ADVANCED METHODS FOR SYSTEM DEVELOPMENT

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Development of a software to support the installation of solar panel systems

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1. Goal

The task is to develop a software for a company that designs and installs solar panels. The software needs to support the assessment and management of the components required for an installation, from design to extraction from stock.

2. Requirements

For a new order the first step is an on-site survey during that a specialist determines which and how many elements to select (solar panels, brackets, inverters, cables, etc.) for the installation. To produce a price calculation the necessary components are entered into the system and it gives feedback on the current stock level. Pre-bookings can be made for items that are currently out of stock, so that the items that will be received can be automatically reserved for the project. The system also stores the current prices so that a preliminary cost estimate can be generated.

Before starting the construction the warehouse keeper must assemble the parts booked for the selected project that are supported by the system using the shortest route available. To achieve this we need the exact location of the parts that are provided by the warehouse shelving system, where the row, column and level are defined by a unique identifier.

The compartment can accommodate only a limited number of parts, the maximum value of which per part stored. By putting the compartment and the parts together it is now possible to determine the correct path for the warehouseman. The warehouse manager must also be able to identify parts that are not yet available or that have already been reserved must be listed separately. Another task is to receive the parts when the orders are received, assigning them to the appropriate compartment and taking into account the maximum number of parts allowed. Only one type of part can be stored in a compartment.

Each project goes through several phases of implementation, based on the following possible states that the system has to manage:

> **1. New**: the project has been created but the on-site survey has not yet been carried out
> **2. Draft**: the on-site survey is in progress but the design has not yet been finalized
> **3. Wait**: the on-site survey has been done, but the price estimation could not be completed because there was parts that are out of stock so the price is not known
> **4. Scheduled**: price estimation has been completed, project is waiting for implementation
> **5. InProgress**: project implementation has started, the first step of which is to remove the parts from stock
> **6. Completed**: the project has been successfully implemented
> **7. Failed**: the project has failed.

For each project, a log is created that stores the status of the project and its current state so that his information could be used by other systems to generate statistics.

3. Functionality

3.1 Actors

Specialist, Storekeeper, Warehouse manager

3.2 Use Case

3.2.1 UC1: Creating new project

- **Primary actor:**
  Specialist
- **Stakeholders and Interest:**
  - Storekeeper: Works according to the created project
  - Warehouse manager: Works according to the created project
  - Customer: Wants service according to their needs
  - Company: Wants to satisfy the customer needs precisely
  - Solar Panel Planning Software
  - Solar Panel Manufacturers
  - Solar Panel Installers
  - Electricity Companies
  - Local Government
  - Environmental Organizations
  - Community Members
- **Preconditions:**
  Specialist is identified and authenticated
- **Success Guarantee (Postconditions):**
  New project is created in the and has been successfully saved.
- **Main Success Scenario (or Basic Flow):**
  1. Specialist launches the software and provides their credentials to log in.
  2. Specialist selects the option to create a new project.
  3. Specialist enters the project details such as location, description, and data of the customer.
  4. Specialist selects which components will make up the solar panel system
  5. Specialist reviews the project details and makes any necessary adjustments.
  6. Specialist submits the project to the software and saves it.

- **Extensions:**
  1. Specialist fails to log in due to incorrect credentials.
  2. Specialist fails to enter all the necessary project details.
  3. Specialist fails to select the components for the solar panel system.
  4. Specialist fails to review the project details properly and make any necessary

adjustments.

      5. Specialist fails to finalize the project and save the details.

- **Technology and Data Variation List**:

      Technology:

      -3D modelling software

      -Optimization software

      Data:

      -Solar irradiance data

      -Surrounding infrastructure data -Land elevation data

      -Environmental data

      -Historical weather data

- **Frequency of Occurrence**: Depend on the usage patterns of the software
- **Open Issues**:

      1. Ensuring adequate user training on how to use the software.

      2. Creating an intuitive user interface for the software.

      3. Ensuring the software is compatible with existing solar panel planning systems.

      4. Developing a comprehensive help and support system for users.

      5. Implementing a system for sharing project data across multiple users.

3.2.2 UC2: Listing existing projects in order to check status

- **Primary acto**r:

      Specialist

- **Stakeholders and Interest:**
    - Storekeeper: Works according to the created project
    - Warehouse manager: Works according to the created project
    - Customer: Wants service according to their needs
    - Company: Wants to satisfy the customer needs precisely

- **Preconditions:**

      1. Specialist must have a valid account and be logged in.

      2. Specialist must have access to the project list view.

      3. Specialist must have the appropriate permissions to view the list of existing projects.

      4. The system must have a list of existing projects stored in its database.

- **Success Guarantee (Postconditions):**

      1. The list of existing projects must be displayed.

      2. Specialist must be able to modify, delete, or add new projects to the list.

      3. Specialist must be able to save changes to the list.

      4. Specialist must be able to exit the list of projects.

5. Specialist must be able to log out of the solar panel planning software.
- **Main Success Scenario (or Basic Flow):**
    1. The user launches the solar panel planning software.
    2. The user is presented with a list of existing projects.
    3. The user selects an existing project and is presented with its details.
    4. The user is able to view the project's current status and any other relevant information.
    5. The user can either modify the project, delete the project, or create a new project.
- **Extensions:**
    1. The database connection fails and the application is unable to access the projects data. 2. The user does not have the required permissions to view the projects list.
    3. The user is unable to filter the projects by parameters such as project name, location, and project status.
    4. The user is unable to view the project details such as project budget, project size, and project timeline.
    5. The user is unable to export the project list to an external file.
    6. The user is unable to add or delete projects from the list.
- **Technology and Data Variation List:**
    - Software development tools to create the interface and logic of the application
- **Frequency of Occurrence:**
    Depends on the usage patterns of the software
- **Open Issues:**
    1. Ensuring that all existing projects are listed accurately and in a timely manner.
    2. Creating a user-friendly interface for listing existing projects.
    3. Ensuring that all relevant information regarding existing projects are included.
    4. Ensuring data security of the existing projects.
    5. Developing a feature that allows users to search through existing projects.

3.2.3 UC3: Listing spare parts, checking their prices and availability
Primary actor: Specialist
Short description: The user is able to search for spare parts by name or description, check their prices and availability, and add the parts to their current solar panel plan. The user is also able to save their plans and access them at a later time.

3.2.4 UC4: Assign selected parts to a project ("Draft")
Primary actor: Specialist
Short description: This use case describes the process of assigning selected parts to a project in a solar panel planning software. The user will select the parts they need from a catalog, and

then assign them to the project. The system will then update the project with the parts assigned, and the user will be able to see the parts that have been selected and their associated costs.

2.2.5 UC5: Recording of estimated working time, determination of payment for work

Primary actor: Specialist

Short description: The user will input the estimated working hours for the solar panel planning project. The software will calculate the rate of payment based on the estimated working hours. The software will generate an invoice for the customer with the total amount due.

2.2.6 UC6: Price calculation if all parts are available in the warehouse ("Wait", "Scheduled")

Primary actor: Specialist

Short description: This use case involves calculating the total cost of a solar panel system based on the availability of parts in the warehouse. The user will input the necessary information such as the type of panel, location, and other details, and the software will calculate the total cost of the project based on the parts available in the warehouse. This cost will include the cost of the parts and any additional fees or taxes associated with the project. The user will be able to view the total cost and make adjustments to the project if needed.

2.2.7 UC7: Closing of project („Completed", „Failed")

Primary actor: Specialist

Main Success Scenario: The specialist would be able to close the project and save the details for future reference if the project had been successfully finished, give the status "Completed".

If a failed scenario was taken place, the project would be closed by the status "Failed".

2.2.8 UC8: Adding new parts to the project

- **Primary actor:**
  Storekeeper
- **Stakeholders and Interest:**
  1. Solar panel manufacturer: They need the software to be able to easily add new parts and keep track of their inventory.
  2. Solar panel installer: They need the software to be able to accurately plan and install solar panels, and to be able to add new parts quickly and efficiently.

3. End user: They need the software to be able to accurately plan and install solar panels, and to be able to add new parts quickly and efficiently.

4. Software developer: They need to create a system that is easy to use and understand, and that is able to accurately track the parts and inventory.

5. Regulatory body: They need to ensure that the software meets all safety and regulatory standards.

- **Preconditions:**

    1. The user must have valid credentials for the system.

    2. The user must have the authorization to add new parts to the system.

    3. The user must have the necessary information about name, price, and maximum number of parts for the new parts to be added.

    4. The user must specify the compartment in which the parts will be added.

    5. The user must have access to the solar panel planning software.

    6. The user must have the ability to save the changes after adding the new parts.

- **Success Guarantee (Postconditions):**

    1. The new parts have been successfully added to the system.

    2. The new parts are visible in the system.

    3. The new parts have been assigned a valid name, price and maximum number of parts per compartment.

    4. The system has been updated to reflect the changes.

    5. Any necessary changes to existing plans or projects have been made.

- **Main Success Scenario (or Basic Flow):**

    1. The user opens the software and navigates to the parts module.

    2. The user enters the new part details including name, price, and maximum number of parts per compartment.

    3. The software validates the entered data and checks for existing parts with the same name. 4. If the part name is unique, the software adds the new part to the system and updates the parts inventory accordingly.

    5. The user is notified of the successful addition of the new part to the system.

- **Extensions:**

    1. Validation fails for the new parts.

    2. Order for the new parts is not generated.

    3. Inventory system does not update with the new parts.

    4. Cost of the new parts is not calculated.

    5. Maximum number of parts per compartment is exceeded.

    6. Customer is not notified of the new parts added.

    7. Record of the new parts added to the system is not archived.

    8. Report of the new parts added to the system is not generated.

- **Technology and Data Variation List:**

    Technology:

-Database software such as MySQL

-A web-based interface to manage and view parts

-A graphical user interface (GUI) to easily add

- **Frequency of Occurrence**:

Depends on the specific needs of the software and the users

- **Open Issues:**

1. What is the best way to enter the price of the parts?

2. How will the software handle different currencies?

3. How will the software handle pricing changes over time?

2.2.9 UC9: Modification of prices

Primary actor: Storekeeper

Short description: The use case for modification of prices in a solar panel planning software involves allowing the storekeeper to modify the price if needed (due to the change of market) of different components used in the solar panel planning process. This would enable the user to make better decisions on the cost of the project and optimize their budget accordingly.

