Granite State Railroad (GSRR) Information System Design and Analysis Final Report

Course: IST 654 Information Systems Analysis Spring 2020

Client: Ping Zhang

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Executive Summary

In this report, we are working on the analysing and designing the information system of the Granite State Railroad and divided the whole report into six main parts: Business Background, Project Scoping and Scheduling, Requirements Analysis, System Diagrams Analysis, User Interfaces and Lessons Learned. In the Business Background section, we would introduce the business model of the Granite State Railroad (GSRR) and the client's needs on the information system that we would be working on later. The second section would be the Project Scoping and Scheduling which contains how we are planning for the whole project based on the information that we gather about the company. Then we did the analysis work on the requirements of the information system for the further designing stage. After the system analysis, we started to draw the information system diagrams to describe the information system that we design after analyzing results in the previous stages. With the diagrams, we entered into the designing user interfaces for the users to implement their use cases according to the user experiences consideration. The last section is the Lessons Learned from the whole project which would be the knowledge documents and transfer for this project as the system analysts.

Business Background

Granite State Railroad (GSRR) is an independently owned and operated New Hampshire company that was founded, has operated and continues to expand without any state or federal funds or bank mortgages. The GSRR is working with the Boston and Maine (B&M) Railroad and the Vermont Railroad (VTR) and running the interface with these companies to exchange freight cars on the daily operation. The GSRR does lease its trackage to 33 industries from the state of New Hampshire and also would be required to provide rail service to thirty-three industries along the leased rail right-of-way. Meeting timely requirements of customer service requests, scheduling activities with minimal delay, and billing for the service used are key functionalities of GSSR. All the activities carried out within the system are form-based and paper-based.

The current system employed by GSRR has been established over the past 10 years by trial and error. The manual process used to keep track of requests, freight cars, billing, location of rail cars and train movements. The whole system business works as following: Customer request service to the GSRR dispatcher through phone calls and dispatcher fill in all the necessary forms. Then dispatcher notifies the yard master of the car movements scheduled for the next day and then provides the pending request to the accounting department. The yard master physically assembles the train meanwhile notifies the dispatcher. Each morning, the dispatcher has meetings with engineers and conductors to discuss the daily movements and the forward time schedules. Then engineers do the safety check like the consumables of the train. After all clear, the train departs for the day's movement. Then after delivering all the things, the train returns to the GSRR and drops returning cars for the yard master. Then all the paper works are completed by the dispatcher and returned all the documents to the billing department.

Moreover, not only Boston & Maine but also Vermont Railroad both impose a per-diem procedure on GSRR and charge GSRR one hundred dollars per day. And because the limit of GSRR customers only could load or off-load in three days of Boston & Maine and Vermont Railroad. In the past several years, 25% of GSRR customers have been charged a per-diem fee of non-GSRR freight cars moved to GSRR customers.

Client’s perceived needs

The current system is paper based and has been established by trial and error method over the years. Majority of the functional processes involved in the system require manual filling out forms right from handling customer requests to tracking, scheduling of the cars & trains and billing. This invites room for error and operational inefficiency. Coming up with an information system that can reduce these errors and improve efficiency would be an ideal way to remove dependencies on a manual-based system.

Project scoping and scheduling

Through the whole project, the team needs to experience the four stages: planning, analysis, design and implementation over the fifteen weeks from January to April. In the initial stage, the team worked on selecting the case and getting familiar with it at the end of the January, and also

had the brief planning about the case that we selected. Then the team moved to the analysis stages and provided the first draft of the project proposal to discuss with the client. Based on the information in the case and the support documents, the project proposal contains the understanding of the business case and client's needs, defined scope of the project, and main functional requirements of the information system that the team would focus on in the further analysis and design. The aim of the client meeting to discuss the project proposal is to make sure that the client is satisfied with the analysis that we made for the information system. In this stage, the team finalized the scope of the project in February. The GSRR would interface with the Boston & Maine Railroad, and Vermont Railroad's existing systems and focus on automating the tracking, billing and scheduling of the cars and trains to make sure the delivery and efficiently handle the customer requests. The features of the information system include being able to process the customer requests, reserve trains, train assembly management, view availability and location of trains and cars and to view and edit the scheduled train and car services. The third stage is the really time consuming part. The team is working on the data flow diagrams, entity relationship diagrams and object oriented analysis of the information system that we design for GSRR. In March and April, the team held several team meetings to discuss and also talked with the client twice to confirm the diagrams which reached the requirements of the client. The team used Microsoft Visio and Access to display the diagrams and also designed the user interfaces to implement the main functions of the information system. We also created the inputs forms and output reports to show how the information system would operate for the client. At the end of the April, the team finally presented to the client about the information system that the team analyzed and designed and how that would support the company for the future development.

Requirements Analysis

In this part, we analyzed the current business and provided the functional and non-functional requirements for the information system of GSRR.

Functional Requirements

- The system must be able to process customer requests for car delivery
- The system must allow the employee to check the car inventory in GSSR and communicate with B&M | VTR for resources
- The system must allow the employee to schedule train with cars and locomotive information
- The system must be able to generate bills for different services after delivering the service to the customer.

Non-functional requirements

- The system must have an interactive and easy to use online interface.
- There must be support for multiple types of users for the system.

- The system should be secure and will be accessed by authorized users only.
- The system should be accessible to the users at all times of the day.
- The system should have high performance which remains constant regardless of the workload.

Supporting documents

The following are the supporting documents available for the current system:

- Bill of Lading GSRR Inbound/ Outbound local move
- GSRR Request for services
- GSRR Train order
- GSRR Yard order
- Exchange order
- GSRR Organizational data

