COMP3004 Assignment 1:
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Part 1:

a. I don't think we can say software itself is safe because oftentimes, there is no such thing as software "by itself". For example, software often relies on some sort of external mechanism to run it and if some component that the software relies on causes an issue, then the software is no longer safe.
b. As mentioned in the article, we should be designing software based on the worst-case scenario and therefore safety should come into play even *before* development starts.
c. I think in the case of a malfunction such as the Therac-25 (in less extreme scenarios as well), it would be better to build from scratch. I think you can use similar concepts but it may be nice to restart with a fresh plate completely.
d. As the article said, OOP may be fine for one type of system (ex. data-oriented) but not another (control-oriented), so my answer is not necessarily. There is no definitive answer because it should be decided on a case-to-case basis.
e. From a safety perspective, it is better first to implement error-handling behaviour to ensure that the system can safely handle failures before normal functionality is added. Of course, even after normal functionality is added you should still be checking for more ways to make software safer.

Part 2:

Use Case 1: Install Rail Brackets and Guide Rails

Primary Actor: Installation Team (Carpentry Team)

Stakeholders and Interests:

Installation Team - wants to complete the task accurately and efficiently, ensuring the rails are properly aligned.

Project Manager - wants the guide rails to be installed with high precision to ensure smooth elevator operation.

Building Owner - wants the guide rails to be installed safely and on time.

User - eventually the user wants the elevator to work properly, and therefore have the guide rails installed properly

Precondition: The elevator shaft is framed, and the installation team has all of the necessary tools and materials.

Success Guarantee: The guide rails are securely installed, aligned, and properly tested for elevator use.

Main Success Scenario:
1. The team prepares for installation, gathering tools and preparing the area
2. The team makes precise measurements and levelling for guide rail and bracket alignment
3. The team installs spot brackets at the topmost part of the shaft
4. The team aligns the lower brackets with the top (spot) ones by using a plumb line
5. The team uses proper communication to secure guide rails onto the brackets using a chain hoist to help guide them into place.
6. Computerize motion control system is installed, jumpers that bypass functionalities are added, and the run box is set up
7. The team tests the guide rails for proper alignment and movement.

Extensions:
7. a) The rails are misaligned
    7. a1) The team adjusts the alignment using a hoist.
    7. a2) The team rechecks the position with the plumb line.

Use Case 2: Install Cab Sling and Platform:

Primary Actor: Installation Team (Carpentry Team)

Stakeholders and Interests:

Installation Team - wants to complete the task accurately and efficiently, ensuring the car sling and platform are secure.

Project Manager - wants the car sling and platform to be installed securely and efficiently to avoid project delays.

Building Owner - wants the car sling and platform to be installed safely and on time.

User - eventually the user wants the elevator to work properly, and therefore have the car sling and platform installed properly

Precondition: The elevator guide rails are in place, and the installation team has all of the necessary tools and materials.

Success Guarantee: The car sling and platform are correctly installed, aligned, and securely fastened.

Main Success Scenario:
1. The team prepares for installation, gathering tools and preparing the area

2. The team assembles the car sling and platform components.
3. The team positions the platform correctly within the elevator shaft.
4. The car sling is attached to the platform and aligned.
5. The team ensures all components are securely fastened and adjusted.
6. The platform and car sling installation are verified for alignment and stability.

Extensions:
5. a) The components aren't fastened properly
    5. a1) The team checks connections and tightens or replaces any loose connections
    5. a2) The team tests the changes to ensure components are fastened and connections are no longer loose.
6. a) The components are misaligned or unstable
    6. a1) The team makes necessary adjustments
    6. a2) Team tests the changes to ensure the components are aligned and stable

Use Case 3: Install Landing Doors:

Primary Actor: Installation Team (Carpentry Team)

Stakeholders and Interests:

Installation Team - wants to install the landing doors accurately and efficiently, ensuring they function correctly.

Project Manager - wants the landing doors to be installed according to design specifications and safely.

