STARSHIP

Peanuts LLC
Requirement Engineers

Peanut's Drone Delivery Service
By Peanuts LLC.

For Starship Technologies

Date:
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Project Drivers

Purpose of the Project

The project that Peanuts LLC. is undertaking involves the creation of web, Android, and iOS applications that will be integrated with the drone delivery system of food for STARSHIP Technologies. The applications will serve as a central platform for customers to order food, track their delivery in real-time, and communicate with the drone operators, supplying a seamless user experience. Peanuts LLC. will handle developing the software for the applications, which will require ability in programming and user interface design. Collaborating with STARSHIP Technologies, Peanuts LLC. will ensure that the applications are integrated with the drone delivery system and meet the needs of both companies. The project aims to revolutionize the food industry by supplying an innovative solution that makes the delivery process faster, more efficient, and more convenient for customers. With this project, Peanuts LLC. is contributing to the development of innovative technology that will transform the future of food delivery. This project stands for a significant step forward in the use of technology for food delivery and is expected to improve the speed and convenience of the service while also enhancing customer satisfaction.

Stakeholder Table

Peanuts Drone Delivery Service Stakeholder Analysis		
Stakeholder Functional Group	**Stakeholder Role**	Stakeholder Rationale (Why does this stakeholder need to be involved? Consider benefits and Impacts)
Customer	**Starship Technologies**	**Impact: Organization that will own and manage the product after handoff**
Project Sponsor	Project Owner	This stakeholder is the owner of the product and makes all the final decisions with Peanuts Leadership
Marketing	Marketing VP	This stakeholder oversees overseeing Starship's marketing operations
IT	IT VP	This stakeholder oversees overseeing Starship's IT operations from design, development, and implementation all the way to maintenance and support
IT	Project Manager	This stakeholder handles planning, executing, and monitoring Starship's projects and handles its success.
IT	Security Lead	This stakeholder handles implementing security tools in the system to protect the company and customer's data
Sales	Sales VP	This stakeholder oversees overseeing the sales made by the company and ensuring all disputes are resolved
Sales	Complaints Manager	This stakeholder handles processing any customer complaints and resolving them on time
Operations	Operations VP	This stakeholder oversees overseeing the company's operations and ensuring that all workflows are being executed smoothly to ensure customer satisfaction
Operations	Order Dispute Reps	This stakeholder handles handling and resolving all disputes about a customer's order
Finance	Finance VP	This stakeholder oversees overseeing the financial standpoint of the company to ensure that they are maximizing on profit
Leadership		
Upper Management	CEO	This stakeholder makes all final decisions related to Peanuts LLC and all project decisions with Starships Leadership
Upper Management	President	This stakeholder manages all day-to-day operational decisions of Peanuts LLC
Upper Management	Vice President	This stakeholder follows the President’s decisions and acts as their right man
Upper Management	Board of Directors	This stakeholder board of stakeholders that carry profound influence over Peanuts LLC's direction and projects
Middle Management	Project Manager	This stakeholder manager of a particular project in the company, has influence over the project
First Line Management	Team Lead	Leads a small team at the request of a project manager, has a greater connection with the development team
Operations / IT		
IT	Maintenance Lead	This stakeholder oversees the installation, repair, and upkeep of the drone delivery software systems
IT	Drone Maintenance Workers	These stakeholders oversee maintenance on the drone hardware, making sure it is up to date
Marketing		
Sales	Restaurant Marketing Lead	This stakeholder is the interests of the restaurants, monetarily wise
Sales	Marketing Reps	This stakeholder handles executing marketing strategies and producing innovative ideas to target audiences that the drone delivery service will appeal to the most
Customer Service		

Customer Support	Customer Service Lead	This stakeholder handles answering all customer questions about the drone delivery service and supporting the FAQ page
Customer Support	Customer Service Reps	These stakeholders carry the complaints and issues that the starships customers will have
Core Project Team		
Core	Requirements Lead	This stakeholder leads the requirements gathering and analysis, decides what the product will look like in conjunction with input from all stakeholders
Core	Design Lead	This stakeholder leads the design of the application, in charge of design systems and UX teams
Core	Architect Lead	This stakeholder leads the application and database architecture, in charge of the structure of the app and controllers
Core	Development Lead	This stakeholder leads the main development of the code for the application, in charge of the most important aspect of the project
Core	Deployment Lead	This stakeholder leads the deployment of the front-end, back-end and databases of the application, in charge of hardware
Core	Testing Lead	This stakeholder oversees all types of testing that needs to be performed on both the system and the drones, should coordinate with IT
Users		
Clients	Restaurant Owners	These stakeholders are the restaurant owners who will be using the drone delivery system to make a profit by selling meals
End Users	Starship Customers	These stakeholders are the end users who will buy their meals from the restaurants using the drone delivery system

Project Constraints

Peanuts LLC is creating a software platform for Starship Technologies to support their drone delivery service. The software is expected to supply an interactive and easy-to-use interface for customers to browse and order food, as well as track their order status and delivery time. To ensure a high-quality user experience and meet the needs of Starship Technologies, Peanuts LLC has found several constraints that the software must meet. These constraints include requirements for accessibility, user account management, performance, security, scalability, maintainability, and compliance with relevant standards and regulations. By adhering to these constraints, Peanuts LLC aims to deliver a software platform that not only meets the needs of Starship Technologies, but also exceeds customer expectations for a seamless and efficient delivery service.

Mandated Constraints

- User Experience: The software should supply an interactive, easy-to-use, and visually appealing interface for customers to browse and order food.

- Accessibility: The software should be accessible through a web browser or a mobile application, available on both Android and iOS platforms and be compatible with tablet devices.

- Database Backend: The software will need to be developed to work for the Amazon Simple Storage Service (AWS S3).

- Platform Compatibility: The software must be compatible with Android, iOS, and be viewable as a website. It must also be perfected to run on tablets.

- Security: The software must provide customers with the ability to sign up and log in to their account, which must be protected with proper security measures to ensure the privacy and confidentiality of their user information.

- Performance: The software must be designed to provide a fast and reliable experience for customers, with minimal lag or downtime, to ensure that the customer can access the service at any time and place.

- Integration: The software must integrate with Starship Technologies' existing systems and infrastructure to ensure seamless operations of the drone delivery service.

- Response Time: The software must be able to provide fast updates on the status of the drone and the user's order, with a maximum delay of 10 seconds for each update. This ensures that the user has up to date information on the progress of their delivery and can plan accordingly, while also enabling the business to monitor the delivery process and ensure that everything is running smoothly.

- Availability: The software must be available to users at least from 7am to 9pm every day. Since restaurants are not typically open after 9pm, the software could have time to go down for maintenance at night.

- Scalability: The software must be able to handle a minimum of 1000 concurrent users and 100 orders per hour, with the ability to easily scale up to meet increasing demand. This ensures that the software can support a growing user base and handle peak usage periods without crashing.

Relevant Facts and Assumptions

- The drone delivery service will run in areas where drone operation is permitted by law.
- The demand for drone delivery service will continue to grow over time.
- The application will be deployed as a web application.
- The app will be used by Starship Technologies and its customers.
- The software will need to be compliant with government regulations related to drone operation and food safety.
- The software will need to have robust security features to protect customer data and prevent fraudulent activities.

The Scope of Work

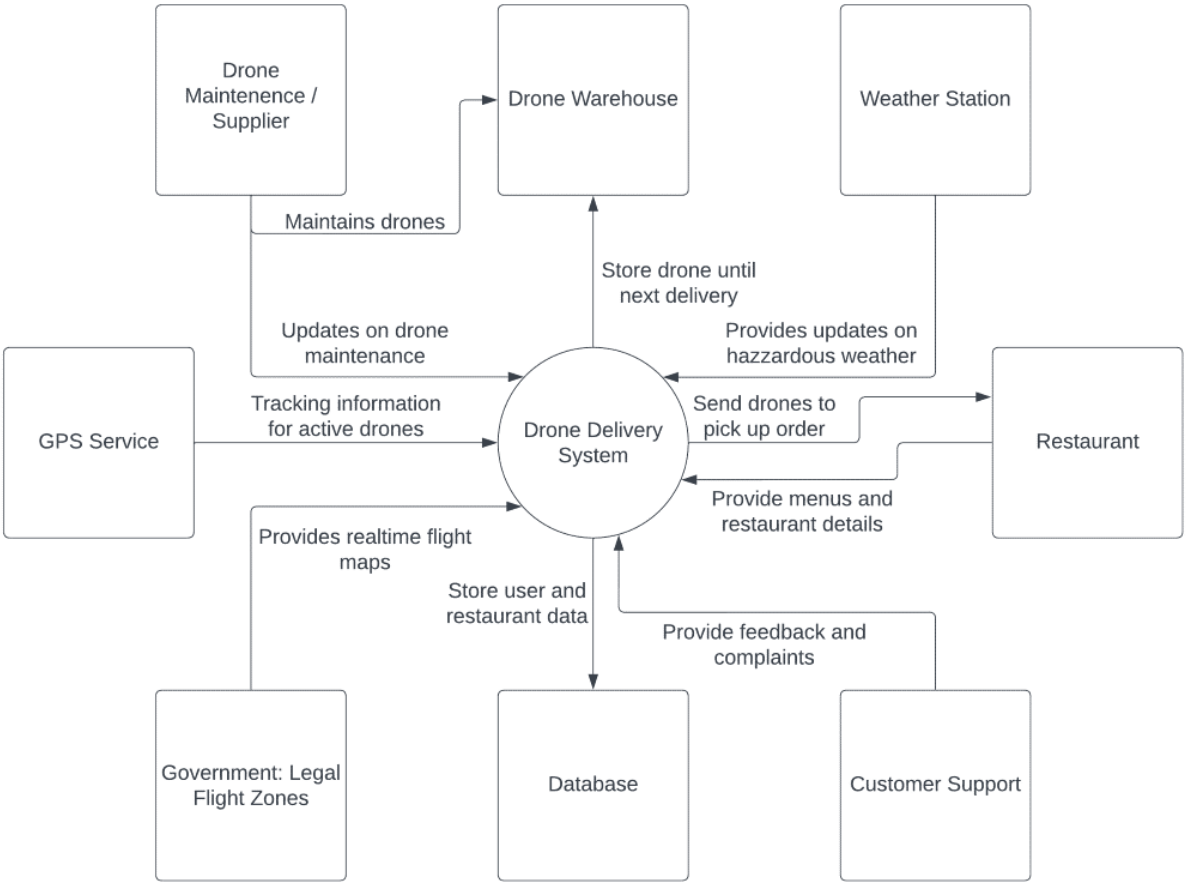
Current Situation

Starship Technologies is a technology company that supplies food delivery services to customers using automated robots that move on the ground. However, the current method of delivery involves robots that must navigate through traffic, pedestrians, and other obstacles. This process can take time and is not as efficient as it could be.
There is also the factor of limited range due to the inability of automated robots not being able to cross heavy traffic intersections. This is where automated delivery drones will be able to shine, by taking flight paths through the sky they will be able to travel further distances than the automated robots were able to.

