

# COS214 Project: Functional Requirements

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## 1 Engineering Requirements

### 1.1 Component Storage

1. The system must be able to add new component to storage
2. The system must be able to return used component to storage after launch
3. The system must be able to retrieve part from storage
4. Constraints:
  - If launch was unsuccessful, all parts are lost and none are returned to storage

### 1.2 Construction

1. The system must allow a user to input a mass for the cargo that will be launched by the rocket (in kilograms).
2. The system must allow a user to specify the type of cargo that will be launched by the rocket.
  - Constraint 1: The cargo must be of type **astronauts**, **supplies**, **satellites**, or a combination thereof
3. The system must be able to display all viable combinations of rockets (where **rocket** is either a Falcon Rocket, a Falcon Rocket with a Dragon Spacecraft attached, or a Falcon Rocket with Starlink satellites attached).
  - 3.1 The system should be able to model a **Falcon 9 first stage** with a single Falcon 9 core and 9 Merlin engines.
  - 3.2 The system should be able to model a **Falcon 9 second stage** with a single Vacuum Merlin Engine.
  - 3.3 The system should be able to model a **Falcon Heavy first stage** with a three Falcon 9 cores and a total of 27 Merlin engines.
  - 3.4 The system should be able to model a **Falcon Heavy second stage** with a single Vacuum Merlin Engine.
  - 3.5 The system should be able to model the **Crew Dragon Spacecraft** to send and safely return Humans and Cargo to the International Space Station.
  - 3.6 The system should be able to model the **Dragon Spacecraft** to send only cargo to the International Space Station.
  - 3.7 The system should be able to model a launch of the **Starlink satellites**.
4. The system must allow a user to specify the type of orbit that the rocket will be launched into.
  - Constraint 1: The orbit must be of type **Lower Earth Orbit (LEO)** or **Geostationary Transfer Orbit (GTO)**
  - Constraint 2: If orbit type is **GTO** and cargo mass is of **>8.3 tonnes**, a Falcon Heavy Rocket will be required.
  - Constraint 3: If orbit type is **LEO** and cargo mass is of **>22 tonnes**, a Falcon Heavy Rocket will be required.
5. The system must be able to remove the selected components from storage and add them to a new Rocket.
6. The system must be able to repeat this process.

## 2 Logistics Requirements

### 2.1 Launch Batch

1. The system must be able to receive a rocket/a list of rockets and add it to the launch batch
2. The system must allow a user to choose the type of launch.
  - Constraint 1: The launch must be of type **real** or **simulation**.

### 2.2 Launch Cost

1. The system must be able to calculate the cost of the launch and return that calculation to the user.
  - 1.1 The launch cost is encompassed by:
    - The damage done to the components.
    - The cost of preparing the launchpad.
    - The cost of the fuel used.

## 3 Launch Simulation Requirements

### 3.1 Test Mode Simulated Launch

1. The system should allow a test mode simulation to be paused, changed and resumed.
  - 1.1 The system should allow a user to **add a component** to the rocket.
  - 1.2 The system should allow a user to **remove a component** from the rocket.
  - 1.3 The system should allow a user to **change a component** of the rocket.
2. The system must be able to return an appropriate message on a **failed** launch simulation.
3. The system must be able to return an appropriate message on a **successful** launch simulation.
4. In the case of a launch with Starlink satellites, the system must be able to test communication between satellites.

### 3.2 Real Launch

1. The system must be able to ensure that a new launchpad is built or that an existing launchpad has been maintained and is in a condition to withstand the rocket launch.
  - 1.1 All necessary launchpad inspections should have been performed by a launchpad inspector.
  - 1.2 If a launchpad that is intended for use has not been inspected, then the user should be notified and given the choice to either **send a team in to inspect it** or **choose another launchpad to use**.
  - 1.3 If the inspection team finds an issue with a launchpad, the user should be notified that it is not usable and another launchpad should be used.
2. The system must be able to run a "**static fire**" test by firing up each of the rocket engines to ensure that they are working.
3. The system must provide an interface to setup and run actual launch simulations (where 'actual launch simulations' refers to launch simulations not being run in test mode).
  - 3.1 The system should be able to simulate the rocket flight and the separation of stages.
  - 3.2 The system should be able to simulate a landing of **Stage 1** on a drone ship in the middle of the ocean, so that it can be refurbished and then reused.
  - 3.3 The system should be able to simulate:
    - A Dragon Spacecraft landing on the **International Space Station (ISS)**.
    - The Starlink satellites being launched into **LEO** and communicating.
    - An unsuccessful launch, wherein a component fails.