ID.	
Postconditions:	Total Quantity on Hand is updated to reflect the items in stock in the Inventory File. New shipment order is created. Sales Order data is updated on database as result of information received from a "picker". New Shipment Order with customer's expected goods is fully picked and handed to the shipping department.	
Flow of Events:	Actor	System
	1. General Office receives notice that an error has occurred with a customer's order 2. FGI verifies customer order was sent incorrect product	

	3. Customers Incorrect Order is received 4. FGI Foreman contacts “picker” 5. Picker checks inventory at specified bins 6. Picker returns inventory report to FGI foreman 5. FGI Foreman updates Inventory File 6. FGI Foreman creates new Shipping Order	5.1 Update Total Quantity on Hand
Exception Conditions:	2. Customer Order shows that the customer was indeed sent the correct Product based on the Order ID and Product number 6. If an item is not in stock, the Warehouse Foreman places the item on backorder in the Inventory File 6. If an item is not where it is supposed to be, the “picker” can contact the Warehouse Foreman and update the Inventory File (Bin Location)	

Use Case Diagrams




Perform Production Transfer Use Case Diagram
Production Department Personnel
Perform Production Transfer
<<extends>>
Create item bin location
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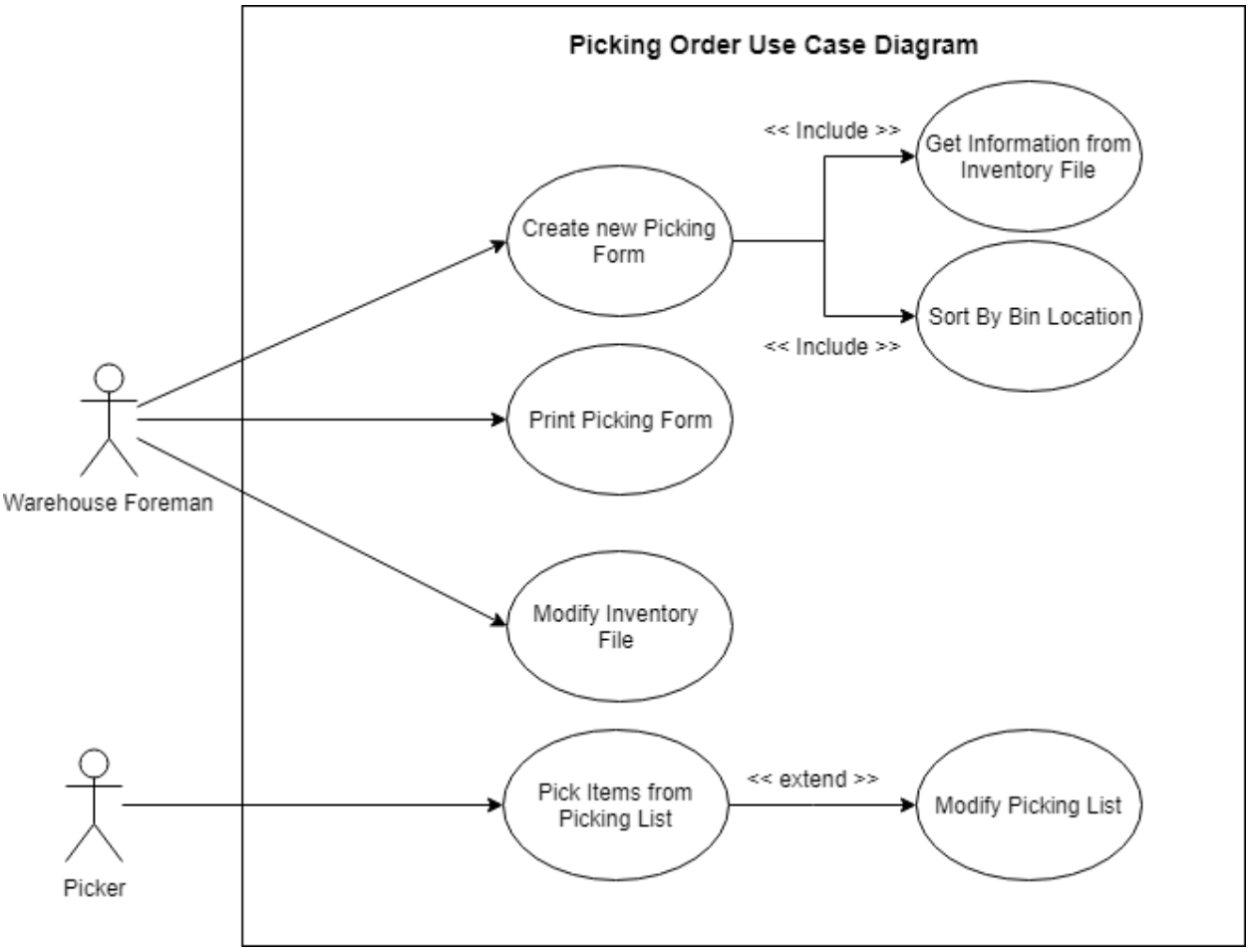
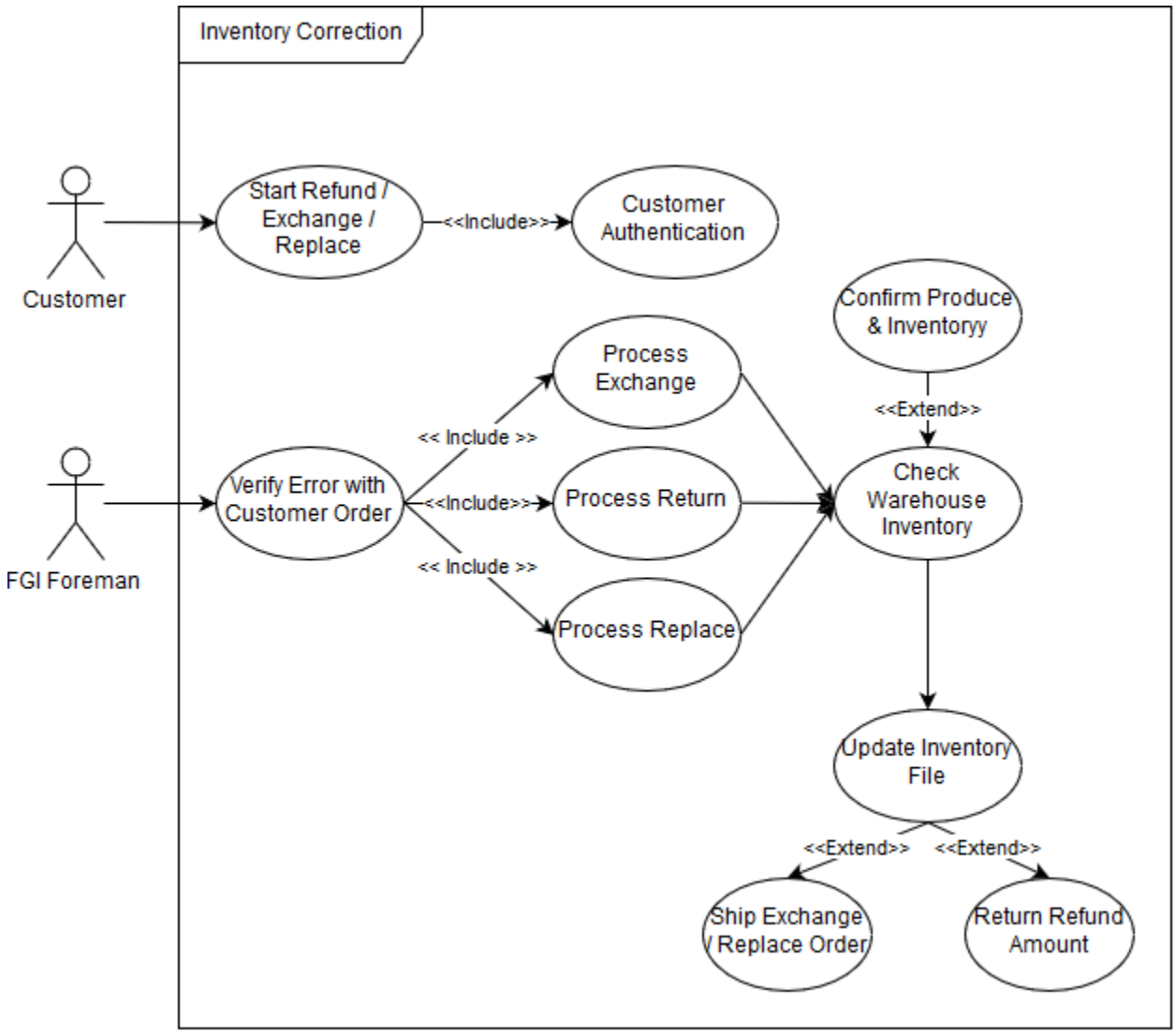
Update Inventory File
<<include>>
Move items
FGI Foreman
FGI Worker