System Diagrams

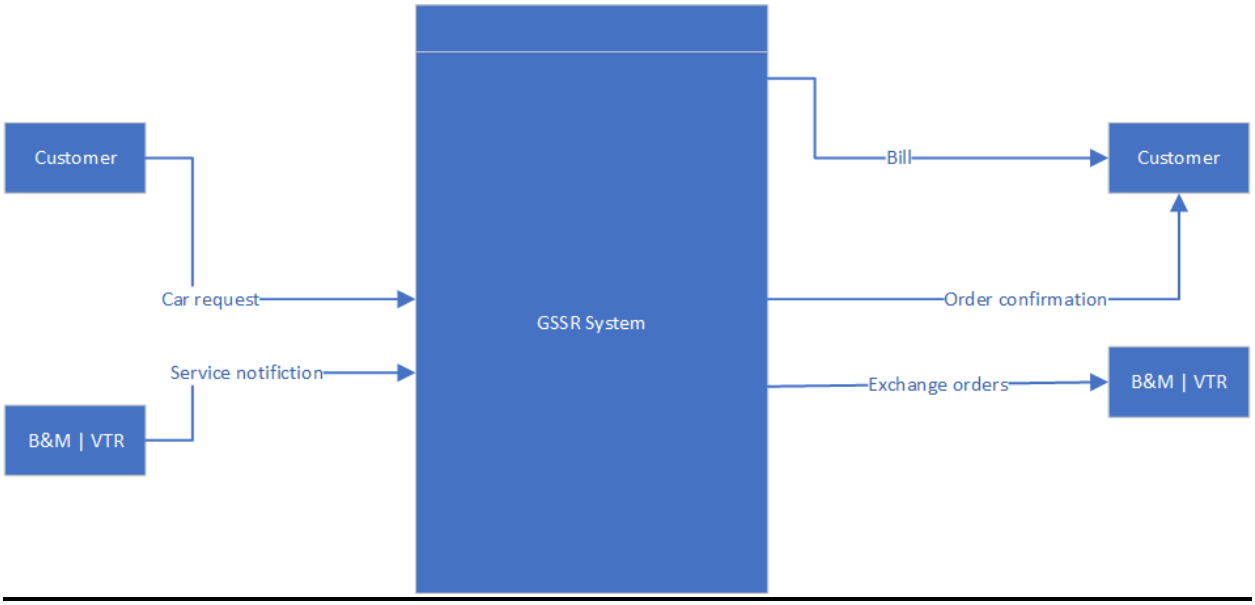
In this section, we used the GSRR cases analysis information and the functional requirements in the previous section and now analyzed the identified GSRR information system by using three analysis methods, including Entity Related Diagram (ERD), Data Flow Diagrams (DFD), and Object-oriented Analysis (OOA).

In the following paragraphs, we divided into four parts: Data Flow Diagrams (DFDs) which contains the context DFD and the level-0 DFD, Entity Related Diagram (ERD) & Extend Entity Related Diagram (EER) and Object-oriented Analysis (OOA) which includes user-case diagram, state transition diagram, sequence diagrams and class diagram with the detailed explanations.

DFDs

The context DFD shows how the source actors will interact with the destination actors via the GSSR system.

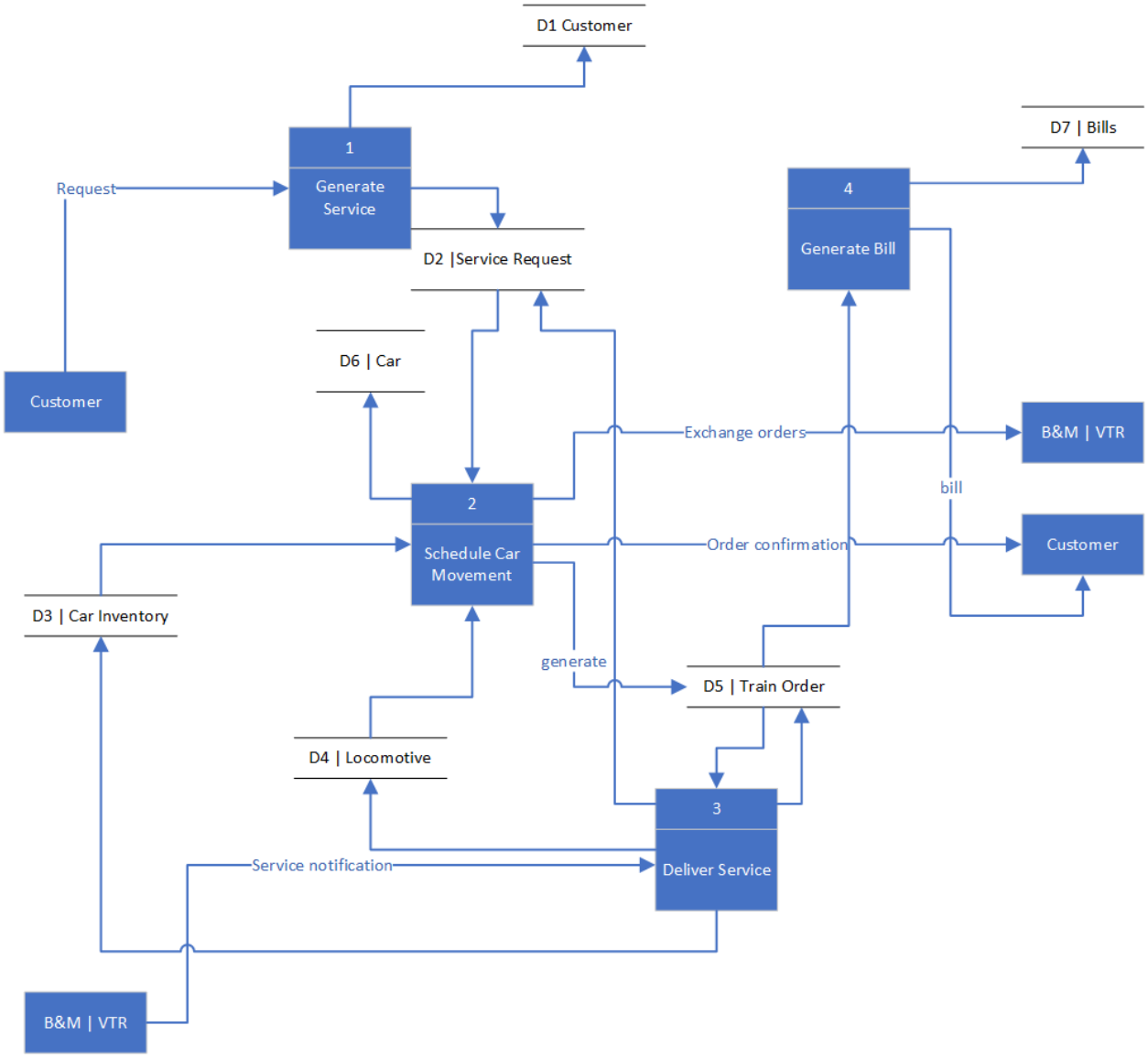
The context DFD



The level-0 DFD

The level-0 DFD shows the key processes of the case and how the actors interact with these processes.

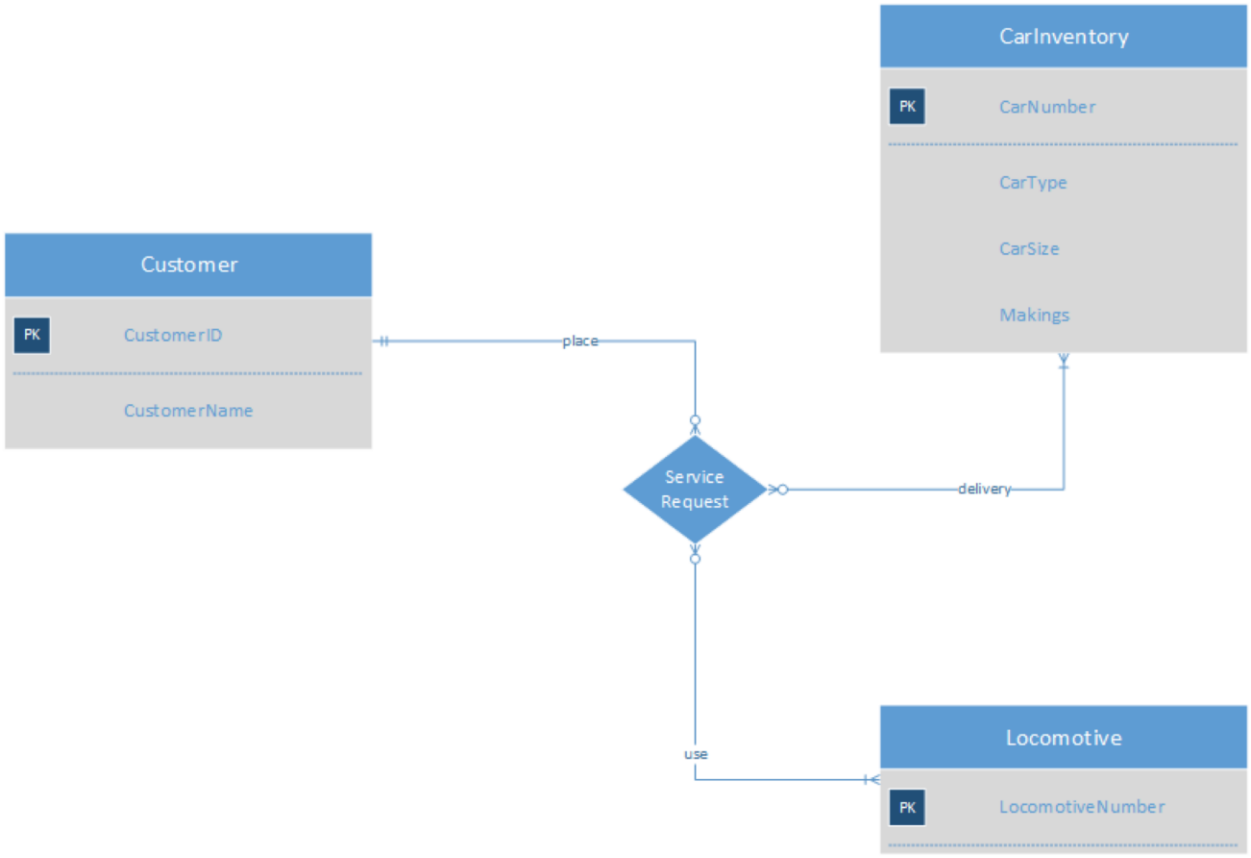
1) Generate Service
2) Schedule Car Movement
3) Deliver Service
4) Generate service



ER & EER

In this part, we firstly show the basic ER that shows the high level abstract about the communication between client and analysts. Then, we created EER (Extend ER) diagrams which provided more semantics and precise details based on the basic ER.

Basic ER



In the ERD, we have three entities: Customer, CarInventory, and locomotive.

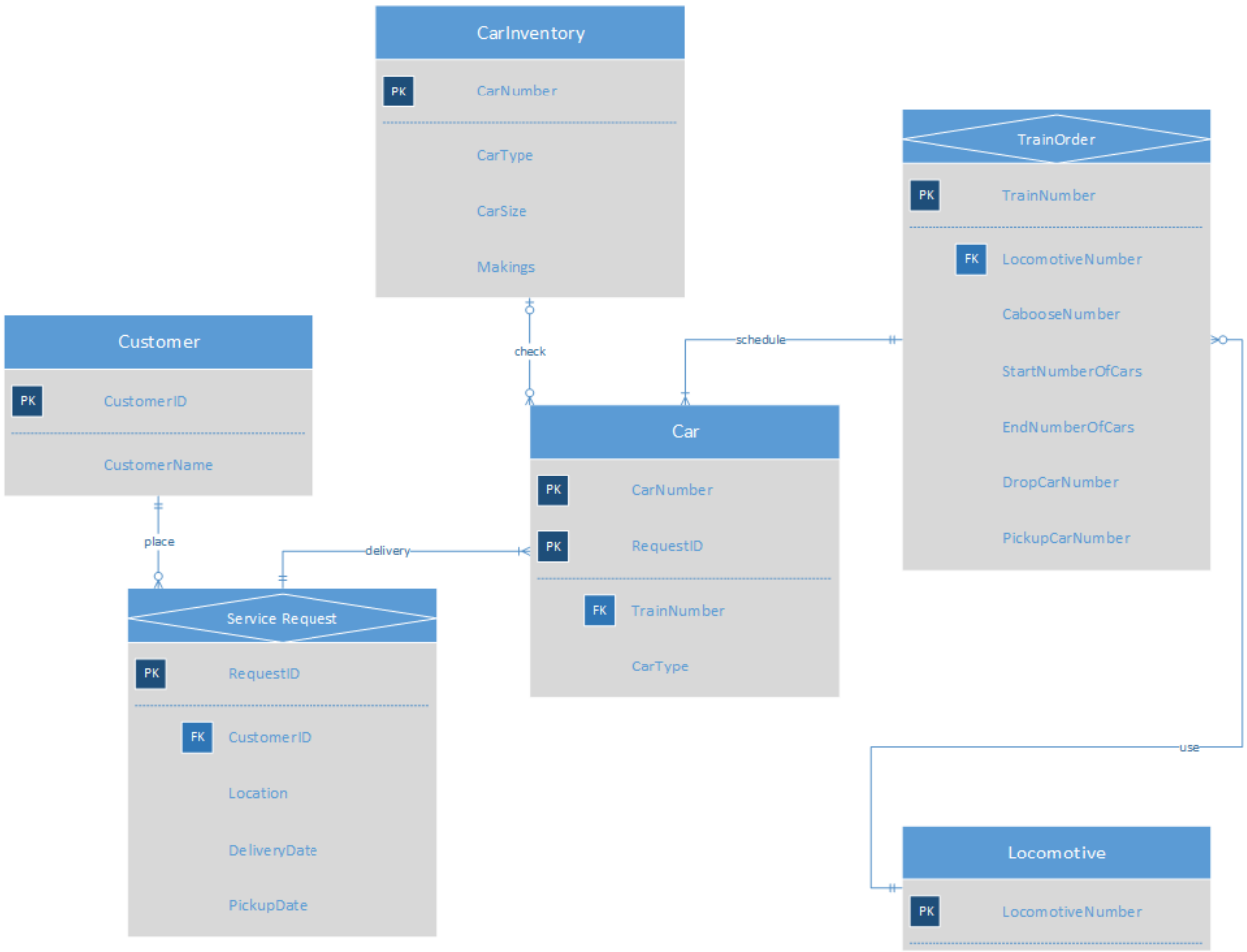
- The Customer entity having the attributes :CustomerID and CustomerName
- The CarInventory entity having the attributes: CarNumber, CarType, CarSize and Makings
- The Locomotive entity having the attribute: LocomotiveNumber

The Service Request is a diamond-typer here, connecting the relationship between three entities.

- One customer could place zero or more service requests, and one service request must be placed by one and only one customer.
- One service request could be asked to deliver one or more cars and one car must belong to one and only one ServiceRequest.
- One Car can check in zero or one CarInventory, and one CarInventory can be checked zero or more Car.

ERR

Business Assumption: Each train has one locomotive.



Attributes

Fundamental entity

- **Customer** (CustomerID, CustomerName)
- **CarInventory** (CarNumber, CarType, CarSize, Making)
- **Locomotive** (LocomotiveNumber)

Attributive entity

- **Car** (CarNumber, RequestID, TrainNumber, CarType, CarSize, Making)

Associate entity

- **ServiceRequest** (RequestID, CustomerID, Location, DeliveryDate, PickupDate, CarType, NumberOfCars, EstimatedLoading/Off-loadingTime, EstimatedNetWeight, Destination, TypeCargo, SpecialInstructions)

- **TrainOrder** (TrainNumber, LocomotiveNumber, Assigned Caboose Number, StartCarNumber, EndCarNumber, DangerousCargo, SpecialInstructions, CarDestination)

In the Extended ER diagram, we added the associate entities, ServiceRequest and TrainOrder, to handle the many to many relationships based on the basic ER diagram. We also add an attributive entity, Car, which is the element entity for ServiceRequest that contains the car information for the specific ServiceRequest.

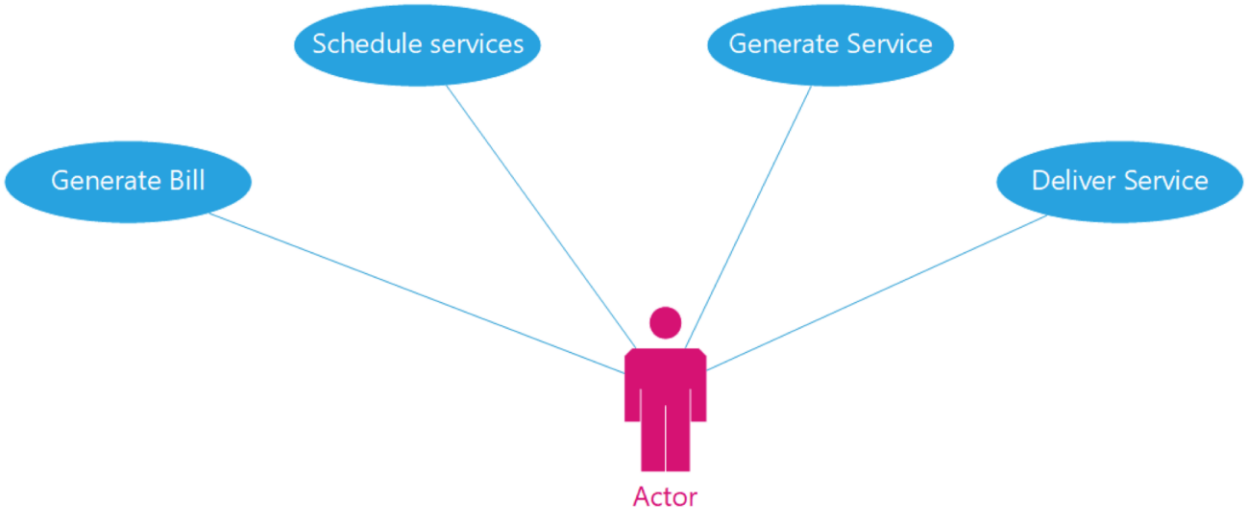
- One customer can place zero or more ServiceRequest; One ServiceRequest must be placed by one and only one customer.
- One ServiceRequest can be asked to deliver one or more cars; One car must belong to one and only one ServiceRequest.
- One Car can check in zero or one CarInventory; One CarInventory can be checked zero or more Car.
- One Car must be scheduled in one and only one TrainOrder; One TrainOrder schedules one or more Car.
- One TrainOrder must use one or two Locomotives; One Locomotive can be used for zero or more TrainOrder.

OOA

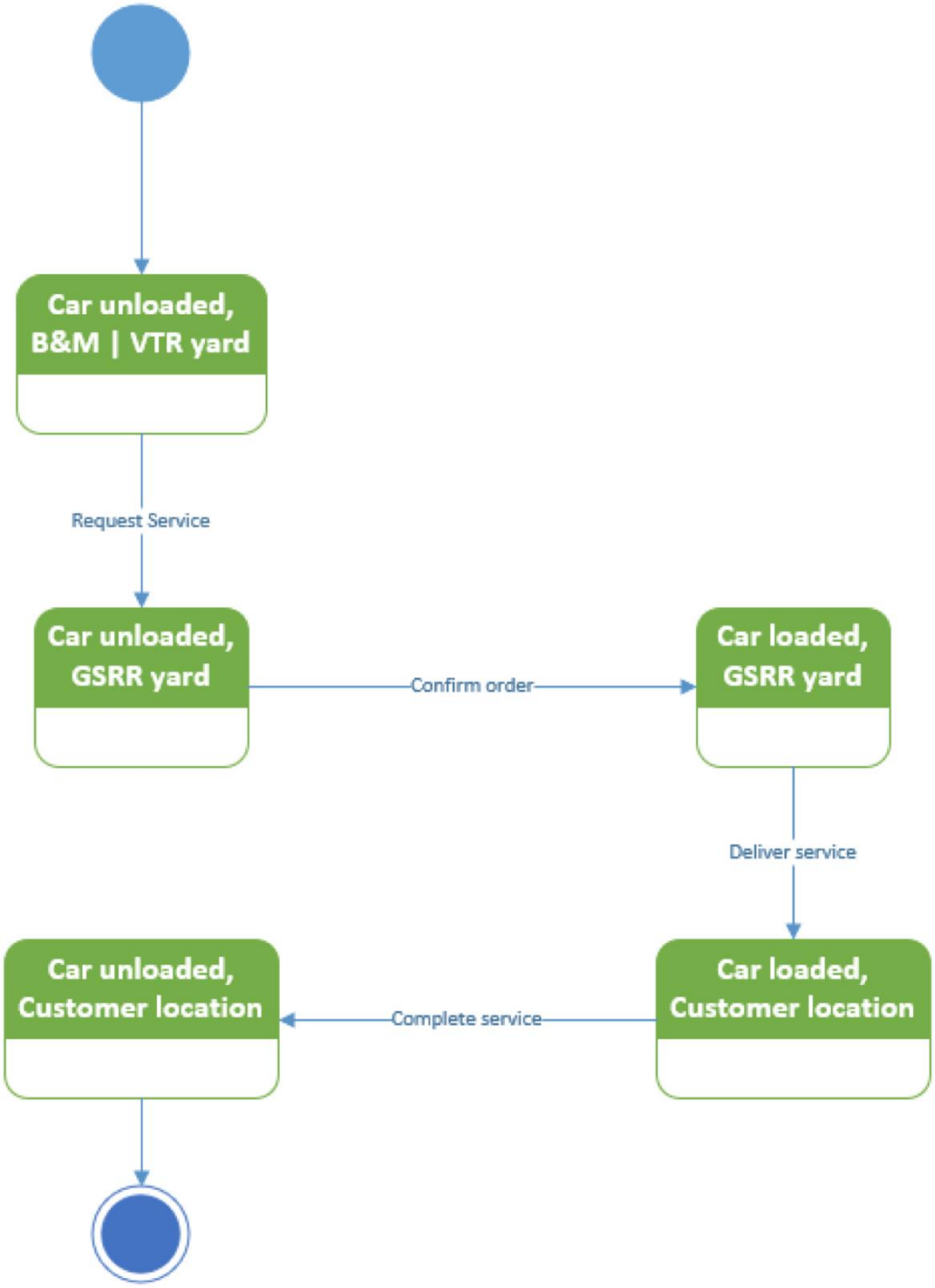
Use UML notations for all:

- **Use-case diagram**

The use case diagram indicates different actions an actor will perform in order to initiate the system.



- **State transition diagram for Car:**

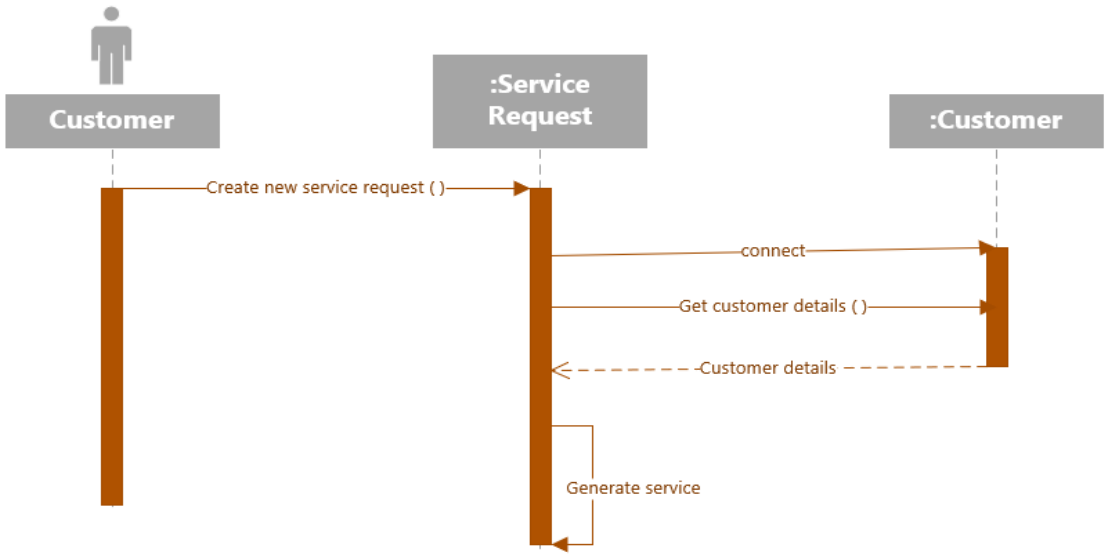


The car is initially unloaded when it is at B&M and VTR yard. When a request for service is generated, the GSRR requests for an unloaded car and is parked on the GSRR yard. When the order is confirmed, the car is loaded at the GSRR yard. When the service is delivered at the

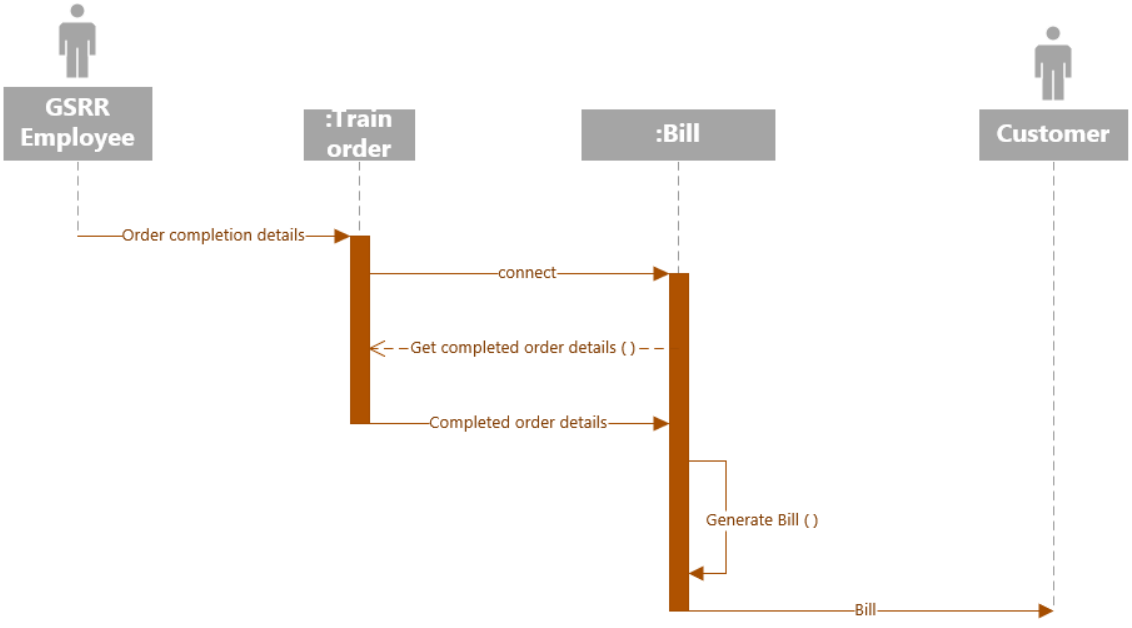
customer's location, the car is initially loaded. Once the car is unloaded at the customer's location, the service is completed.

- **Sequence diagrams**

1. **Generate Service**

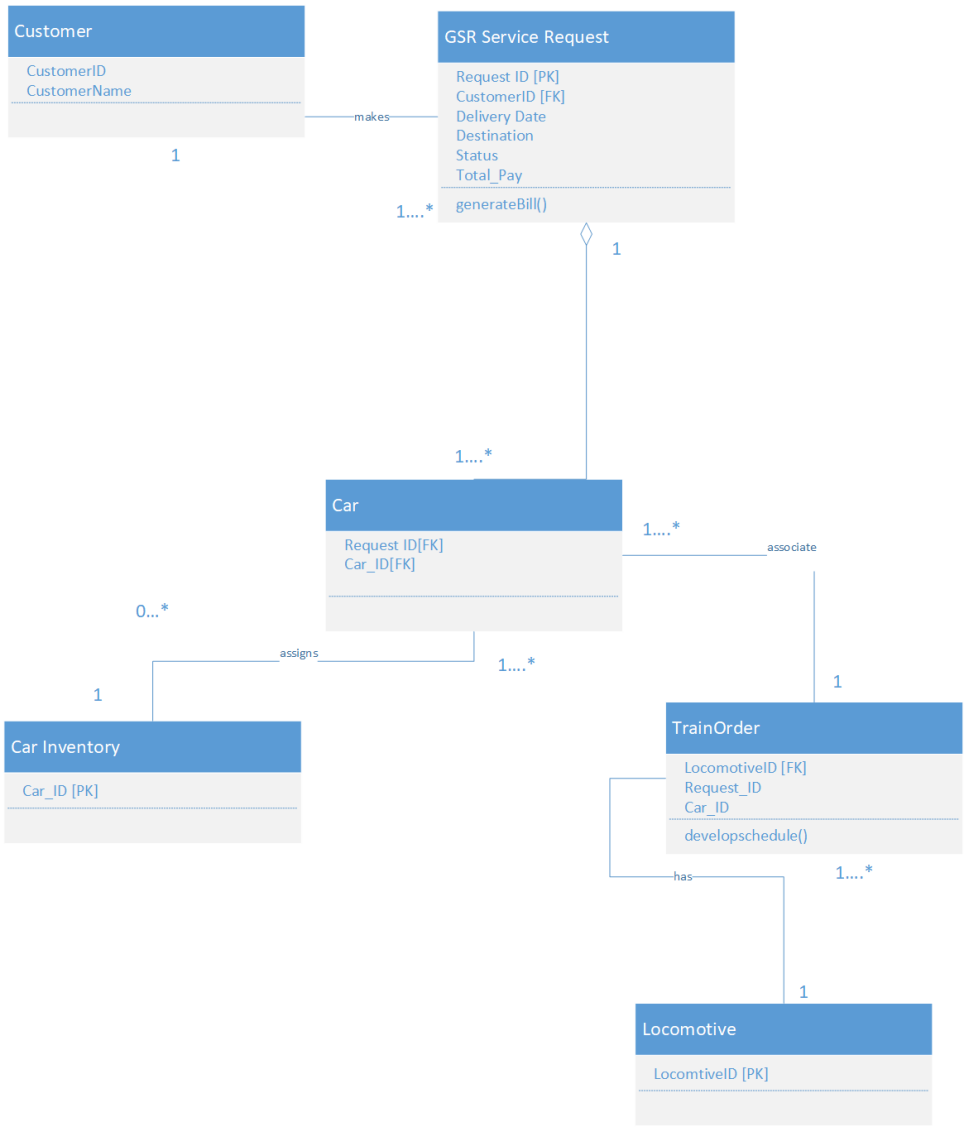


2. **Generate Bill**



- **Class Diagram**

This is pretty much similar to the Extend ERD with only “GSSR Service request” having (Whole part) “HAS” relationship with “Car” and having important methods.



USER INTERFACE DESIGNS

In this section, we designed the main screen that contains the four main functions of the information system, and also created two input forms and two output reports for the different kinds of the users to use this system.

Main Page

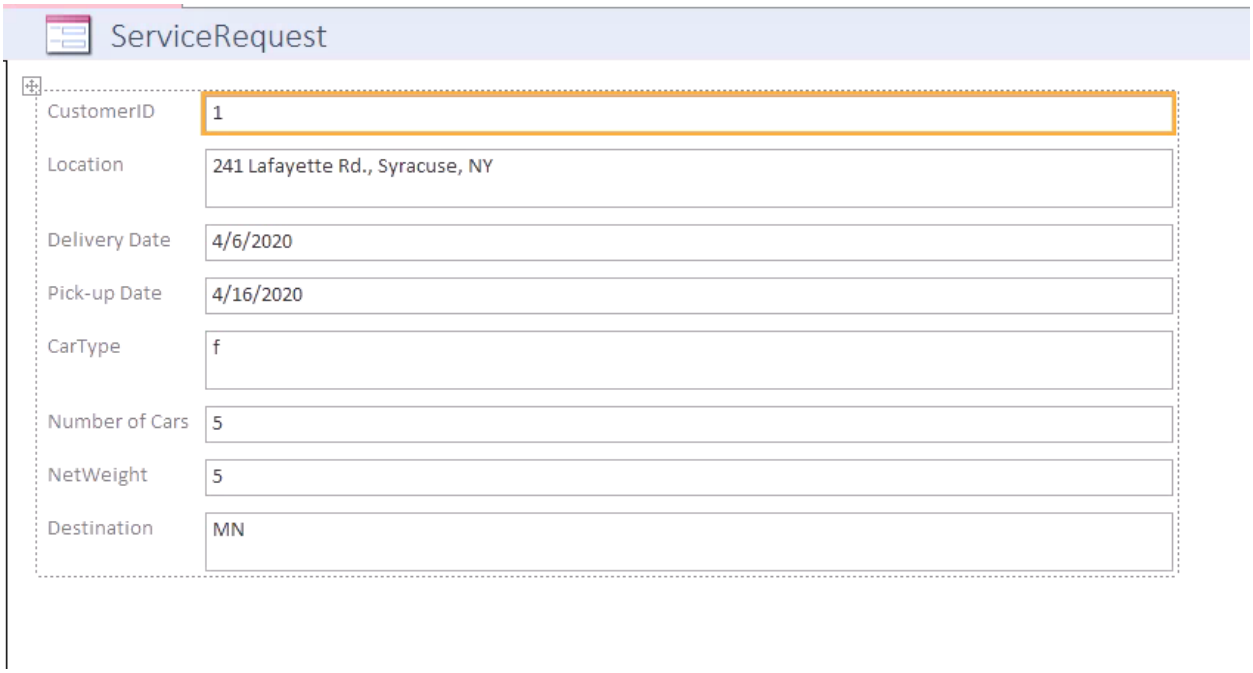
The main screen shows the four main functions of the information system: generate service, schedule service, deliver service and generate bills.

The web size screen let the user use the computer. As the system analysts who will graduate from Syracuse University, we chose the syracuse color for the interfaces of the information system.

Two input forms

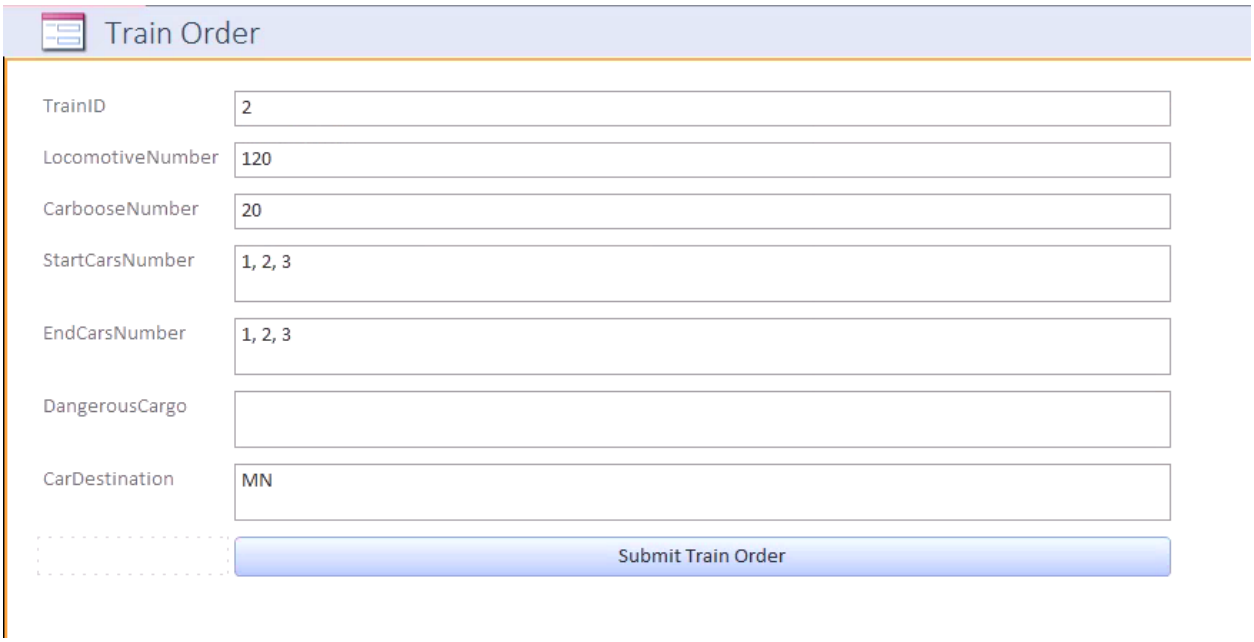
- Generate service

The customer can enter their service request information into the information system. The following is the input about the service request.



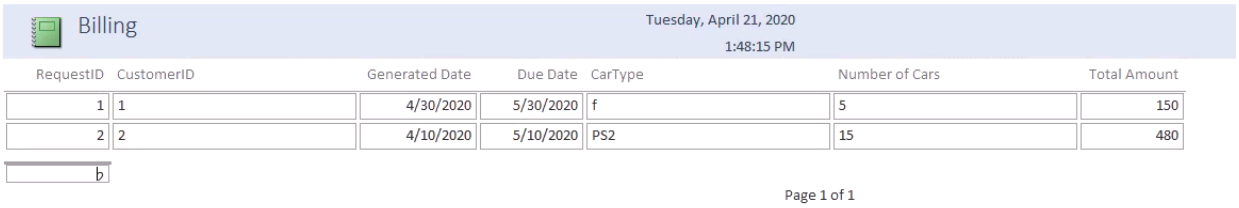
- Train Order

For scheduled service, we did the train order input for the train engineer to schedule the train.



Two output reports

- Bill of lading



Billing

Tuesday, April 21, 2020
1:48:15 PM

RequestID	CustomerID	Generated Date	Due Date	CarType	Number of Cars	Total Amount
1	1	4/30/2020	5/30/2020	f	5	150
2	2	4/10/2020	5/10/2020	PS2	15	480

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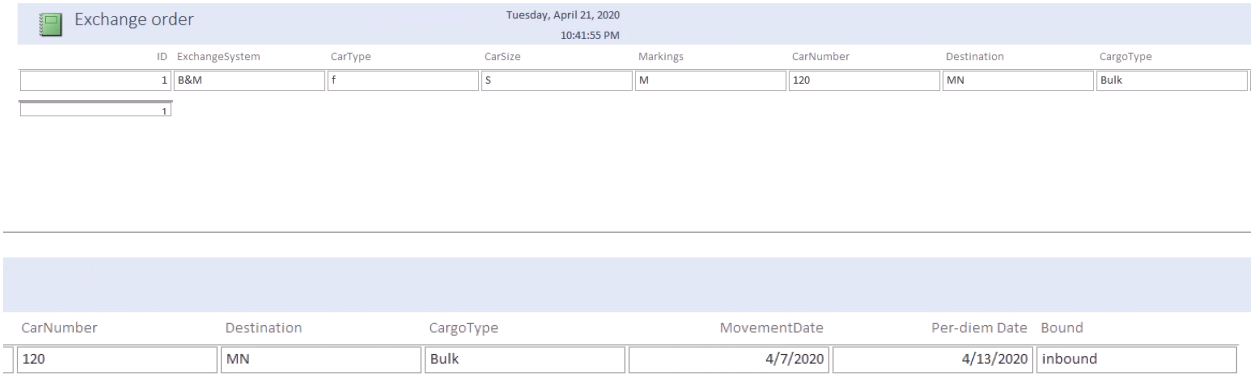
The billing report would be sent to the customers for payments.

- Exchange order

For the interaction with other two companies, we did the exchange order report to convey the information.



Exchange order

Tuesday, April 21, 2020
10:41:55 PM

ID	ExchangeSystem	CarType	CarSize	Markings	CarNumber	Destination	CargoType
1	B&M	f	S	M	120	MN	Bulk

1

CarNumber	Destination	CargoType	MovementDate	Per-diem Date	Bound
120	MN	Bulk	4/7/2020	4/13/2020	inbound

Because the report contains a lot of information, we can only take two screenshots to display it.

