Requirement Elicitation

November 2022

1 Business Context

Urban waste management is one of several significant problems faced by many countries in the world and thus considered one of the important points to be improved in Sustainable Development Goal (SDG) 11: sustainable cities and communities and SDG 6: clean water and sanitation. Particular attention is given to developing countries that continue to prioritize development and economic growth. In urban contexts, solid waste management is costly and ineffective. Improvement of waste collection and management is emphasized by governments and organizations for positive impacts on cities, societies and environments.

Waste collection is often designated to an organization that provides professional waste management services. A typical waste collection process involves (1) back officers, who operate a central system, (2) collectors who drive trucks to transfer waste, and (3) janitors who manually collect using trollers. Back officers have a general view of all vehicles and MCPs. In this context, an MCP is an intelligent major collection point which comprises several garbage containers, as illustrated by Figure 1.

Figure 1: A simple collection point

An MCP can regularly report its load back to the management system via its specialized hardware. Schedules and tasks were assigned among teams of janitors and collectors and coordinated by back officers. These assignments are often arranged on a weekly basis. Everyday, the back officers sent messages with information about collecting routes, work areas and time to collectors and janitors. Collectors will start from a depot, pick up garbage from all janitors at some MCPs , and drive to the treatment plant (disposal facility). These MCPs that a collector drives through make up a route, which is included in tasks that are

predetermined by some back officer. The routing scheme is demonstrated in Figure 2. We make an assumption that there is only one treatment plant and one depot. When the collector goes on work, the system optimizes his/her predetermined route by dropping out the assigned MCPs with load less than 15% their capacity. The collector travels the shortest paths between the MCPs. This optimization is also performed by the system.

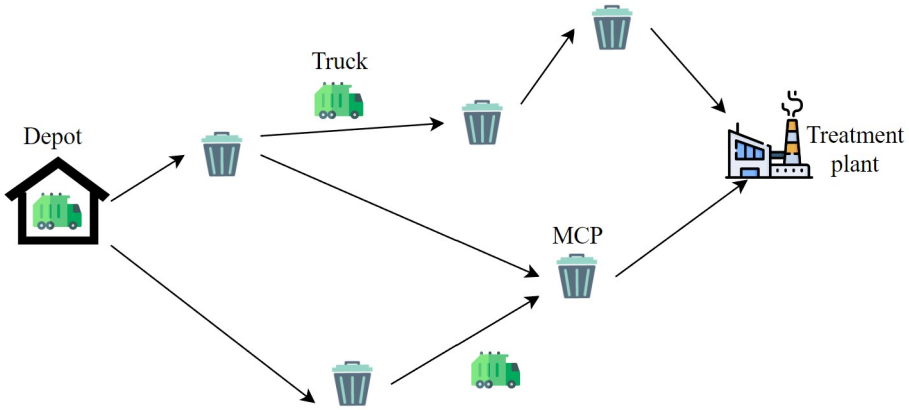


Figure 2: A simplified routing scheme

Janitors are hired based on the MCPs' locations and population density of the surrounding areas. The more busy an MCP is, the more janitors work on it, with each of them collecting garbage within a 500m-radius of their home. Customers who demand the waste management service can sign up so that their location is directed to the closest on-demand janitor. For simplicity, we will not model these customers in our upcoming data model.

To accompany all these business requirements, we need a specialized application and a corresponding database. While a piece of software UWC 1.0 is assumed to have already existed and aided the business, there are a lot of constraints to account for; therefore the need for a better system arises in form of detailed Front End and Back End Architecture. The following sections captures the necessary steps to construct them. Before that, we summarize the system stakeholders and their needs into Table 1.

Table 1: System Stakeholders and Needs

Stakeholders	Potential Problems	Needs
Back officers	- Communication delay is significant - Management module is labor intensive - Data query is slow - Insufficient amount of features and statistics	- Better communication system - More user-friendly interface - Optimal query - More features supporting work-flow
Employees	- Assigned tasks are unoptimized - Task delivery is slow - Lacking displayed features	- Real-time optimized workload - Faster real-time notification - More user-friendly interface
The community	- Customer service is lackluster - Area sanitation barely improves	- Better customer service - Higher system performance

2 System Requirements

2.1 Functional Requirements

Interaction within the system revolves around Back officers, Employees (Janitors and Collectors), and MCPs. So naturally, all of our system functionality can be categorized into three groups as follows.
Back officers are enabled to:

- View/Update employees' personal profile and schedule.
- Register new employees and remove those that hopped out.
- Assign areas to janitors and routes to collectors.
- View/Update MCPs and vehicles technical details, including their weight, load, capacity, fuel consumptions, etc.
- Register new assets (MCPs and vehicles) and remove when needed.
- Assign vehicles to employees, that is, trucks to collectors and trolleys to janitors.

