1 Task 1.1

Question 1. Identify the context of this project. Who are relevant stakeholders? What are their current needs? What could be their current problem? In your opinion, what benefits UWC 2.0 will be for each stakeholder?

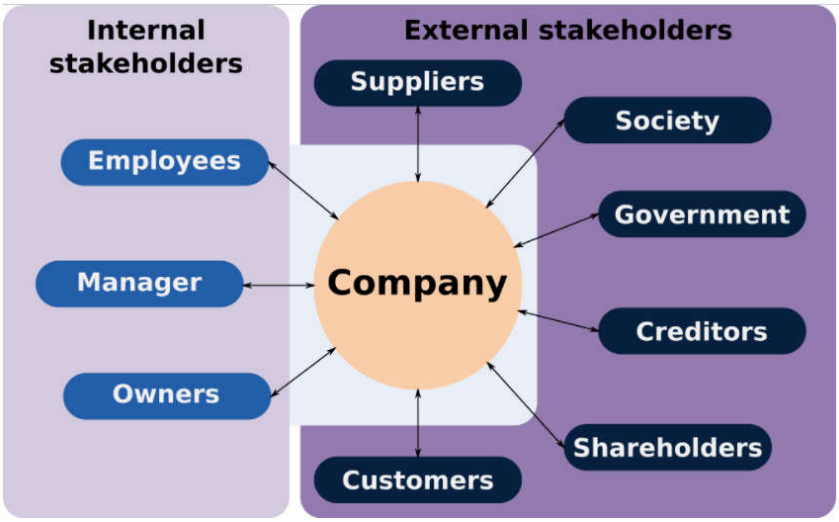
Solution

1.1 Context of this project - Background information

> "In 2015, United Nations adopted the Sustainable Development Goals (SDGs) as a universal call for action to end poverty, protect the planet and ensure that by the end of 2030, every human can enjoy peace and prosperity."

With the goal of sustainable development, adherence to the SDGs regulations should be taken into consideration whenever launching any development or economic growth projects. However, given the situation in developing countries around the world, the treatment of waste in urban areas is an urgent problem because it violates SDGs 6 – clean water and sanitation and SDGs 11 – Sustainable cities and communities. As a result, governments and businesses in these countries are concentration their efforts on mitigating the harmful effects of industrialization on the city, society and the environment
With that in mind, we created the UWC 2.0 product to aid in urban waste management.

1.2 Relevant stakeholders



Stakeholders: are related parties that have effects on or be affected by the company in various aspects. Stakeholders can be divided into two categories: either internal stakeholders (individuals and parties that are parts of the organizations) or external stakeholders (not part of the organization but affected by the company).
In the context of developing UWC 2.0, the stakeholders can be determined as follow:
Internal stakeholders:

- **Organization X**: because they are the one who contracted to develop the UWC 2.0 software to aid urban management systems.
- **Service Provider Y**: because they will be the one who receive the UWC 2.0 software and deploy it on cities scope.
- **Back officers**: because they create calendars and plans for collectors and janitors.
- **Collectors**: because they are the ones who work with the janitors to collect waste.
- **Janitors**: because they directly collect waste.

External stakeholders:

- **Government**: because they are interested in proposing solutions to mitigate the impact that industrialization in metropolitan areas causes to the environment.
- **Society**: because the UWC 2.0 assists urban waste collection, which in turn affects the surrounding environment.

1.3 Stakeholders' current needs

For each stakeholder, their needs may be different.

- **Government:** need a way to balance development and economic growth while still protecting the environment and following SDGs. To be more specific, they need a better waste management method to stop unhandled trash from contaminating pure source of water and land areas.
- **Society:** need to live in unpolluted areas and information about the waste collection plans. In detail, urban citizens also need better waste management methods so that the surrounding environment is fresh and clean. Also, the need for waste collection plans is crucial because they can classify trash into different categories and hand them to the janitors on schedule.
- **Back officers:** also need a better waste management method so that they can easily plan which vehicles collectors will use, determine the specific routes for collectors, and keep track of the activity.
    1. Have an overview of janitors and collectors, their work calendar.
    2. Have an overview of vehicles and their technical details (weight, capacity; fuel consumptions, etc)
    3. Have an overview of all Major Collection Points and information about their capacity. Information should be updated from Major Collection Points every 15 minutes with the availability of at least 95 percent of their operating time.
    4. Assign vehicles to janitors and collectors.
    5. Assign janitors and collectors to Major Collection Points.
    6. Create a route for each collector. Assigned routed is optimized in term of fuel consumption and travel distance.
    7. Be able to send messages to collectors and janitors.
- **Collectors and janitors:** also need a better waste management: need to know which vehicle to use, which route to follow and when to gather waste to Major Collection Points.
    1. Have an overview of their work calendar.
    2. Have a detailed view of their task on a daily and weekly basis. All important information should be displayed in one view (without scrolling down).
    3. Be able to communicate with collectors, other janitors and back officers. The messages should be communicated in a real-time manner with delay less than 1 second.
    4. Check in / check out task every day.
    5. Be notified about the Major Collection Points if they are fully loaded.