REFLECTION COMMENTS & INSIGHT

In this report, we chose to analyze and design the GSRR system because we found the necessary to implement an information system for the company to improve their business effectively and efficiently for the future development. Lacking related knowledge and experience, the team experiences the hard time to figure out the problems and the difficulty of the system analysis and design. Some problems did not completely figure out clearly in the plan and analysis stages which also led the team to go back to rework on the planning and analyzing when we entered into the design stage. In the following paragraph, we are explaining the details about what kind of the problems that we met and how we figure out.

The initial problem that we meet is to understand the current system. Based on our previous experience, not all of us have relevant experience in the railroad industry. As a system analyst, have the current understanding about the current business that the information system would

service for, and have a comprehensive understanding of improvements that we need to achieve based on the original system or original data and forms. One of the difficulties that some of the team members meet is having the wrong understanding about cars and parts of the train, locomotive. With the communication in the client meeting, we finally figure out the locomotive and cars in the system which lead us to have a clear view and the right direction to analyze and design the information system of the GSRR. However, we noticed the problems when we already finished the analysis and delivered the first draft of the design diagrams for the information system when we met the client during the meeting. This mistake let the team redo the design work of the diagrams which waste the time and prolonged the project period. From this mistake, we realized the significance of doing pre-investigation on gathering the necessary information. The second difficulties that the team met is that we didn't quite understand the meaning of information in the forms, such as per-diem and cargo. We really get confused about how we should handle these information and whether we should create the related entities in the diagrams when we do the analysis and design work on the information system of GSRR. The third difficulty that we meet is how should the system interact with the other two companies B&M and VTR. Luckily, the client pointed out these missing points in our proposal, then we made the changes on the functional requirements that we analyzed for the designed diagrams. Due to the lack of enough pre-investigation, we misunderstood the basic definitions of cars and several concepts in forms. We are supposed to figure out these in the proposal section rather than un-effectively discussed during the first meeting with clients. In this project, it is obvious that the current understanding about the business and communication would be quite important for us to learn as an analyst.

The system that we did analysis and design is just a case. If we enter into the real world and work on the real system for the improvement, we would suggest for the more detailed investigation on the current system and business. For example, we did not notice the locomotive in the proposal section and first draft of the diagrams. After communication in the client meeting, we only found the word “locomotive” twice in the case. However, the locomotive is one of the important parts of the train that we need to contain it in the diagrams of the information system. In the real world, an analyst would not only focus on what kind of information that company gave, but also do more research to make sure to get more insights about the current business. However, we are working on the paper case in this project which has limitations on the information of business. For the future improvement, we would suggest putting more detailed necessary information in the case and also encourage others to work on more research when you plan to analyze and design the information system for the organization. With more deep understanding, we would precisely know the strength and weakness of it which would be the really strong support for an analyst to work on it to make the analysis and design work effectively and efficiently.

It gave us a clear understanding of how one designs an information system in the real-world. We had data consolidated in the case which made it easy for us to understand the requirements of the case. However in the real world, there is a lot of collaboration required, in order to understand the requirements of different stakeholders in the company. Having said that, the course and the GSSR case helped us in building a strong foundation in Data Modelling (Conceptual, Logical and Physical) and the most important thing that the professor kept on reiterating in each and every group meeting that each and every diagram should convey the same story. I will now follow a pattern when it comes to data modelling which starts with

1) Identifying the functional requirements
2) Drawing the DFD (This gives you a better understanding of your interaction with the system)
3) Drawing the ERD (These are basically relationship between fundamental entities, the one that don't change over time)
4) UML Diagrams
    a) Class Diagram (Object, functions, attributes)
    b) State Diagram
    a) Sequence Diagram (Interaction with the object)

5) Forms (How the interaction with the end-user will take place)

We were stuck at different stages of the project, but we were able to come up to mutual consensus via Brainstorming Sessions in the group meetings.

We are now confident in stepping on to any project that has to do with data modelling in the real-world and in my future endeavors.

Finally, the group had the opportunity to conduct face to face meetings in the beginning phases of the project, which we found to be much more convenient as it was easier to communicate face to face. As the meetings transitioned to online formats, the team observed that more efforts needed to be taken to communicate their ideas to others and get the work done as a group. It was harder to synchronize all the different diagrams as all the members were not able to meet that often. With an increased need to communicate and get the work done on time, the team had to conduct much more online meetings than we would if they were face to face or physical meetings. Even as a remote team, each member was able to adjust the pace quickly and transition to the new workstyle. As a system analyst, the biggest challenge can be to not only understand what the client's expectations are, but also to understand each member's expectations. It is possible to be a good system analyst by being clear in communicating the purpose and goals, and by understanding each team member's as well as the client's point of view.

Interaction Worksheet

Date	Other Party	Ways of Communication	Appx. Duration/ Length	Topic	Major Decision	Other Comments
1/27/20	Teammates	In person meeting at Bird Library	30 minutes	Select project topic and create documentation	The Granite State Railroad was selected as the project topic.	Vedika, Shwet and Shu attended the meeting
01/30/20	Teammates	In person meeting at Bird Library	45 mins	Project Proposal	Discussion on the proposal and assigned everyone sub-topics for the project.	Vedika, Shwet, Shu, Yanqi attended the meeting
02/05/20	Client, Teammates	Client meeting at iSchool	30 min	Clarifications on project proposal	The client suggested changes for the proposal.	Vedika, Shwet, Shu, Yanqi attended the meeting
02/10/20	Teammates	Zoom meeting	1 hr 10 mins	Project Proposal	Worked on the changes suggested by the client.	Vedika, Shwet, Shu, Yanqi attended the meeting
03/21/20	Teammates	BB G3 meeting room	30 mins	Assign the work about Analysis Report	Follow the plan to work on the diagrams seperately	Vedika, Shwet, Shu, Yanqi attended the meeting
03/26/20	Teammates	BB G3 meeting room	1 hr	Work together on DFDs	Finalize the first draft of DFDs	Vedika, Shwet, Shu, Yanqi attended the meeting
03/29/20	Teammates	BB G3 meeting room	1hr	Discuss on DFDs and ER&EER	Work on the changes suggested by team members	Vedika, Shu, Yanqi attended the meeting

03/30/20	Client, Teammates	BB G3 meeting room	1 hr	Discuss the draft of diagrams in the analysis report	Work on the changes suggested by client	Vedika, Shwet, Shu, Yanqi attended the meeting
04/02/20	Client, Teammates	BB G3 meeting room	1hr	Discuss the second draft of diagrams in the analysis report	Work on the changes suggested by client to finalize the analysis report	Vedika, Shwet, Shu, Yanqi attended the meeting
04/17/20	Teammates	BB G3 meeting room	1hr	Discuss the user interfaces design and lesson learned part	Work on the parts that be assigned on the team meeting	Vedika, Shwet, Shu, Yanqi attended the meeting