Janitors and collectors are enabled to:

- View/Update their own personal profiles.

- View their own schedules and tasks.
- Check in/out task.
- Be notified about fully-loaded MCPs.
- Communicate with their colleagues and back officers.
- Update their status and locations when in work.

MCPs are equipped with hardware to:

- Update their loads.
- Notify system users when fully loaded.

2.2 Non-functional Requirements

- *Scalability*. The system should be able to handle real-time data from at least 1000 MCPs at the moment and 10.000 MCPs in five years.
- *Reliability*. Communication channel (messages, notification) works with at most 1 second delay.

  Query and update to the database work with at most 5 minute delay.
- *Availability*. Information/status of janitors and collectors, vehicles, MCPs must be updated every 15 mins with the availability of at least 95% of their operating time.

  The system must be operational through out normal working hours, from 8:30 am to 17:30 pm.
- *Supportability*. The system UI supports desktop view for back officers and mobile view for employees.

  UWC 2.0 system interfaces should be in Vietnamese, with an opportunity to switch to English in the future.

Figure 3: System Use Case Diagram

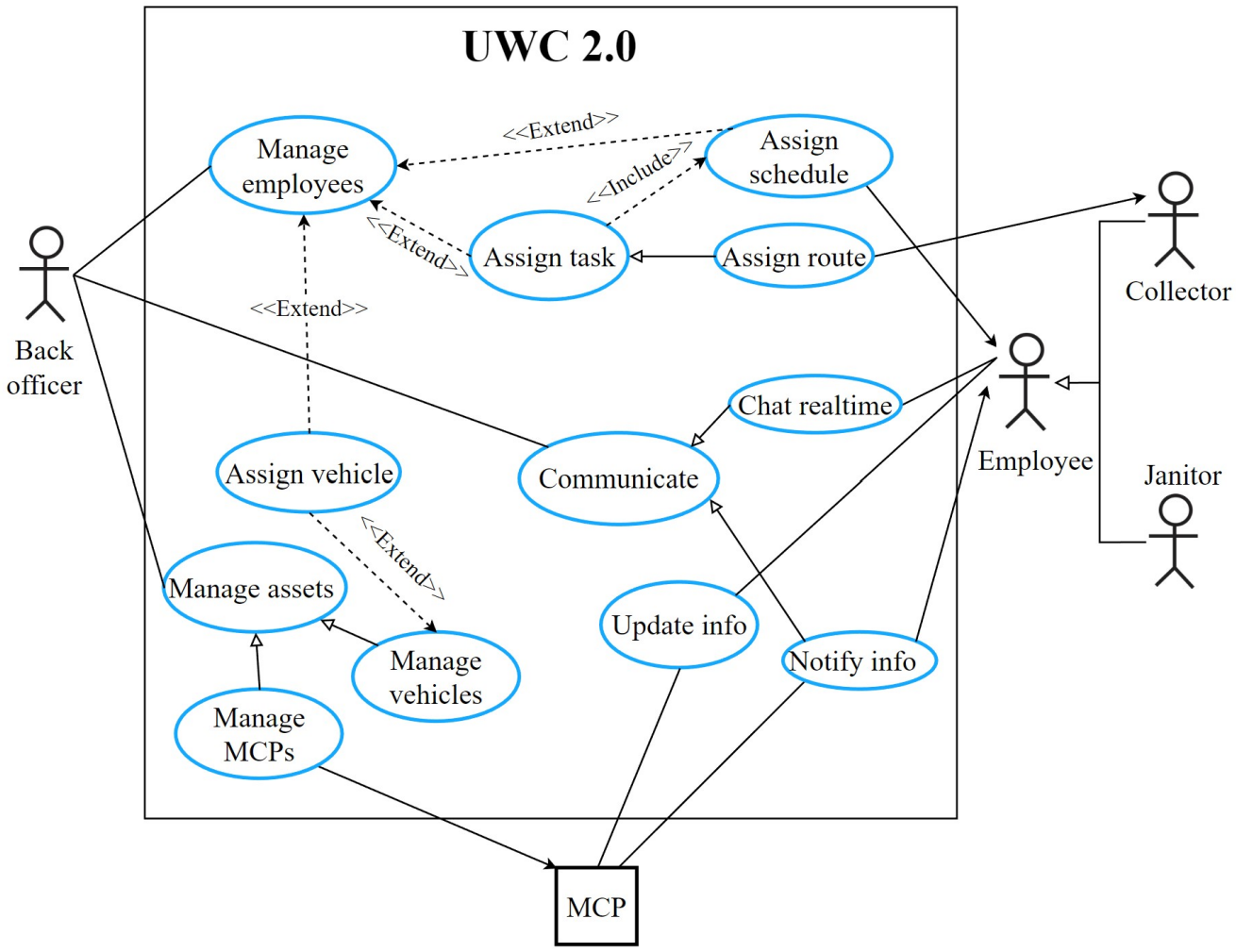
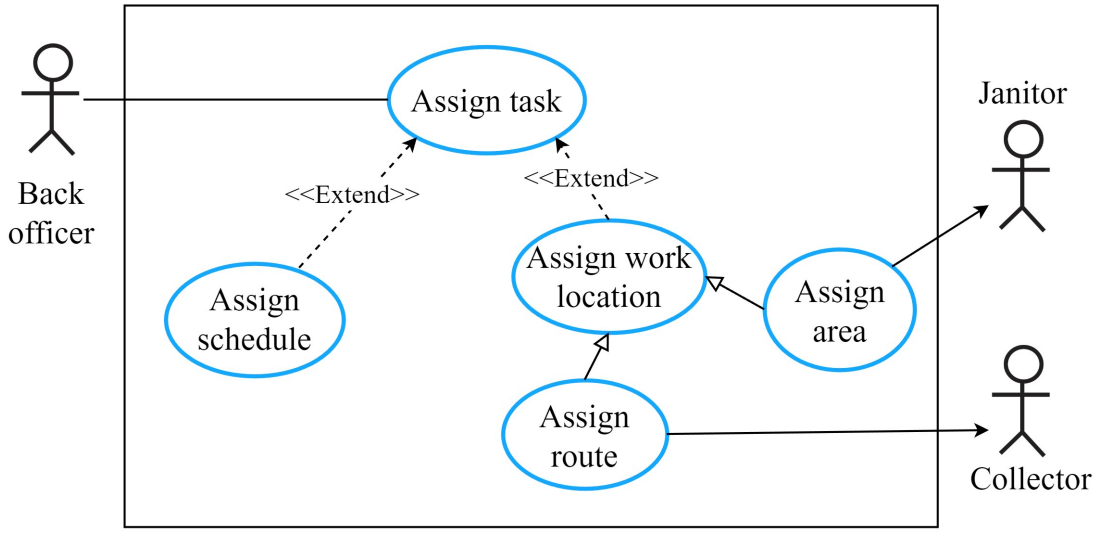