Building Owner - wants the landing doors to be installed safely and on time.

User - eventually the user wants the elevator to work properly, and therefore have the landing doors installed properly

Precondition: The elevator shaft, guide rails, car sling, and platform are installed, and the installation team has all of the necessary tools and materials.

Success Guarantee: The landing doors are installed and operate correctly.

Main Success Scenario:
1. The team prepares for installation, gathering tools and preparing the area
2. Precise measurements are taken to install the struts
3. Brackets are installed to hold the struts in place, the team ensures they're properly aligned
4. Struts are installed with precise measurements
5. Hoistway sill is placed on the entrances at each level and installed
6. The cab sill is aligned with the hoistway sill and installed

7. Precise measurements are taken to prepare for the installation of the door box
8. The header is installed at the top of the entrance at each landing
9. Landing door lies on smooth-rolling castors
10. Install Gibbs to ensure the landing door is in track with the hoist sill.
11. The team tests the landing door for smooth movement.

Extensions:

4. a) The struts are misaligned
    4. a1) The team will recheck the measurements and adjust the placement of the struts to ensure proper alignment.
    4. a2) The team tests the changes to ensure struts are aligned
6. a) The cab sill is not aligned with the hoistway sill
    6. a1) The team uses measuring tools to check and adjust the positioning of the sills to ensure they are level and aligned with the rest of the elevator structure.
    6. a2) Team tests the changes to ensure the components are aligned and stable
9. a) The landing doors are not resting properly on the castors
    9. a1) The team will adjust the placement of the castors and check the door's alignment with the track.
    9. a2) The team will test the changes to ensure the door now lies on the castors
11. a) The landing door does not move smoothly and with ease
    11. a1) The team will check for any obstructions which aren't allowing the door to move smoothly
    11. a2) If the problem still persists the team can check various parts of the installation again. For example, the Gibbs may need adjusting.
    11. a3) The team will test the changes to ensure the door slides smoothly.

Use Case 4: Install Elevator Cab:

Primary Actor: Installation Team (Carpentry Team)

Stakeholders and Interests:

Installation Team - wants to install the elevator cab accurately and efficiently, ensuring they function correctly.

Project Manager - wants the elevator cab to be installed according to design specifications and safely.

Building Owner - wants the elevator cab to be installed safely and on time.

User - eventually the user wants the elevator to work properly, and therefore have the elevator cab installed properly

Precondition: The elevator shaft, guide rails, car sling, platform, and landing doors are installed, and the installation team has all of the necessary tools and materials.

Success Guarantee: The elevator cab is installed and operates correctly. Components are securely fastened.

Main Success Scenario:
1. The team prepares for installation, gathering tools and preparing the area
2. The team installs the side and interior walls loosely on the platform.
3. The team unpacks the dome and ceiling units.
4. The strike and return columns are installed
5. The front panels of the cab are assembled, including the cab operating system
6. The team attaches the dome
7. The door control and motor drive unit are placed atop the front of the cab, and joined to the front walls and the dome
8. Parts are tightened, double-checked for square, and anchored to the platform
9. The cab door is put into place and attached to the door operator.
10. Adjustments are made until the door is running smoothly.
11. Gibbs are installed to keep the cab doors in line with the capsule
12. The door clutch assembly is attached to the cab door and adjusted
13. The mechanism to lock and unlock the door on each floor is installed and adjusted for proper operation.
14. Sensors to open the door when obstructed are installed
15. The team will test the changes to ensure everything is working as expected.