Picking Order Use Case Diagram
<< Include >>
Get Information from Inventory File
Create new Picking Form
Sort By Bin Location
<< Include >>
Print Picking Form
Warehouse Foreman
Modify Inventory File
Pick Items from Picking List
<< extend >>
Modify Picking List
Picker


Inventory Correction
Customer
Start Refund / Exchange / Replace
<<Include>>
Customer Authentication
FGI Foreman
Verify Error with Customer Order
<< Include >>
<<Include>>
<< Include >>
Process Exchange
Process Return
Process Replace
Confirm Produce & Inventoryy
<<Extend>>
Check Warehouse Inventory
Update Inventory File
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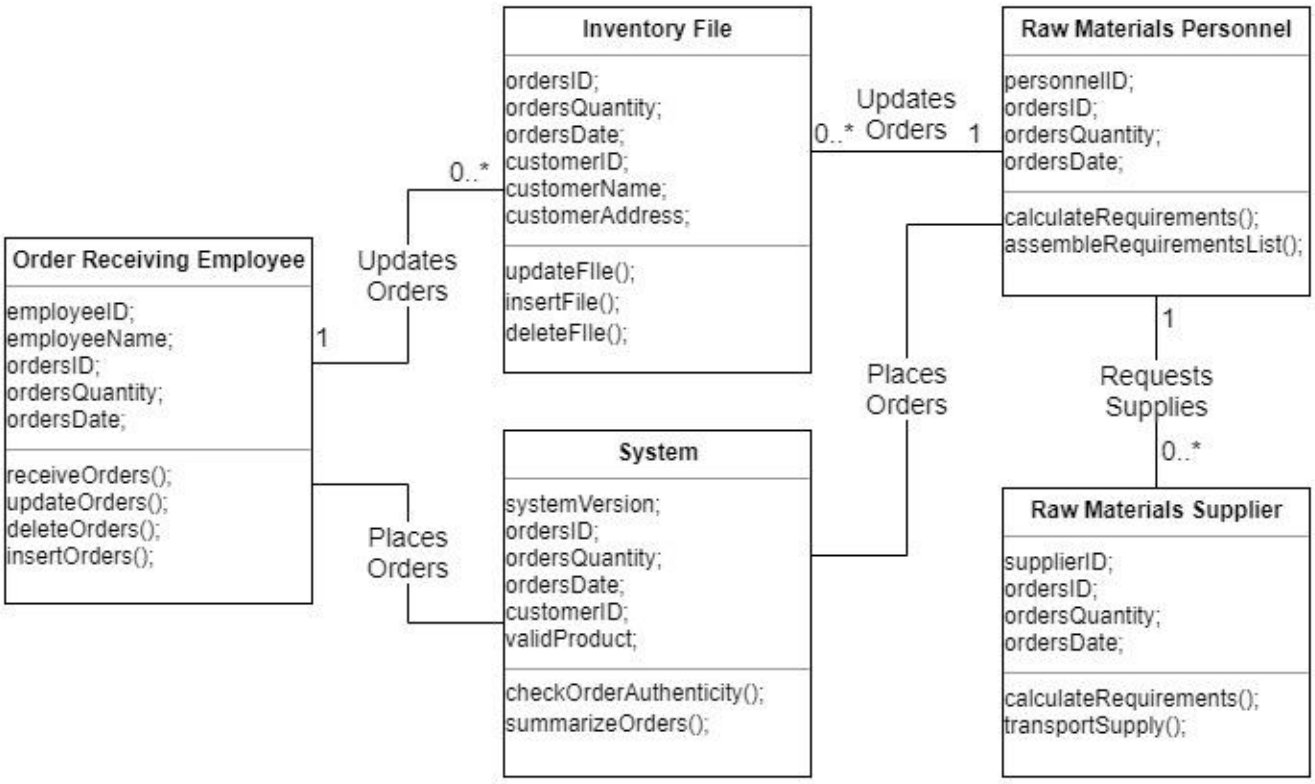
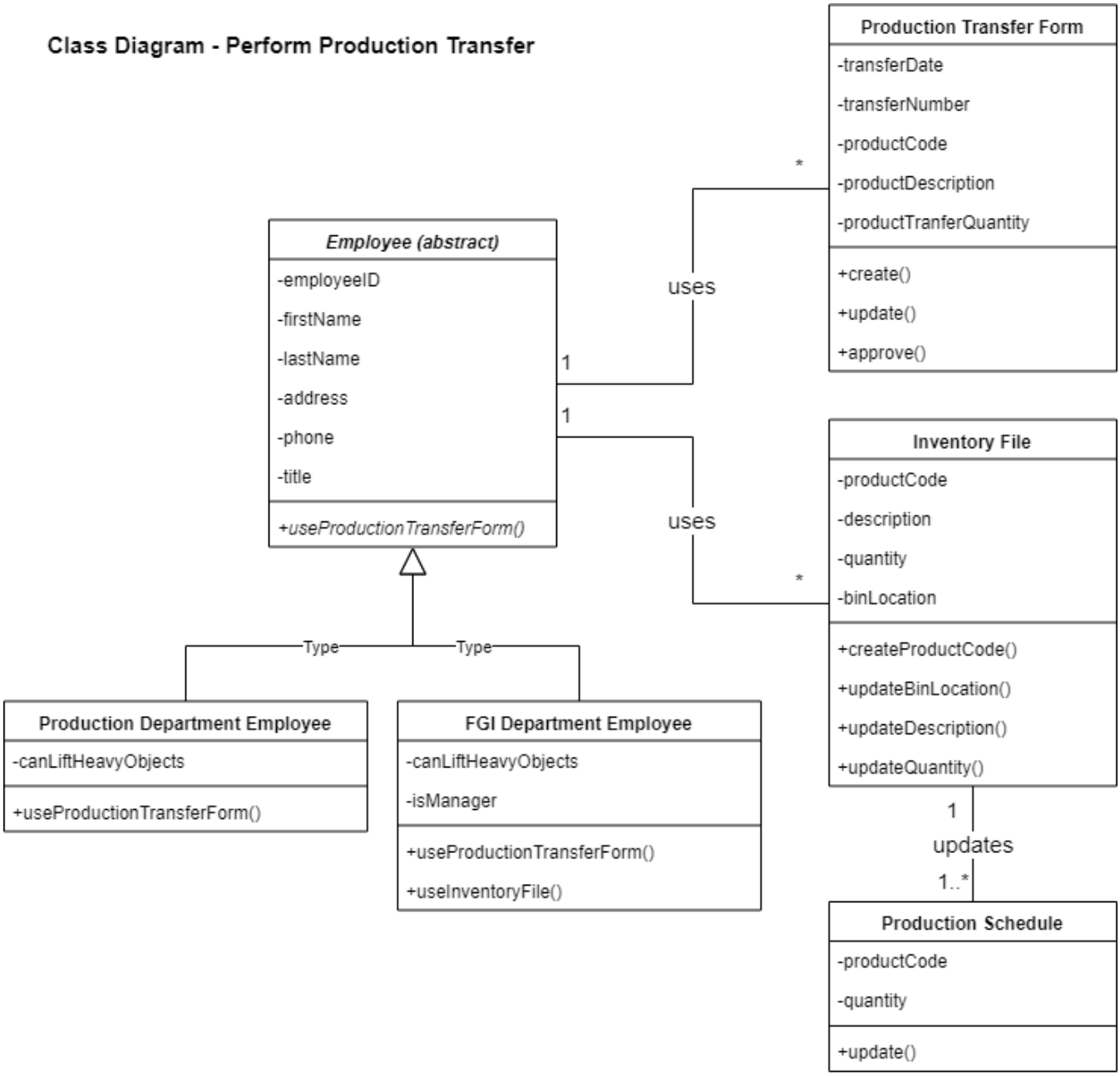
Ship Exchange / Replace Order
Return Refund Amount