Figure 3 illustrates a Use Case Diagram for our system. The general view includes three main use cases - `Manage employees`, `Manage assets`, and `Communicate` - which are further specified into sub use cases. The main actors of the system are back officers, janitors and collectors (which specialize employees), and MCPs. Back officers have access to all use cases while the other are mostly on the receiving end.

3 Task Assignment Module

Figure 4: Task Assignment Use Case



Use case name	**Assign Task**
Description	The back officer specifies which employee to assign the task. If the chosen is Janitor, the Back Officer needs to assign MCP where the Janitor works and the time. Otherwise, If the chosen is a collector, the Back Officer needs to assign an optimized route
Actor	Back officers
Preconditions	The back officer is logged in The back officer has chosen an employee from the dashboard
Postconditions	The back officer assigns a new schedule, OR The back officer assigns a new work location, either route or area

Normal flow	1. The system displays options, either `Schedule` or `Work location` 2. The back officer chooses either 3. If the back officer chooses Schedule 3.1. The back officer `assign schedule` 3.2. The system updates the schedule to the database 4. If the back officer chooses `Work location` 4.1. If the employee is a janitor 4.1.1. The back officer `assign area` 4.1.2. The system updates the area to the database 4.2. If the employee is a collector 4.2.1. The back officer `assign route` 4.2.2. The system updates the area to the database
Exceptions	None
Alternative flows	None