## 

**Final Year Project Report**

**(Product Based)**

**Project Name: PharmaChain**

****

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**Submitted By:**

**Session**

**University of Management and Technology**

**C-II Johar Town Lahore Pakistan**

**Dedication**

## 

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(If any)

**Acknowledgment**

**Project Title**

**Objective**

**Undertaken by**

**Supervised by**

**Starting Date**

**Completion Date**

**Tools Used**

**Operating System**

**Documentation**

**Plagairism Report**

**Declaration Form**

I have carefully examined the documentation of the Final Year Project titled *“Project title”*; and I endorse that this documentation complies with the standards of an undergraduate level Final Year Project report.

The document has been checked for plagiarism through Turnitin software available in UMT Library. The similarities of the document are within acceptable range.

Moreover, the accompanying CDs contain PDF of the documentation, as well as the source code and binaries with user manual and installation guide.

**FYP Advisor Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Abstract**

Revision Chart

This chart contains a history of this document’s revisions. The entries below are provided solely for illustration purposes. Those entries should be deleted until the revision/s they refer to have actually been created.

The document itself should be stored in revision control, and a brief description of each version should be entered in the Revision Control System. A brief description can be repeated in this section. Revisions need not be described elsewhere in the document, unless they explain the document.

| Version | Primary Author(s) | Description of Version | Date Completed |
| --- | --- | --- | --- |
| *Draft* | TBD | Initial draft created for distribution and review comments | (To be decided) TBD |
| *Preliminary* | TBD | Second draft incorporating initial review comments, distributed for final review | TBD |
| *Final* | TBD | First complete draft, which is placed under change control | TBD |
| *Revision 1* | TBD | Revised draft, revised according to the change control process and maintained under change control | TBD |
| *Revision 2* | TBD | Revised draft, revised according to the change control process and maintained under change control | TBD |
| *Etc.* | TBD | TBD | TBD |

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## Definitions and Acronyms

*Provide definitions or references to all the definitions of the special terms and acronyms used within this document*

e.g

Table 1

|  |  |
| --- | --- |
| **Acronym** | **Definition** |
| L1 | Layer 1 Blockchain ( eg. Ethereum ) |
| L2 | Layer 2 Blockchain build on top of another blockchain |
| EOA | Externally Owned Accounts |
| CA | Contract Accounts |
| Metamask | Crypto wallet for interaction with decentralized applications |
| RFID | Radio-Frequency Identification |
|  |  |

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New figures that are given captions will be added to the table automatically.

* **Insert caption:**
  1. select picture
  2. right click
  3. select “insert caption”
  4. under “options”, choose label as “figure”
  5. Under “caption”, an automatic insertion of “figure no” will appear. Give your figure an appropriate caption
* **Update list of figures:**To update this list in Microsoft Word, put the cursor anywhere in the table and press F9.
* **Note:**  If you want the table to be easy to maintain, do not change it manually.

Figure 1: sample use case diagram with explanation 10

Figure 2: System Architecture **Error! Bookmark not defined.**

## List of Tables

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* **Insert caption:**
  1. select picture
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  3. select “insert caption”
  4. under “options”, choose label as “table”
  5. Under “caption”, an automatic insertion of “table no” will appear. Give your table an appropriate caption
* **Update table:** To update this table of contents in Microsoft Word, put the cursor anywhere in the table and press F9.
* **Note:**  If you want the table to be easy to maintain, do not change it manually.

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[Table 2: list of stakeholders](#_Toc470104184) **[Error! Bookmark not defined.](#_Toc470104184)**

# Introduction

*This section should describe the project and the software product being to be built. No text is necessary between the heading above and the heading below unless otherwise desired.*

## Motivations

*We chose the PharmaChain project because we wanted to tackle real-world problems in the pharmaceutical industry. There are issues with the current way medicines move through the supply chain – it's not always transparent, and there's a risk of fake drugs reaching people. We aim to fix this by using new technologies like RFID, temperature monitoring, blockchain, and QR codes. Our goal is to create a system that ensures medicines are safe, of high quality, and can be tracked at every step. This way, we hope to make a positive impact on people's health by preventing theft, fighting against fake drugs, and providing a way to keep a close eye on medicine deliveries in real-time.*

## Project Overview

The PharmaChain project aims to make sure that medicines reach people safely and are of high quality. We're developing a system that uses technologies like RFID, temperature monitoring, blockchain, and QR codes. This system will help track medicines in real-time, making the supply chain transparent. It also prevents fake drugs by using QR codes with unique serial numbers and other features. Additionally, we're improving quality control by monitoring the temperature of sensitive medicines. The system enhances security to stop theft during transportation and quickly manages product recalls if there are any issues. Ultimately, PharmaChain creates a safer and more reliable way to deliver good-quality medicines to people worldwide.

Following are the sample artifacts for this section:

* Problems or Overview Statement
* Customer
* Goals
* System functions
* System attributes

## Problem Statement

The pharmaceutical industry faces critical challenges in supply chain management, leading to a lack of transparency, compromised quality control, and the proliferation of counterfeit medicines. Current systems often fail to ensure the safe and efficient movement of pharmaceuticals from production to the end user, posing significant risks to public health.

The PharmaChain project addresses these issues by integrating RFID, temperature monitoring, blockchain, and QR code authentication to establish a secure and transparent supply chain. This initiative seeks to eliminate counterfeit drugs, enhance quality control, and provide real-time tracking, thereby safeguarding the health and well-being of consumers globally.

## Objectives

The objectives of the PharmaChain project are:

* **Enhanced Transparency:** Implementing a system that provides real-time visibility into the pharmaceutical supply chain, allowing stakeholders to track the movement of medicines from manufacturing to delivery.
* **Quality Control Improvement:** Utilizing RFID technology and temperature monitoring to ensure adherence to specified temperature ranges for temperature-sensitive medicines, thereby elevating quality control standards.
* **Counterfeit Prevention:** Integrating a robust authentication system with QR codes, individual serial numbers, scratch-able covers, and a comprehensive reporting mechanism to deter and prevent the circulation of counterfeit medicines.
* **Security Measures:** Incorporate stringent security protocols to mitigate the risks of theft during transportation and throughout the supply chain, ensuring the safe delivery of pharmaceuticals to end consumers.
* **Blockchain Integration:** Implementing blockchain technology to secure and tamper-proof the recording of every step within the supply chain, ensuring data integrity and fostering confidence in the pharmaceutical ecosystem.
* **Efficient Recall Mechanism:** Developing and implementing a recall mechanism to manage and record product recalls swiftly in response to quality issues or safety concerns, minimizing potential risks to consumers.
* **Proactive Decision-Making:** Provide a platform that enables proactive decision-making at every stage of the supply chain, empowering stakeholders to respond swiftly to potential issues and ensure the timely delivery of high-quality medicines.

# Domain Analysis

## Customer

A brief description of the client with whom you are working (or the potential customers). The organization, its products/services etc.**You will fill this section only if you have a client (contracted) .**

## Stakeholders

Table 2

|  |  |
| --- | --- |
| **Stakeholder** | **Role in System** |
| Project Team | Actively involved in the development of the PharmaChain system, responsible for the design, coding, testing, and documentation of the project. Ensures the project meets specified requirements and objectives. |
| University Supervisor | Provides guidance, feedback, and evaluation throughout the development process. Ensures the project aligns with academic standards and contributes to the student's learning objectives. |
| Project Advisors | Offers subject matter expertise and guidance to the project team. Provides assistance in resolving technical challenges and ensures the project's academic and technical integrity. |
| Manufacturers | Input data during the production phase. Responsible for ensuring accurate and timely information about batches of medicines entering the supply chain. |
| Distributors | Facilitate the distribution of medicines to various points in the supply chain. Use the system to track and manage the movement of pharmaceuticals. |
| Retailers | Receive medicines from distributors and make them available to end consumers. Utilize the system to ensure the authenticity and quality of the products on their shelves. |
| Consumers | End users who purchase and use pharmaceutical products. Authenticate medicines through QR codes, ensuring they receive genuine and high-quality medications. |
| Security Personnel | Responsible for overseeing and ensuring the security measures in place to prevent theft or unauthorized access. |
| Regulatory Authorities | Monitors and regulates the pharmaceutical industry. Ensures the PharmaChain system complies with industry standards and regulations, contributing to the safety and quality of pharmaceuticals. |
| System Administrator | Manages and maintains the PharmaChain system. Responsible for the smooth operation, troubleshooting, and updates of the system. |

## Affected Groups with social or economic impact

Following are the affected groups with social or economic impact resulting from the deployment of the PharmaChain system. The impacts on these groups align with specific project objectives, ranging from enhanced quality control to improved transparency and security measures.