⇒ All of the stakeholders are interested in a software that aid urban waste collection.

1.4 Stakeholders' possible current problems

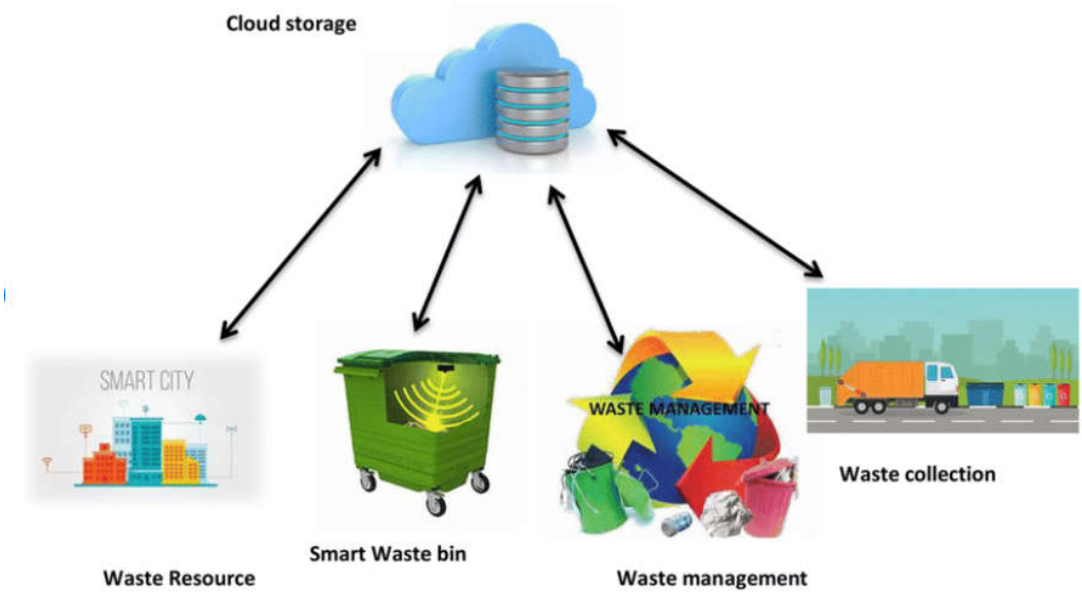
Current problems:

- **Government:** They could not afford the cost of harming the environment with more development and economic growth projects because it would violate the regulations stated in SDGs.
- **Society:** Citizens can not tolerate living in polluted areas (waste everywhere - uncollected and unhandled) - this could be detrimental to their health and limit their living space.
- **Back officers:** They do not have a clear overview of vehicles and their technical details (weight, capacity, etc) and the calendar of collectors and janitors, so they can not efficiently plan. Moreover, they can not message the collectors and janitors, so if collectors and janitors act incorrectly during the job, they could not guide them the right way.
- **Collectors and Janitors:** For collectors and janitors, it would be difficult for them to use various software simultaneously, including calendar for work shifts, map to follow the correct route, etc. Also, if they face problems during the time doing tasks, they can not message the back officers for help. In some nations, the jobs of collectors and janitors are even more troublesome because of no software available so their information are not digitized. This could, in turn, reduces their productivity.

1.5 Our opinion on the benefits of UWC 2.0 for each stakeholder

For each stakeholder, they can receive different benefits from the software, but in common, a better waste management method.