Extensions:
8. a) If parts are not square or aligned
    8. a1) The team will readjust any necessary parts
    8. a2) Then the team will test the changes to ensure they are square and aligned.
11. a) If the doors still aren't aligned
    11. a1) The team will adjust the Gibbs
    11. a2) The team will test the changes to ensure the door is aligned with the capsule.
15. a) If the door clutch assembly is misaligned
    15. a1) The door clutch assembly will be remeasured and reinstalled
    15. a2) The team will test the changes to ensure it is working
15. b) If the mechanism to lock and unlock the door on each food is not operating
    15. b1) The team will adjust the placement until it is working properly
    15. b2) The team will test the changes to ensure it is working as expected
15. c) If the sensors to open the door when obstructed aren't working as expected
    15. c1) The team will test the sensors and readjust placement until it is working
    15. c2) The team will test the changes to ensure the sensors are working properly

Use Case 5: Wire and Connect Electrical Systems:

Primary Actor: Installation Team (Electrician Team)

Stakeholders and Interests:

Installation Team - wants the electrical systems to be connected to proceed with the final setup.

Project Manager - wants the electrical systems to be installed and tested correctly to ensure safety and operation.

Building Owner - wants the wiring to be done and installed safely and on time.

User - eventually the user wants the elevator to work properly, and therefore have the wiring done properly

Precondition: The elevator shaft, guide rails, car sling, platform, landing doors, and elevator cab are installed, and the installation team has all of the necessary tools and materials.

Success Guarantee: All electrical systems are wired correctly and functioning as expected.

Main Success Scenario:
1. The team prepares for installation, gathering tools and preparing the area
2. The team will do the electrical wiring on top of the elevator for the lights and ventilation
3. The team does the higher voltage wiring for powering the various electric systems for the elevator
4. The team completes the connections for the complex lower voltage wiring which runs between the computer and the devices and sensors in the elevator
5. The team will remove any jumpers that bypass functionalities as well as the run box

Extensions:
2. a) If the lights or ventilation aren't working after installation
    2. a1) Team will troubleshoot the problem and look for any loose connections or faulty wires
    2. a2) Team will fix the issue by replacing, fastening, insulating, etc. wires. And testing the changes
3. a) If the electrical system does not power on after completing the higher voltage wiring
    3. a1) The team will test the circuit breakers, fuses, and connections to confirm the integrity of the electrical system.
    3. a2) The team will fix the issue and test the changes
4. a) If the devices or sensors do not operate correctly
    4. a1) The team will troubleshoot the devices themselves, checking for any damaged components, faulty connections, or software issues.

4. a2) Team will fix the issue and test the changes

5. a) If the system fails to operate correctly after the jumpers are removed

5. a1)The team will recheck the connections that the jumpers were bypassing to ensure they are correctly integrated into the system.

5. a2) After identifying the issue, the team will fix the issue and test the changes

Use Case 6: Program Elevator Control System

Primary Actor: Installation Team (Programmer)

Stakeholders and Interests:

Installation Team - wants to ensure the elevator's control system is correctly programmed and functioning as intended

Project Manager - wants the control system to be fully operational and turned over to automatic control without any errors.

Building Owner - wants the elevator to function seamlessly once it's turned over to automatic control.

User - eventually the user wants the elevator to work properly, and therefore have the programming done properly

Precondition: The elevator shaft, guide rails, car sling, platform, landing doors, and elevator cab are installed, the wiring is completed, and the installation team has all of the necessary tools and materials.

Success Guarantee: The elevator control system is successfully programmed and operational, with all automatic functions tested and confirmed.

Main Success Scenario:

1. The computers are programmed with various command and control protocols.
2. The elevator is turned over to full automatic control
3. All buttons, sensors, and functions are tested

Extensions:

3. a) The elevator doesn’t respond properly to programmed commands/any other functionality

3. a1) The installation team will check for errors in the control code, including misconfigured logic or incorrect parameters.

3. a2) Programmers will fix the issue in the code and test the changes

Use Case 7: Perform Final Inspection

Primary Actor: Certified Inspector

Stakeholders and Interests:

Project Manager - wants the elevator to pass the final inspection and be ready for use.

Building Owner - wants the elevator to meet all safety standards before use.

User - eventually the user wants the elevator to work properly, and therefore have the inspection done properly

Precondition: The elevator is fully installed and programmed. The inspector has all the necessary tools to perform the inspection.

Success Guarantee: The elevator successfully passes the inspection and is ready for use.