* **Pharmaceutical Manufacturers:**

**Impact:** Manufacturers benefit from improved quality control facilitated by RFID enabled temperature monitoring. The RFID technology ensures unique identification and continuous tracking of medicine batches, contributing to the objective of quality control improvement.

* **Distributors and Retailers:**

**Impact:** Distributors and retailers have improved visibility into the movement of medicines, facilitated by RFID enabled real-time tracking. RFID tags on medicine batches contribute to proactive decision-making at every stage of the supply chain, aligning with the objective of real-time tracking system implementation.

* **Consumers:**

**Impact**: Consumers gain assurance of the safety and authenticity of medicines through the RFID enabled QR code authentication system. RFID tags on medicine packs contribute to unique identification, preventing counterfeiting and ensuring the delivery of high-quality medicines.

* **Regulatory Authorities:**

**Impact:** Regulatory authorities experience enhanced transparency in the pharmaceutical supply chain, thanks to RFID enabled real-time tracking. The integration of RFID technology aligns with the objective of regulatory compliance and data integrity in the PharmaChain system.

## Dependencies/ External Systems ( FIX THIS )

The successful completion of the PharmaChain project relies on the integration and collaboration with various external systems and technologies. These dependencies include:

* **RFID Technology:**

The project relies on RFID technology for unique identification and continuous tracking of medicine batches throughout the supply chain.

* **Blockchain Infrastructure:**

Integration with a secure and reliable blockchain infrastructure is crucial to ensure the tamper-proof recording of every step within the pharmaceutical supply chain.

* **Temperature Monitoring Systems:**

The project depends on temperature monitoring systems to guarantee adherence to specified temperature ranges for sensitive medicines, thereby elevating quality control standards.

* **QR Code Generation Systems:**

QR code generation systems are essential for creating unique QR codes with individual serial numbers, scratchable covers, and robust reporting mechanisms for scanned codes, contributing to the counterfeit prevention objective.

* **Email Notification System:**

The project relies on an email notification system to notify stakeholders in specific situations, enhancing communication and ensuring timely responses.

* **Metamask Wallet for Authentication:**

Integration with the Metamask wallet is crucial for authentication purposes, providing a secure and user-friendly method for users to access and interact with the PharmaChain system.

* **IT Infrastructure:**

The project requires a robust IT infrastructure for hosting and maintaining the PharmaChain system, ensuring its smooth operation, and efficient recall management.

These dependencies play a crucial role in the successful development, implementation, and functionality of the PharmaChain system, ensuring its effectiveness in addressing the identified objectives.

## Reference Documents

Provide references to all documents that have been consulted during the analysis phase.

### Related Projects

List of all the documents/ projects that you have looked up as reference material for this project along with their links/references. E.g

In order to develop UMTmanagementSystem, we looked up several similar systems. Their details are given below

1. FastManagementSystem(FMS)

Developed by XYZ. The partial documentation was obtained by the XYZ development team and the working of this management software was observed from abcFAST.com.pk

1. BeaconHouse Management System (BHMS)

Developed by ABC. the working of this management software was observed from abcbeaconhouse.com.pk. no relevant documentation was available.

1. “constructing and ideal academic system” (CIAS)

Research paper published by IEEE. The research paper is not available for free. It is only available to IEEE members

### Feature Comparison

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr No. | Comparison Feature | FMS | BHMS | CIAS | remarks |
| 1 | ABC | FMS covers the feature ABC completely as desired | BHMS does not support feature ABC | CIAS suggests that maximum efficiency can be achieved if ABC is implemented using algorithm abc. | Using the ABC feature from FMS and improving it with abc algorithm can provide maximum efficiency |

# Requirements analysis

## Requirements

*This section is can be skipped, if Requirement Specifications document has been developed for the project. Otherwise this section is mandatory.*

*This section may contain*

*End user, operator, support, or integration functions,*

*Performance requirements,*

*Design constraints,*

*Programming language, and*

*Interface requirements.*

*System functions are descriptions of what a system is supposed to do. They should be identified and listed in logical cohesive groups, with their category (priority) assigned. These system functions will be identified as a result of the requirement gathering process conducted with the client. However, in some cases, prior to the development of the Functional Specifications the requirements may already have been listed in a document: if this is so then a reference to the document may suffice.*

*To verify that some* ***X*** *is indeed a system function; it should make sense in the following sentence:*

*The system should do <****X****>*

*The table below gives an example of how system functions can be listed:*

*The Functions column gives a brief one-line description of the required functionality.*

*The Category column refers to the status of the functionality for the proposed system. The options for the Category are defined below.*

*The Attribute column defines the system characteristics. The Details and Constraints column specifies the conditions within which the attribute is applicable. Section 1.12 defines the default Attributes and the related Constraints. In case, the default conditions are to be over-ridden then the conditions can be defined in this table.*

*Function Categories*

|  |  |
| --- | --- |
| ***Functional Requirements*** | ***The services requested by the user*** |
| *Non-Functional Requirements* | *The supporting requirements for functional requirements. Theses include the* ***measureable*** *quality attribute.* |
| *Data Requirements* | *How your data will be stored* |
| *SConstraints* | *by the client On your system* |
| *External interface requirements* | *How will your system connect to other software/components* |

|  |  |  |
| --- | --- | --- |
| **FR\_ID** | **Functional Requirements** | **Description** |
| FR\_1: | Manufacturer Registration | The manufacturer shall be able to register an account on the system. |
| FR\_2: | Distributor Registration | The distributor shall have the ability to register an account on the system. |
| FR\_3: | Provider Registration | The Providers (Pharmacies or Hospitals) shall be able to register an account on the system. |
| FR\_4: | Dashboard for Manufacturer | Upon login, the manufacturer shall be presented with a personalized dashboard displaying relevant information and options. |
| FR\_5: | Dashboard for Distributor | Upon login, the distributor shall be presented with a personalized dashboard displaying relevant information and options. |
| FR\_6: | Dashboard for Provider | Upon login, the provider shall be presented with a personalized dashboard displaying relevant information and options. |
| FR\_7: | Dashboard for Consumer | Upon login, the consumer shall be presented with a personalized dashboard displaying relevant information and options. |
| FR\_8: | QR Code Scanning Process | The consumer shall initiate the QR code scanning process through a designated interface in the system. |
| FR\_9: | Data Display for Scanned QR Code | The system shall retrieve and display relevant data associated with the scanned QR code, including but not limited to batch information, manufacturing details, and distribution history. |
| FR\_10: | Medicine Availability Check for Providers | Providers shall have the functionality to check the availability of specific medicines in their inventory through the system. |
| FR\_11: | Order Placement for Providers | Providers shall be able to place orders for medicines directly through the system. |
| FR\_12: | Real-time Tracking for Distributors | Distributors shall have access to a real-time tracking system to monitor the movement of medicines from manufacturers to their locations. |
| FR\_13: | Recall Notification for Providers | In the event of a product recall, the system shall promptly notify providers about the affected batches and guide them on the necessary actions to be taken. |
| FR\_14: | Temperature Recording for Specific Medicines | The system shall include temperature sensors to record the temperature during transportation for medicines categorized as temperature-sensitive |
| FR\_15: | Temperature Data Storage | The system shall store the recorded temperature data for each shipment of temperature-sensitive medicines securely in the database. |
| FR\_16: | Temperature Display | The system shall provide a display of the recorded temperature data, accessible to authorized actors (Manufacturer, Distributor, Provider) for each shipment of temperature-sensitive medicines. |
| FR\_17: | Expiry Date and Manufacturing Date Display | The system shall display the expiry date and manufacturing date of each medicine to the consumers upon scanning the QR code |
| FR\_18: | Transport Condition Visibility | For temperature-sensitive medicines, the system shall indicate whether the required temperature conditions were maintained during transportation. |
| FR\_19: | Notification for Temperature Deviations | If there are deviations from the specified temperature ranges during transportation for temperature-sensitive medicines, the system shall generate notifications to the concerned parties (Manufacturer, Distributor, Provider). |
| FR\_20: | Exception Handling for Temperature Deviations | The system shall provide a mechanism for stakeholders to handle exceptions resulting from temperature deviations during transportation, ensuring appropriate actions are taken. |
| FR\_21 | RFID Scanner Integration | The system shall integrate RFID scanners for the purpose of scanning RFID cards associated with medicine batches during various stages of the supply chain. |
| FR\_22 | RFID Data Recording | The system shall record relevant information from RFID cards, including Unique Identification Numbers (UIDs) and other pertinent data, for each scanned medicine batch. |
| FR\_23: | Real-time RFID Tracking | The system shall provide real-time tracking capabilities for medicine batches through the RFID system, allowing stakeholders to monitor their movement at each stage of the supply chain. |
| FR\_24: | RFID Information Display | The system shall display the recorded information from RFID cards, such as batch details and movement history, on the respective dashboards of authorized actors (Manufacturer, Distributor, Provider). |
| FR\_25: | RFID Registration for Medicines | Manufacturers shall be responsible for registering RFID information for each batch of medicine in the system before distribution. |
| FR\_26: | RFID Verification for Providers | Providers shall have the ability to verify the authenticity of medicine batches through RFID scanning, ensuring the products received match the recorded information. |
| FR\_27: | RFID Data Security | The system shall implement robust security measures to ensure the confidentiality and integrity of RFID data, preventing unauthorized access or tampering. |
| FR\_28: | RFID Exception Handling | The system shall have mechanisms for handling exceptions related to RFID data discrepancies or errors, notifying stakeholders and guiding them in resolving the issues. |
| FR\_29: | Metamask Wallet Integration for User Authentication | The system shall integrate Metamask wallet functionality to allow users to log in securely using their Metamask wallets. |
| FR\_30: | Metamask Wallet Registration | Users shall have the option to register their Metamask wallet within the system, linking it to their account for streamlined and secure authentication. |
| FR\_31: | Wallet Authentication Process | Upon selecting the Metamask login option, the system shall initiate a secure authentication process, verifying the user's identity based on their Metamask wallet credentials. |
| FR\_32: | Wallet-Based User Profiles | The system shall maintain user profiles linked to their Metamask wallets, storing relevant information such as preferences, transaction history, and security settings. |
| FR\_33: | Wallet-Based Transaction Authorization | For certain actions within the system, additional authorization through the user's Metamask wallet is required, ensuring secure and authorized operations. |