2.2.10 UC10: Listing of missing parts (taking into account reservations, orders to support orders)

Primary actor: Storekeeper

Main Success Scenario: The use case for listing of missing parts in a solar panel planning software allows the storekeeper to view any parts that are needed for the planned solar panel set-up. It will take into account any existing reservations and orders, as well as provide support for placing orders for the missing parts. This will help the storekeeper manage the solar panel set-up process, ensuring that all the necessary components are available when needed.

2.2.11 UC11: Listing missing parts that have been reserved already

Primary actor: Storekeeper

Main Success Scenario: This use case outlines the process for listing missing parts for solar panel planning projects that have already been reserved in the software. The process begins when the storekeeper navigates to the solar panel planning page and selects the project from the list of available projects. The software then displays a list of all the parts that have been reserved in the project. The storekeeper can then review the list and identify any parts that are missing from the list. They can add the missing parts to the list and the software will update the list accordingly. The process ends when the storekeeper has reviewed and updated the list of missing parts.

2.2.12 UC12: Handling of the maximum number of pieces that can be placed in compartments
Primary actor: Storekeeper
Short description: This use case would allow users to plan their solar panel installations in an efficient and accurate manner by setting the maximum number of pieces per compartment and would not allow to add new items if the limit has been reached.

2.2.13 UC13: Listing projects, selecting project, automatic setting of project status

- **Primary actor:**
    Warehouse manager
- **Stakeholders and Interest:**
    1. Solar panel planning software developers: they will be creating the system and making sure it functions properly.
    2. Solar panel installers: they will be using the software to plan out their projects and select the right panels for the job.
    3. Solar panel customers: they will be the ones who ultimately benefit from the use of the software and its features.
    4. Regulatory bodies: they will be ensuring that the use of the software and its features comply with any applicable laws and regulations.
    5. Investors: they will be looking at the success of the software and its features to determine if they should invest in it.
- **Preconditions:**
    1. Warehouse manager must have access to the software and be logged into the account.
    2. Warehouse manager must have the necessary permissions to view and modify project information.
    3. The system must have access to the relevant project information.
    4. Warehouse manager must know what project they want to select.
    5. Warehouse manager must have the ability to set the project status automatically.
- **Success Guarantee (Postconditions):**
    1. The user has successfully listed the projects and selected a project for editing.
    2. The project status has been automatically set based on the user's selection.
    3. The project plan has been updated with the new information.
    4. The user has been provided with the necessary information to continue with the project.
- **Main Success Scenario (or Basic Flow):**
    1. Warehouse manager opens the software and is presented with a list of projects.
    2. Warehouse manager selects a project from the list.
    3. The software automatically sets the project status to "planning".
    4. Warehouse manager is presented with a list of tasks related to the project.

> 5. Warehouse manager selects a task from the list and begins planning the project.
>
> 6. Warehouse manager can check the project status at any time to view the progress.

- **Extensions:**
  > 1. Incorrect data entry: If the user enters incorrect data while listing projects, selecting a project, or automatically setting the project status, it could lead to inaccurate results or project statuses.
  >
  > 2. Inadequate user permissions: If the user does not have adequate permissions to list projects, select a project, or automatically set the project status, the user will not be able to complete the task.
  >
  > 3. Invalid project selection: If the user selects an invalid project, the system may not be able to automatically set the project status and the process may fail.

- **Technology and Data Variation List:**
  > **Technology Variations:**
  >
  > - Use of an automated project planning software package
  >
  > **Data Variations:**
  >
  > - Ability to set project status parameters and thresholds, such as green, yellow, and red status levels based on meeting deadlines or completing milestones.
  >
  > - Ability to generate reports on project progress, performance, budget, and other project-related metrics.

- **Frequency of Occurrence:**
  > Depends on the particular software being used.

- **Open Issues:**
  > 1. Creating a user-friendly interface for selecting and setting project statuses.

2.2.14 UC14: Listing of project parts and their location (row, column, shelf, manage compartment)

Primary actor: Warehouse manager

Short description: This use case describes the ability for a user to view the location of parts associated with a solar panel project. The user will be able to view the parts' row, column, shelf, and manage compartment location information. This will allow the user to easily view the parts' location and plan the solar panel project accordingly.

2.2.15 UC15: Optimising the route to be taken when collecting parts

Primary actor: Warehouse manager

Short description: This use case describes the process of optimising the route for collecting parts for a solar panel planning system. The system will take into consideration the warehouse manager's current location, the availability of parts, the cost of each part, the distance between each part, the time taken to travel between each part and any other constraints the warehouse

manager may have. The system will then generate a route which is optimal based on these factors and present it to the warehouse manager.