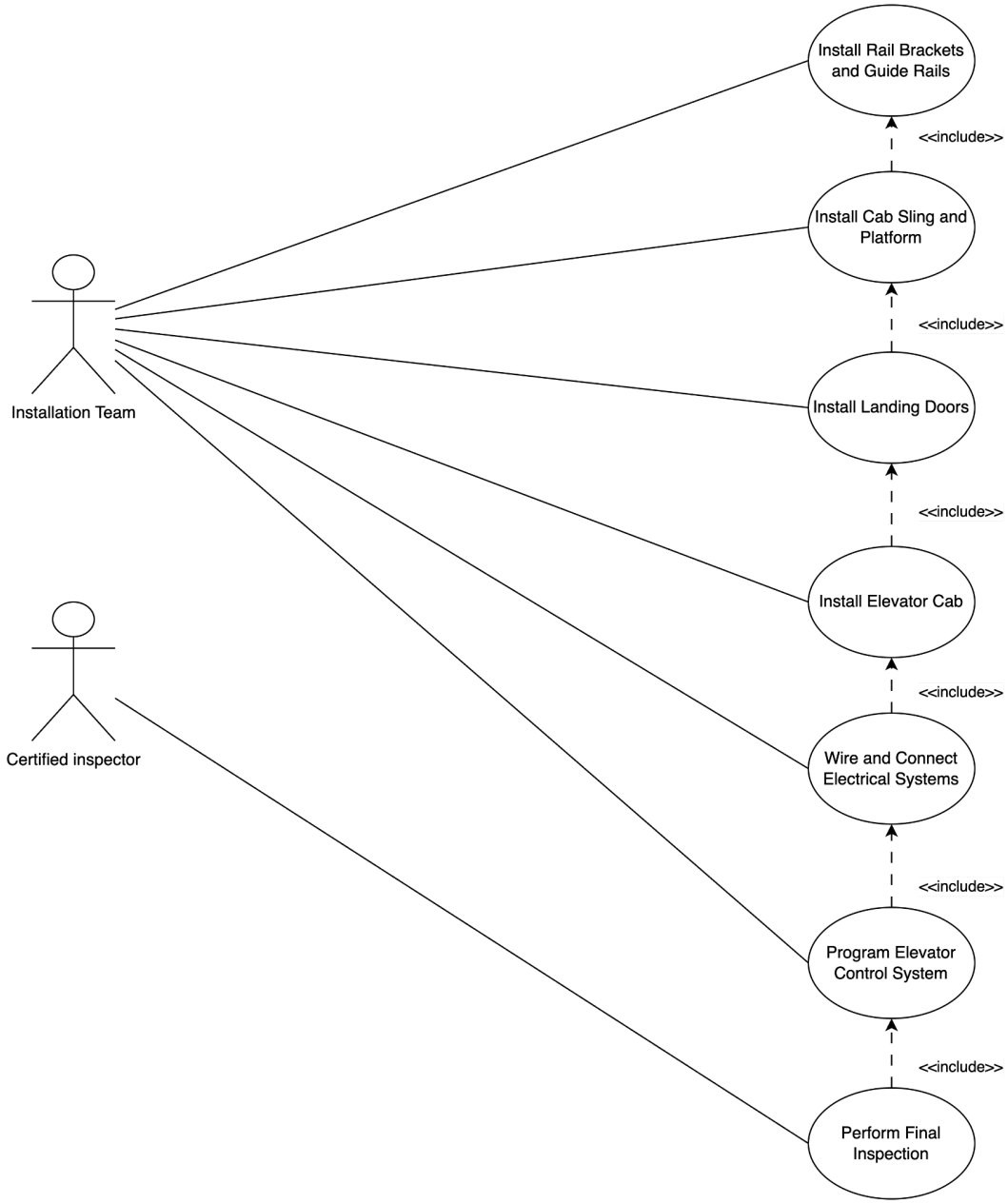
Main Success Scenario:
1. The inspector conducts a series of tests on the electronic devices
2. The inspector conducts a series of tests on the safety devices
3. The inspector conducts a series of tests to replicate any scenario with the passenger and the elevator system.
4. The inspector conducts a series of tests to test the full load.
5. The inspector marks the elevator as safe