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *RID* | *description* | *Category* | *Attribute* | *Details & Boundary Constraints* |
| *R1.1* | *Record the underway sale – the items purchased* | *non-functional* | *System Response time* | *Price listing within 3 seconds*  *Availability agreement in less than 10 sec* |
| *R1.2* | *Reduce inventory quantities when a sale is committed* | *non-functional* | *Concurrent user load* |  |

## - For certain actions within the system, such as financial transactions or critical updates, the system shall require additional authorization through the user's Metamask wallet to ensure secure and authorized operations.

## List of Actors

The PharmaChain system encompasses the entire pharmaceutical supply chain, from the manufacturing phase to the final delivery of medicines. It involves the integration of RFID technology, temperature monitoring, blockchain, and QR code authentication.

**Manufacturer:** Produces medicines and initiates their entry into the supply chain.

**Distributors:** Facilitates the distribution of medicines to various points in the supply chain.

**Retailer:**Receives medicines from distributors and makes them available to end consumers.

**Consumer:** End user who purchases and uses the pharmaceutical products

**Regulatory Authority:** Monitors and regulates the pharmaceutical industry, ensuring compliance with standards and regulations.

**Security Personnel:** Responsible for overseeing and ensuring the security measures in place to prevent theft or unauthorized access.

**System Administrator:** Manages and maintains the PharmaChain system, ensuring its smooth operation..

## List of use cases

List all the use cases, with a brief description (should not exceed two lines)

Buy Item; captures a sale and its payment

Log In; allow user to provide account information and access the restricted services

**(1) Manufacturer:**

**1. Batch Creation:** Manufacturer creates a new batch of medicines.

**Use Case:** The system allows manufacturers to add new batches, providing details such as production date, expiration date, and product specifications.

**2. RFID Assignment:** Assign unique RFID identifiers to each unit in a batch.

Use Case: Manufacturers associate individual RFID tags with specific units within a batch during the production process.

**3. Quality Control Record:** Log the results of quality control checks during production.

Use Case: System captures and stores information about quality control measures undertaken during the manufacturing process.

**(2) Distributor:**

**4. Receiving Shipments:**

Use Case: The system records the reception of medicine batches, including quantities, timestamps, and relevant details.

**5. Warehouse Inventory Management:**

Use Case: The system provides tools for distributors to track and manage the movement of medicines within their warehouses.

**6. Delivery Scheduling:**

Use Case: Distributors plan and schedule deliveries to providers based on inventory levels and demand.

**(3) Provider (Pharmacies, Hospitals, etc.):**

**7. Order Placement:**

Use Case: Pharmacies and hospitals request specific medicine batches based on demand and stock levels.

**8. Receiving Deliveries:**

Use Case: The system records the reception of medicine batches by providers, updating their inventory accordingly.

**9. Dispensing Medicines:**

Use Case: Pharmacies and hospitals use the system to track the dispensing of medicines to patients.

**(4) Consumer:**

**10. QR Code Scanning:**

Use Case: End consumers verify the authenticity and view the supply chain history of medicines by scanning the QR code.

**11. Viewing Supply Chain History:**

Use Case: End consumers have access to a detailed log of all the nodes the medicine passed through, confirming its authenticity.

**12. Feedback Submission:**

Use Case: Patients use the system to submit feedback or report any issues related to the medicine they have purchased.

**(5) Wallet:**

**13. Authentication using Metamask:**

Use Case: The system integrates Metamask wallet functionality for secure user authentication.

**14. Signing Transaction using Metamask:**

Use Case: Metamask wallet is utilized for secure authorization of critical operations within the system.

**(7) Regulatory Authority:**

**16. Audit Trail Access:**

Use Case: The system maintains an audit trail accessible to regulatory authorities, detailing actions and changes within the PharmaChain system for regulatory auditing purposes.

**(8) System Administrator:**

**17. User Account Management:**

Use Case: The system administrator has the capability to add, modify, or deactivate user accounts, ensuring effective management of system access.

**18. System Maintenance:**

Use Case: The system administrator performs maintenance tasks to ensure the smooth operation and optimal performance of the PharmaChain system.

**(9) Recall Management:**

**19. Recall Execution:**

Use Case: The system facilitates the efficient execution of product recalls, allowing stakeholders (Manufacturer, Distributor, Provider) to manage and record recalls due to quality issues or safety concerns.

**20. Recall Status Tracking:**

Use Case: The system provides real-time updates on the status of product recalls, enabling stakeholders to monitor progress and take necessary actions.

**(10) Temperature Deviation Handling:**

**21. Exception Resolution:**

Use Case: The system guides stakeholders (Manufacturer, Distributor, Provider) in handling exceptions resulting from temperature deviations during transportation, ensuring appropriate actions are taken.

**22. Temperature Deviation Notification:**

Use Case: The system generates timely notifications to concerned parties (Manufacturer, Distributor, Provider) if there are deviations from the specified temperature ranges during transportation.

## System use case diagram

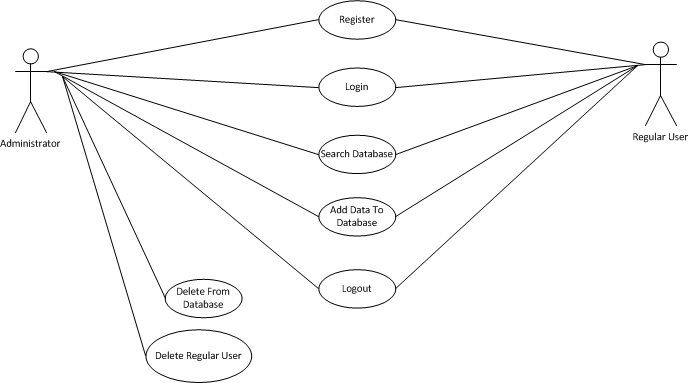


Figure 1: Sample use case diagram with explanation

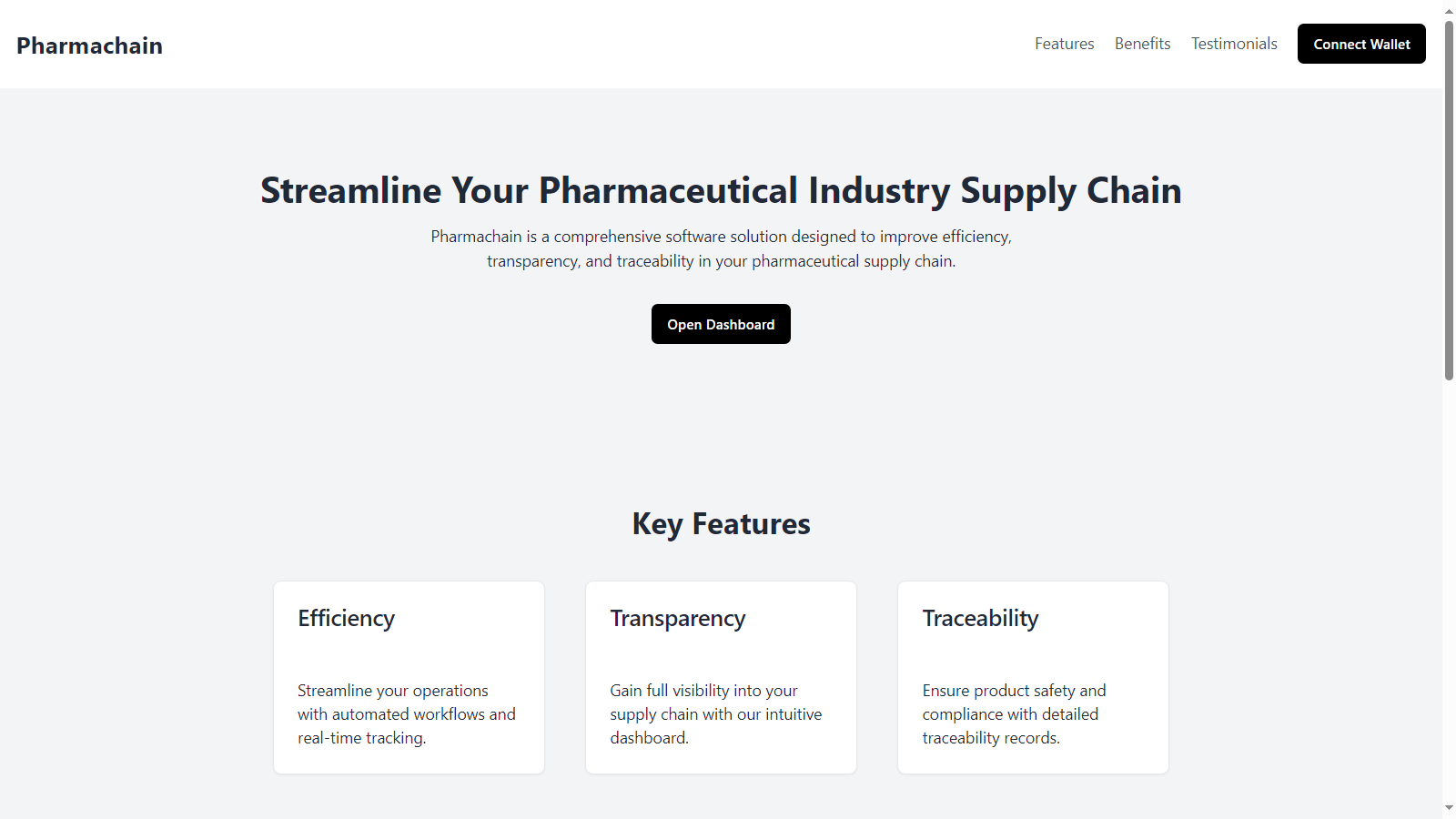
## Extended use cases

Every use case form the list must be elaborated here. E.g

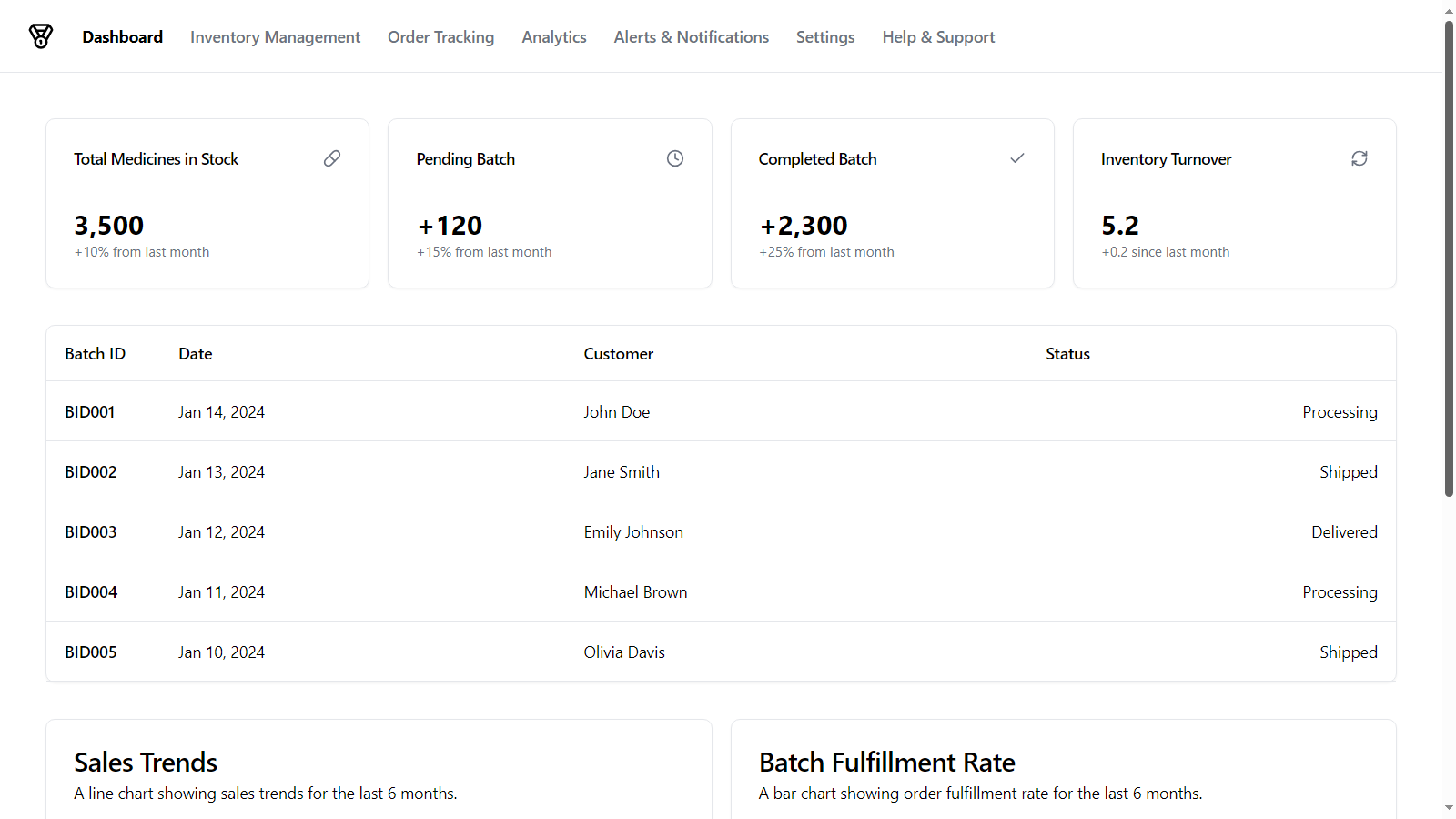
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Use Case ID:** | Enter a unique numeric identifier for the Use Case. e.g. UC-1.2.1 | | | |
| **Use Case Name:** | Enter a short name for the Use Case using an active verb phrase. e.g. Withdraw Cash | | | |
| **Created By:** |  | | **Last Updated By:** |  |
| **Date Created:** |  | | **Last Revision Date:** |  |
| **Actors:** | | [An actor is a person or other entity external to the software system being specified who interacts with the system and performs use cases to accomplish tasks. Different actors often correspond to different user classes, or roles, identified from the customer community that will use the product. Name the actor that will be initiating this use case (primary) and any other actors who will participate in completing the use case (secondary).] | | |
| **Description:** | | [Provide a brief description of the reason for and outcome of this use case.] | | |
| **Trigger:** | | [Identify the event that initiates the use case. This could be an external business event or system event that causes the use case to begin, or it could be the first step in the normal flow.] | | |
| **Preconditions:** | | [List any activities that must take place, or any conditions that must be true, before the use case can be started. Number each pre-condition. e.g.   1. Customer has active deposit account with ATM privileges 2. Customer has an activated ATM card.] | | |
| **Post conditions:** | | [Describe the state of the system at the conclusion of the use case execution. Should include both *minimal guarantees* (what must happen even if the actor’s goal is not achieved) and the *success guarantees* (what happens when the actor’s goal is achieved. Number each post-condition. e.g.   1. Customer receives cash 2. Customer account balance is reduced by the amount of the withdrawal and transaction fees] | | |
| **Normal Flow:** | | [Provide a detailed description of the user actions and system responses that will take place during execution of the use case under **normal, expected** conditions. This dialog sequence will ultimately lead to accomplishing the goal stated in the use case name and description.   1. Customer inserts ATM card 2. Customer enters PIN 3. System prompts customer to enter language performance English or Spanish 4. System validates if customer is in the bank network 5. System prompts user to select transaction type 6. Customer selects Withdrawal From Checking 7. System prompts user to enter withdrawal amount 8. … 9. System ejects ATM card] | | |
| **Alternative Flows:**  **[Alternative Flow 1 – Not in Network]** | | [Document **legitimate** branches from the main flow to handle special conditions (also known as extensions). For each alternative flow reference the branching step number of the normal flow and the condition which must be true in order for this extension to be executed. e.g. Alternative flows in the *Withdraw Cash* transaction:  4a. In step 4 of the normal flow, if the customer is not in the bank network   1. System will prompt customer to accept network fee 2. Customer accepts 3. Use Case resumes on step 5   4b. In step 4 of the normal flow, if the customer is not in the bank network   1. System will prompt customer to accept network fee 2. Customer declines 3. Transaction is terminated 4. Use Case resumes on step 9 of normal flow   Note: Insert a new row for each distinctive alternative flow. ] | | |
| **Exceptions:** | | [Describe any anticipated **error conditions** that could occur during execution of the use case, and define how the system is to respond to those conditions.  e.g. Exceptions to the Withdraw Case transaction  2a. In step 2 of the normal flow, if the customer enters and invalid PIN   1. Transaction is disapproved 2. Message to customer to re-enter PIN 3. Customer enters correct PIN 4. Use Case resumes on step 3 of normal flow] | | |
| **Includes:** | | [List any other use cases that are included (“called”) by this use case. Common functionality that appears in multiple use cases can be split out into a separate use case that is included by the ones that need that common functionality. e.g. steps 1-4 in the normal flow would be required for all types of ATM transactions- a Use Case could be written for these steps and “included” in all ATM Use Cases.] | | |
| **Frequency of Use:** | | [How often will this Use Case be executed. This information is primarily useful for designers. e.g. enter values such as 50 per hour, 200 per day, once a week, once a year, on demand etc.] | | |
| **Special Requirements:** | | [Identify any additional requirements, such as nonfunctional requirements, for the use case that may need to be addressed during design or implementation. These may include performance requirements or other quality attributes.] | | |
| **Assumptions:** | | [List any assumptions that were made in the analysis that led to accepting this use case into the product description and writing the use case description.  e.g. For the *Withdraw Cash* Use Case, an assumption could be:  The Bank Customer understands either English or Spanish language.] | | |
| **Notes and Issues:** | | [List any additional comments about this use case or any remaining open issues or TBDs (To Be Determined) that must be resolved. e.g.   1. What is the maximum size of the that a use can have?] | | |

## User interfaces (mock screens)

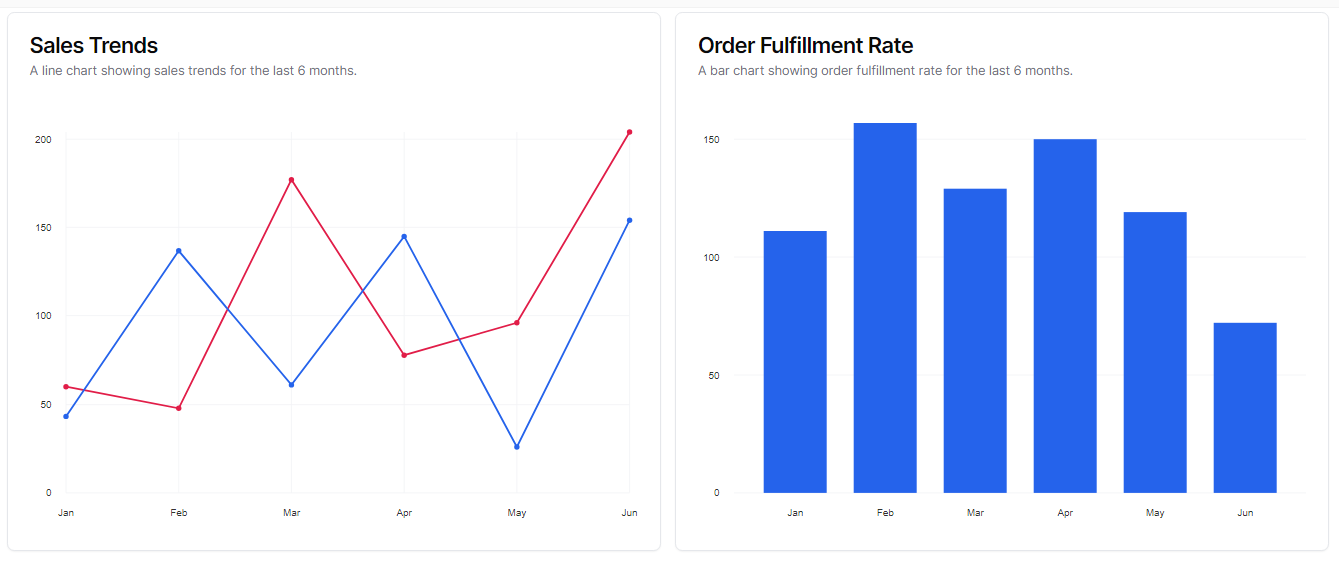
Prototype1: (P1) Landing Page



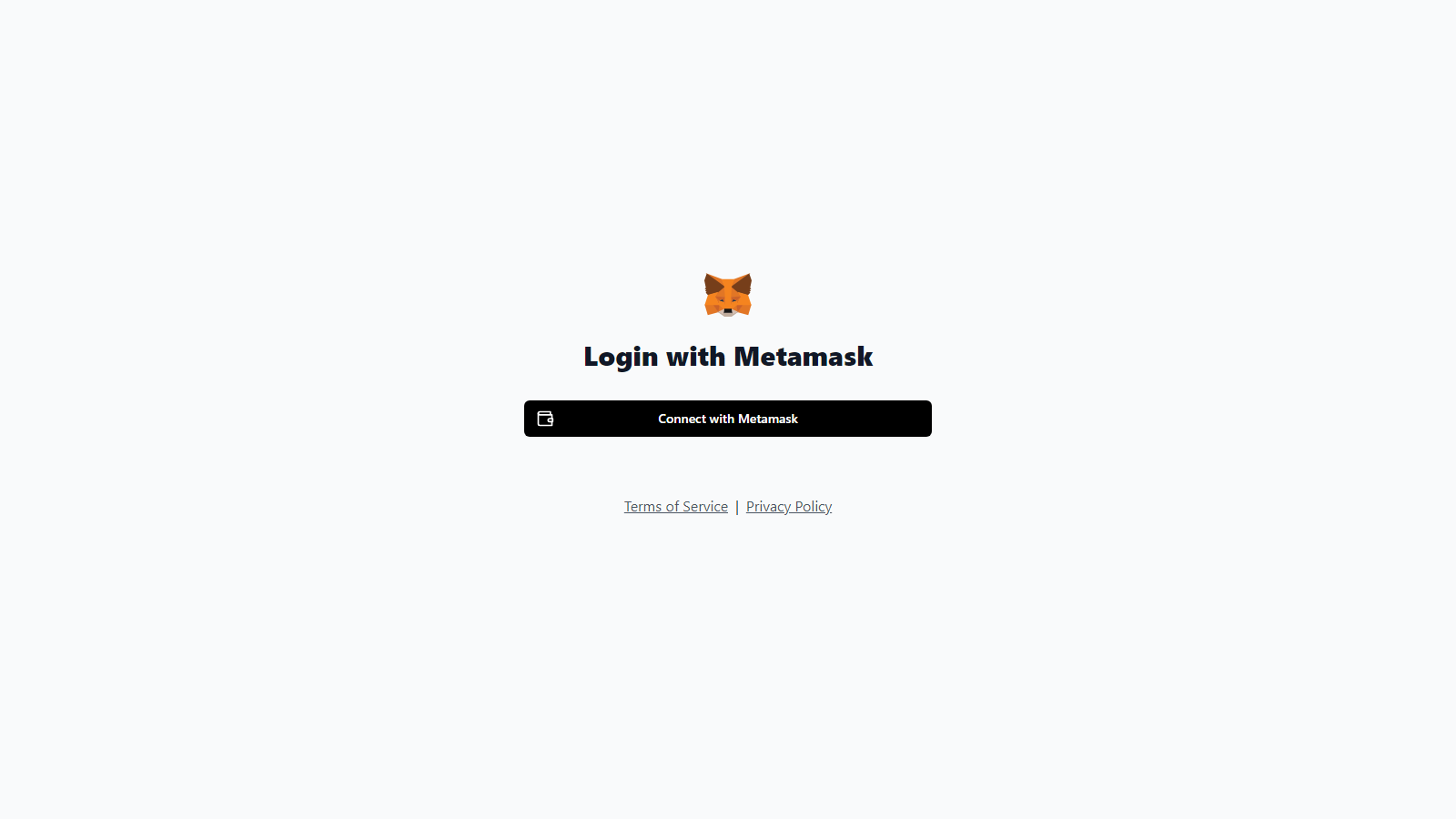
Prototype2: (P2) Dashboard

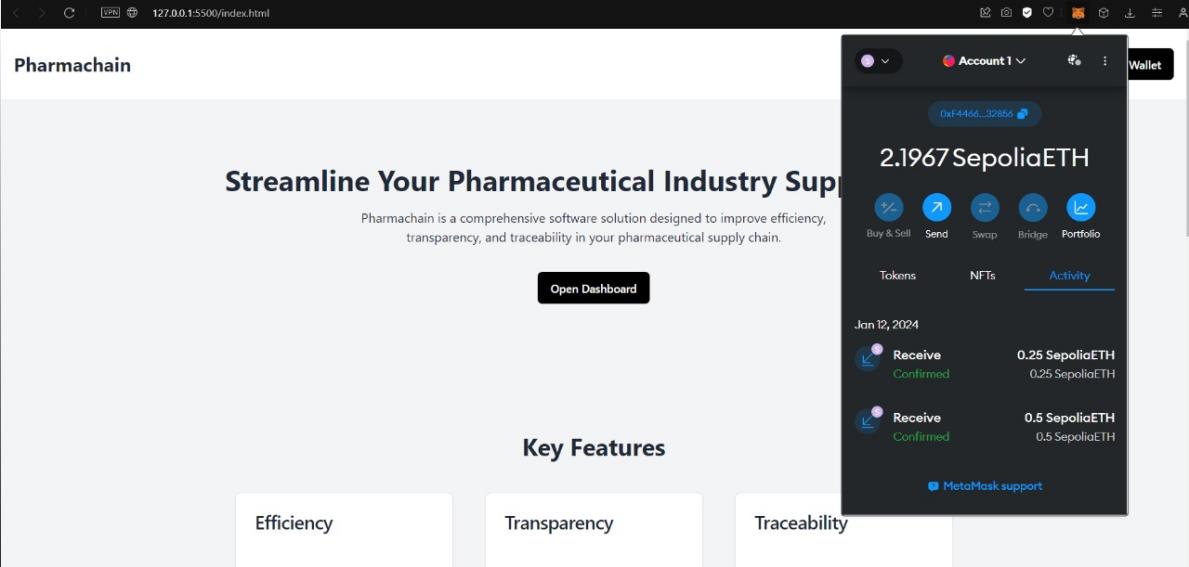


Prototype3: (P3) Sales & Order Chart



Prototype4: (P4) Authentication using Metamask





# Data flow diagram (optional)

## Data Flow Diagram Level 0

Identifies sources and sinks only e.g

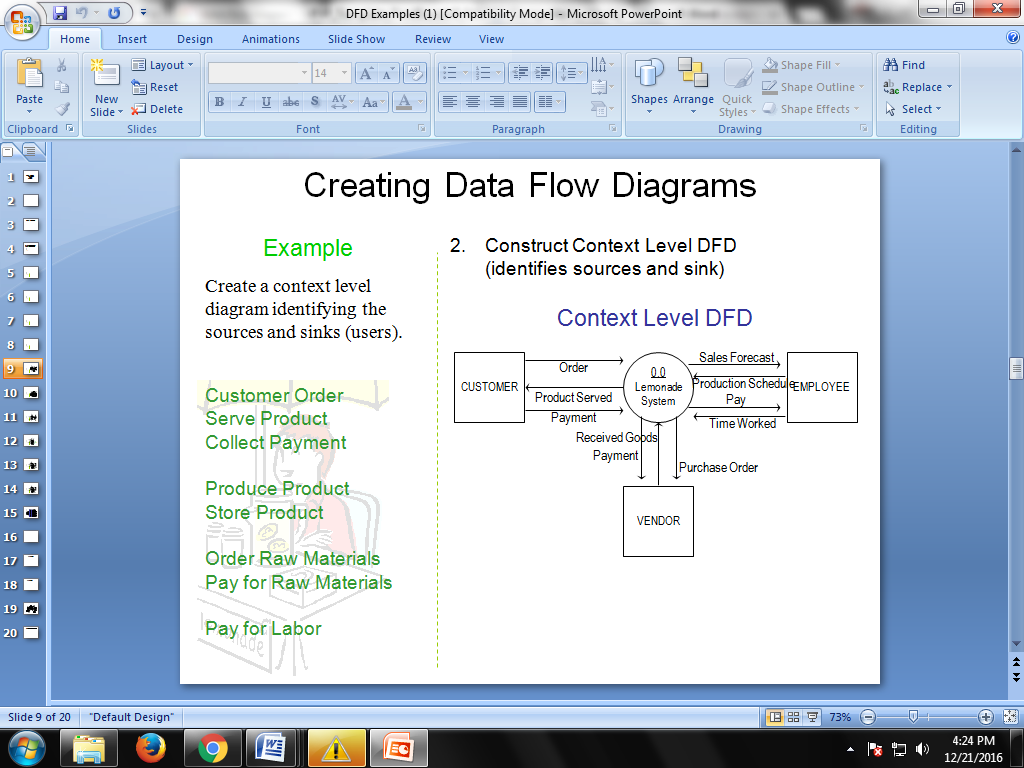


Figure 2

## Data Flow Diagram Level 1

Identifies actual data flows and data storese.g

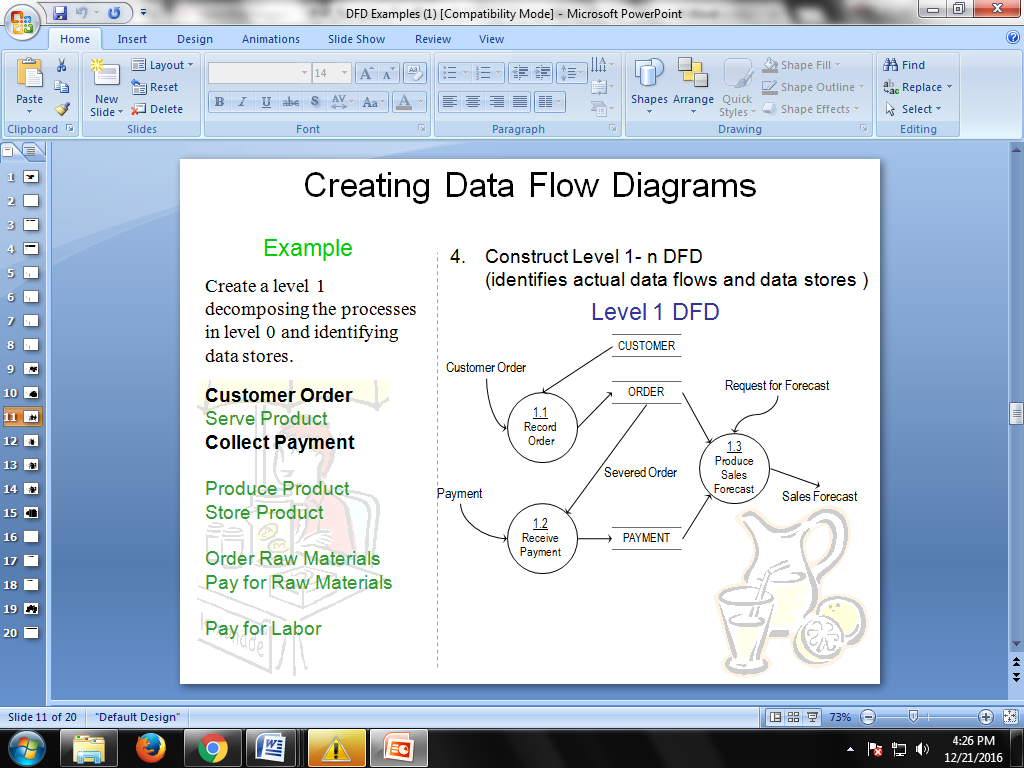


Figure 3

## Data Flow Diagram Level 2

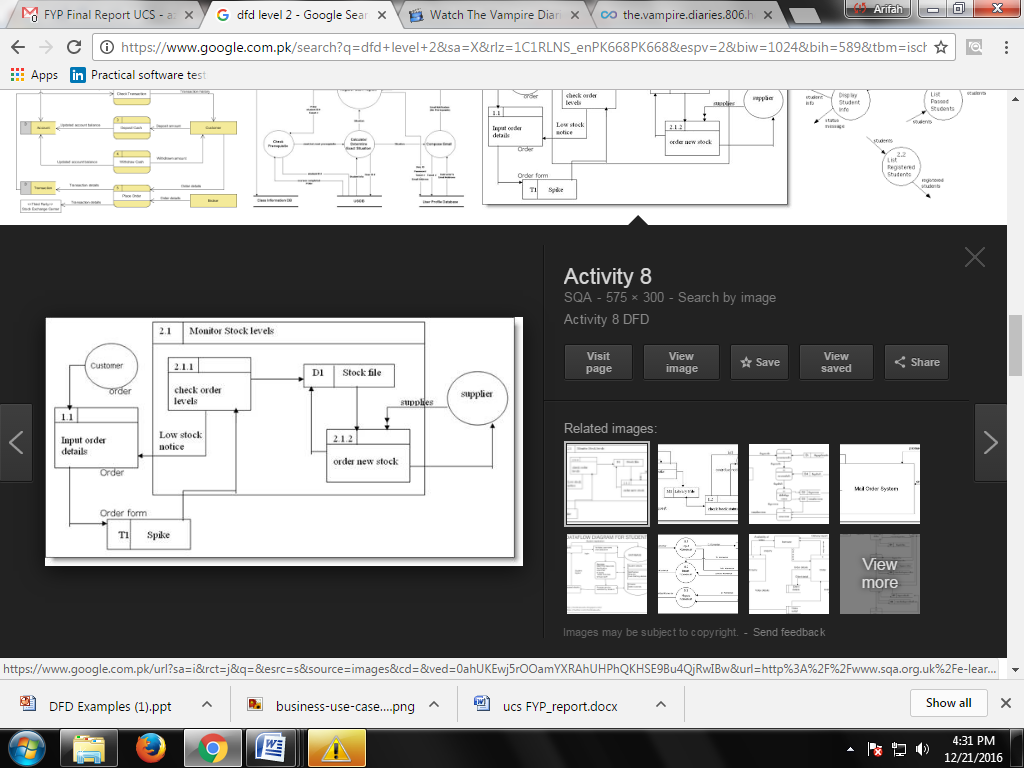


Figure 4

# System Design

Describe the system architecture, or simply provide the architecture diagram. For School system it may include web based front end, webserve , database etc. Don’t worry too much about it just give a simple diagram of a typical web based project.

## System Architecture Diagram



Figure 5 :System Architecture

## Class Diagram

## class-example-online-shopping-domain

Figure 6

## Sequence Diagrams

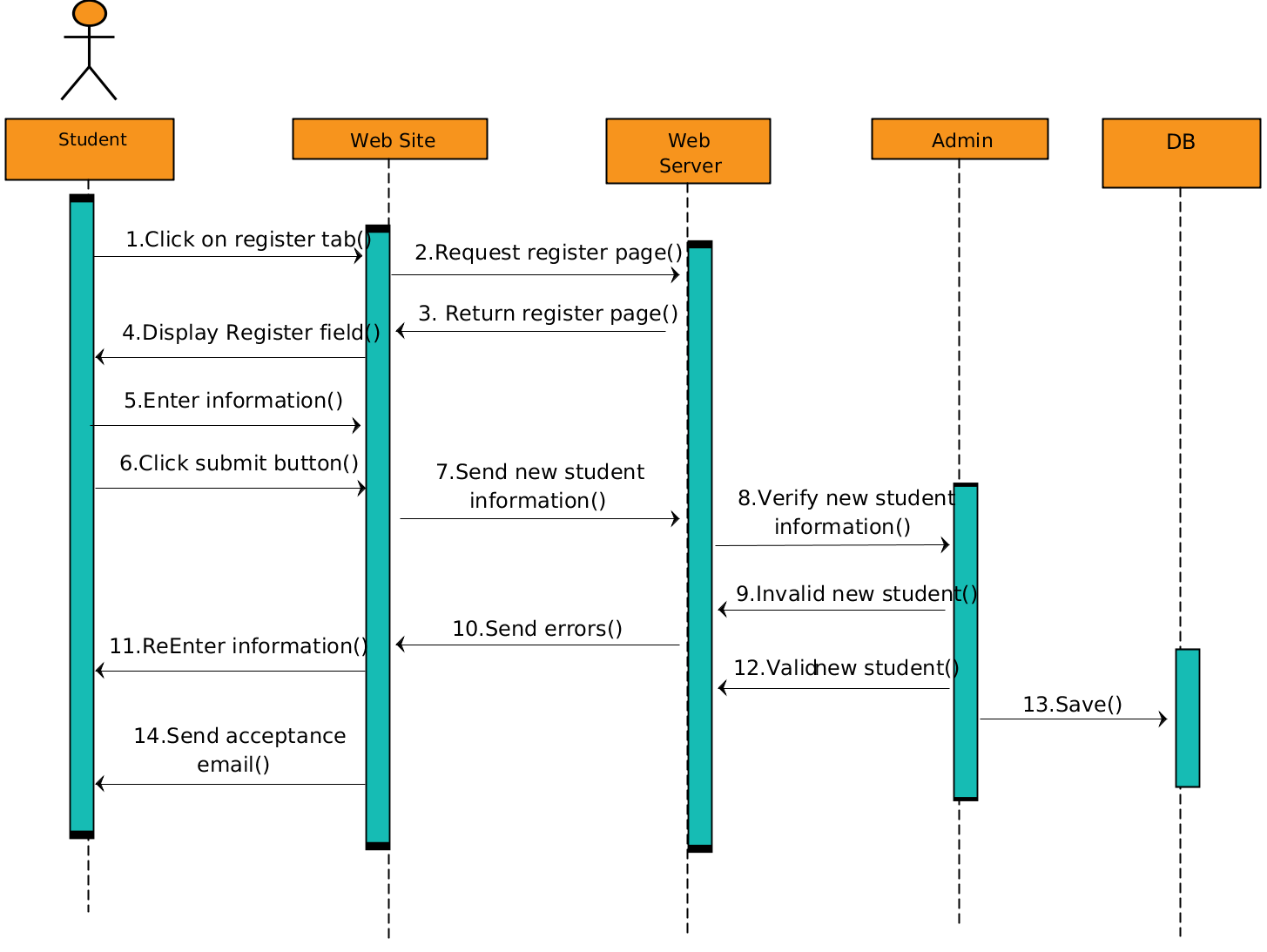


Figure 7

## Collaboration Diagrams

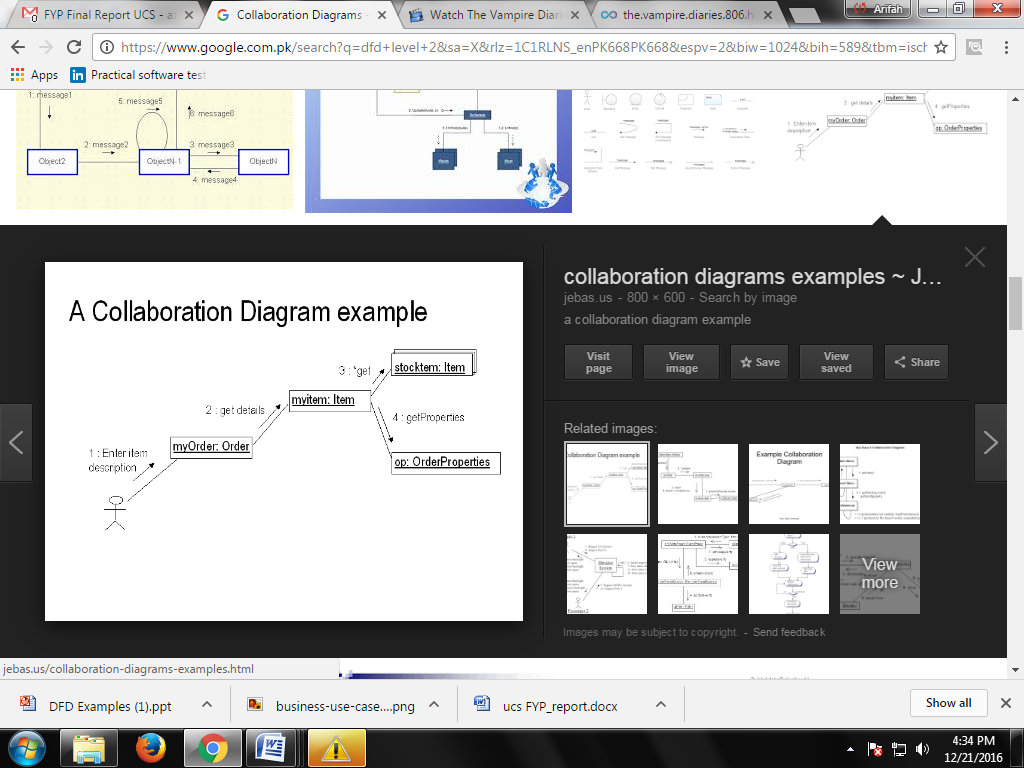


Figure 8

## Other UMLs

This is optional. You may include any other UML to support your system.

## ERD

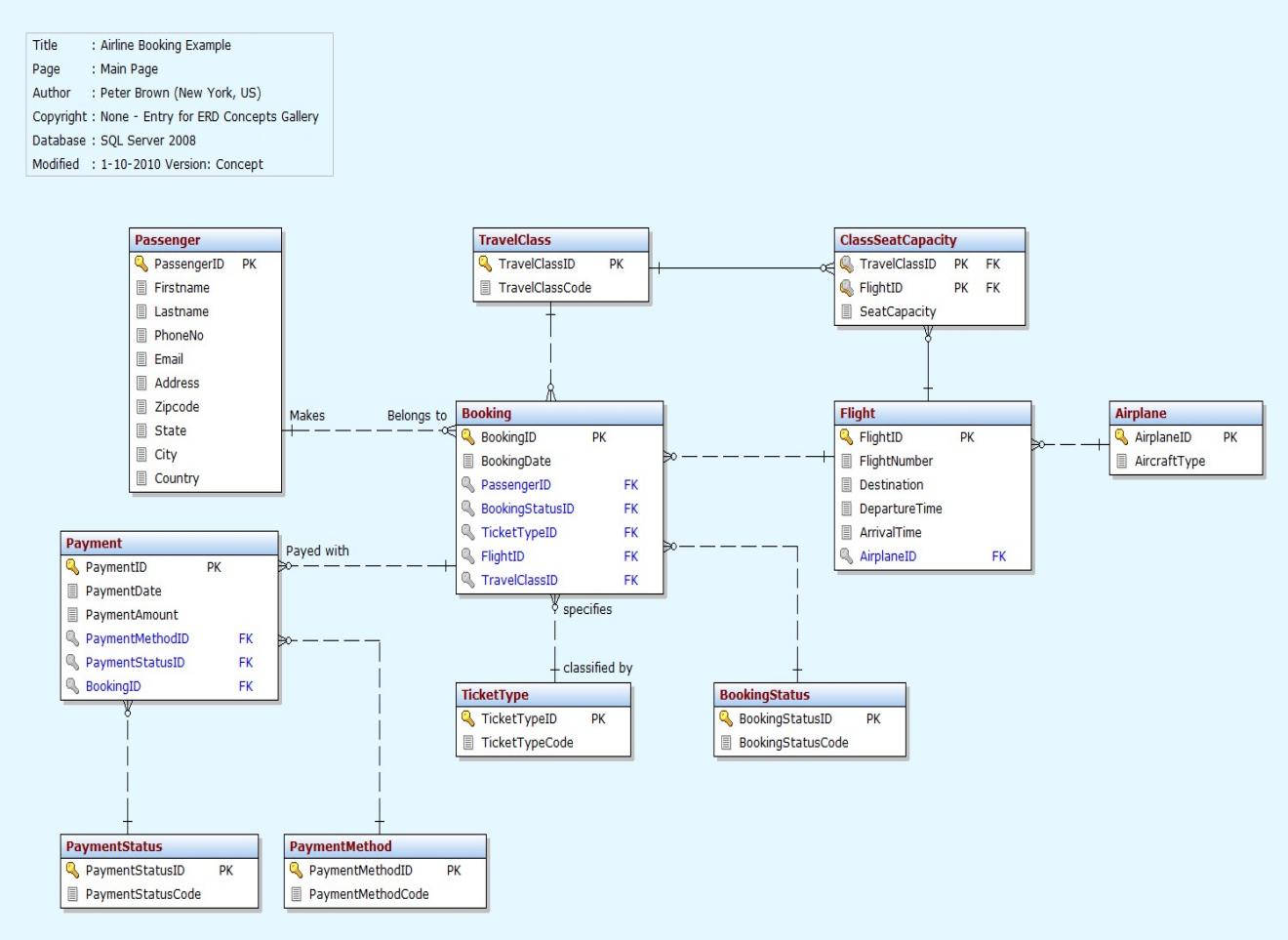


Figure 9

## Data Dictionary

This section may be used to provide the details of interface elements that are present on the screenshots.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element Name | Type | Validation | Mandatory | Remarks |
|  |  |  |  |  |

# Implementation details

## Development Setup

List your tools and technologies and their role in development.

## Deployment setup

How and where was your software deployed? Did you face any problems, how did you overcome these problems.

## Algorithms

Entire code of software is not required. Just highlight your important (user defined/ improved) algorithms.

## Constraints

### Assumptions

Things we assume will be true.

e.g.:

* *We will receive all necessary technical support from the engineers at cMeRun, Select and Mellon Bank to help design the interfaces between their systems and enGyro.*
* *All database maintenance will be handled by the client.*
* *There will be no real-time interfacing with any accounting systems.*

### System constraints

 A constraint specifies how the system must operate or how it must be built

### Restrictions

Constraints applied on the system by the client

### Limitations

Services your software is unable to provide

# Testing

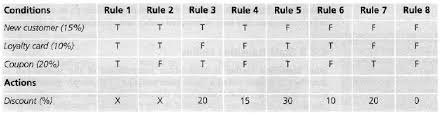
## Extended Test Cases

## 

## Decision Table

### Code snippet

### Decision coverage table



## Traceability Matrix

### RID vs UCID (requirements vs use cases)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UCID/RID** | **R**  **1** | **R**  **2** | **R**  **3** | **R**  **4** | **R**  **5** | **R**  **6** | **R**  **7** | **R**  **8** | **R**  **9** | **R**  **10** | **R**  **11** | **R**  **12** | **R**  **13** | **R**  **14** | **R**  **15** | **R**  **16** | **R**  **17** | **R**  **18** | **R**  **19** | **R**  **20** | **R**  **21** |
| UC 1 | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 2 |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 3 | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |
| UC 4 | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |
| UC 5 | ✓ | ✓ | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 6 | ✓ | ✓ |  | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 7 | ✓ | ✓ | ✓ |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 8 | ✓ | ✓ |  | ✓ |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |
| UC 9 | ✓ | ✓ | ✓ |  | ✓ |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |  |  |
| UC 10 | ✓ | ✓ |  | ✓ |  | ✓ |  |  |  |  |  | ✓ |  |  |  |  |  |  |  |  |  |
| UC 11 | ✓ | ✓ | ✓ |  | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 12 | ✓ | ✓ |  | ✓ |  | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 19 | ✓ | ✓ | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |  |
| UC 20 | ✓ | ✓ |  | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |  |
| UC 21 | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 22 | ✓ | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UC 23 | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |  |
| UC 24 | ✓ | ✓ |  | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |  |
| UC 25 | ✓ | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |  |
| UC 26 | ✓ | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |  |
| UC 27 | ✓ | ✓ | ✓ | ✓ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ✓ |

### Prototypes (RID vs PID)

### Test Cases (RID vs TID)

### Coverage (UCID vs TID)

# Results/Output/Statistics

## %completion

Use the matrix & values from 7.3.1 to show that all requirements are being fulfilled.

## %accuracy

Use the matrix & values from 7.3.3 to show that all requirements have been implemented correctly.

## %correctness

Use the matrix & values from 7.3.4 to show that all requirements have been tested to be conforming to requirements.

# Conclusion

# Future work

# Bibliography

Use IEEE or ACM format for citations

## Books

## Journals

## Articles

## Research papers

## Other References

# Appendix

## Glossary of terms

## Pre-requisites

Must use contents of development/ deployment setup & external system dependencies