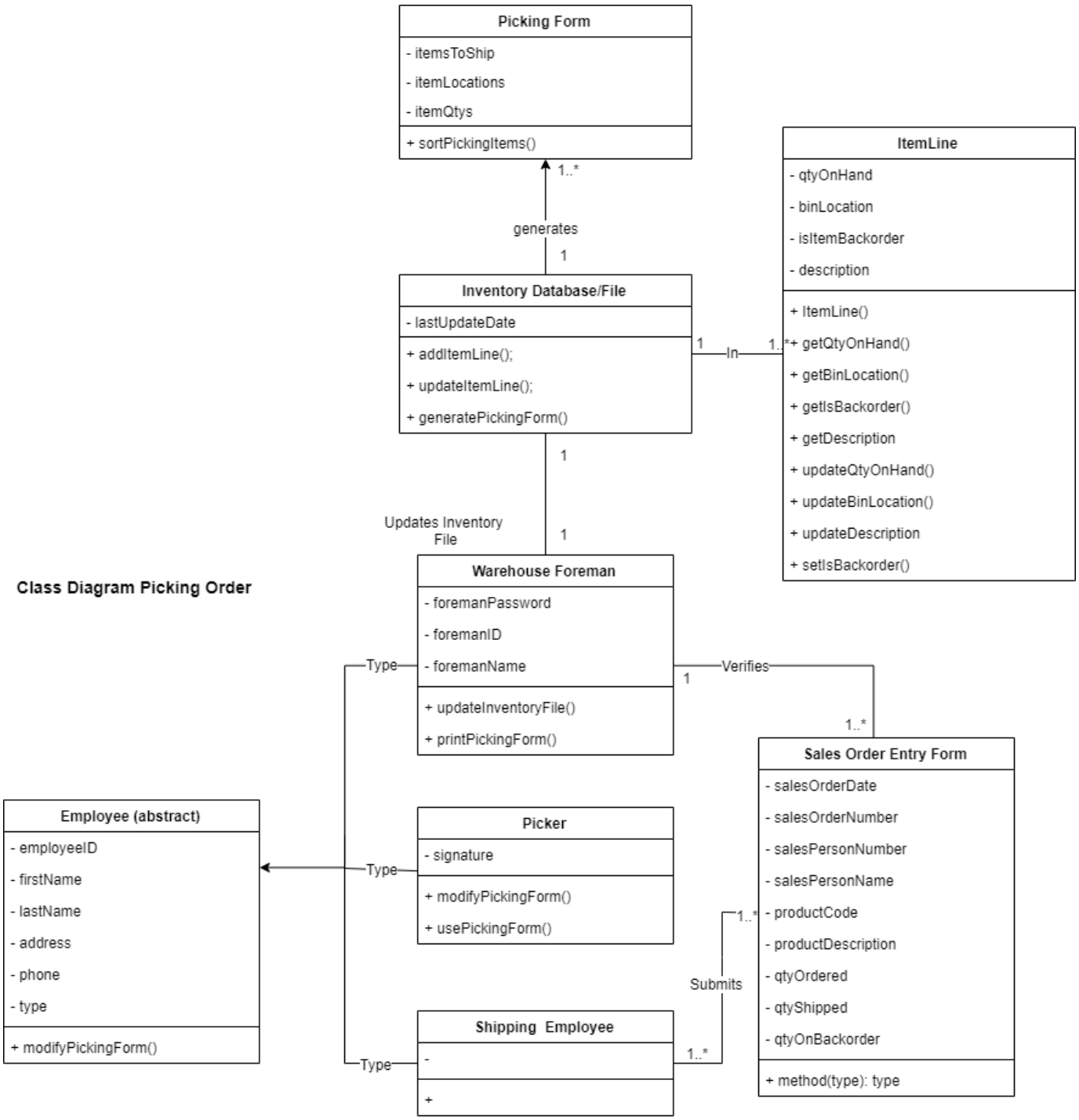
Class Diagrams

Class Diagram for Managing Raw Materials

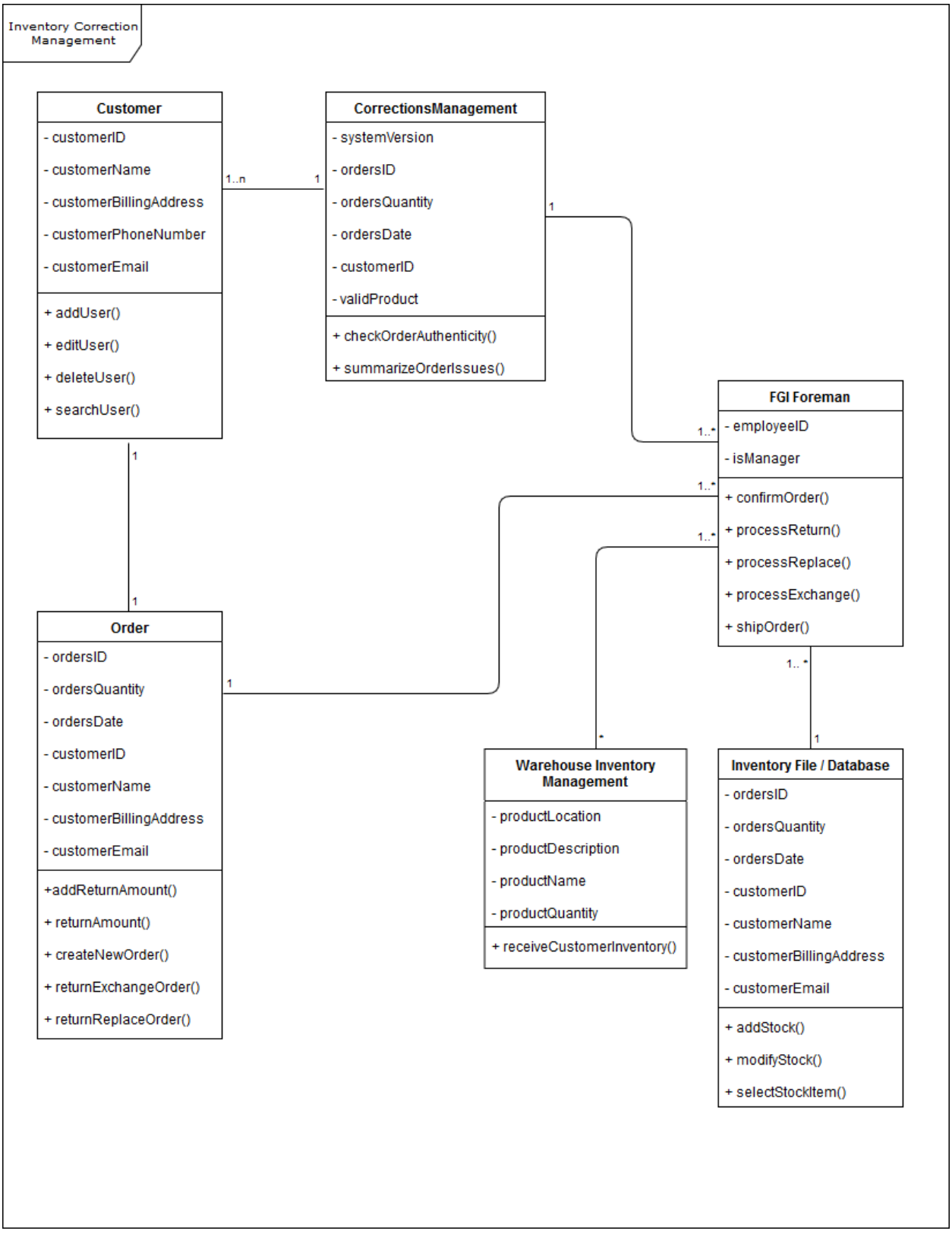


Class Diagram - Perform Production Transfer





Class Diagram Picking Order


Inventory Correction Management
Customer
- customerID
- customerName
- customerBillingAddress
- customerPhoneNumber
- customerEmail
+ addUser()
+ editUser()
+ deleteUser()
+ searchUser()
CorrectionsManagement
- systemVersion
- ordersID
- ordersQuantity
- ordersDate
- customerID
- validProduct
+ checkOrderAuthenticity()
+ summarizeOrderIssues()
FGI Foreman
- employeeID
- isManager
+ confirmOrder()
+ processReturn()
+ processReplace()
+ processExchange()
+ shipOrder()
Order
- ordersID
- ordersQuantity
- ordersDate
- customerID
- customerName
- customerBillingAddress
- customerEmail
+addReturnAmount()
+ returnAmount()
+ createNewOrder()
+ returnExchangeOrder()
+ returnReplaceOrder()
Warehouse Inventory Management
- productLocation
- productDescription
- productName
- productQuantity
+ receiveCustomerInventory()
Inventory File / Database
- ordersID
- ordersQuantity
- ordersDate
- customerID
- customerName
- customerBillingAddress
- customerEmail
+ addStock()
+ modifyStock()
+ selectStockItem()
1..n
1
1
1..*
1..*
1..*
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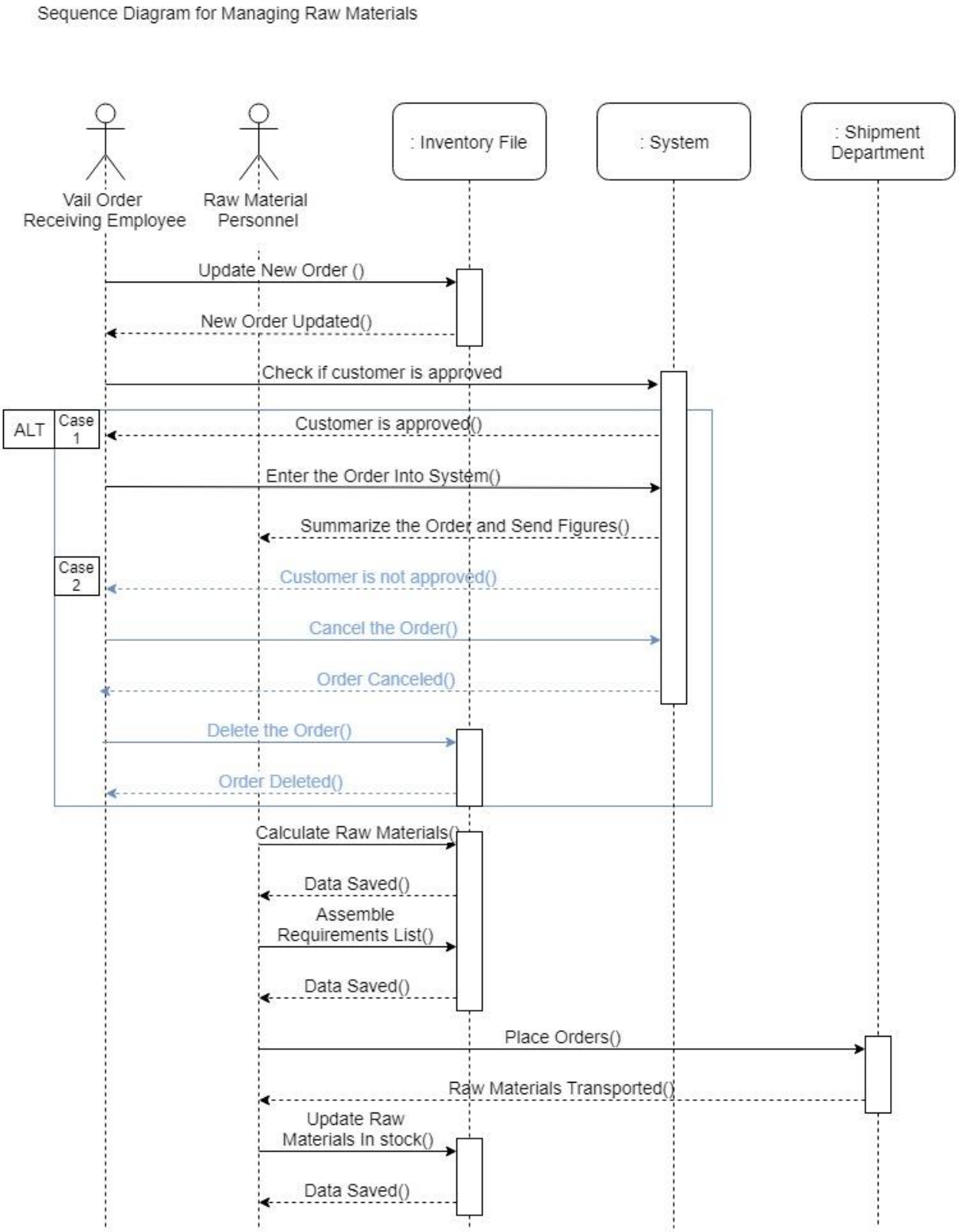
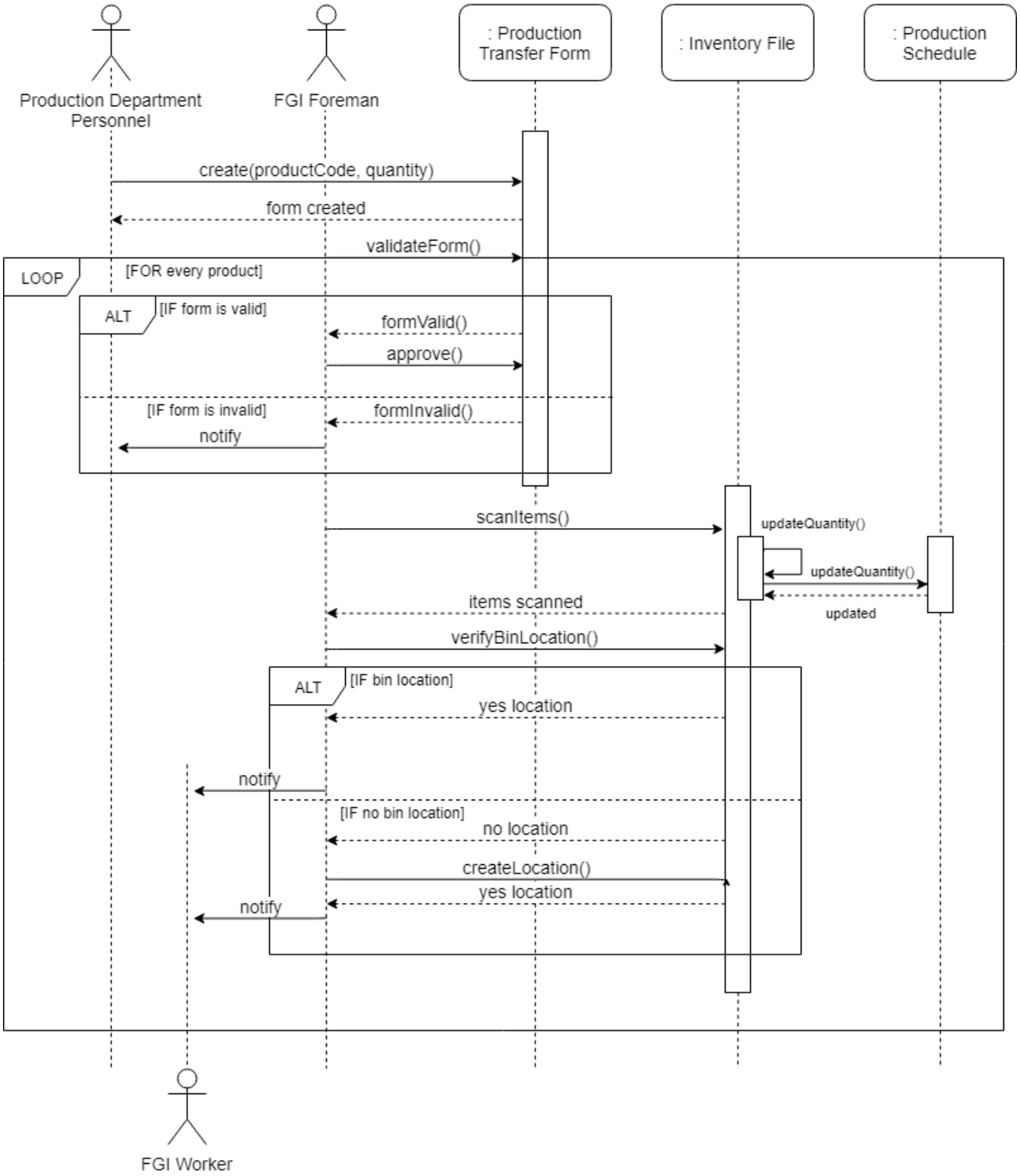
1
1
*
1..*
1

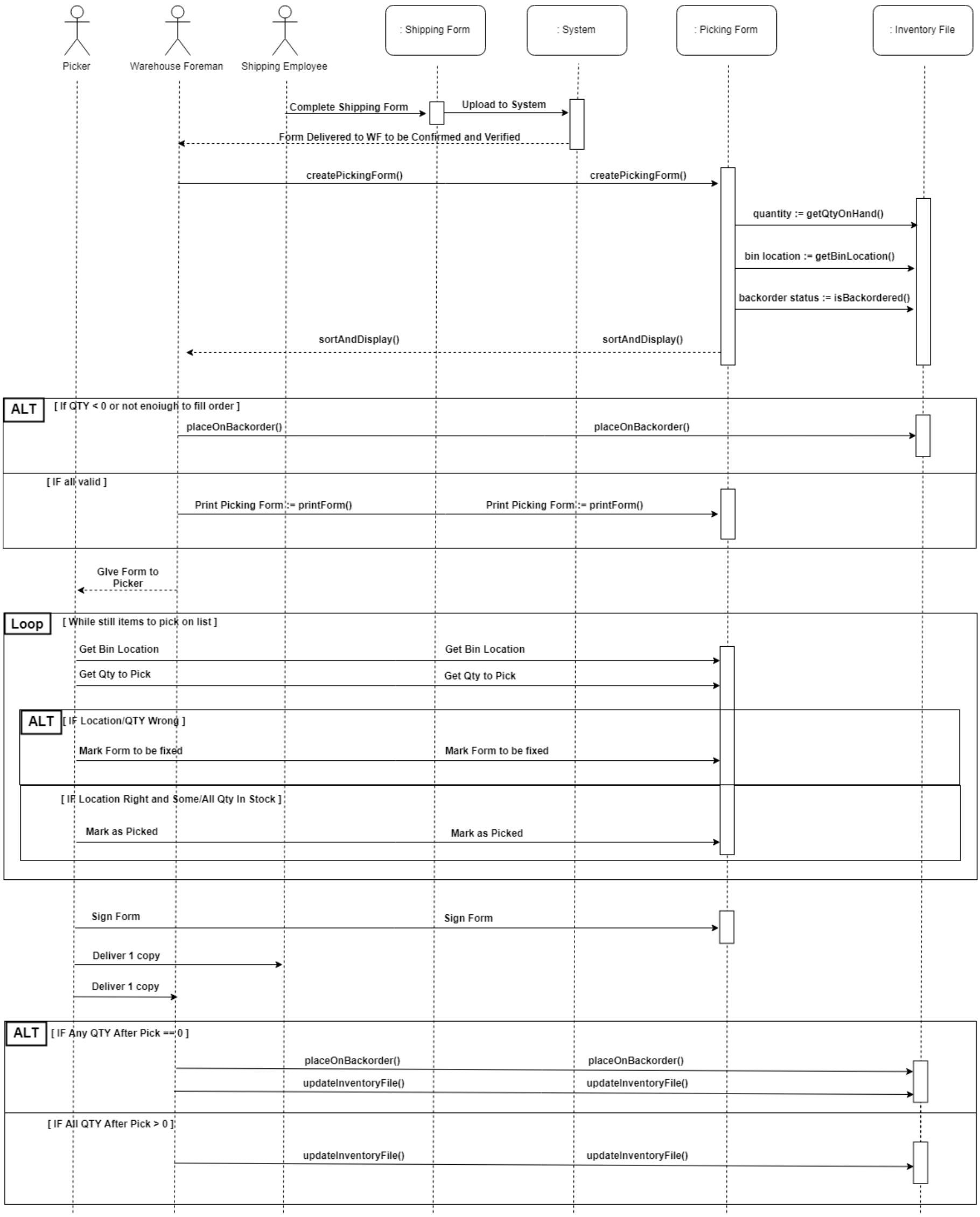
Sequence Diagrams



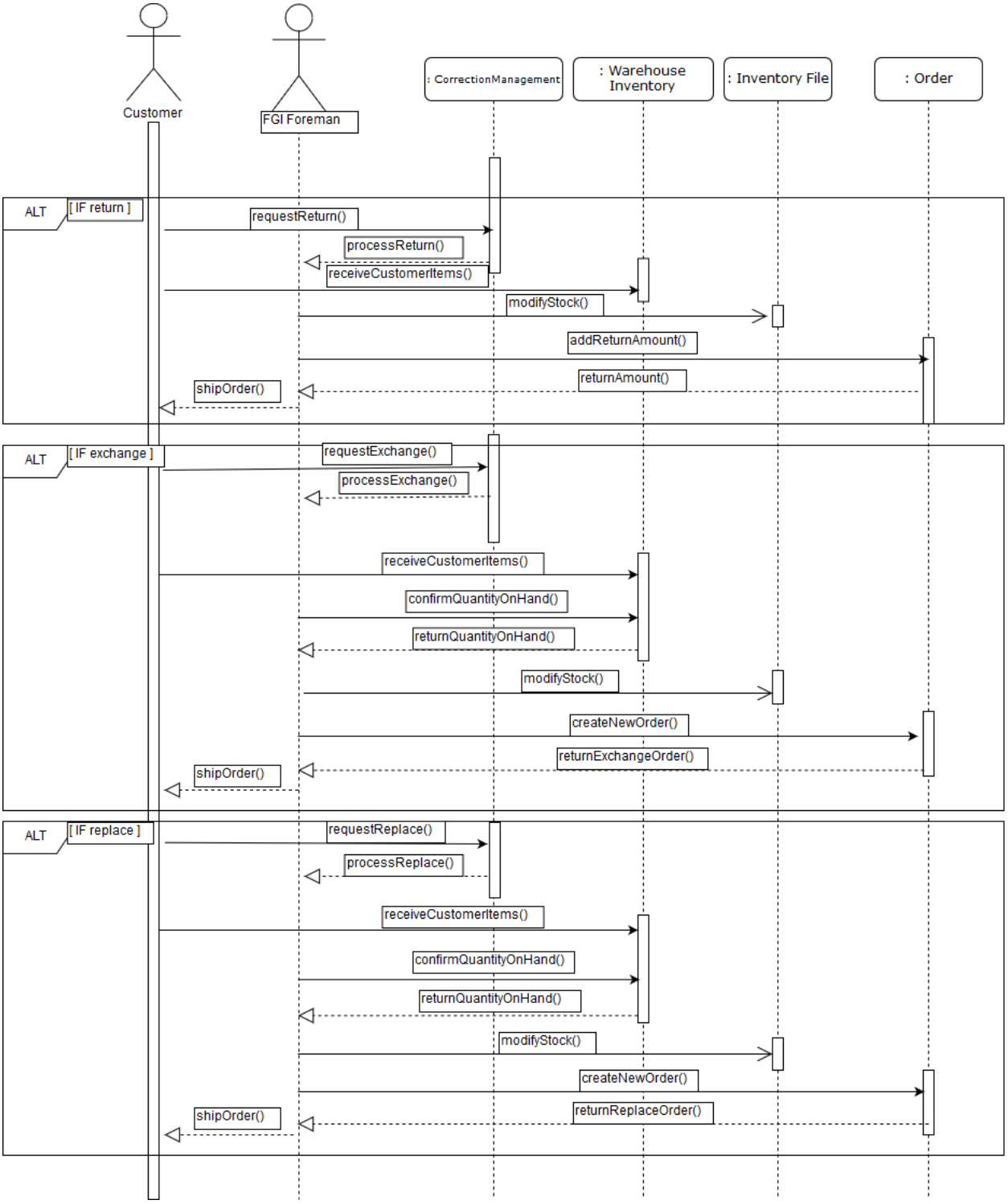
Sequence Diagram for Perform Production Transfer



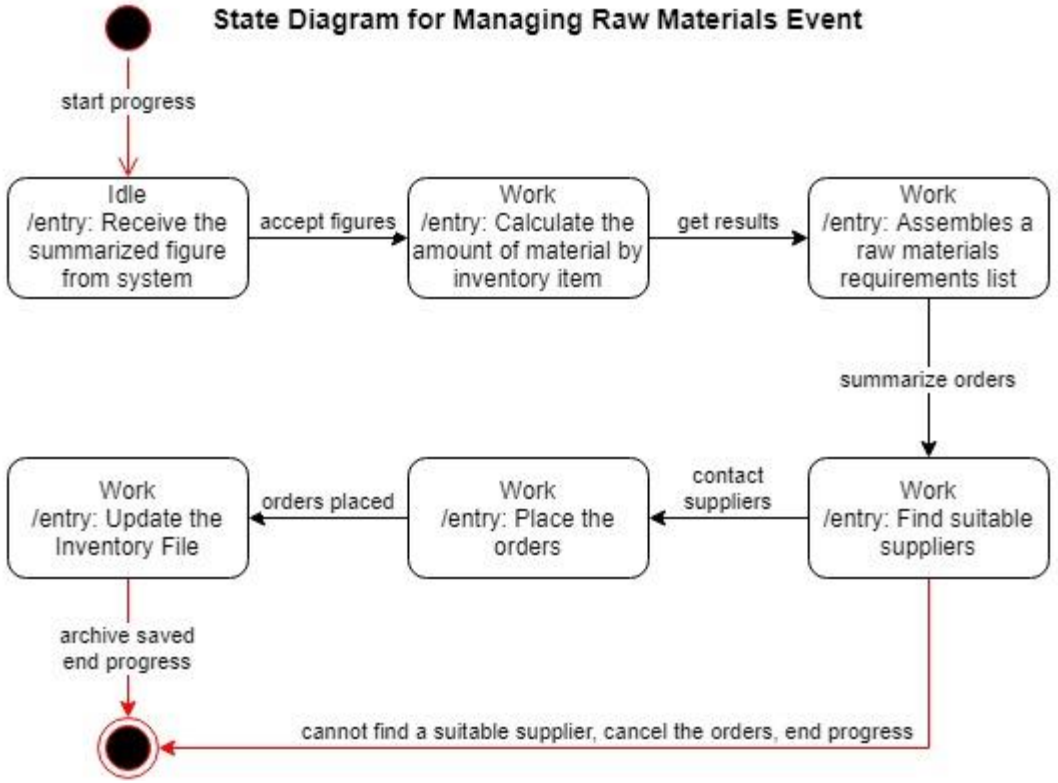
Sequence Diagram for Picking Orders

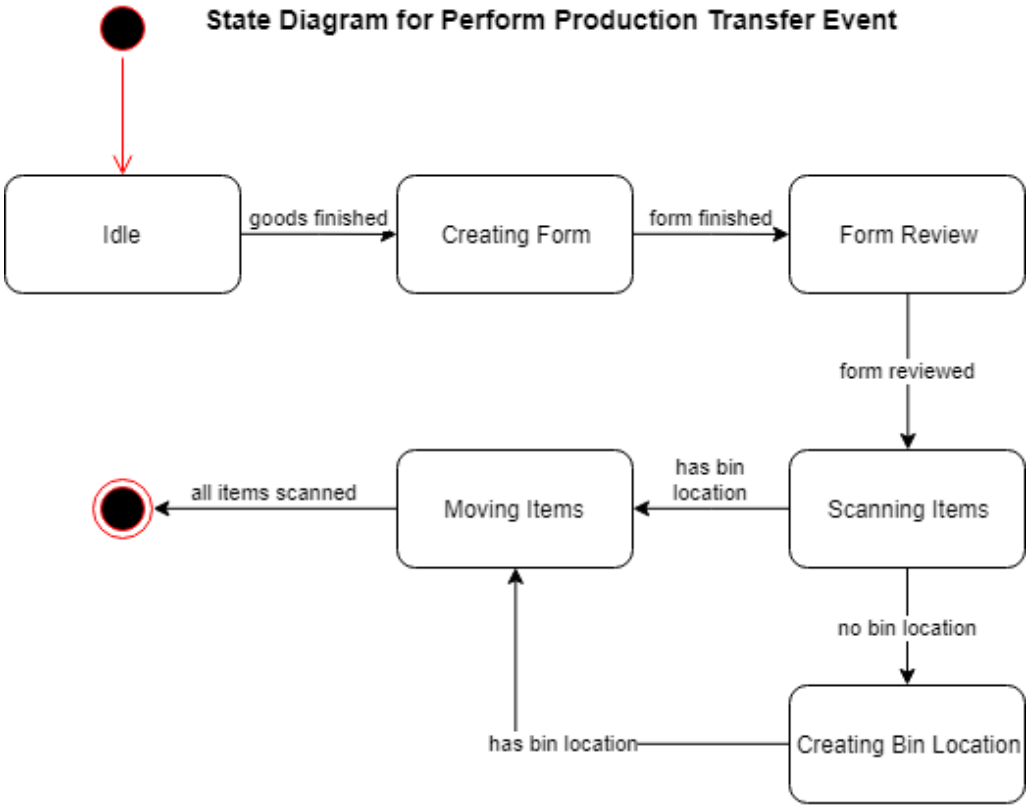


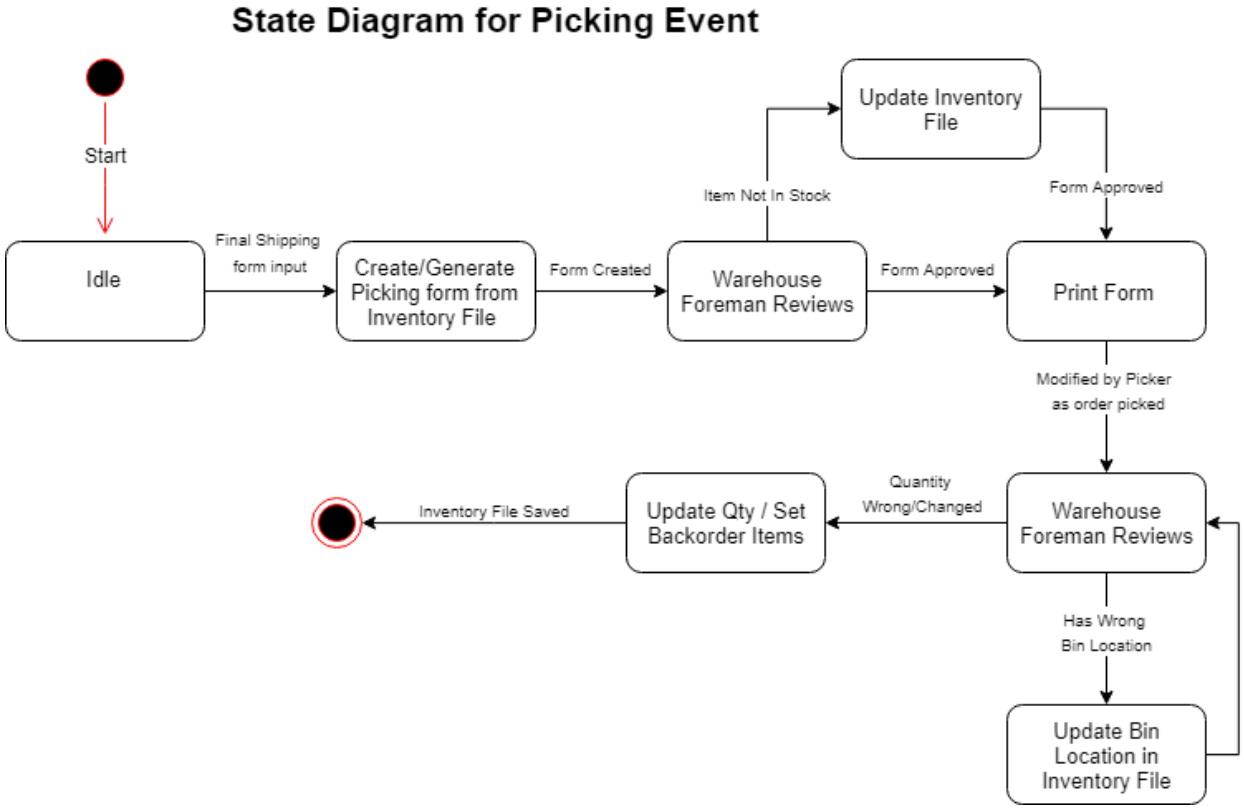
Sequence Diagram for Error Correction

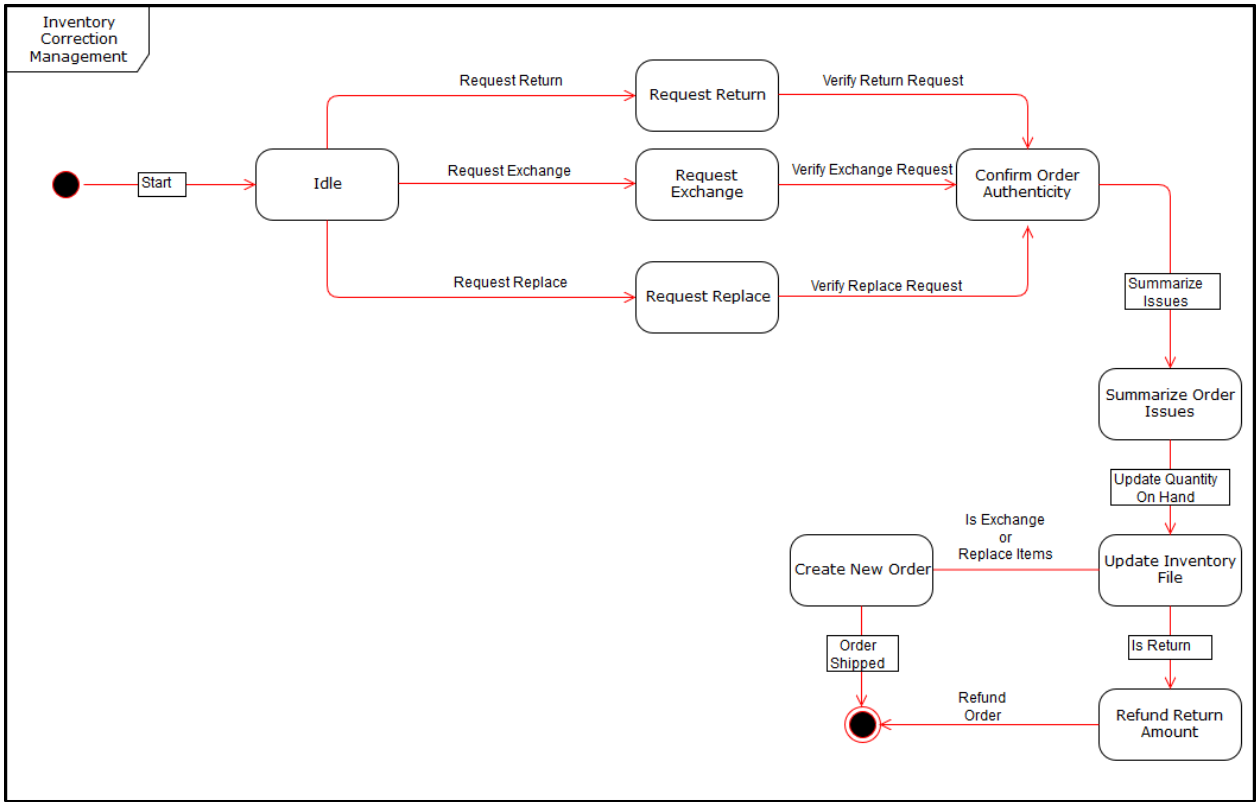


State Diagrams




State Diagram for Perform Production Transfer Event
Idle
goods finished
Creating Form
form finished
Form Review
form reviewed
Scanning Items
has bin location
Moving Items
all items scanned
no bin location
Creating Bin Location
has bin location


State Diagram for Picking Event
Start
Idle
Final Shipping form input
Create/Generate Picking form from Inventory File
Form Created
Warehouse Foreman Reviews
Item Not In Stock
Update Inventory File
Form Approved
Form Approved
Print Form
Modified by Picker as order picked
Warehouse Foreman Reviews
Quantity Wrong/Changed
Update Qty / Set Backorder Items
Inventory File Saved
Has Wrong Bin Location
Update Bin Location in Inventory File


Inventory Correction Management
Start
Idle
Request Return
Request Exchange
Request Replace
Request Return
Request Exchange
Request Replace
Verify Return Request
Verify Exchange Request
Verify Replace Request
Confirm Order Authenticity
Summarize Issues
Summarize Order Issues
Update Quantity On Hand
Update Inventory File
Is Exchange or Replace Items
Create New Order
Order Shipped
Is Return
Refund Order
Refund Return Amount

Conclusion

This concludes the team's proposal for the redesign of the inventory management subsystem. These changes should allow Vail Skiwear to adequately receive raw materials, schedule production, pick items for orders, and correct any issues as they arise. The main issue that was corrected from the previous system was the abundance of physical paperwork, most of which was in turn delivered by an employee in person. By transferring some of this paperwork to the system, the entire inventory system becomes more efficient since there are less man hours wasted hand delivering hardcopies of the paperwork. Ultimately, this and all the other changes that were made to the system culminate in the most economical and productivity-oriented inventory system that could be designed given the requirements stated by Vail Skiwear.

References

https://www.tutorialspoint.com/uml/uml_class_diagram.htm

http://www.agilemodeling.com/artifacts/sequenceDiagram.htm

https://www.lucidchart.com/pages/uml-class-diagram

https://www.lucidchart.com/pages/uml-state-machine-diagram

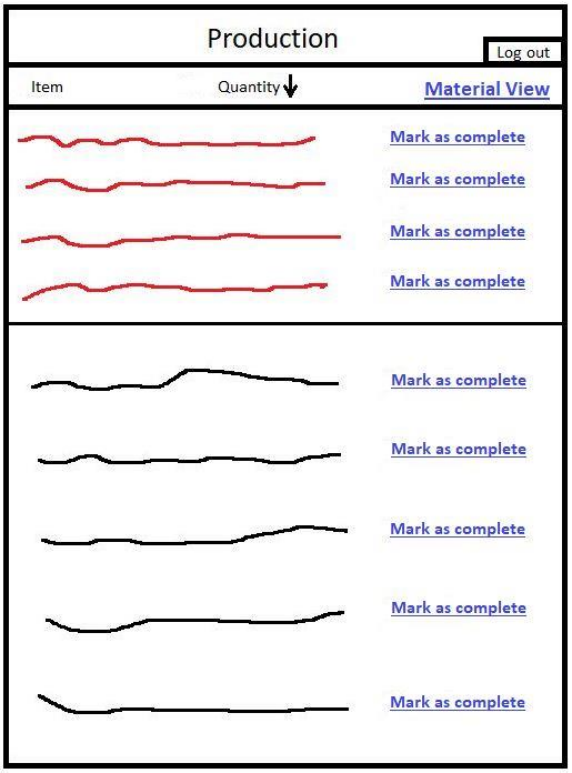
https://www.geeksforgeeks.org/unified-modeling-language-uml-state-diagrams/

https://www.tutorialspoint.com/uml/uml_statechart_diagram.htm

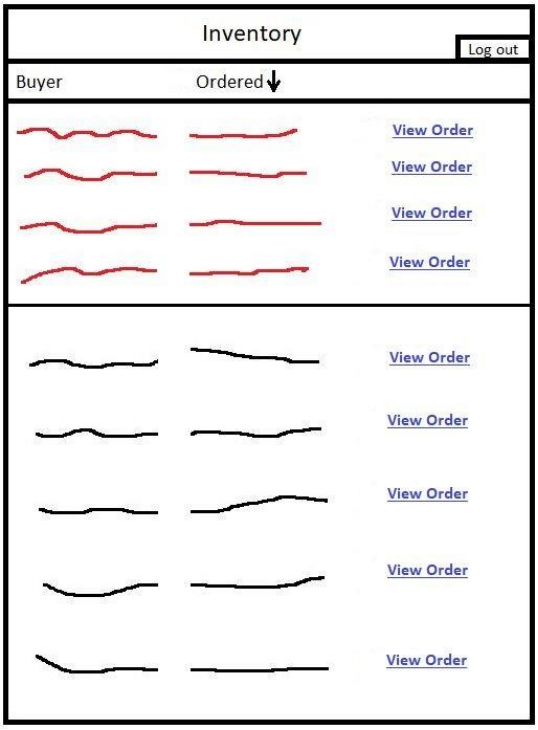
https://www.uml-diagrams.org/state-machine-diagrams.html

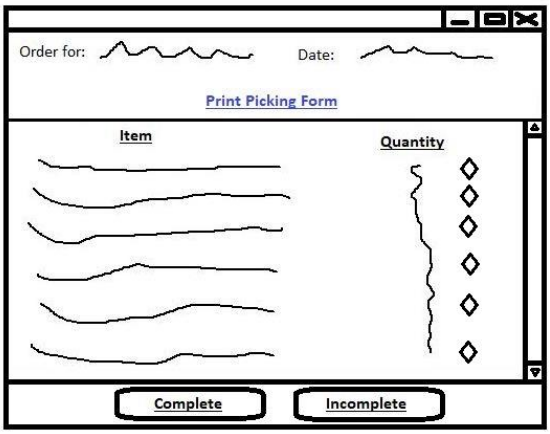
https://www.uml-diagrams.org/bank-atm-uml-state-machine-diagram-example.html?context=stm-examples

Appendix

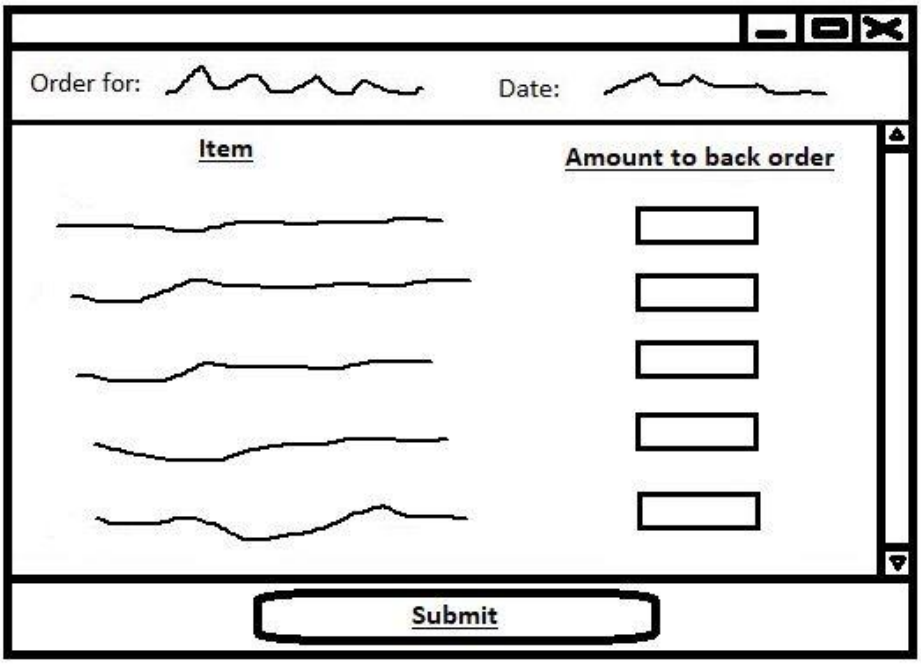


Production Screen





Inventory File Screen / Picking Order Form



Backorder Screen