Extensions:
1. a) If the electronic devices fail the tests
    1. a1) The inspector identifies the specific issue
    1. a2) The inspector communicates the issue to the project manager
    1. a3) The elevator is marked as “unsafe” until the issue is resolved
    1. a4) The inspector revisits after issue is resolved
2. a) If the safety devices fail the tests
    2. a1) The inspector identifies the specific issue
    2. a2) The inspector communicates the issue to the project manager
    2. a3) The elevator is marked as “unsafe” until the issue is resolved
    2. a4) The inspector revisits after issue is resolved
3. a) If any of the scenarios fail the tests
    3. a1) The inspector identifies the specific issue
    3. a2) The inspector communicates the issue to the project manager
    3. a3) The elevator is marked as “unsafe” until the issue is resolved
    3. a4) The inspector revisits after the issue is resolved
4. a) If the full load fails the tests
    4. a1) The inspector identifies the specific issue

4. a2) The inspector communicates the issue to the project manager
4. a3) The elevator is marked as “unsafe” until the issue is resolved
4. a4) The inspector revisits after the issue is resolved

5. a) If the inspector does not mark it as safe
5. a1) The inspector notifies the project manager of the results and the issues
5. a2) The installation team fixes the issue
5. a3) The inspector revisits once issues are resolved.

Use Case Diagram Part 2:



Use Case 1: User Requests an Elevator

Primary Actor: Elevator User

Stakeholders:

Elevator User - wants to use the elevator

Building Owner - wants the elevator to operate properly for end user's satisfaction

Pre-conditions: The elevator system is operational, the user is on a floor of the building with access to an elevator, and the user has access to the elevator buttons.

Success Guarantees: The elevator receives the request and dispatches the elevator to the floor. The elevator button lights up to indicate the request has been taken.

Main Success Scenario:

1. The user selects the desired direction (up or down) and selects the corresponding button.
2. The button illuminates after being pressed indicating the elevator has received the request.
3. An elevator takes the request and is dispatched to the requested floor.
4. An elevator arrives at the requested floor and the button light turns off.

Extensions:

2. a) There is a power outage, the button does not illuminate, the elevator does not take the request

    2. a1) The elevator system detects a power outage and initiates safety protocols, initiating audio and visual signals, and moving to the closest floor.

    2. a2) Passengers disembark the elevator.

    2. a3) Users waiting for the elevator will not be able to use the elevator while there is a power outage and will have to use the stairs or wait for the elevator to be in operation again

3. a) There is a fire alarm and the elevator does not take the request

    3. a1) The elevator system receives a fire alarm signal from the building or the elevator itself and initiates safety protocols, initiating audio and visual signals, and moving to a safe floor.

    3. a2) Passengers disembark the elevator.

    3. a3) Users waiting for an elevator will have to evacuate the building via stairs, in correspondence with building fire protocols.

Use Case 2: Elevator Arrival

Primary Actor: Elevator

Stakeholders:

Elevator Users - want to board or deboard the arriving elevator
Building Owner - wants the elevator to operate properly for end-users satisfaction

Pre-conditions: The elevator system is operational, the user has requested the elevator stop at a floor, and the elevator has arrived at the requested floor.

Success Guarantee: The elevator arrives at the requested floor, the doors open, users get on and off, and the doors close.

