MRO Facility MTrak System

Phase I – User Requirement for Software Application
IEM 5723 - DATA, PROCESS, AND OBJECT MODELING

Heartful thanks to Dr. Kamath for assisting us

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Date: 4/22/2020

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BACKGROUND

Maintenance, Repair and Overhaul (MRO) is a facility that work on reparing parts for the customer end item. The end items are obtained from the customer before it is stripped to individual parts to locate the defective or malfunctioning part/s. MRO facility then sends this individual part/s to different repair shops which are located across the United States for different types of repair. After the repair, repair shops ship the parts to the MRO facility before being reassembled to end item and shipped back to the customer. The overall process can be divided into following departments which handle their own work

- Receiving end item from customer in MRO facility.
- Disassembly of the end item to individual parts.
- Inspection of individual parts and shipping defected part/s to repair shop.
- Repair shops receiving parts, repairing it and shipping it back to MRO facility.
- Receiving repaired parts from repair shops.
- Assembly of all individual parts to form end item and shipping back to customer.
- Storage of important individual parts and end items.

PROBLEM STATEMENT

MRO facility wants to be able to track every part within the MRO system, which includes all the sections of MRO facility, the repair shops and transit processes.

OBJECTIVE

To solve the above problem statement, MRO wants to design and develop a tracking and repair progress reporting system called MTrak which will be able to effectively facilitate operations such as instant material tracking and reporting progress on repair tasks. The MTrak product should be a web-based application with a back-end database hosted by MS SQL Server. This overall objective will be fulfilled in two different stages. For the first part, detailed user requirements statement will be collected, and the second part will be the web-based application itself.

SCOPE

Like different projects, this project also has boundaries. This project only captures the operations under MRO facility and repair shop. The scope of the web-based application involves the process from the time of receiving end item from the customer in receiving section till the time the end item is shipped back to customer after the defected parts are repaired and assembled. The various process which the MTrak system captures is as mentioned in the background section. Some of the assumptions for this project are listed below:

- Customer will provide the end item with barcode system.
- Shipping carriers are always available to the MRO facility.
- This project covers the user requirements in broader sense and not too granular.
- MRO facility have necessary resources and staff members for different stage.

SUMMARY OF ACTIVITIES

To develop the MTrak system, in this phase, we wanted to capture the user requirement details and description of important system concepts. Regarding the first requirement, we developed use cases department wise. This will help us to capture an understanding of what each section of MRO facility expects from the MTrak system. The brief description of user narrative can be found in Table 1 followed by its detailed description. In the second part, we constructed a use case diagram which show the interaction between actors and MTrak system. And in the last part, we have transformed this user requirements to form a domain model using UML class diagram.

TABLE 1: BRIEF DESCRIPTION OF USE CASES FOR MTRAK SYSTEM OF MRO FACILITY

Use Case No.	Process	Use case name
1.	Receiving from customer	Receiving items from customer
2.	Disassembly	Disassembling the customer items
3.	Inspection	Inspection of the individual parts
4.	Storage and Retrieval	Storing different items and parts
5.	Receiving from repair shop	Receiving parts from repair shop
6.	Assembly	Assembling of the parts to form item for customer
7.	Repair Shop	Receiving defected parts from inspection of MRO facility, repairing it and shipping the repaired part/s back to MRO facility

Use Case 1: Receiving items from customer

Attributes	Description
Use Case Name	Receiving items from customer
Description	MRO facility has a receiving stage. This stage receives the customer items that are defected and needs to be repaired. This use case describes the process of receiving items and updating it in MTrak system before sending it to disassembly section.
Scope	MTrak system
Level	User-goal
Primary Actor	Warehouse receiver/operator
Stakeholders and Interests	**Warehouse receiver:** Wants accurate, fast entry and reliable procedure to record the data. **Customer:** Wants item details and other information recorded swiftly alongside the receipt. **MRO facility:** As a company wants to accurately record the customer details and provide customer satisfaction **IT Team** – Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Pre-conditions	There is a unique identifier (RFID barcode) for each item provided to us which corresponds to the customer and item details. Warehouse receiver is authorized to use the MTrak system.
Post condition	The item from customer is recorded in the MTrak system and with all details and passed to Disassembly section.
Main success scenario	1.Warehouse receiver logs into the MTrak system 2. Receiver scans the barcode for the customer item and records important customer and item details. 3.System displays the unique barcode number and timestamp. 4.MTrak system generates the receipt after the details is entered.

	5.Receiver provides the receipt to the customer 6.Receiver sends the item to disassembly section.
Alternate Scenario	**2a. Barcode is not being recognized in the system** - Receiver will manually input data fields such as customer details and item details. - New barcode will be assigned corresponding to manual entry - Return to Step 3 in main success scenario.

Use Case 2: Disassembly of the customer item

Attributes	**Description**
Use Case Name	Disassembling the customer item
Description	MRO facility has a disassembly stage. This stage receives the customer item from either receiving stage or storage and disassembles the whole item into individual parts.
Scope	MTrak system
Level	User-goal
Primary Actor	Disassembly staff
Stakeholders and Interests	**Disassembly staff:** Wants accurate, fast entry and reliable procedure to record the data. Access all the resources for disassembling **Customer:** Wants item details and other information recorded swiftly alongside the receipt. **MRO facility:** As a company wants to precise disassembly and provide customer satisfaction **IT Team** – Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Pre-conditions	Customer end item is received either from receiving stage or storage. Disassembly staff is authorized to use the MTrak system. Enough Disassembly staff are available
(Post condition)	Customer end item is disassembled and sent to the inspection section with all details updated in the MTrak system.
Main success Scenario	1)Disassembly staff receive end items that needs to be disassembled 2)Disassembly staff logs into the MTrak system and scans the end item to check the customer and item details. 3)System reflects the updated activity as 'In Process' for disassembly. 4)Disassembly staffs disassemble end item to individual parts. 5)Disassembly staff assigns individual parts with identifier (barcode). 6)Disassembly staff scans the barcode and enter other required details into the Mtrak system 7)System reflects the updated activity as 'Done' for disassembly with timestamp. 8)The stripped parts are sent to the inspection section
Alternate Scenario	**6a. Barcode is not being recognized in the system**

	- Disassembly staff will manually input data fields such as part id and item details for respective parts. - New barcode will be assigned corresponding to manual entry - Return to Step 7 in main success scenario. **8.a Inspection section is not free** - Disassembly staff will send the part/s to storage if inspection section in not available.

Use Case 3: Inspection of the individual parts

Attributes	**Description**
Use Case Name	Inspection of the individual parts
Description	In the inspection section, the disassembled individual parts will be inspected and updated in the MTrak system.
Scope	MTrak system
Level	User-goal
Primary Actor	Chief inspection operator
Stakeholders and Interests	**Operator** – Wants accurate, fast entry and error free data of individual parts. **Customer**– Wants to have accurate and timely updates on the end-item progress. **Company** – Wants to accurately record transactions and satisfy customer interests. **IT Team** – Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Pre-conditions	Inspecting team receive the stripped parts from the disassembly section or storage. Chief inspecting operator have access to the MTrak system Enough inspection staff members are available
Success Scenario (Post condition)	Individual parts are inspected and sent to repair shop via carriers with all details updated in the MTrak system.
Main success scenario	1. Inspection team receive the individual parts from the disassembly section or storage. 2. Chief inspecting operator logs into the MTrak system and scans the individual parts to check the parts detail. 3. System reflects the updated activity as 'In Process' for inspection 4. Inspecting team inspects individual parts to locate the defected parts and good parts. 5. Chief inspecting operator updates the parts that have been inspected, date and time details of inspection etc.& find suitable repair shop in the MTrak system. 6. system updates the information for individual parts. 7. The defective part/s is then prepared for shipping using carriers and shipping details are updated in the Mtrak system 8. Defective parts are then shipped to the repair shops
Alternate Flow.	**4.a If there is not any defected part/s** - Chief inspecting operator will update the information as no defective part/s in the Mtrak system. - system updates the information

	- Chief inspecting operator will send the parts to assembly section or storage section depending upon availability. **4.b Part/s that are good and not defected** - Chief Inspecting operator will send the good parts to the storage and update in the MTrak system

Use Case 4: Storage and Retrieval of end items and individual parts

Attributes	**Description**
Use Case Name	Storing and retrieving customer end items and individual parts
Description	In the storage section, items are individual parts will be stored if different sections are not available or if there is any bottleneck.
Scope	MTrak system
Level	User-goal
Primary Actor	Storage Manager
Stakeholders and Interests	**Storage staff:** Wants accurate, fast entry and reliable procedure to record the data regarding storage and retrieval of the product. **Customer:** Wants item and part details and other information recorded swiftly and accurately **MRO facility:** As a company wants to precise recording of item and parts located in storage for tracking **IT Team** – Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Pre-conditions	There is enough storage space in the storage section Storage Manager have access to the Mtrak system
Post condition	End items or individual parts are either stored or retrieved in designated location and it is updated in the Mtrak system.
Success Scenario	

	Steps	**Description**
Storage	1.	Storage manager receives either end item or repaired part/s from receiving stage and individual parts from disassembly and inspection stages
	2.	Storage manager logs into the MTrak system and scans the item or part/s received to check the status.
	3.	Storage manager locates the respective area for the item or part/s to be stored.
	4.	Storage manager updates the system with necessary details such as storage location, time and date etc.
Retrieval	5.	Storage manager will receive the end items or part/s retrieval request via Mtrak system from where the items or part/s are required.
	6.	Storage manager locates the demanded items or part/s and sends to the section required.

		7.	Storage manager updates the details into the MTrak system such as new location of the item or part/s etc.
Alternate Scenario	**2a. Barcode is not being recognized in the system** -Storage manager will manually input data fields such as part id or item id for respective parts or items. - New barcode will be assigned corresponding to manual entry - Return to Step 3 in main success scenario.		

Use Case 5: Receiving parts from repair shop

Attributes	**Description**
Use Case Name	Receiving parts from the repair shop
Description	MRO facility has a receiving stage. This stage also receives the repaired parts from the repairing shops. This use case describes the process of receiving repaired parts and updating it in MTrak system before sending it to assembly section.
Scope	MTrak system
Level	User-goal
Primary Actor	Warehouse receiver/operator
Stakeholders and Interests	**Warehouse receiver:** Wants accurate, fast entry and reliable procedure to record the data. **Customer:** Wants part details and other information recorded swiftly alongside the receipt. **MRO facility:** As a company wants to accurately record the repaired part details. **IT Team** – Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Pre-conditions	Repaired part/s have already been shipped from the repair shops Warehouse receiver/operator is authorized to use the MTrak system.
Post condition	The part/s obtained from repair shops is recorded in the MTrak system with all details and passed to Assembly section
Main success scenario	1. Warehouse receiver logs into Mtrek system 2. Warehouse receiver Scans barcode for the received repaired parts 3. System updates the status, records item id and timestamp 4. Warehouse receiver updates the part as repaired. 5. System shows activity status as'done' 6. Receiver sends the repaired parts to assembly section.
Alternate Flow	**2a. Barcode is not being recognized in the system** - staff will manually input data fields such as part id and other required details for respective parts. - New barcode will be assigned corresponding to manual entry - Return to Step 3 in main success scenario. **4a. Assembly section is not free** - Receiver will send the repaired parts to the right storage location

Use Case 6: Assembling of the parts to form item for customer

Attributes	Description
Use Case Name	Assembling of the parts to item for customer
Description	This use case will guide any authorized personnel to enter parts and end item entry in the system at Reassembling station
Primary Actor	Assembling Operator
Stakeholders and interests	**Assembling Operator**: Wants to enter the information about receiving parts and end item in a fast and accurate manner **Customer**: Wants end item details and other information recorded swiftly once assembling is completed **MRO facility**: As a company wants to accurately record the Assembled end item details. **IT Team**: Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved.
Preconditions	User/ Operator/ Administrator is authenticated
Main Success Scenario	1. Assembling Operator Scans the barcode of the individual parts received from shop, update the part status to available and enter other required information such as date & time of receiving, location etc. 2. System reflects updated information with activity status as 'done' 3. Assembling Operator ask for other parts of end item from storage. 4. Assembling Operator Scans the barcode of the individual parts received from storage update the part location and enter other required information such as date & time of receiving, location etc 5.System reflects updated information with activity status as 'done' 6. Parts will be assembled to end time 7. Once end item is made, Assembling Operator will scan the barcode of end item to update activity and item status and add other required field. 8. Sends the reassembled item to the shipping station.
Alternate Flow	**3a. if Some parts of end item is not available in storage** - Check for the availability of other parts of end item in system - If any part of end item is not repaired, send the repaired parts to storage and update the location of repaired part **4a. If the shipping station is overloaded** - send the repaired parts to storage and update the location of repaired part

Post conditions	**Part Information, End item information and other required data fields have been successfully updated and system is in running mode**

Use Case 7: Parts repaired at Repair shop

Attributes	**Description**
Use case	Repairing the parts
Primary Actor	Repair Shop Operator
Description	This use case will guide any authorized personnel to enter information about repaired(shipping) and defective parts(receiving) into the system with required field.
Stakeholders and interests	**Repair shop Operator:** Wants to enter the information about receiving parts and repaired parts in a fast and accurate manner **MRO facility:** Wants part details and other information recorded and updated swiftly once repairing is completed **IT Team:** Wants to have information whether system is operating efficiently. Wants to make sure every information is recorded and saved
Preconditions	User/ Operator/ Administrator is authenticated
Main Success Scenario	1. Operator Receive Defective part from MRO facility 2. Operator Scans the barcode of the defective part received from MRO facility, record status as defective and enter other required information such as date & time of receiving etc. 3. System reflects the recorded information timestamp 4. Once the part is repaired, operator update the part status to repaired. 5. System shows updated status and shows activity status as done 6. Operator chose available carrier from system, ship the part to MRO facility, update the location of the repaired part & enter time and date of shipping.
Alternate Flow	**6.a Carrier is not available** - User/Operator/ Administrator wait for carrier status to get available. - Once it is available, he will repeat step 6 and ships the part to MRO facility.
Post conditions	Part Information, End item information and other required data fields have been successfully updated and system is in running mode

USE CASE DIAGRAM

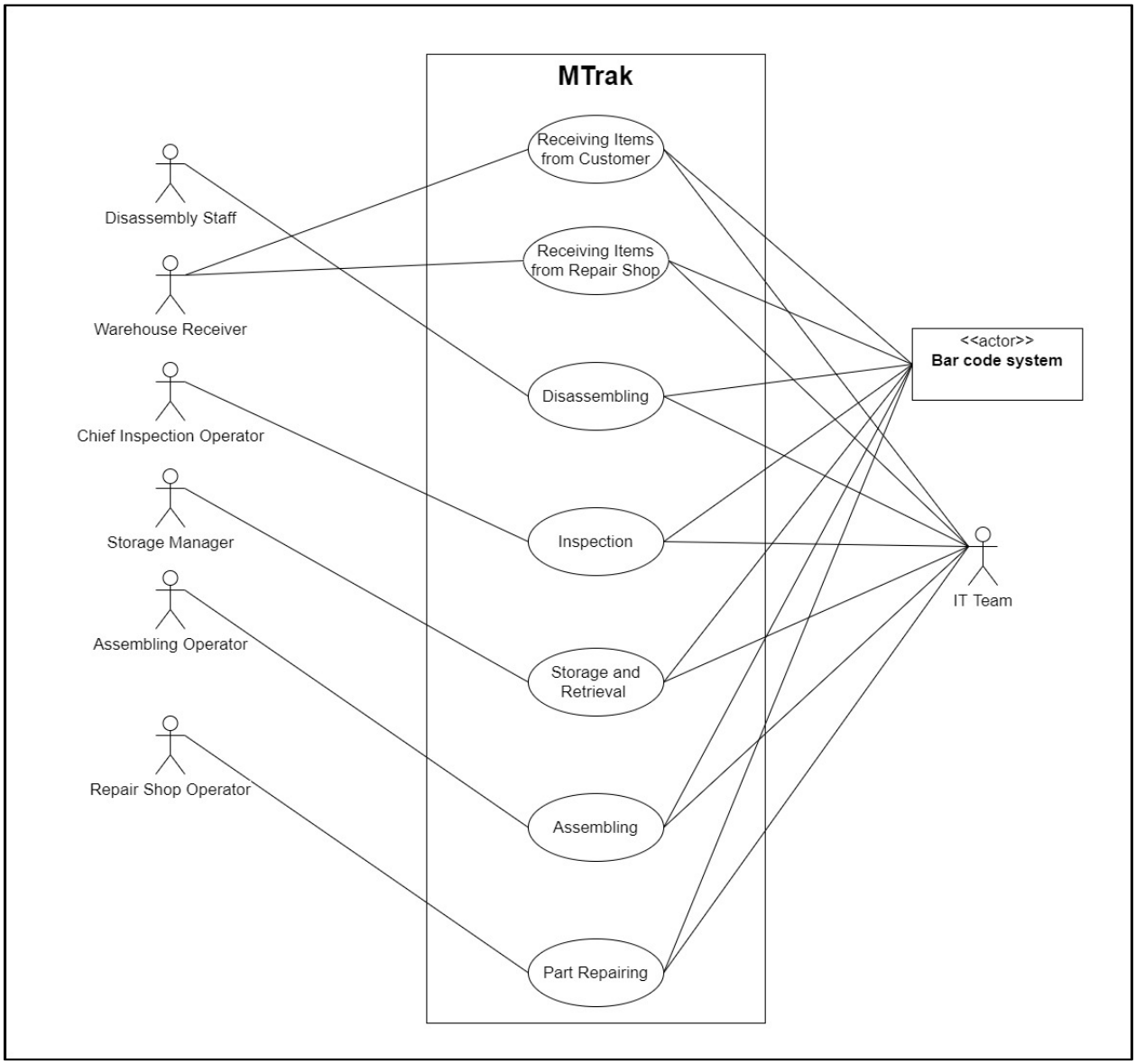

Fig 1: Use Case Diagram showing all the processes

DOMAIN MODEL

The Domain Model is structure and organized knowledge of a problem. Domain Model is the visual representation of conceptual classes or real-world objects which are in the interest of our domain. The domain model for MTrak system has been shown below which shows relations between conceptual classes and association in between them in the domain model, for simplicity we only have defined one Repairing shop. In the real world there would be many repairing shops but the association to part objects would remain the same for all of them. The attributes within each class and objects have been shown to define relationships.

Use cases have been very useful while creating the domain model. Creating different use cases for the whole MTrak system gave us the idea about the conceptual classes for the domain model. In addition to that, use cases helped us identify the association between classes and attributes within each class for example, parts have been recognized by Part_ID in use cases and it is associated within many stages of MRO facilities and Repairing shops. This arose an idea about adding conceptual class 'part' and attribute 'Part_ID' within class 'part'. In addition to this, several scenarios of use cases show the relationship within classes. In this way the domain model has been created with the help of use cases shown in Figure 2.

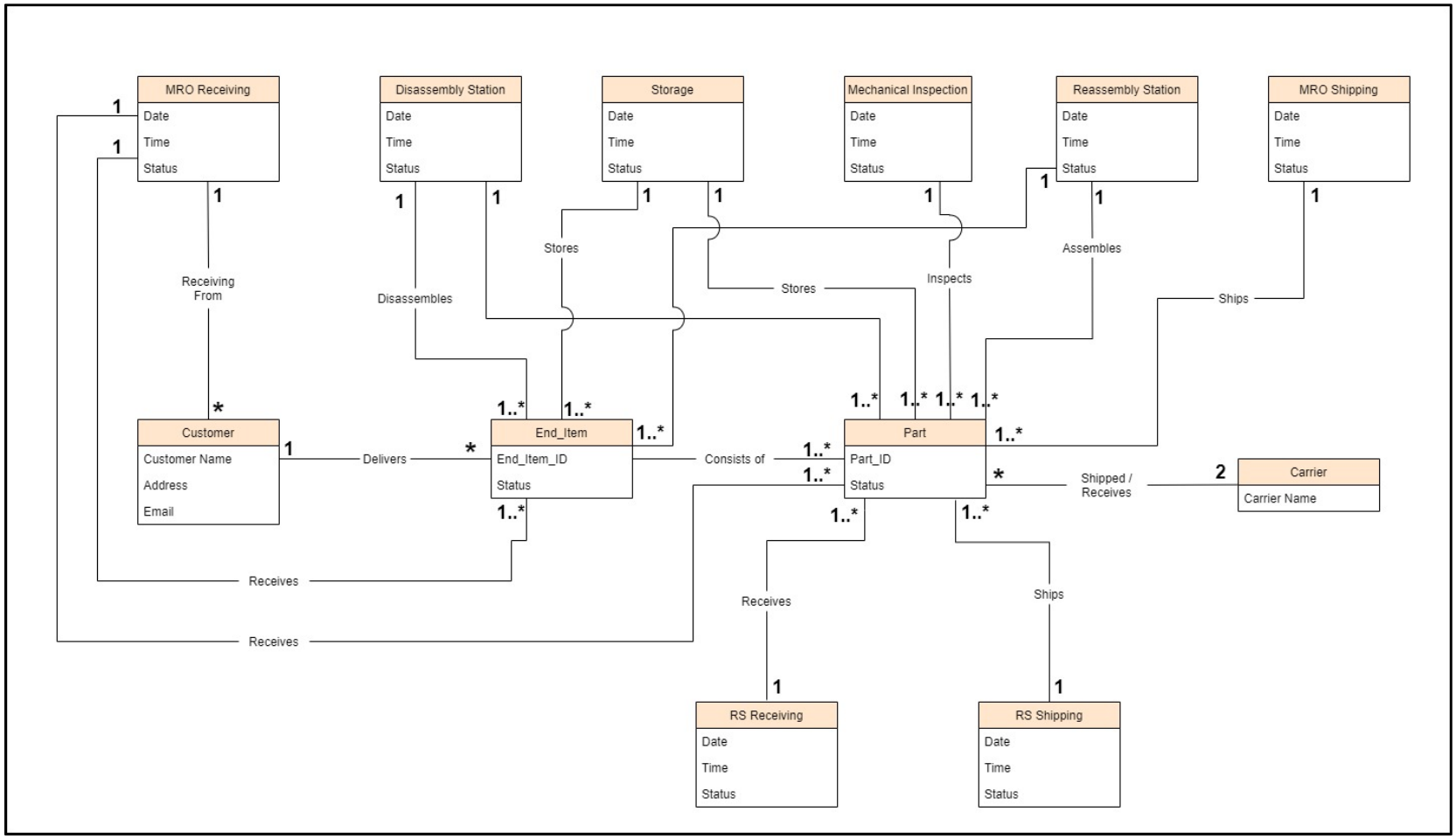

Fig 2: MTrak System Domain Model

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