- **Governments:** A better waste management method provides them the opportunities to focus on more development and economic growth while still adhere to the Sustainable Development Goals.
- **Society:** Citizens can live in a fresher and cleaner environment with no health risk and can be active in handing in domestic waste to the janitors to keep their house clean.
- **Back officers:** They can have better overview of vehicles and their technical details (weight, capacity, etc) to plan and assign tasks efficiently. This could not only reduce fuel consumption but also make their jobs become clear and straightforward. In addition, they will not have to spend too much time training for the collectors and janitors as before.
- **Collectors and Janitors:** They can enjoy a much less stressful task - to take care of multiple things simultaneously. Instead, the UWC 2.0 would provide them with everything they need (from calendar and working shifts, to map, to the ability the message the back officers to ask for help).



2 Task 1.2

Question 2. Describe all functional and non-functional requirements that can be inferred from the project description. Draw a use-case diagram for the whole system

Solution

2.1 Theoretical basis

2.1.1 Functional and nonfunctional requirements

- **Functional requirements:** statements of services the system should provide, how the system should react to certain inputs and what the system behavior should be.
- **Nonfunctional requirements:** describe the system's properties and constraints, such as its availability, response time, I/O device capability.

2.1.2 Use-case diagram

A UML use case diagram is the primary form of system/software requirements for a new software program underdeveloped. Use cases specify the expected behavior (what), and not the exact method of making it happen (how). Use cases represent only the functional requirements of a system.
Use-case diagram is used to:

- Specify the context of a system
- Capture the requirements of a system
- Validate a systems architecture
- Drive implementation and generate test cases
- Developed by analysts together with domain experts

Some basic concepts of use-case diagram includes:

- **Actor:** someone interacts with use case, named by noun, plays a role in the business, similar to concept of user (a user can play different roles).
- **Use case:** system function, named by verb/compound verb. Each Actor must be linked to a use case, while some use cases may not be linked to actors.
- **Communication links:** shows participation of an actor in a use case. Actors may be connected to use cases by associations.
- **Boundary of system:** potentially the entire system as defined in the requirements document.
- **Relationships:**

- **Include:** a use case is depicted as using the functionality of another use case
- **Extends:** indicates that a use case may include (subject to specified in the extension) the behavior specified by base use case.
- **Generalization:** a parent-child relationship between use cases.

2.2 Functional requirements

As a back officer, I would like a system that have two pages:

1. The first page displays the general information about the janitors and collectors such as their name, age, address and their availability at the moment on one side and the vehicles such as their name, models and their availability on the other side. There will also be a drag-and-drop mechanism for me to assign vehicles to team of collectors and janitors.

2. The second page displays the map of all roads and route that the collectors have to travel through to collect garbage. At each MCP, there will be a dropped-down menu for me to assign which collectors will collect at this point.

As a janitor/collector, I would like a system that has: A UI that is a calendar. For each day, it will show some texts on what I have to do that day. When I click on that day, it will detail information on what I have to do. Also, there is a button for me to check in the task and a button for me to report if I am not fit for the task. When I am finished with the task, it will also have a button for me to check out.

2.3 Nonfunctional requirements

- As back officers/janitors/collectors, we expect that the system will be available during normal working hours, with downtime during working hours not exceeding 10 seconds.

- As back officers/janitors/collectors, we expect that the system be able to handle information about 1000 MCPs at the moment and 10000 in five years.

- As back officers/janitors/collectors, we expect that the system's texts and controls be in Vietnamese, with an option to switch to English in the future.

- As Service provider Y, we expect UWC 2.0 to import and to use the existing data from UWC 1.0. We also expect that the Task Management Module from UWC 2.0 to be inter-operable with the Task Management Module from UWC 1.0 as much as possible.

- As a back officer, I would like the map of MCPs to display accurately every possible route leading to the MCPs so that I can assign the best one to the collectors. For each MCP, there should be at least one route to it.

- As a back officer/janitor/collector, I would like the messaging features to send my message the instant I send it, with a delay less than 1 second.

- As a back officer/janitor/collector, I would like the application to encrypt my personal data and messages for my privacy.

2.4 Use-case diagram for the whole system

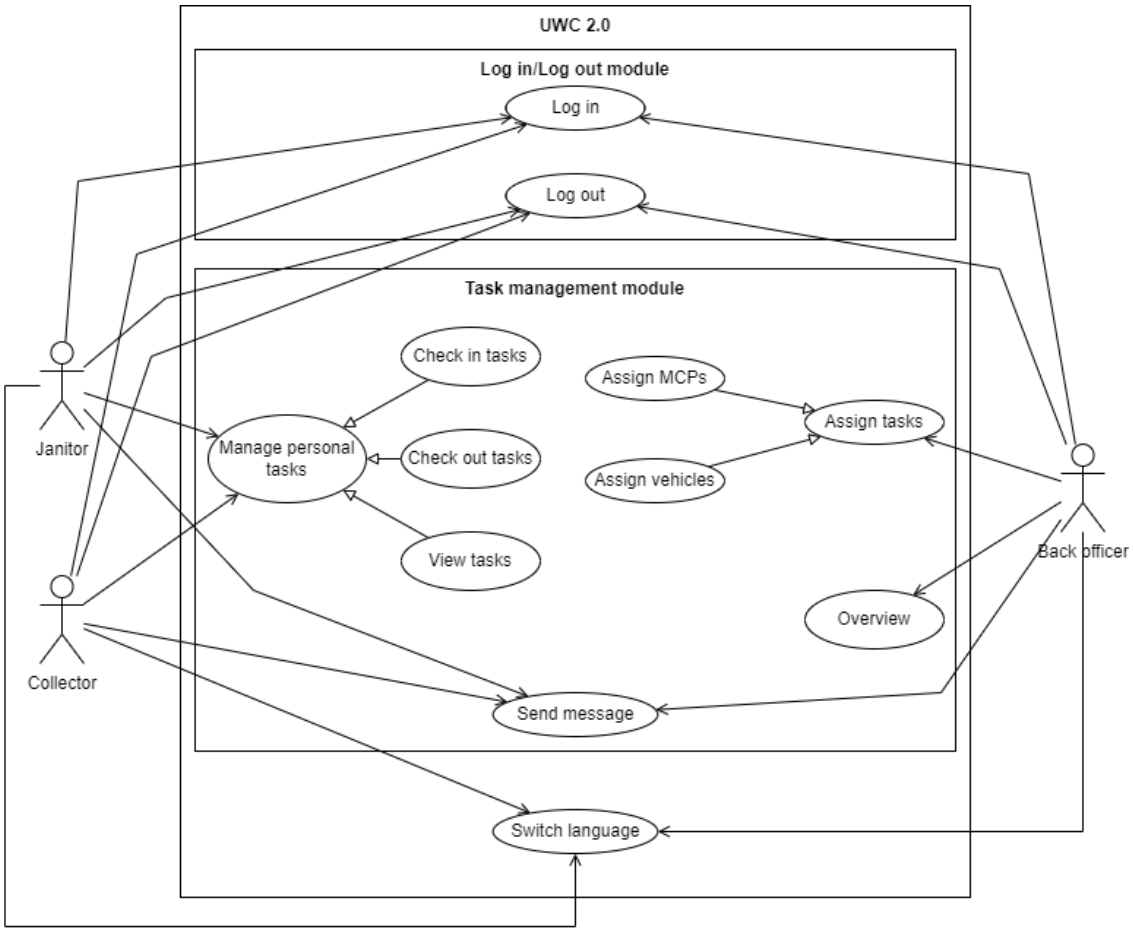


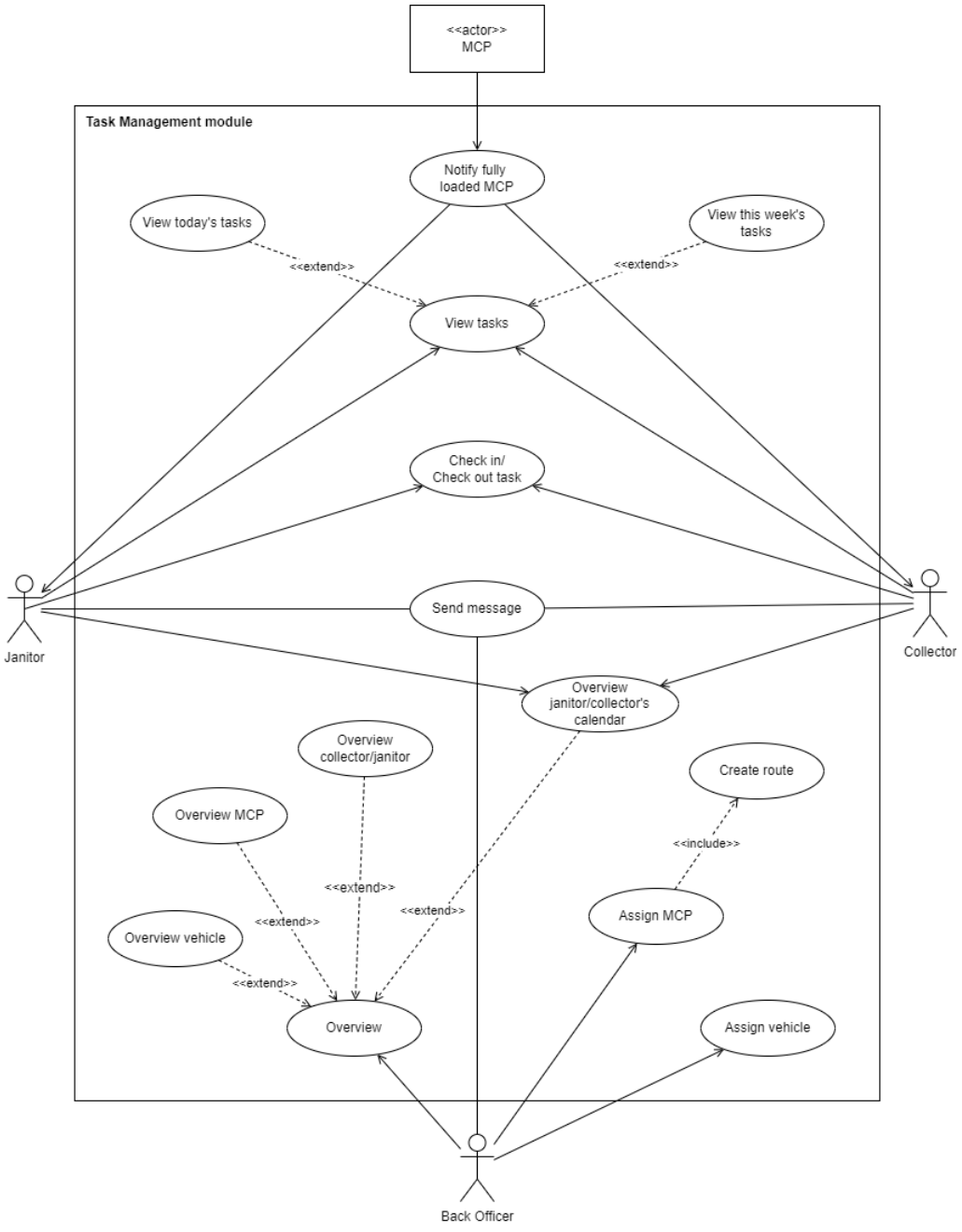
Figure 1: Use-case diagram of UWC 2.0

3 Task 1.3

Question 3. For the Task assignment module, draw its use-case diagram and describe the use-case using a table format

Solution

3.1 Use-case diagram for Task assignment module



3.2 Table description of each use case

a. Overview collectors/janitors:

Use-case ID Use-case name	U1. Overview collectors/janitors.
Use-case overview	To provide information about collectors/janitors.
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	Users click the "Detailed info" button.
Steps	1. Retrieve corresponding information. 2. Display information on the screen of users' devices.
Post conditions	The required information is displayed on the screen of users' devices.
Exception flow	None.

b. Overview collectors/janitors' work calendar:

Use-case ID Use-case name	U2. Overview collectors/janitors' work calendar.
Use-case overview	To provide information about collectors and janitors' schedules.
Actors	Back officers, collectors, janitors.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	When a user press the "Detailed Info" button .
Steps	1. Check the user's privilege. 2. If the user is a back officer, display all calendars. If the user is a collector/janitor, display only their calendar.
Post conditions	The requested calendar(s) is displayed.
Exception flow	None.

c. Overview vehicle:

Use-case ID Use-case name	U3. Overview vehicle.
Use-case overview	To provide information about vehicles and their technical details (weight, capacity, fuel consumption, etc).
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is available. 3. Users click the "Vehicles' overview" button. 4. Internet connection is available.
Trigger	Users click the "Get overview" button.
Steps	1. Users choose vehicles from the list of vehicles. 2. The system creates a list of selected vehicles. 3. Retrieve the information of vehicles in the list from the database. 4. Display all information on the screen of users' devices.
Post conditions	Required information are displayed on the screen of users' devices.
Exception flow	If the list of selected vehicles is empty then a "Please select at least one vehicle" message is displayed.

d. Overview MCP:

Use-case ID Use-case name	U4. Overview MCP.
Use-case overview	To provide information about Major Collecting Points (MCPs) and their current capacity.
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is connected to MCPs. 3. Internet connection is available.
Trigger	Users click the "MCPs' overview" button.
Steps	1. Retrieve all MCPs' information and capacity. 2. Display all information on the screen of users' devices. 3. Update MCPs' capacity every 15 minutes, then retrieve new capacities from the database and overwrite the old capacities with the new ones.
Post conditions	Required information are displayed on the screen of users' devices and are updated every 15 minutes.
Exception flow	None

e. Assign vehicle:

Use-case ID Use-case name	U5. Assign vehicle.
Use-case overview	To assign vehicles to janitors and collectors.
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is available. 3. Users click the "Info modify" button. 4. Internet connection is available.
Trigger	Users click the "Apply changes" button.
Steps	1. Users choose vehicles to assign to janitors/collectors. 2. Update the corresponding information in the database. 3. Change the information displayed on the screen of users' devices.
Post conditions	1. A "Assignment has been completed" message is displayed. 2. The information in the database are updated. 3. The displayed information are updated.
Exception flow	If the vehicle is not available, a "Vehicle is not available" message is displayed.

f. Assign MCP:

Use-case ID Use-case name	U6. Assign MCP.
Use-case overview	To assign janitors and collectors to the MCPs.
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is available. 3. Users click the "Info modify" button. 4. Internet connection is available.
Trigger	Users click the "Apply changes" button.
Steps	1. Users choose MCPs to assign to the janitors/collectors. 2. Update the corresponding information in the database. 3. Change the information displayed on the screen of users' devices.
Post conditions	1. A "Assignment has been completed" message is displayed. 2. The information in the database are updated. 3. The displayed information are updated.
Exception flow	None.

g. Create route:

Use-case ID Use-case name	U7. Create route.
Use-case overview	To create the optimized routes in term of fuel consumption and travel distance.
Actors	Back officers.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	When a collector is assigned to new MCPs.
Steps	1. Retrieve all relevant routes‘ information from the database. 2. Create the optimal routes from the given data. 3. Update the corresponding information in the database. 4. Change the information displayed on the screen of users’ devices.
Post conditions	1. The information in the database is updated. 2. Displayed information is updated.
Exception flow	None.

h. Send message:

Use-case ID Use-case name	U8. Send message.
Use-case overview	To allow communication between back officers, collectors, and janitors.
Actors	Back officers, collectors, janitors.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	A user types out their message, then press “Send” .
Steps	1. The user choose their recipient. 2. The user type their message. 3. The user press “Send”.
Post conditions	1. The message is sent. 2. Whether the recipient is online or not, the message still arrives at their mailbox. 3. The message is retained as a copy in the sender “Sent” box.
Exception flow	When the message sending procedure is interrupted (weak Internet connection,...), a message is displayed to inform the user about the incident and suggest them to try again.

i. View tasks:

Use-case ID Use-case name	U9. View tasks.
Use-case overview	To allow collectors and janitors to see in detail their daily/weekly task in one view.
Actors	Collectors, janitors.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	A janitor/collector press the "View daily/weekly tasks" button.
Steps	1. The user choose whether they want to see their daily or weekly tasks. 2. The tasks are represented.
Post conditions	The user is fully informed of their daily/weekly tasks.
Exception flow	When there is no task, a message is displayed (so that the user doesn't think their app is malfunctioning).

j. Check in/check out task:

Use-case ID Use-case name	U10. Check in/check out task.
Use-case overview	To allow collectors and janitors to inform the system about their arrival/departure.
Actors	Collectors, janitors.
Preconditions	1. The system is running. 2. Database is available. 3. Internet connection is available.
Trigger	A janitor/collector press the "Check in" button when they start their duty and press the "Check out" button when they finish their work.
Steps	1. The user press the button. 2. Based on their initial status, the system will perform the task automatically. If the user hasn't checked in, the system will perform check in function and vice versa.
Post conditions	1. The user is checked in/checked out. 2. Their check in/check out timestamp is saved.
Exception flow	None.

k. Notify fully loaded MCP:

Use-case ID Use-case name	U11. Notify fully loaded MCP.
Use-case overview	Automatically inform (nearest/most optimal) janitors and collectors when a MCP is fully loaded.
Actors	Collectors, janitors.
Preconditions	1. The system is running. 2. Database is available. 3. The MCP is online and connected. 4. Internet connection is available.
Trigger	An MCP is fully loaded.
Steps	Periodically dispatch message to appropriate collectors and janitors until the MCP is unloaded.
Post conditions	The appropriate collectors/janitors are informed about the MCP.
Exception flow	None.