Main Success Scenario:

1. The elevator arrives at the requested floor using a sensor
2. The elevator rings a bell to indicate it has arrived
3. The doors open for a fixed amount of time of 10 seconds
4. People exit, board, or remain on the elevator
5. Elevator doors close after 10 seconds

Extensions:

3. a) The “open door” button is pressed
    3. a1) The user presses the “open door” button and the doors will remain open for more than the standard time (10 seconds)
    3. a2) The doors will remain open as long as the button is depressed
    3. a3) The doors will close after the button is released
4. a) There is an overload detected on board
    4. a1) The system receives an overload alarm signal indicating the maximum cargo has been reached.
    4. a2) The elevator does not move.
    4. a3) The elevator presents an audio and visual warning until the load is reduced.
    4. a4) The elevator begins moving again
5. a) If something is obstructing the door
    5. a1) The light sensor is interrupted when the door is closing
    5. a2) The doors will open
    5. a3) The system will repeat 4. a1) and 4. a2) until there is no longer an obstruction
    5. a4) If the system continually detects an obstruction an audio and visual warning will go off.
    5. a5) The doors will close after the obstruction has been cleared from the doors.
5. b) If the “close door” button is pressed
    5. b1) The user presses the “close door” button
    5. b2) If there is an obstruction, preventing the doors from closing, refer to 5. a)
    5. b3) If there is no obstruction, the doors will close prematurely.

Use Case 3: User Selects Buttons on the Control Panel

Primary Actor: Elevator User

Stakeholders:

Elevator Users - want to select a button on the control panel
Building Owner - wants the elevator to operate properly for end-users satisfaction

Pre-conditions: The elevator system is operational, there is a user in the elevator car, with the doors closed, wanting to use the control panel.

Success Guarantee: The user can select any of the buttons on the control panel and the elevator will respond accordingly.

Main Success Scenario:

1. The user is in the elevator cab
2. The user selects a floor, or multiple floors, where they would like the elevator to stop.
3. The elevator takes the request and will begin heading to the selected floor.

Extensions:

2. a) The user selects the “Help” button
    2. a1) The elevator system receives a help signal
    2. a2) The user is connected to the building safety service through an audio connection
    2. a3) If there is no response from building safety within 5 seconds, the user will be connected to emergency services (911)
    2. a4) If there is no response from the user, a call to 911 will be placed.
3. a) There is a power outage, the elevator will not take the request
    3. a1) The elevator system detects a power outage and initiates safety protocols, initiating audio and visual signals, and moving to the closest floor (current one).
    3. a2) Users disembark the elevator
    3. a3) Users must use the stairs to get to their destination or wait until the elevator is operational again.
3. a) There is a fire alarm, the elevator will not take the request
    3. a1) The elevator system receives a fire alarm signal from the building or the elevator itself and initiates safety protocols, initiating audio and visual signals, and moving to a safe floor (current one).
    3. a2) Passengers disembark the elevator.
    3. a3) Users will evacuate the building via stairs, in correspondence with building fire protocols.

Use Case 4: Elevator Moves Between Floors

Primary Actor: Elevator
Stakeholders:

Users - want to get from one floor to another
Building Owner - wants the elevator to operate properly for end-users satisfaction

Pre-conditions: The elevator system is operational and has received a request to go to a floor.

Success Guarantee: The elevator moves from its current position to the requested floor, displays the current floor, and plays any audio or visual warnings.

Main Success Scenario:
1. The elevator begins moving to the requested floor
2. The elevator displays the current floor as it's moving
3. The elevator arrives at the requested floor (refer to Use Case 2)

Extensions:
2. a) There is a power outage, the elevator will stop moving and the current floors will stop displaying

2. a1) The elevator system detects a power outage and initiates safety protocols, initiating audio and visual signals (removing the current floor from the display), and moving to the closest floor (possibly not the requested floor).
2. a2) Users disembark the elevator
2. a3) Users must use the stairs to get to their destination or wait until the elevator is operational again.

3. a) There is a fire alarm, the elevator will stop moving and the current floors will stop displaying

3. a1) The elevator system receives a fire alarm signal from the building or the elevator itself and initiates safety protocols, initiating audio and visual signals (removing the current floor from the display), and moving to a safe floor (possibly not the requested floor).
3. a2) Passengers disembark the elevator.
3. a3) Users will evacuate the building via stairs, in correspondence with building fire protocols.

Use Case Diagram Part 3: