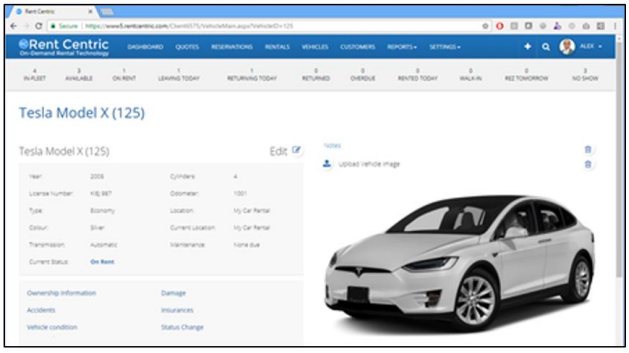
SOFTWARE REQUIREMENT SPECIFICATION (VERSION 0.9)

CAR RENTAL MANAGEMENT SYSTEM

Software Application for Managing Car Rental Business



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CAR RENTAL MANAGEMENT SYSTEM

1. Purpose of the Document

The purpose of this document is to specify the requirements for developing a car rental management system. The requirements will become the basis for designing and implementing the target software.

2. Overview of the Target System

The target system, CRMS, provides the common and comprehensive set of functionalities for managing car rental operations for car rental companies.

2.1. Functionality

The functionality of the system is summarized as the followings.

- **Customer management**

  This functionality is to manage the profiles of customers.

- **Staff Management**

  This functionality is to manage the profiles of staffs who manage the rental operations.

- **Rental Center Registration**

  A rental company operates a number of rental centers. Each rental center maintains on inventory of cars and provides car rental services. This functionality is to manage the information of rental centers.

- **Inventory Management**

  This functionality is to manage the inventory of rental cars for the company. The system maintains two types of information; information about car models and information all rental cars owned by the company.

- **Car Maintenance**

  This functionality is to assist various maintenance operations of rental cars. The maintenance can be in various forms including cleaning a rental car that is returned and preventive maintenance operations.

- **Rental Fee Pricing**

  This functionality is to set the right amounts for rental fees by considering various factors. The determination of competitive rental fees is an essential factor for successful car rental businesses.

- **Reservation Management**

  This functionality is to manage car rental reservations for the customers. A reservation can directly be made by a customer or by a staff on the behalf of a customer.

- **Checkout Management**

  This functionality is to manage the checkout operation for rentals. There is a well-established procedure for the checkout.

- **In-Rental Management**

  This functionality is to assist the in-rental operations for active rentals. The in-rental management includes the following tasks.

- **Return Management**

  This functionality is to assist the operations for returning rental cars.

- **Business Analytics**

  This functionality is to perform various analytics on the car rental operations. The system generates business analytics reports periodically or on demand. Also, the system allows various business-related inquires entered by staffs.

2.1.1. Deployment

The target system consists of 4 types of computing nodes, and its deployment is shown in Figure 1.

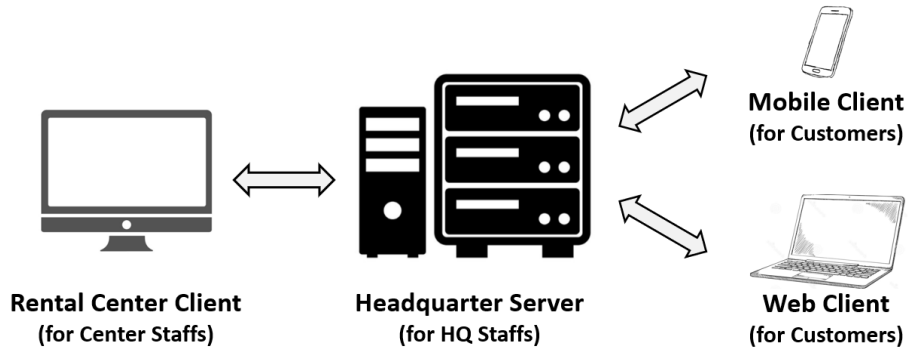

Figure 1. Deployment of the Target System

- **Mobile Client (for Customers)**

  The mobile app for the system is for customers who wish to make reservations, reviewing active rentals, changing rental conditions, and others.

- **Web Client (for Customers)**

  The web service for the system is for customers who wish to make reservations, reviewing active rentals, changing rental conditions, and others.

- **Rental Center Client (for Center Staffs)**

The rental center system is for the company staffs who manage rental operations on behalf of customers. This system provides all the essential functionality of managing car rentals. The rental center systems interact with the Headquarter System.

- **Headquarter Server (for HQ Staffs)**

  The headquarter system is for the company headquarter office. The system provides the common functionality that is required in operating rental center systems effectively, such as maintaining car inventory and setting rental fees.

3. Functional Requirements

The functionality of the software is classified into functional categories.

3.1. Customer Management

This functionality is to manage the profiles of customers who reserve and rent cars.

- **Customer Profile**

  A customer or a staff of the company can create the profile of customers. The profile includes the identification information including Driver's License, contact information, login information, and the credit card information of customers. Once registered, a customer can login the system, make rental reservations, and browse rental status and history.

- **Member Profile**

  The system evaluates the rental histories of customers every year and offers a VIP membership to the customers with a high volume of transactions. The company provides benefits to the members as the followings.

  - Fast-track Checkout
    A reserved car is pre-assigned in advance for the member. Hence, a member does not have to wait in the line to check out a car, just go to the assigned parking spot, and drive out the assigned car.
  - Pre-specified Discount applied to all rentals
    A member his offered a pre-specified rate of discount on all rentals. The rate is annually determined by the company.

3.2. Staff Management

This functionality is to manage the profiles of staffs who manage the rental operations. A staff may work for a rental center or the headquarter office. The staff profile includes the identification information including his/her employee number, contact information, login information, and the department information.

There are two types of staffs; rental center staffs and headquarter staffs. A rental center staff works of a rental center and a headquarter staff works for the headquarter office.

The company maintains the log of all the operations performed by rental center staffs, and the information is further utilized in improving the quality of their business processes.

3.3. Rental Center Registration

This functionality is to manage the profiles of rental centers. The company operates a number of rental centers and each rental center provides car rental services to the customers. Many of the rental centers are located in the airport or a location nearby airport.

Each center is assigned with a number of staffs and maintains an inventory of rental cars. Customers visit a rental center to rent or return cars.

3.4. Inventory Management

This functionality is to manage the inventory of rental cars in the company. The inventory information consists of car model profiles and profiles of rental cars.

- **Maintaining Car Model Profiles**

  The company carries a set of selected car models that are known to be mechanically reliable, economically maintainable, and popular among customers. The system maintains the profiles of selected car models including the manufacturer, car type such as sedan, SUV, van, or truck, car size, power generation type such as gasoline, diesel, hybrid, electric, or Hydrogen-fueled, transmission type, and other features. Some of the car models are shown in Figure 2.

Figure 2. Examples of Car Models

- **Purchasing Rental Cars**

  The company purchases new cars for rental from the pre-selected car models. The system maintains the profiles of purchased rental cars including car model, VIN, color, equipment options, date purchased, rental car ID, and others. An example of car description is shown in Figure 3

Name	2019 Toyota Mirai Sedan
Offers	• **Price:** 51930.0 • **Currency:** USD • **Availability:** InStock • **Regular Price:** 59430.0
SKU	119D490
MPN	3000
Brand	Toyota
Main image	
Description	Show Description content
VIN	VIN: JTDBVRBD8KA007287
Mileage	• **Unit:** KMT • **Value:** None
Transmission	Automatic / Front Wheel Drive
Production date raw	2019
Production date	2019
Engine specifications	• **Raw Value:** 0.0 ELECTRIC MOTOR
Color	Celestial Black / Deep Ocean Blue

Figure 3. Descriptive Attributes of Cars

Once a car is purchased, it is assigned to one of the rental centers for the purpose of effective maintenance.

- **Discarding Rental Cars**

  The company occasionally discard rental cars that are not appropriate for rental anymore. The criteria for discarding cars are the followings.

  - A car is too old for rental purpose. In fact, some countries enforce a policy of discarding rental cars that have been used as a rental car longer than a pre-specified period such as 3 years.

- A car of which condition becomes too poor to be used a rental car. The poor condition might be due to the physical damages or dents on the car, excessive noise or frequent breakdowns.
- A car on which an accident occurs and not repairable for reasons.

❑ **Maintaining Optimal Level of Inventory**

The company needs to maintain an optimal level of inventory for each rental center to increase the rental contracts while minimizing the cost for rental cars waiting in parking lots.

To do so, the company purchases new rental cars on demand. The company also relocates the rental cars of selected car models from one center to another center. The decision for car relocation is made by the current rental transactions, reservations, and forecasts on the demand.

3.5. Car Maintenance

This functionality is to assist the rental car maintenance-related operations for returned cars or cars in parking lots. The maintenance includes the following tasks.

❑ **Re-conditioning Returned Cars**

This is to clean the returned cars and re-condition the car for subsequent rentals.

❑ **Filling in Gas**

This is to fill the gas of the returned cars, if necessary.

❑ **Repairing Cars**

This is to initiate a process of repairing a car in accident or with a damage.

❑ **Preventive Maintenance**

This is to perform a preventive maintenance on the returned cars such as changing engine oil, filling various fluids on cars, and changing tires.

3.6. Rental Fee Pricing

This functionality is to specify the rental fees of the rental cars. The degree of rental fees is one of the key factors that customers consider when choosing a car rental company. Hence, the rental fees should be determined by considering various marketing points of views.

If the rental fees are set to considerably be higher, the number of potential rentals would be decreased. If the rental fees are set to considerably be lower, the amount of the net profit would be decreased. Therefore, the rental fees should optimally be determined. An example of comparing rental fees among rental companies is shown in Figure 4.

best deal Name Your Own Price®	Budget Shuttle	AVIS Shuttle	DOLLAR Shuttle	Alamo Shuttle	National Shuttle
Economy 	GREAT VALUE! lowest price **$15** /day $184 total	**$29** /day $303 total	**$310** /week $350 total	**$70** /day $544 total	**$64** /day $579 total
Compact 	GREAT VALUE! lowest price **$16** /day $192 total	**$30** /day $312 total	**$319** /week $361 total	**$72** /day $557 total	**$64** /day $580 total
Mid-Size 	GREAT VALUE! lowest price **$16** /day $197 total	**$31** /day $318 total	**$328** /week $370 total	**$74** /day $569 total	**$67** /day $604 total
Standard 	GREAT VALUE! lowest price **$17** /day $203 total	**$32** /day $327 total	**$338** /week $381 total	**$75** /day $583 total	**$68** /day $617 total
Full-Size 	GREAT VALUE! lowest price **$18** /day $209 total	**$33** /day $334 total	**$346** /week $390 total	**$77** /day $596 total	**$70** /day $630 total
Premium 	GREAT VALUE! lowest price **$28** /day $296 total	**$46** /day $436 total	**$476** /week $527 total	**$82** /day $634 total	**$72** /day $650 total

Figure 4. Comparison of Rental Fees among Rental Companies

The rental fees are periodically determined by considering various factors. When determining the rental fees, the company often consider the following factors.

- Popularity and Demand on each Car Model
- Seasonable Demands such as Thanksgiving Day, Christmas Day, and Summer/Winter Breaks
- Special Events and Occasions such as Exhibitions, Conferences, and Olympic-like Sport Event.

The company applies the flexibility in applying the rental fees. A reservation in advance to the date of rental is offered with a discounted rental fee. The degree of discount depends on how advance the reservation is made. A rental without a reservation is typically applied the full rental fee.

3.7. Reservation Management

This functionality is to assist the reservation-related operations. Customers can make new reservations. And they can review, modify, and cancel the reservations. They can make reservations directly or by calling the company.

Upon a request for a reservation, the system should check the projected inventory for the check-out date and decide the availability of the requested car model. If the projected inventory for the check-out shows low, the reservation is not be allowed.

- **Reservation by Customer**

  A customer can make a reservation by using the mobile app or the company web site.

- **Reservation by Staff**

  A staff can make a reservation on the behalf of a customer when the customer calls the company.

A reservation profile includes the following details.

- Type of Car or Size of Car
  - Can be a specific car model such as Tesla Model X.
  - Can be a car type or a size such as Toyota RAV4 SUV.
- Location for Checkout
- Location for Return
  - At participating rental centers, a car can be rented in one location and returned to another location. There can be a one-time drop charge in addition to the rental fee.
- Identification and Driver License Information
  The driver information for a registered user is automatically entered. An unregistered customer needs to enter the identification, contact information, and driver license information.
- Duration of Rentals
- Number of Drivers
- Insurance Options (optional)
- Others

A screen output for typical reservation confirmation is shown in Figure 5.

Figure 5. Confirmation of Car Rental Reservation

3.8. Checkout Management

This functionality is to assist the checkout-related operations. Customers with or without a reservation may visit a rental center and check out cars. For customers without reservation, the rental is subject to the availability of rental cars.

The typical procedure for processing a check-out is shown in Figure 6.

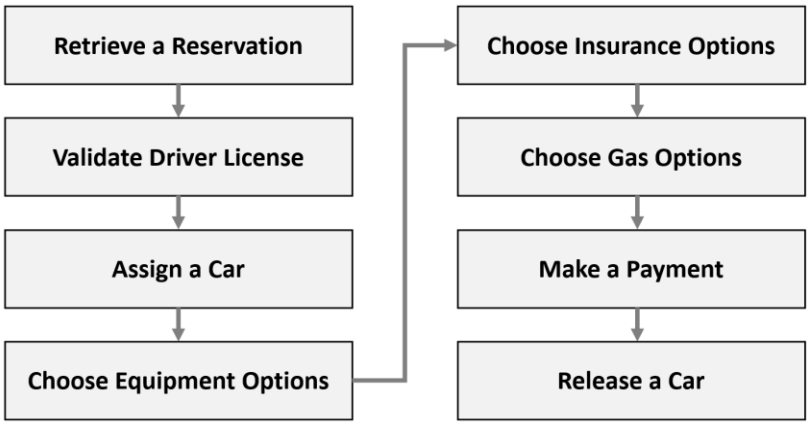

Figure 6. Procedure for Checkout

- **Step 1. Retrieve a Reservation**

  This step is to check for a reservation and retrieve the details for the reservation. For a walk-in checkout, the system asks if the customer has already registered on the system and retrieves the customer information if registered.

- **Step 2. Validate Driver License**

  This step is to validate the customer's driver license by accessing the validation system operated by the *National Driver License Office*. If the driver license is not validated, the checkout procedure is not proceeded. Examples of validating driver licenses are here.

  - KOREA) Korean National Police Agency
  - USA) Department of Motor Vehicles (DMV) by State
  - Japan) National Police Agency.

- **Step 3. Assign a Car**

  This step is to confirm the car model requested by a customer and the rental period, and assign a rental car from the pool of available rental cars. The rental car should be determined by considering the rental content such as returning to same location, returning to different location, driving abroad, and upcoming checkouts.

  The staff should acquire the agreement on the assigned car before proceeding to the next step.

- **Step 4. Choose Equipment Options**

  This step is to ask the customer to choose equipment options such as GPS navigator, car seat for child, and a tag for tollway pass.

- **Step 5. Choose Insurance Options**

  This step is to ask the customer to choose insurance options such as no-coverage, damage waiver, or full coverage. When choosing the no-coverage option, the staff should ensure the customer maintains a valid insurance to cover the rental car.

Figure 7. Rental Insurance Options

- **Step 6. Choose Gas Options**

  This step is to ask the customer to choose an option among the following options.

  - Pre-purchasing a full tank of gas upon Return
  - Self-fulfilling the gas upon Return
  - Self-filling the gas to the original level of the gas upon Return

- **Step 7. Make a Payment**

  This step is to compute the total rental amount by considering the rental fee of the assigned car, equipment options, insurance option, gas option, and discount rate. Most of the rental cars nowadays have no limitation on the allowed mileage to drive. If a rental has a limitation on the allowed mileage, then the total rental amount is computed accordingly.

  Upon the computation, the staff enters the credit card information of the customer and acquires a payment authorization by accessing the appropriate online *Credit Card Payment Authorization* system. If not authorized, the checkout is not proceeded.

  A typical order of acquiring an authorization for card payment is shown in Figure 8.

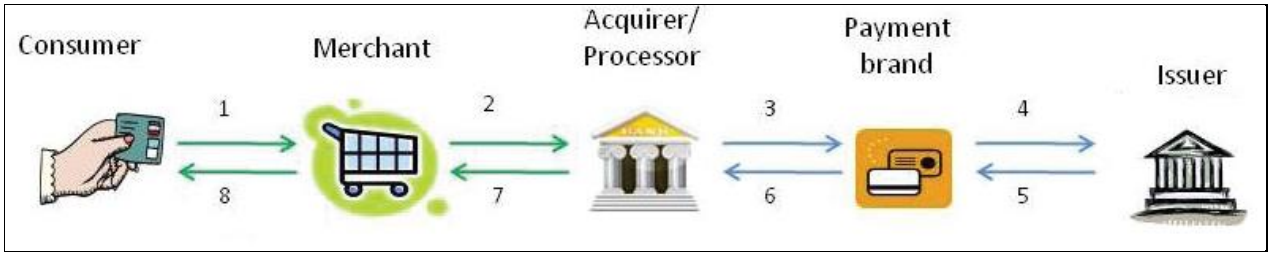

Figure 8. Process of acquiring Authorization for Card Payment

❑ **Step 8. Release a Car**

This step is to finalize the rental contract and release the car key to the customer. Then, the customer may go to the designated parking spot and drive out the car.

3.9. In-Rental Management

This functionality is to assist the in-rental operations for active rentals. The in-rental management includes the following tasks.

❑ **Tracing Location of Rental Cars**

When a customer wants to take the car abroad, he or she should inform the staff the driving plan. Then, the staff will arrange to insure the car. In some companies and locations, it may not be allowed to drive a rental across a country.

For taking the car abroad, the company would charge a 'cross-border fee' when checking out the car. This fee will extend the rental's basic damage, theft and third-party protection so it works in another country.

Most of the rental cars are equipped with a GPS sensor so that rental companies may keep track the current location. If a rental car without a cross-border option/permission crosses a country, the system generates an automatic alert and a corresponding staff would take a necessary action for it. An example of tracing the location of cars and displaying it on map is shown in Figure 9.

Figure 9. System Tracing Location of Cars

❑ **Replacing Rental Car**

A rental car in operation might have a mechanical or some other problem that prevents the customer from operating the rental car anymore. The customer then call the company or visit a rental center to get a replacement car. Examples of having a replacement car can be ‘car does not start’, ‘car key lost’, and ‘car disappeared’.

❑ **Processing Car Accidents**

A rental car in operation might be involved in a car accident. Then, the customer would contact the company immediately and receive a necessary assistance to resolve the accident.

❍ Replacing Car

The company may issue a replacement car at a nearest rental center.

❍ Repairing Car

The company may bring the car to a service shop and get it repaired.

❍ Insurance Claim

The company checks for the insurance coverage for the accident. If applicable, the company processes an insurance claim for the repair or a reimbursement fee if the car is discarded.

❍ Claiming Repair Fee to Customer

If the insurance coverage is not enough for the accident, the company proceeds to claim the necessary fee to repair the car or a reimbursement fee if the car is discarded.

❍ Discarding Car

If the car in accident is not repairable or the repair fee is too high, the company may discard the car without a repair.

3.10. Return Management

This functionality is to assist the operations for returning rental cars.

❑ **Return by Due Date/Time**

If a car is returned by the due, the staff checks for the current mileage, the fuel level, and the car condition. The company computes any additional fee for the mileage driven and the fuel level and receives the payment for the additional fee.

If the car is not in the original condition at the time of checkout, the staff assesses the severity and may purpose a necessary action for the car condition such as collecting a repair fee.

❑ **Return after Due Date/Time**

If a car is returned after the due, the staff check the additional rental fee in addition to the routine checking. And, the staff receives the payment for the additional rental fee as well as other fees applied.

In either case, the staff wraps up the rental operation and issues a final receipt to the customer.

3.11. Business Analytics

This functionality is to perform various analytics on the car rental operations. The system generates business analytics reports periodically or on demand. Also, the system allows various business-related inquires entered by staffs.

The business analytics are performed on car inventories, rentals, reservations, repairs, and profit summary. And, the system may utilize conventional statistical analysis and/or machine learning-based analytics.

4. Non-Functional Requirements

There can be several non-functional requirements that are essential in the target system. We consider the following NFR items initially.

4.1. NFR-1. Assisting High Net Profitability from Business

Design the system that can effectively assist the rental-related operations to yield high net profits from the business. A net profit is the amount of earning by subtracting various business expenses from the rental-related revenue.

The general principle of high net profits for car rental companies is to maximize the revenue from rentals and to minimize the expenses. Therefore, the system should assist the operations to maximize the rental revenues and minimize the expenses.

The system should provide a comprehensive set of analytics on the business operations in quantitative manner. The relevant staffs then utilize the analytics results in generating high profits. The system may even make specific suggestions for the business decisions made by staffs such as smart pricing on rental fees, car models to carry, optimal level of inventories for each rental center, and policies on insurance fees.

4.2. NFR-2. Providing High Applicability of the System

The applicability of a system is the extent of the target system fulfilling the functional and non-functional requirements set by various car rental companies. That is, the applicability of the system is to measure how widely the target system can be utilized in various car rental companies.

Design the system that provides a high applicability to various car rental companies. Although there exists a high commonality on the car rental operations, practices, and policies among car rental companies, there can be a minor variability on the functionality among the companies. Hence, the system has to be designed with the known and potential variability in advance, then the system would have a high applicability and a high business value.