Motivation to Change

Using Drones would be an effective way for Starship Technologies to both speed up its delivery process and reach more customers. One of the main reasons for using delivery drones is their ability to move faster than the current ground-based robots. The current robots must watch their speed so as not to run into pedestrians, and they must also wait at intersections for cars to let them pass. Drones would not be restricted by traffic or pedestrians since they can fly directly to their destination. This would allow Starship Technologies to make even more deliveries in a shorter amount of time, since the delivery time would be cut down. This would allow Starship Technologies to make more money by being able to make more deliveries.
Another advantage of using the new delivery drones is the expanded delivery radius that the drones have. The current ground robots are limited in how far they can travel, since they will not be able to cross busy highways. The ground robots can only take paths that are safe for them to travel as well, where they will not get stuck. Flying drones, on the other hand, do not have to worry about crossing a busy intersection or taking a well-paved sidewalk. These drones could expand the delivery radius of Starship Technologies and allow them to reach even more customers, which may increase their revenue.

Work Context Diagram



Business Events and Business Use Cases

Summary Table

#	Business Event	Input/Output	Summary of Business Use Case
1	A customer wants to view their order history and track the status of their current delivery.	The customer logs into the web, Android, or iOS application and requests to view their order history and current delivery status. (in)	Peanuts LLC.'s Drone Delivery System of Food application allows customers to view their order history and track the status of their current delivery. This use case provides a convenient way for customers to monitor their delivery progress and ensure that their food arrives on time. By integrating with the database and delivery system, the application can supply real-time updates and personalized information to customers.
2	The drone travels to the delivery location	It needs the GPS coordinates of the drone, the destination provided by the user, the details of the order, the route the drone will take, and weather conditions. (in)	Peanuts LLC.'s Drone Delivery System of Food application needs the drone to travel to the destination of the user to deliver their food. The drone will use its on-board AI system and pre-loaded map to navigate to the location to drop off their food.
3	A customer places an order for food delivery via the web, Android, or iOS application.	The customer's order details, including the type of food and delivery address, are received by the application. The application also receives data on the customer's payment method and delivery preferences. (in)	Peanuts LLC.'s Drone Delivery System of Food application supplies a convenient and efficient solution for customers to order food and have it delivered by drones. The application allows customers to place their orders quickly and easily, while also supplying real-time tracking of their deliveries. By integrating the application with the drone delivery system, Peanuts LLC. can supply a streamlined and reliable service that meets the needs of modern consumers.
4	A drone meets an obstacle during delivery.	The drone's obstacle detection system detects the obstacle and sends a signal to the drone operator via the web, Android, or iOS application. The application also receives data on the drone's location and status. (in)	Peanuts LLC.'s Drone Delivery System of Food application plays a critical role in ensuring the safe and efficient delivery of food via drones. This ensures that the delivery process stays reliable and minimizes the impact of any delays or issues. Additionally, the application supplies a platform for communication between the customer and the CS team, allowing for a personalized delivery experience.
5	Drone arrives at designated delivery location	Food is lowered at designated location (out)	Once the drone arrives at the designated delivery location the drone will begin to descend. Drones will have pre-laid out open spaces such as sidewalks, roads, and walkways where they will descend in height. They will scan the surrounding area and stop if they detect that anything is in the way.

			The drones will not descend lower than a certain height to be decided by our drone maintenance team and other company personnel. Once the drone reaches the smallest Drone Safety Height the drone will hover in place. Once the customer signals they are ready to receive the order via the app, the drone will begin to lower the order via a pulley system. The drone must hover as still as possible. Once the order has been delivered the drone will return to Standard Height and return to their housing.
6	Weather station sends notice of thunderstorm warning	Weather station readings (in)	System receives an alert from the weather station due to a severe thunderstorm and shuts down all drone deliveries until the warning passes. All active deliveries are to be finished ASAP and no more deliveries are to be accepted. All drones must return to drone housing as soon as their deliveries are completed.
7	A drone suffers a crash during delivery	The drone's failure detection system will send a notification to the drone maintenance team, along with its last known location. (out)	A drone will be considered crashed if at any moment in time the drone is below the Drone Safety Height. At this moment, the drone will shut down whether it is operational or not. This is to avoid any potential human injuries from bystanders. Drone Delivery System will have a parachute mechanism to ensure that a drone that meets complete operational failure is not prone to excessive damage if it falls from a great altitude. The landing via parachute must be as delicate as possible to avoid injury. The parachute mechanism must be activated once the drone is considered crashed. A team from the drone maintenance team will be sent to recover the failed drone at its last known location to bring it in for repair. The order must also be retrieved. If the failed drone was in the middle of a delivery, another drone will be notified to fulfill its delivery and the restaurant will be sent a request to recreate the order. The restaurant will be compensated for the extra order.
8	A drone is running low on battery during a delivery.	The drone's battery level is detected by the drone's software and sent to the drone operator via the web, Android, or iOS application. The application also receives data on the drone's location and status. (in)	Peanuts LLC.'s Drone Delivery System of Food application plays a critical role in ensuring the safe and efficient delivery of food via drones. In case of during delivery, the application supplies real-time alerts to both the customer and the drone maintenance team, enabling quick and effective problem resolution.

9	Drone picks up order from restaurant	Food pod has food order (out)	The drone arrives at the restaurant location and lowers the food pod into the restaurant chute. After the food is placed into the pod, the drone will raise the food pod and continue with its delivery.
10	Talk with the fleet manager	The customer wants to know the status of their order or there is a problem with the delivery (in)	If there is a problem with the delivery, the customer should get up to date information from the fleet manager about the status of the order.

BUC Scenario Flow

Business Use Case 1 (Logan Dane)

Business Event: User decides to check location of the delivery
Business Use Case Name: Check Location of User's Food
Trigger: A user places an order through the software
Preconditions:

- The user must have successfully placed an order through the software.
- The restaurant must have accepted and confirmed the order.
- The delivery drone must have begun its trip

Interested Stakeholders:

- Customer support team
- Operations team
- Marketing team

Active Stakeholders:

- User who placed the order
- Restaurant fulfilling the order
- Delivery drone operator
- Customer support representative (if needed)

Steps:

1. User places an order through the software.
2. The restaurant receives the order details and begins preparing the food.
3. The software sends a notification to the user that their order has been received and is being prepared.
4. The software sends real-time updates to the user on the progress of their order (e.g., "Your food is being prepared", "Your food is being loaded onto the drone", "Your order is on its way").
5. The software calculates the estimated delivery time based on the distance between the restaurant and the delivery address, drone speed, and traffic and weather conditions.
6. The software sends the estimated delivery time and location tracking data to the user.
7. The drone operator receives updates on the delivery status and location of the drone through the drone control software.
8. The drone arrives at the delivery address and the software sends a final update to the user that their food has been delivered.

Outcome: The result of the order tracking event is that the user can track the progress of their order in real-time and receive updates on the delivery status and estimated delivery time. This supplies a better customer experience and helps users to plan their day more effectively.

Business Use Case 2 (Logan Dane)

Business Event: Drone goes to the delivery location
Business Use Case Name: Automated Drone Delivery
Trigger: User completes order and payment on the app.
Preconditions:

- The delivery location is within the drone's delivery range
- The item to be delivered fits within the drone's cargo hold
- The drone has sufficient power and to complete the delivery

Interested Stakeholders:

- Operations team
- Technical team
- Fleet Managers

Active Stakeholders:

- Fleet managers
- Customer

Steps:

1. The customer completes an order and payment on the app.
2. The order is processed by the automated system, and a drone is assigned to the delivery.
3. The item to be delivered is loaded into the drone's cargo held by the coordination team.
4. The drone is activated and takes off from the designated launch site.
5. The drone navigates to the delivery location using the pre-loaded map and GPS.
6. The drone lands at a safe and designated area close to the delivery location.

Outcome: The drone has arrived at the delivery location and is ready to complete the delivery process, which includes the final steps of landing and delivering the item to the customer.

Business Use Case 3 (Aadarsha Dhungel)

Business Event: User orders the food via web, Android, or iOS application
Business Use Case Name: User orders the food
Trigger: User successfully logs in the application.
Preconditions:

- The user must have successfully logged in into the application.
- Users must search for the restaurant or type of food they want to order.

Interested Stakeholders:

- Customer support team
- Operations team
- Marketing team

Active Stakeholders:

- User who is about to place order
- Restaurant fulfilling the order
- Customer support representative (if needed)

Steps:

1. User successfully logs in to the system with valid credentials.
2. User searches the item to order based on his desire.
3. User places his orders on the cart and checks out with valid payment method.
4. Restaurant is sent the user's order and it is up to restaurant's discretion if they want to accept it.
5. If the restaurant accepts the order, the software sends a notification to the user that their order has been received and is being prepared and now the user can track the status of food in real time.

Outcome:
The result of the food ordering event is that the user is able place the order for food based on their desire and the restaurants available on the application. After the user places an order, and if the restaurant accepts the order, the user can track the status of his order in real-time through the application.

Business Use Case 4 (Aadarsha Dhungel)

Business Event: A drone meets an obstacle during delivery.
Business Use Case Name: Obstacle Detection and Resolution for Drone Delivery.
Trigger: The drone's obstacle detection system detects the obstacle and sends a signal to the drone operator via the web, Android, or iOS application.
Preconditions:

- The drone is delivering food
- Obstacle Detection System is operational

Interested Stakeholders:

- Customer
- Customer Service Team
- Fleet Manager

Active Stakeholders:

- Customer Service Team
- Fleet Manager

Steps:

1. The drone's obstacle detection system detects an obstacle in its path during delivery.
2. The system sends a signal to the fleet manager, alerting them to the obstacle.
3. The application displays the drone's location and status, allowing the manager to assess the situation.
4. The manager communicates with the customer service team to inform them of the issue and supply an estimated time of arrival for the delivery.
5. The CS team communicates with the customer to inform them of the delay and supply an updated delivery time.
6. The drone operator decides the best course of action to safely avoid the obstacle and resume delivery.
7. The drone resumes its delivery route, avoiding the obstacle.

Outcome:
The obstacle is safely avoided, and the delivery is completed promptly. The customer is informed of the delay and provided with an updated delivery time. The drone delivery system stays reliable and efficient, supporting customer satisfaction and minimizing the impact of any delays or issues.

Business Use Case 5 (Naxel Santiago)

Business Event: Drone arrives at delivery location
Business Use Case Name: Drone lowers order to customer
Trigger: Customer presses phone UI to signal they are at the location
Preconditions: Drone is at designated open-space delivery location and with order in container.
Interested Stakeholders: Customer, restaurant personnel, Starship Technologies, Drone Maintenance Team, Federal Aviation Association
Active Stakeholders: Customer (trigger)
Steps:

1. Drone will scan surroundings to verify there are no obstructions
2. Drone will begin to descend to the Drone Safety Height while continuing the scan
3. Drone will hover in place and wait for customer's signal (largest wait time is 5min)
4. The customer will signal via the app that they are at the location
5. Drone will begin to lower the food pod onto the ground via pulley system
6. Food pod will continue to scan the surrounding environment
7. Food pod will place order on the ground
8. Drone will raise food pod via the pulley
9. Customer will pick order up
10. Drone will ascend to Standard Height and return to drone housing

Outcome: Customer will have received and finished their order; drone will begin flight to return to housing.

Business Use Case 6 (Naxel Santiago)

Business Event: Weather station sends notice of thunderstorm warning
Business Use Case Name: Terminate all drone activities due to inclement weather
Trigger: The weather station sends a severe thunderstorm warning to the system
Preconditions: The weather begins to worsen, and the weather station detects the upcoming change in weather.
Interested Stakeholders: Customer, restaurant personnel, Starship Technologies, Drone Maintenance Team, Federal Aviation Association, weather station
Active Stakeholders: Weather station (trigger), drone maintenance team
Steps:

1. The system receives the weather warning from the weather station
2. No more orders are to be taken once the weather warning has been issued
3. The system sends out a signal to all the drones to complete their deliveries
4. All drones not in active deliveries must return to their housing and the remaining must finish deliveries asap and return to housing after
5. Situation will be checked by the drone maintenance team

More information: In this scenario, the timing between the weather station sending out a warning and the drones finishing their deliveries and returning must be fine-tuned as to avoid potential harm due to severe weather. In other words, the maintenance team must verify that drones have enough time to finish active deliveries and return to housing before weather conditions worsen; this will be depended on how fast the weather worsens from the receiving of the weather warning.
Outcome: All active deliveries will be completed; no more deliveries will be accepted until the inclement weather warning passes and all drones will return to their housing before the weather conditions turn bad.

Business Use Case 7 (Syed Murtaza)

Business Event: A drone suffers a crash during delivery
Business Use Case Name: A drone has crashed, resulting in the potential loss of a customer's order and property damage.
Trigger: The drone experiences a technical failure while in flight.
Preconditions: The drone delivery system is in operation and is either actively carrying a delivery order or is on its way to pick up an order. The crashed drone is equipped with GPS tracking and a camera for real-time monitoring of its location and surrounding areas.
Interested Stakeholders: Customer, Starship Technologies, Insurance, Restaurant Staff, Regulatory authorities/local law enforcement.
Active Stakeholders: Drone operators/administrators, Incident management team, Drone maintenance team
Steps:

1. The drone operator finds the location of the crashed drone using GPS tracking and camera footage and sends the incident management team to retrieve the fallen drone.
2. The drone operator inspects the drone for damage and finds the cause of the crash. If necessary, the drone maintenance team will be called to aid with the investigation.
3. The incident management team notifies all interested stakeholders of the drone crash to start steps to replace the drone's service with minimal delay.
4. The drone is recovered and brought back to the drone maintenance for repair or replacement.
5. The incident management team finds alternative delivery options for customers affected by the drone crash, such as replacing the customer's order free of charge.
6. The incident management team documents the incident, the actions taken, and any lessons learned to improve the drone delivery system's safety and reliability.

Additional Information:
The incident management protocol should be reviewed regularly to ensure its effectiveness and relevance.
The drone delivery service provider should have insurance coverage to mitigate the risk of property damage caused by drone crashes.
Outcome: The drone will be recovered from its last known location before the crash and brought in for repair. The customer's order will be fulfilled via another drone.

Business Use Case 8 (Syed Murtaza)

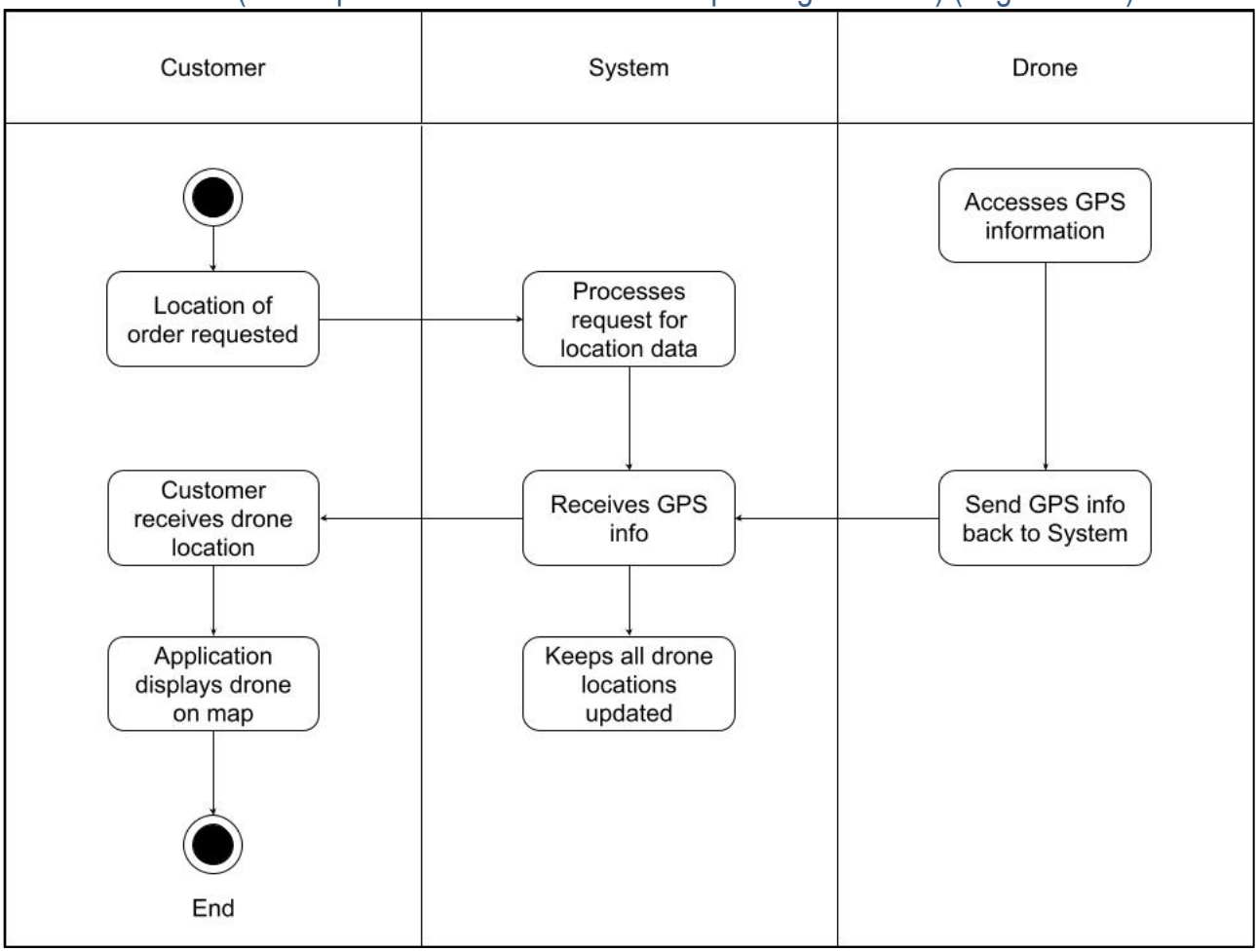
Business Event: A drone is running low on battery during a delivery
Business Use Case Name: Return the drone safely back to the charging station
Trigger: The drone's battery level drops below the predefined threshold while in flight to make a delivery.
Preconditions: The drone delivery system is in operation and is actively carrying a customer’s order. The drones have a predefined low battery level which considers it unsafe to fly if the percentage drops below. The drones are also equipped with GPS tracking and a camera for real-time monitoring of its location and surrounding areas.
Interested Stakeholders: Customers, Starship Technologies
Active Stakeholders: Drone operators/administrators, Drone maintenance team
Steps:

2. The drone operator receives a notification that the drone's battery level has dropped below the predefined threshold.
3. The operator assesses the situation and decides whether the drone can complete its delivery or needs to return to the charging station at once.
4. The incident management team notifies all interested stakeholders of the low battery incident and the potential impact on the delivery schedule.
5. The incident management team evaluates alternative options to ensure the delivery is completed, such as transferring the customer’s order to another drone upon arrival at the charging station.
6. If the drone can complete its delivery, the operator continues its delivery route and ensures the customer’s order is delivered successfully.

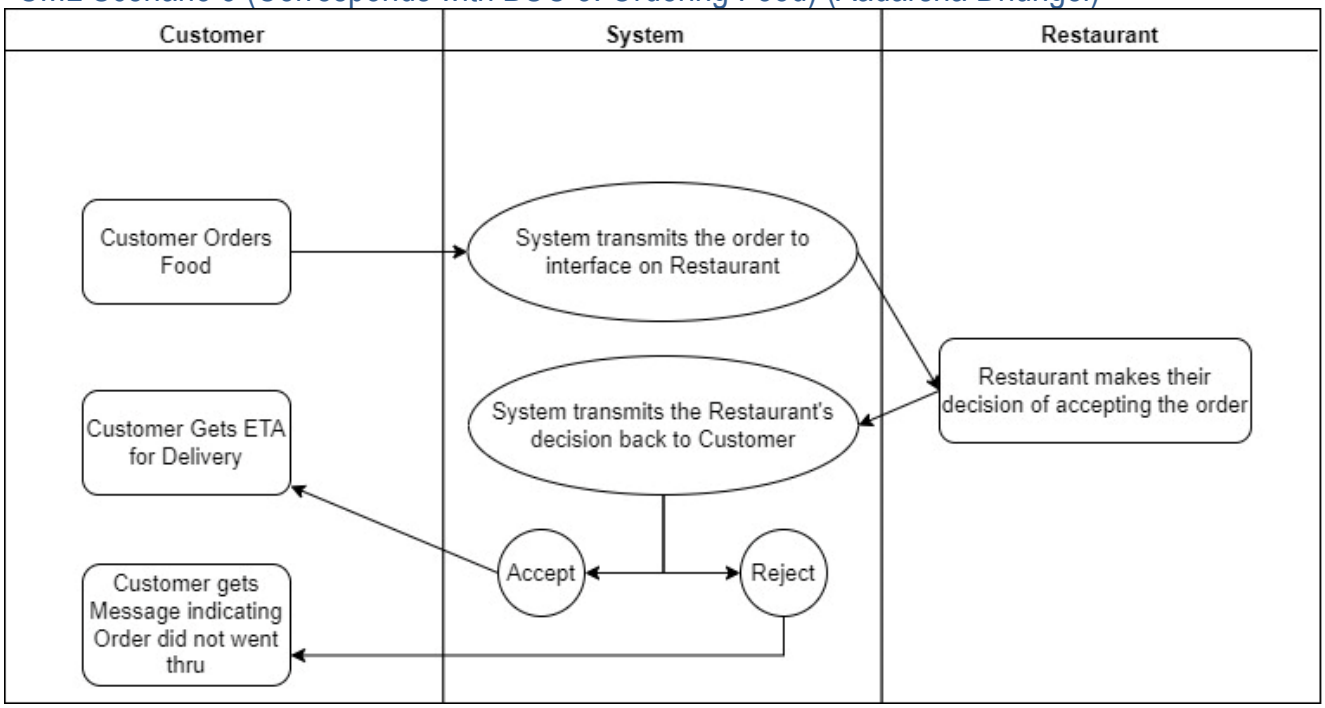
Additional Information:
The drone delivery service provider should have enough drones to mitigate the risk of delays caused by low battery incidents.
The drone operator should regularly watch the drone's battery level and adjust the delivery schedule if necessary.
Outcome: The customer’s order will successfully be delivered either via the drone whose battery is low or via another drone after the low battery one returns to the charging station. The drone operator will ensure that an informed decision is made on whether to allow the low battery drone to complete its delivery or to return to the charging station for an exchange.

UML Scenarios

UML Scenario 1 (Corresponds with BUC 1: User Requesting Location) (Logan Dane)

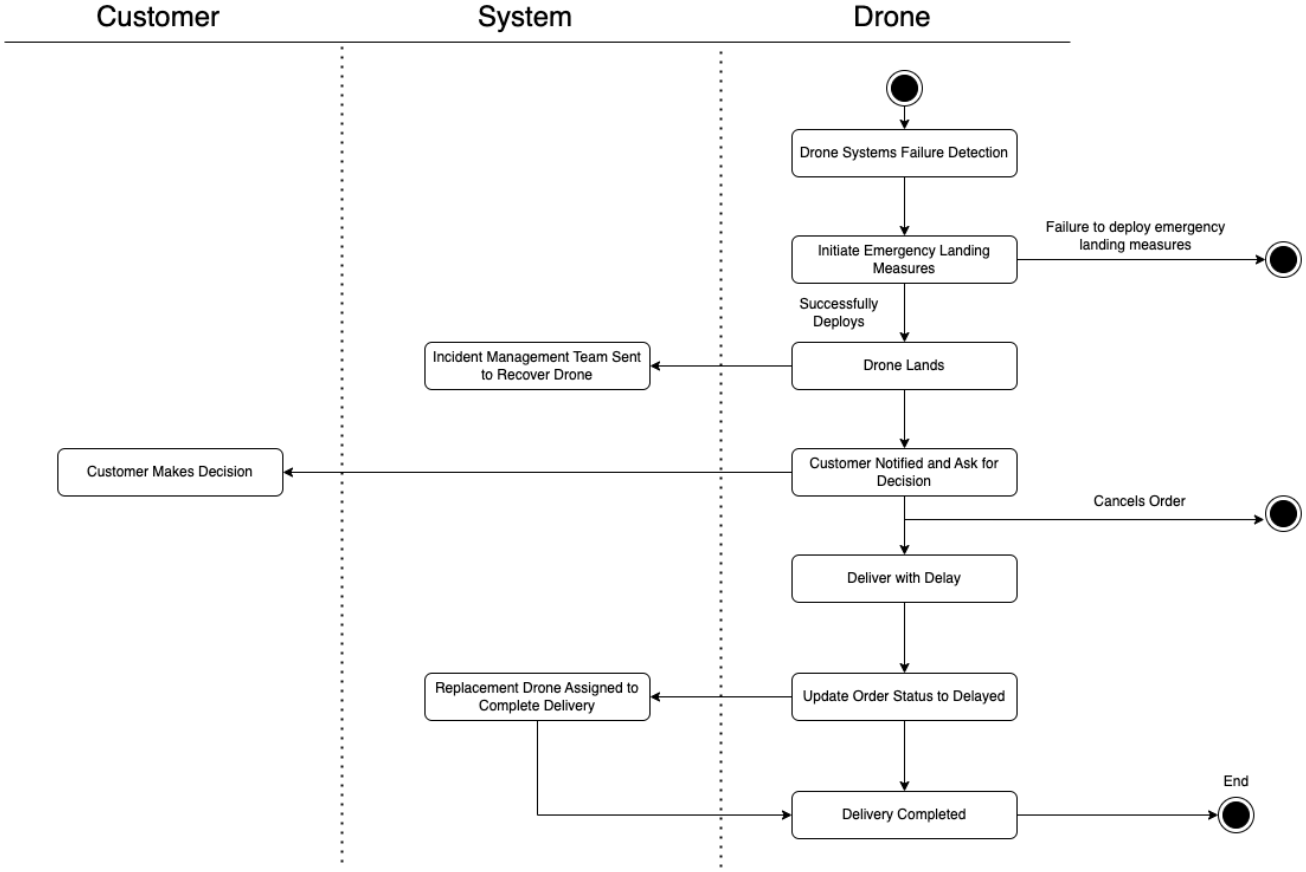


UML Scenario 3 (Corresponds with BUC 3: Ordering Food) (Aadarsha Dhungel)



UML Scenario 5 (Corresponds with BUC 5: Arrives at Delivery Location) (Naxel Santiago)

UML Scenario 7 (Corresponds with BUC 7: Drone Crash) (Syed Murtaza)



Feature Set

- Autonomous operation: The Peanuts Drone Delivery System drones will be able to navigate and fly without human intervention, using sensors and algorithms to avoid obstacles and navigate to their destination.
- Weather resistance: The Peanuts Drone Delivery System drones will be able to run in various weather conditions, including wind, rain, and some extreme temperatures.
- Weight Capacity: The Peanuts Drone Delivery System drone will be capable of carrying a payload of up to 3lbs for each delivery.
- Distance: The Peanuts Drone Delivery System drones will be able to fly a sufficient distance and remain in the air for the required amount of time to complete their deliveries.
- Security: The Peanuts Drone Delivery System drones will have safety features such as backup propellors, emergency battery kit, and location finder to have fail-safe methods in the rare event that a malfunction or failure occurs.
- Interface: The Peanuts Drone Delivery System will incorporate user-friendly features across a variety of different platforms including web, iOS, and Android to reach the maximum number of users possible.
- Efficiency: The Peanuts Drone Delivery System will be a cost-effective food delivery solution that does not have to deal with the traffic and obstacles that are met by ground delivery vehicles.

Product Use Cases

Summary Table

PUC Number	PUC Name	Actor(s)	Input and Output	BUC Mapping	Creator
1	The customer requests the location of their drone	Customer	The customer can open their Starship application and see the location of the drone while the drone is delivering their food. (out)	BUC 1	Logan Dane
2	The fleet manager sees the location of the drone	Fleet Manager	The fleet manager can see the locations of all the drones that are currently out for delivery. (out)	BUC 1	Logan Dane
3	A customer wants to track their food delivery in real-time.	Customer	The customer can log into the STARSHIPS Delivery System of Food application to track the status of their delivery in real-time. The application provides the customer with a map of their delivery route, the estimated delivery time, and any updates on the delivery status. (out)	BUC 3	Aadarsha Dhungel
4	Customer service receives notification of drone maintenance.	Customer Service Team	The drone's maintenance system detects a problem and sends a signal to Customer Service via STARSHIPS Delivery System of Food application. The application also receives data on the drone's location and status. (in)	BUC 4	Aadarsha Dhungel
5	Drone lowers the food pod via the pulley	Customer	The customer receives a notification saying their order has arrived. The sidebar displays the “Lower Food” button. Once the customer is ready, they press the button. (in)	BUC 5	Naxel Santiago
6	Food pod detects that the customer has gotten too close to the food pod sensors	Food pod sensors	The food pod sensors detect that an object has entered the 5ft radius. (in)	BUC 5	Naxel Santiago
7	Drone Crash During Delivery	Drone Maintenance Team	The drone will send a notification to the drone incident management team to alert them of the failure. (out)	BUC 7	Syed Murtaza
8	Drone Battery Low	Drone Operator	The drone will send a notification to the drone operator informing them of the low battery level (out)	BUC 8	Syed Murtaza
9	Drone picks up order from restaurant	Restaurant Employee	Food pod has order (out)	BUC 9	Naxel Santiago
10	Drones receive weather warning	System	Weather warning (in)	BUC 6	Naxel Santiago
11	Chat with Fleet Manager	Fleet Manager	The User can press a button to talk with the fleet manager for updates	BUC 9	Logan Dane
12	Sending route to	Fleet	The system will calculate and send	BUC 2	Logan

	the drones	Manager	the best route to the drone once the order is received.		Dane

PUC Detail Flow

Product Use Case 1 (Logan Dane):

Product Use Case Name: The customer sees the location of the drone.
Trigger: The user looks at the application after ordering an item
Preconditions:

- The user must have an order in progress
- The drone must have left the home base

Interested Stakeholders:

- Customer
- Customer support team
- Operations Team

Actor: The customer
Steps:

1. The customer places an order through the application.
2. The drone, which is back at the home base, is delegated the order and begins its route to the restaurant.
3. While the user is in the application, the user will receive an updated GPS location of the drone from the home base once every 15 seconds.
4. The drone's location will then be presented on the screen as an icon of the drone on a map.
5. These updates continue until the drone has dropped off the food at the customer's requested drop off location, in which the customer will no longer receive updates on the location of the drone.

Outcome: The customer can see the location of the drone while it is on route to the location of the customer.

Product Use Case 2 (Logan Dane):

Product Use Case Name: The fleet manager sees the location of the drone.
Trigger: The drone leaves home base to go pick up and deliver an order
Preconditions:

- A customer has placed an order
- The drone has left the base to go and deliver the order

Interested Stakeholders:

- Fleet Manager
- Customer support team

Actor: The Fleet Manager
Steps:

1. A customer places an order through their application
2. The drone gets delegated the order and leaves to pick it up
3. While outside the home base, the drone will send the GPS location of itself over to the home base once every five seconds.
4. The fleet manager receives this information, and places icons of drones on the map based on the GPS location of the drone.
5. The fleet manager will then be able to watch the locations of the drones in case of any fails during the flight.
6. When a drone returns to the base, the location will not be placed on the map anymore.

Outcome: The fleet manager can watch the location of the drone while it is out of the home base and will know where the drone was last seen if it goes missing (or if there are other errors).

Product Use Case 3 (Aadarsha Dhungel):

Product Use Case Name: A customer wants to track their food in real-time.
Trigger: The user wants to track their delivery status.
Preconditions:

- The user must have an order in progress.
- The application must have access to GPS location tracking.

Interested Stakeholders:

- Customer
- Customer support team
- Operations Team

Actor: The customer
Steps:

1. The customer logs into the STARSHIPS Delivery System of Food application.
2. The customer selects the order that they wish to track.
3. The application provides a map with the route of the drone and an estimated delivery time.
4. The application supplies real-time updates on the status of the delivery, including when the drone has arrived at the restaurant, picked up the food, and is enroute to the customer.
5. If there are any delays or issues with the delivery, the application will supply updates on the status of the delivery and any estimated delays.

Outcome: The customer can track the status of their delivery in real-time, supplying peace of mind and allowing them to plan accordingly.

Product Use Case 4 (Aadarsha Dhungel):

Product Use Case Name: The customer service receives notification of drone maintenance.

Trigger: The drone maintenance system detects a problem.

Preconditions:

- The drone must be in use.
- The application must have access to drone location and status data

Interested Stakeholders:

- Customer Service team
- Drone Maintenance team
- Operations Team

Actor: The Customer Service team

Steps:

1. The drone maintenance system detects a problem with the drone.
2. The system sends a signal to the STARSHIPS Delivery System of Food application.
3. The application receives the notification and provides the customer service team with the location and status of the drone.
4. The customer service team contacts the drone maintenance team to address the issue.
5. The drone maintenance team uses the application to find the drone and figure out the best course of action.

Outcome: The customer service team is notified of the drone maintenance issue and can quickly address the issue, minimizing the impact on the delivery system.

Product Use Case 5 (Naxel Santiago):

Product Use Case Name: Drone lowers the food pod via the pulley

Trigger: The Customer presses “Lower Food”

Preconditions:

- The drone is at the delivery location
- The drone is at DSH
- The food pod contains the food order
- The customer is at the delivery location

Interested Stakeholders:

- Customer
- Starship Technologies
- Fleet Manager
- Restaurant

Actor: The Customer

Steps:

1. Drone sensors scan surroundings to verify there are no obstructions
2. Drone and food pod cameras will continuously be recording
3. Drone pulley system begins to lower the food pod onto the ground
4. Food pod sensors continue to scan the surrounding environment
5. Food pod reaches the ground
6. Food pod opens the bottom doors and places order on the ground
7. Drone raises food pod via the pulley
8. Food pod closes bottom doors
9. Customer picks order up and leaves
10. Drone ascends to Standard Height and returns to drone housing

Outcome: The customer has grabbed and received their order. The food pod has been raised back to the drone and is empty. The drone is on route to return to housing.

Product Use Case 6 (Naxel Santiago):

Product Use Case Name: Food pod detects that the customer has gotten too close to the food pod sensors

Trigger: The customer has walked within the food pod sensor's 5ft radius (10ft in strong winds)

Preconditions:

- The drone is currently lowering the food pod for delivery
- The food pod sensors are currently scanning for potential hazards

Interested Stakeholders:

- Drone Maintenance Team
- Starship Technologies
- Restaurant

Actor: The food pod sensors

Steps:

1. Food pod sensors detect that something has entered the 5ft radius
2. Food pod makes a slight warning sound
3. Drone stops lowering food pod and raises it by 5ft
4. Application pings the customer saying "Food Pod has detected an obstruction, please clear the area or change delivery location"
5. Customer chooses an option between "continue" or "change delivery location"
6. If continue: Food pod will try to be lowered again
7. If change delivery location: the application will allow the customer to change the delivery location via GPS tracking on their phone

Outcome: The food pod has resolved the issue and the order has been successfully delivered without anything touching the food pod.

Product Use Case 7 (Syed Murtaza):

Product Use Case Name: Drone Crash During Delivery
Trigger: A drone delivering food from a restaurant to a customer, crashes during the delivery.
Preconditions: The customer has placed an order using the app. The drone is enroute to the customer's location.
Interested Stakeholders: Customer, Restaurant, Starship Drone Delivery, Drone Maintenance Team, Incident Management Team, Local law enforcement, Fleet Manager.
Actor: Incident Management Team
Steps:

1. The drone suffers a malfunction or other issue during the delivery and crashes.
2. The fleet manager receives a notification that the drone has crashed and dispatches the incident management team to its last known location.
3. The team finds the drone and assesses the extent of the damage.
4. The system notifies the customer to inform them of the incident and arrange for an alternative delivery method or refund.
5. The drone maintenance team receives the damaged drone and assesses the cause of the failure and whether the drone is repairable or needs to be replaced.
6. The incident is reported to Starship to take follow up actions to prevent a similar incident from occurring again

Outcome: The drone delivering food from a restaurant to a customer, crashes during the delivery, but the incident management team responds swiftly. The system then supplies an alternative delivery method or refund to the customer. The drone maintenance team figures out the cause of the failure and reports it to Starship who will take further actions to ensure that such an incident does not occur again.

Product Use Case 8 (Syed Murtaza):

Product Use Case Name: Drone Battery Low
Trigger: The drone's battery level drops below a certain threshold while it is enroute to deliver food to a customer.
Preconditions: The drone is actively enroute delivering a customer's order
Interested Stakeholders: Customer, Fleet Manager
Actor: Fleet Manager
Steps:

1. The fleet manager receives a notification showing that the drone's battery level has dropped below a certain threshold.
2. The fleet manager quickly assesses the distance staying for the delivery and decides if it is safe to continue the delivery or not.
3. If it is unsafe to continue, the operator reroutes the drone to the nearest charging station and prepares to route the delivery to another drone to ensure the customer receives their order as soon as possible.
4. The customer is notified via the app of a possible delay due to the low battery on the drone.
5. The low battery drone is placed on charging at the charging base station.
6. A replacement drone resumes and completes delivering the customer's order.

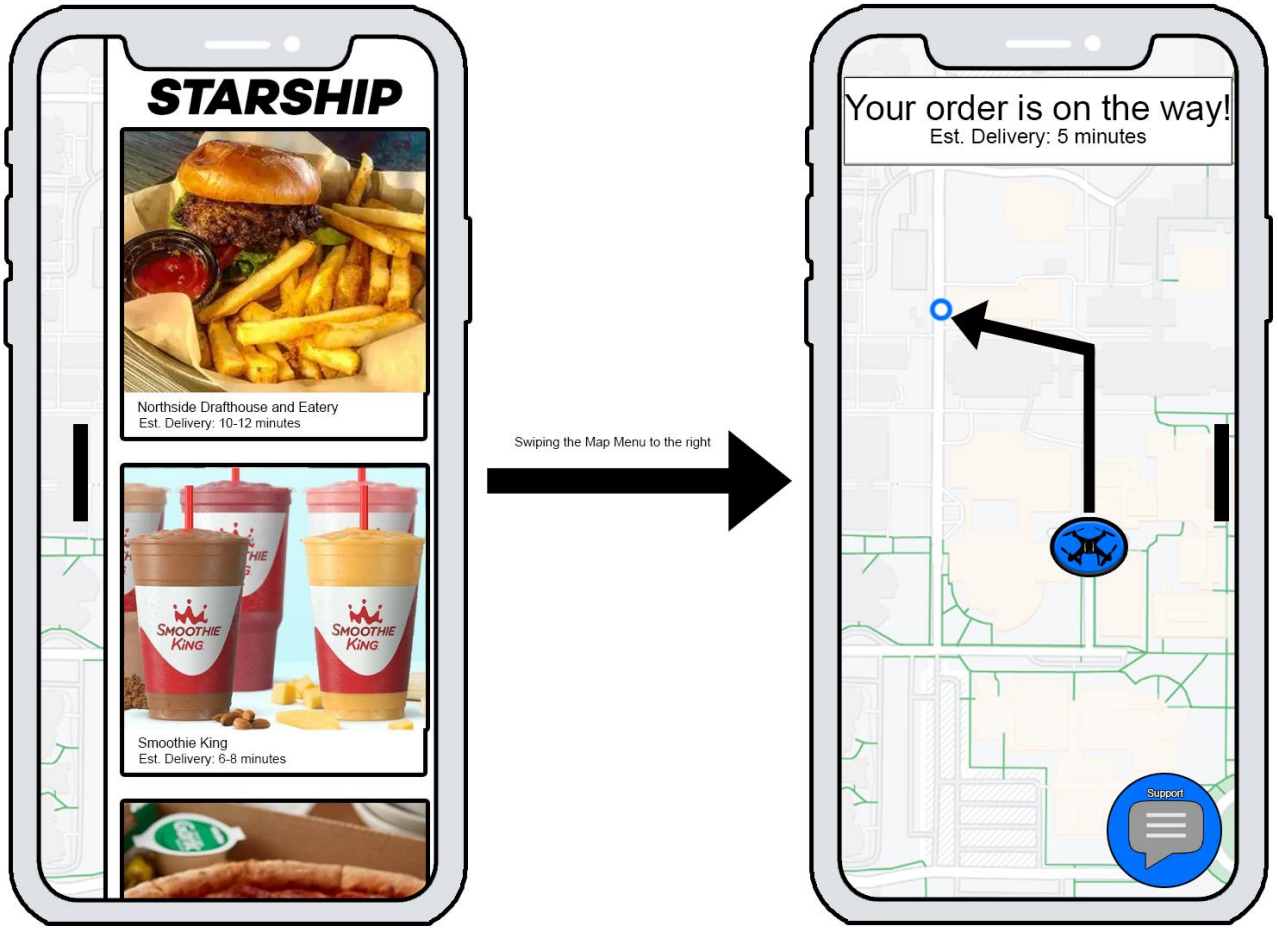
Outcome: The drone can complete the delivery either via the same drone that originally picked up the order or via another drone while ensuring customer satisfaction and supporting the company's reputation for reliable service.

Prototype / Mind Mapping

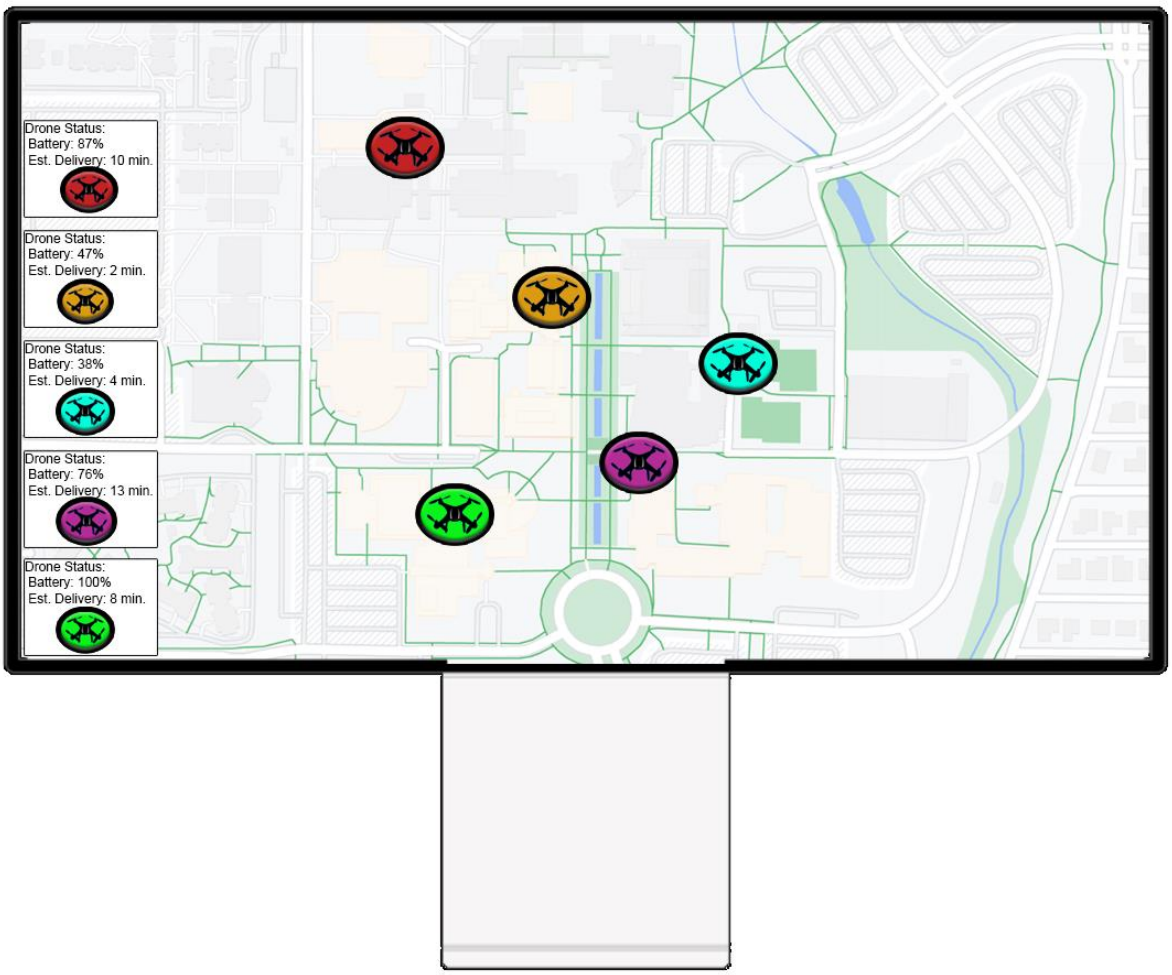
Wire Frames

Logan Dane Wireframes:

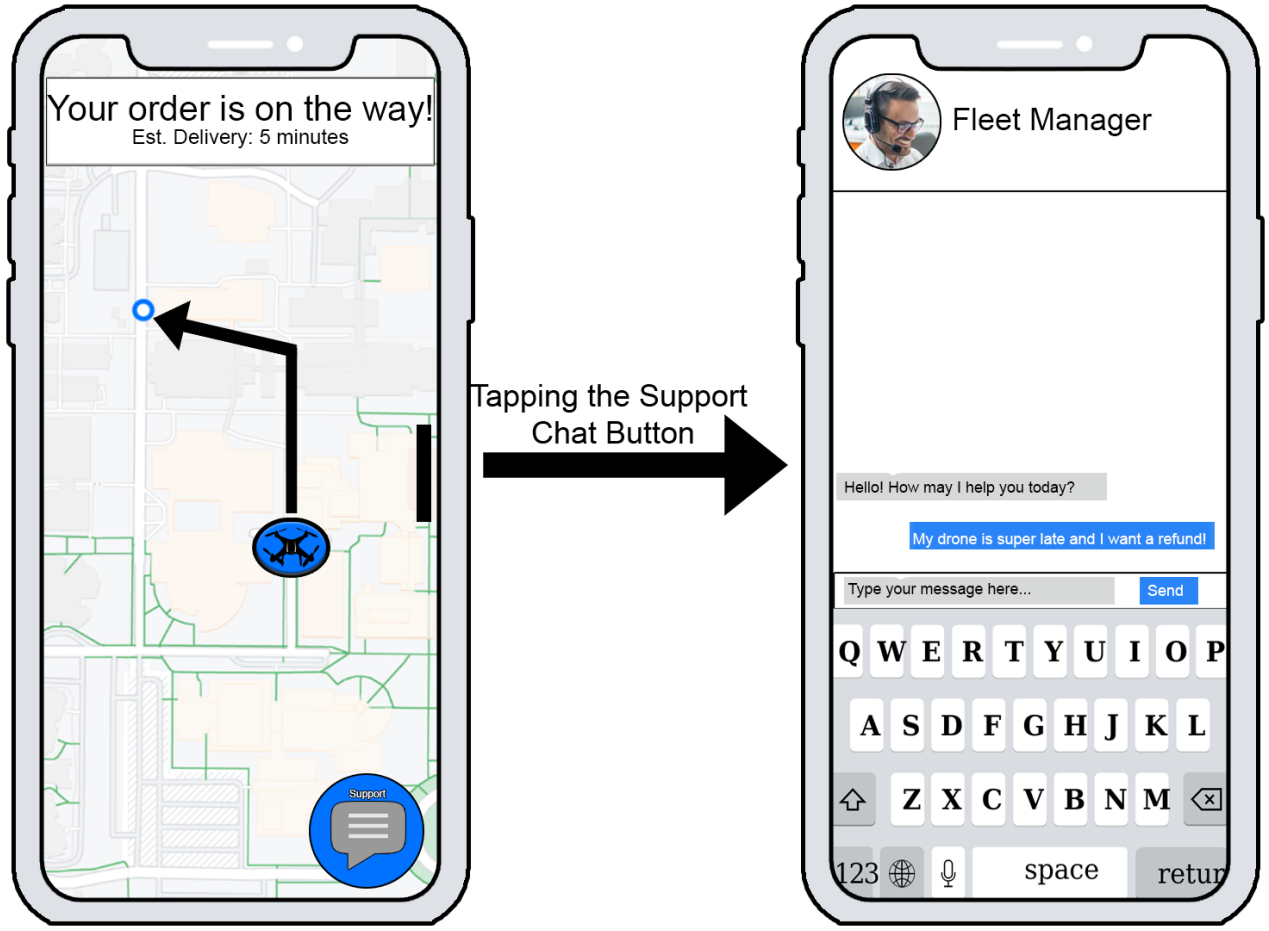
Wireframe 1: Swiping to get the drone location



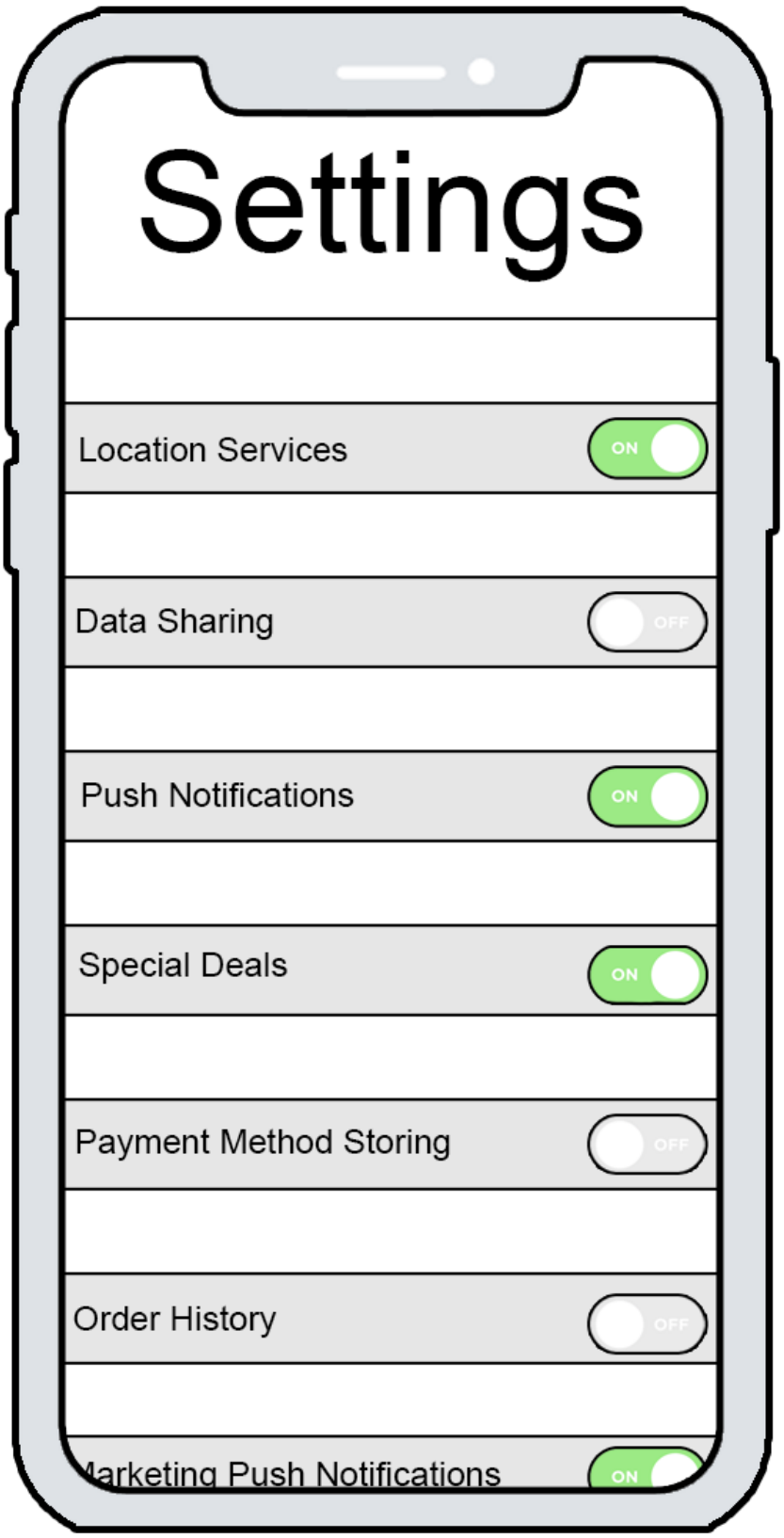
Wireframe 2:Fleet Manager drone overview



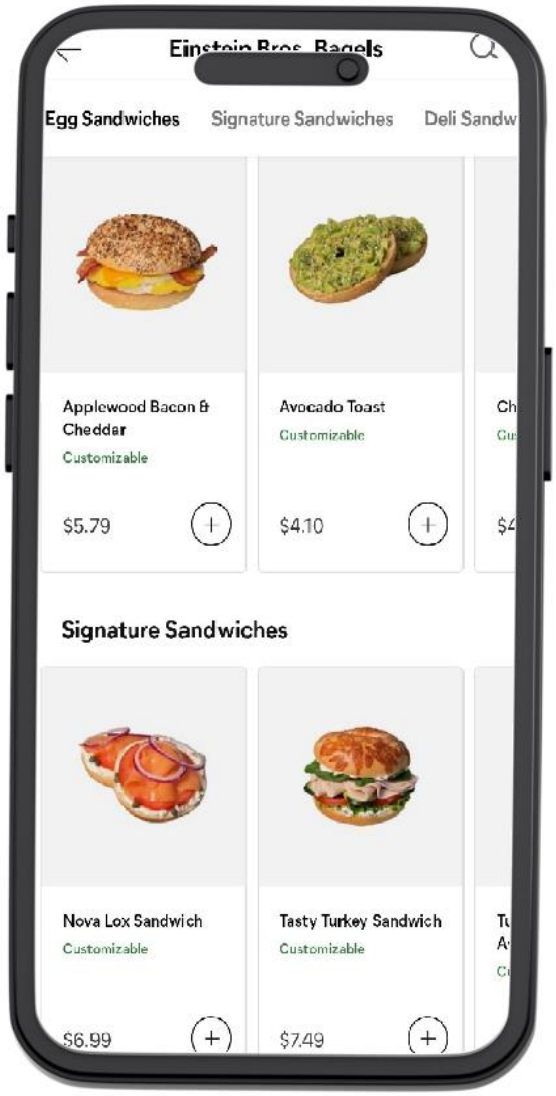
Wireframe 3:Support Chat with Fleet Manager

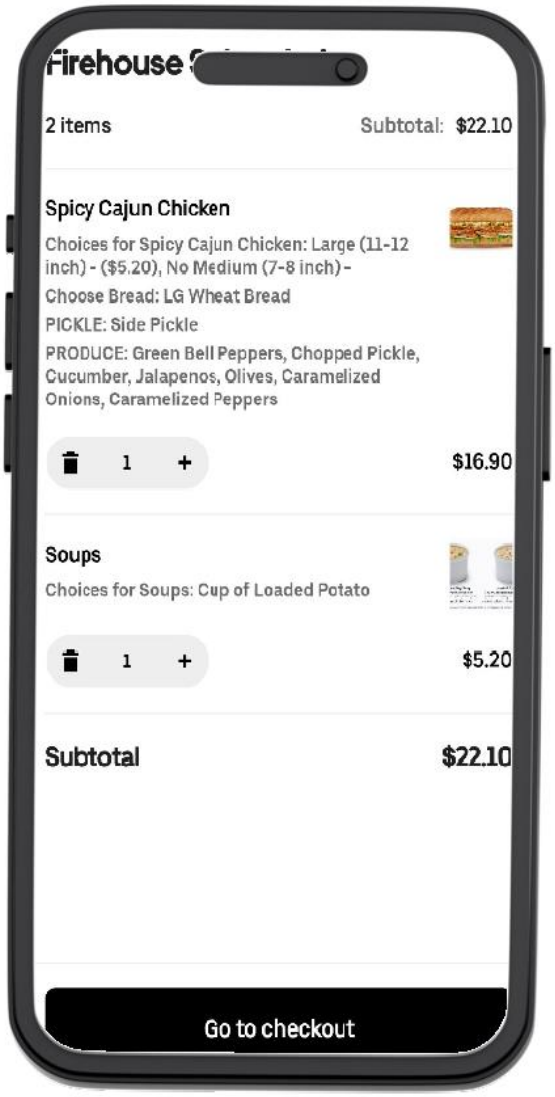


Wireframe 4: Settings



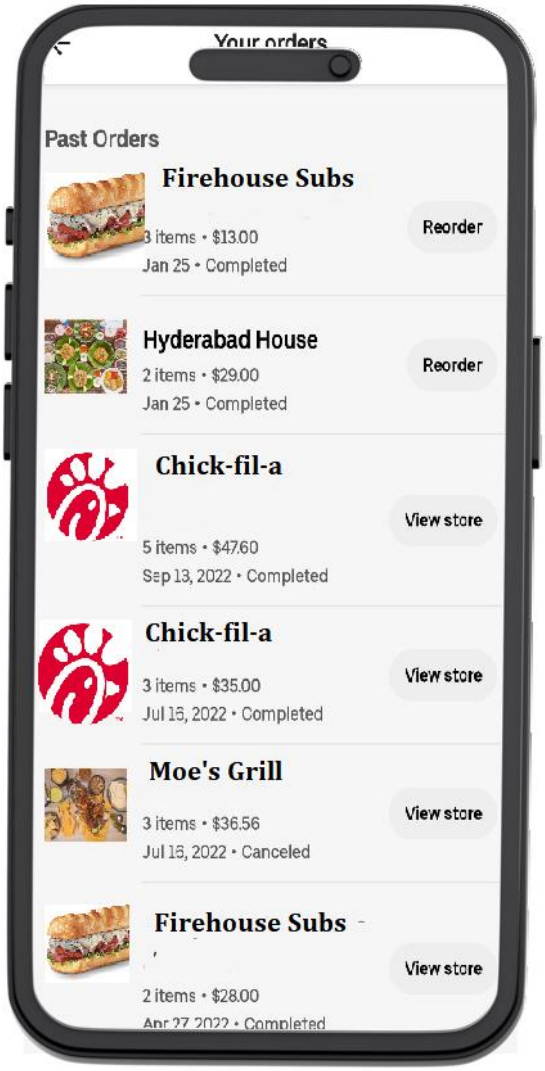
Adarsha Dhungel Wireframes:

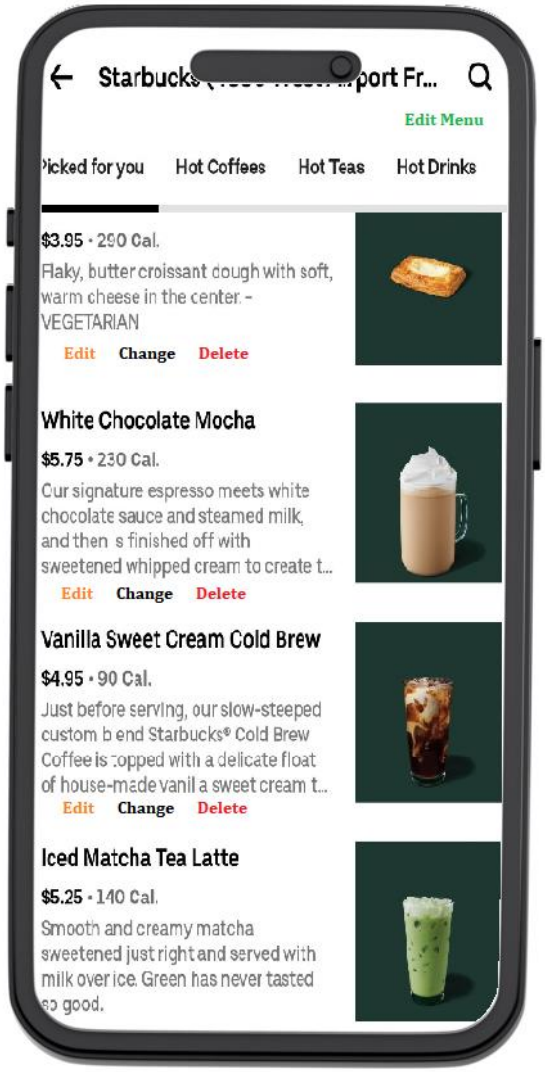




Wireframe1: <u>Restaurant Menu</u>

Wireframe2: <u>Customer Cart</u>





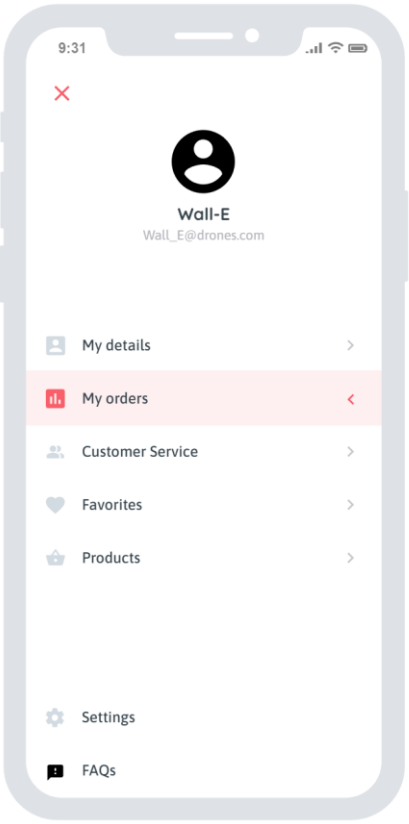
Wireframe3: Customer Order History

Wireframe4: Owner's POV of Menu

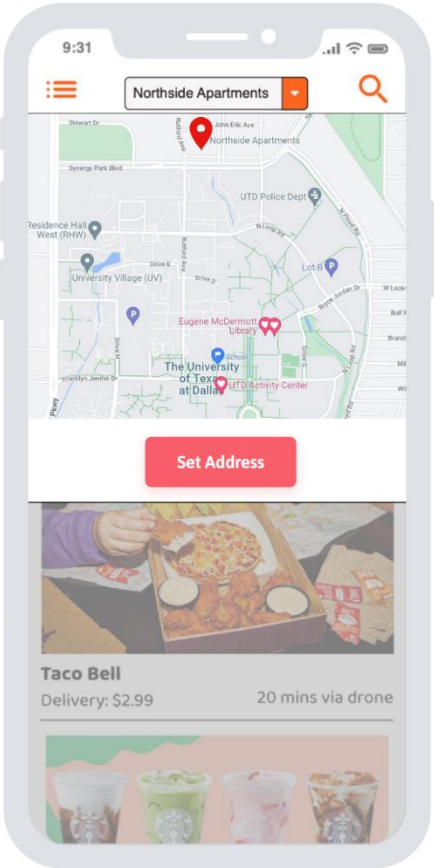
a

Naxel Santiago Wireframes:

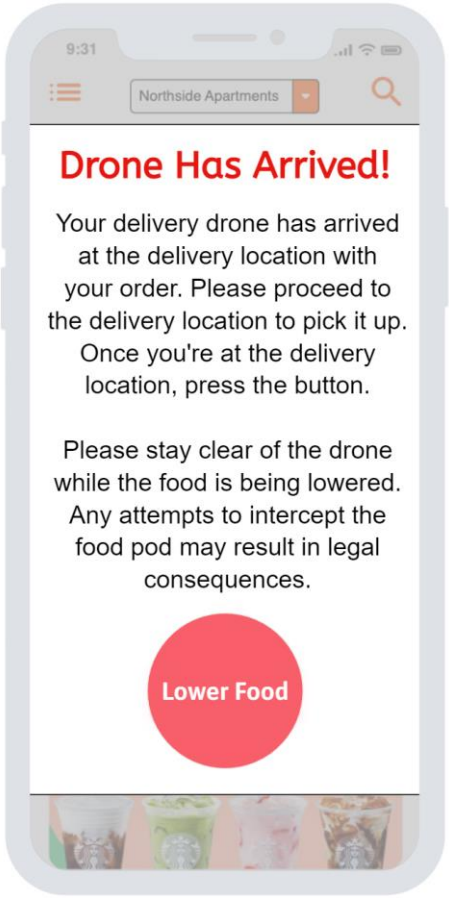
Wireframe 1: Profile



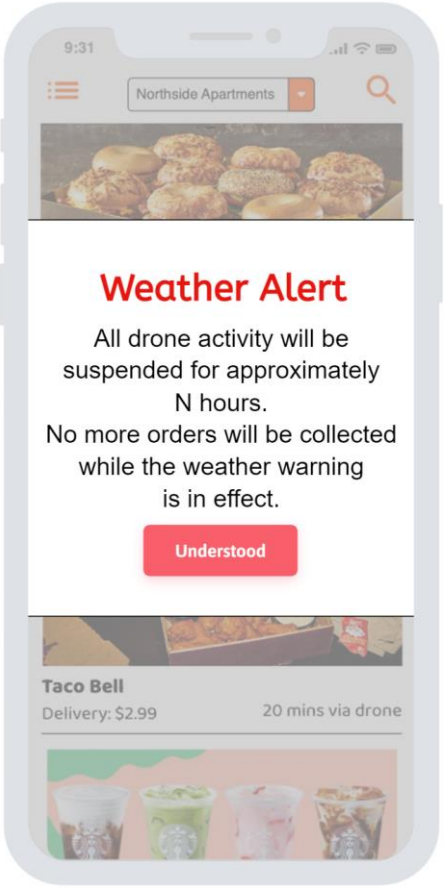
Wireframe 2: Set/Change Delivery Location



Wireframe 3: Drone Delivery - Lower Food



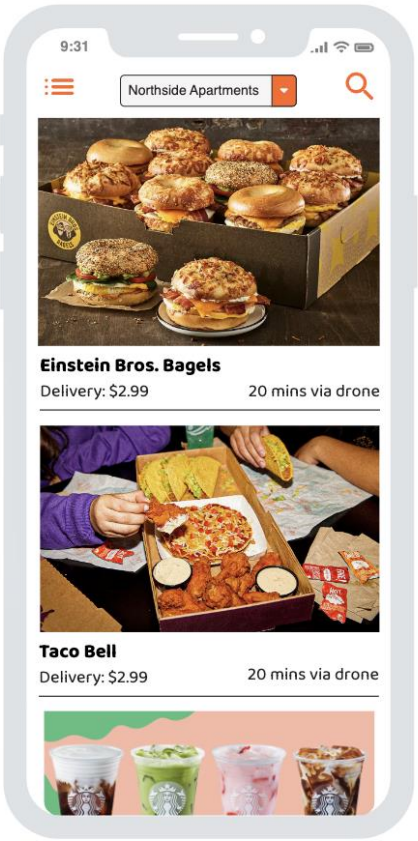
Wireframe 4: Weather Alert

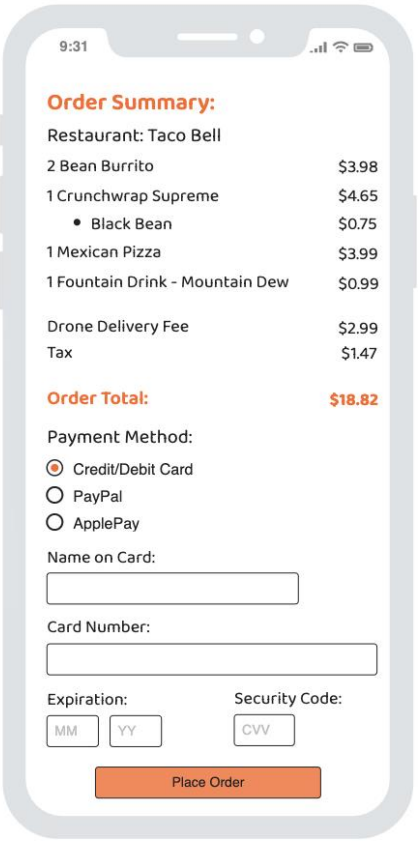


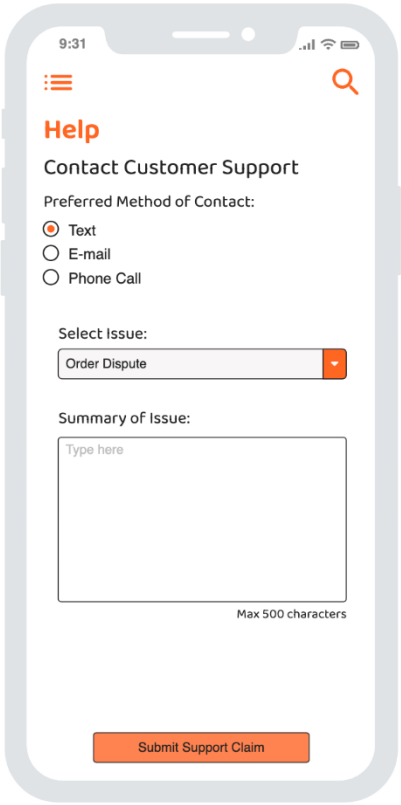
Prototype - Drone with Food Pod:

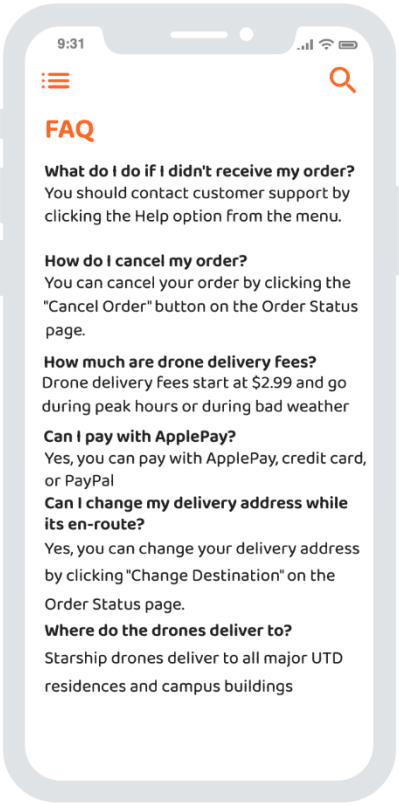
Prototype - Food pod in Restaurant Chute:

Syed Murtaza Wireframes:









Interview Plan

Interview Plan

The interview sessions with stakeholders will be held over the course of 20 weekdays. During these sessions we will be discussing with all stakeholders the direction of the project and their most important needs for their respective technologies. It is of utmost importance to support an easily understood dialect when referring to detailed technologies since not all stakeholders will be heavily acquainted with the intricacies of all related technologies. Conflicts between different stakeholder needs will be resolved in the Conflict-of-Interest sessions. All key points of each session will be recorded and compiled for future use.
If stakeholders require a follow-up interview to clarify certain aspects, they are welcome to reach out to our requirements team.

Key talking points during interviews:

- Scope of the project
- Stakeholder's respective technological needs
- Functionalities related to the session
- Overall project architecture
- Maintain marketing up to date with the budget

The interview plan must receive approval from the sponsor before it is put into execution. Interview plan can be adjusted if the situation considers it necessary. Remember to thank stakeholders for their time.
For a full list of stakeholders and their respective interviews see section "Interview Topics by Stakeholder."

Interview Topics by Stakeholder

Day	Stakeholder	Topics	Duration
1	Sponsor	Review SOW for features, functionalities, components, and important priorities Which influential people should we talk to? What is the vision of the project	1 hr.
1	CEO	Have a follow-up meeting with Peanuts LLC's CEO about the Sponsor meeting and project direction	30 mins
2 - 9	Stakeholder Workshop (Breakout sessions with IT, Security, User Representatives, Legal Representatives and Vendors)	Have the core project team discuss with available stakeholders their respective technologies and the core architecture	½ day for eight days
10	Recap Session	Final session with stakeholders to recap all previously discussed decisions	½ day
11 - 15	Marketing	Discuss with marketing VP and others the important brand themes that should be followed	1 hr. for five days
16	Drone Company	Discuss (with a clear plan) how the system will be constructed around the drones, company must supply drones and Starship Technologies must supply housing / maintenance	½ day
17 - 20	Conflict-of-Interest interviews	Meet with personnel whose priorities resulted in conflict of interest, have them discuss the middle ground and how to move forward.	30 mins for four days

Interview Questions with Responses

Logan Dane Questions to Anthony Ngo from Team 14

Sponsor:

1. **How should the drone location be presented to the user?**
    a. On the sidebar of the screen, accessible by swiping
2. **How should the fleet manager be notified if a drone meets an issue?**
    a. A notification pop up alert pops up on the screen and tells the manager what the occurrence is.
3. **What information will be provided to the drone for mapping its route?**
    a. The drones will have the mapping information downloaded from another source, and it will have the location of the other drones.

Database Manager:

4. **How long should a user's order history be stored for?**
    a. One month
5. **What information will be kept in the order history?**
    a. Prices, taxes, what item they ordered, what time they ordered,
6. **How often will the customer's application update the GPS location of the drone?**
    a. Once every 15 seconds.
7. **How will the weather information be obtained?**
    a. The weather information should be obtained through the "weather api" API at "weatherapi.com".

Fleet Manager:

8. **How often will the GPS system update and send info back to the fleet manager?**
    a. Once every 5 seconds.
9. **In what weather conditions will the drone refuse to fly or abort a mission?**
    a. Too windy (winds above 25mph), in rain, in snow, harsh weather conditions.
10. **What will drive the drone's decision making while on the flight path?**
    a. The onboard computer that is loaded with a pre-trained machine learning algorithm capable of determining the most effective way to navigate around obstacles.

Naxel Santiago Questions

Legal Lead:

1. **What will the Drone Safety Height (DSH) be?**
   -The minimum height that drones can fly in should be 25ft above the ground. If a drone is ever below this height for whatever reason, they will be considered crashed, and their crash safety system will kick in.
2. **What will the Drone Standard Height be?**
   -The standard drone flight height will be 100ft above the ground, and at most the drones can fly to 200ft for special reasons. The legal flight limit is 400ft, but our drones shouldn't need to fly that high.
3. **When the drone scans its surroundings before a descent, what distance should the objects be at for the scan to be valid for descent?**
   -Drones should scan their surroundings and continue scanning while they descent for 10ft from all objects. In the case of a strong wind warning or other special occasions we can increase the distance to 15ft.
4. **How long will the drones wait at the delivery location before automatically lowering the order if the customer doesn't arrive on time?**
   -The drone should only wait for the user's response for 5 minutes in the air. That amount of time should be more than enough for a person to signal the drone to lower the food. There will be constant feedback from the application telling the person how far the drone is from the delivery location so they can prepare in time. There will also be a timer on the app signaling how much time is left. Once the 5 minutes are up the drone will fly back to the warehouse with the food if it was not picked up in time, and the user must go to the warehouse to retrieve their food.
5. **What should we do if the customer tries to pull the order from the drone pulley by force before the drone is done lowering the order?**
   -Drones should come equipped with cameras to record the drop, they should auto drop the order on sensing a pull/tug from any person, make it steady enough so that it won't be triggered by other miscellaneous forces such as the wind. Drones should also be built with stabilizers, so they are resistant to light tugs and any high winds.

Drone Maintenance Lead:

6. **How will the drone keep the food temperature?**
   Drones come equipped with a food pod to store the delivery order. The food pod works as an insulator to keep the food temperatures and can be opened from the top or bottom for the pick-up(top) and delivery(bottom). The food pod is found on the bottom of the drone and is lowered via a pulley system.
7. **How will the drones lower the food pod for delivery?**
   -Once a drone reaches the target destination and has descended to DSH the drone will wait for the user's signal that they have arrived at the delivery point. Once the user signals the system through the app, the drone will begin to lower the food pod via a pulley mechanism.
8. **How will the drone precisely lower the food to the target spot?**
   Drones should come equipped with a horizontal fan to guide the food pod's descent. The goal is to guide the food pod within 1ft precision of the calculated delivery

location. Our aim is for the drone to be able to deliver the food on top of a table without fail.

9. **How will the drone pick up food from the restaurant?**
   -The restaurants who partner with Starship Technologies shall have a special Food Pod station to accept the drone's food pod, the idea is for it to behave as a slide and pass the food pod to the inside of the restaurant where it can be filled with food.
10. **How fast should the drones be returned to the drone warehouse in the case of an inclement weather warning?**
    -Drones should be able to return to the warehouse within 10 minutes. Therefore, all drone deliveries should be done prior to 15min of the weather starting. No further deliveries are to be accepted once the weather advisory is in effect. For information on inclement weather definition turn to Logan Dane's question 9.

Aadarsha Dhungel Questions to Joshua Hubbard from Team 14

As UT Dallas Staff Representative:

1. **As a stakeholder, what specific types of campus foods or northside restaurants would you like to see included in the drone delivery service? Are there any items that you would like to see offered?**
   We would be interested in having a wide variety of food options available for delivery by drone, including campus dining locations, Northside restaurants, and other popular food establishments in the surrounding area. It would be great if the drone delivery service could offer a diverse range of cuisine types to appeal to different tastes and dietary needs.

2. **What specific sustainability factors are important to you, such as the use of renewable energy or reduced carbon emissions?**
   The sustainability factor of a drone delivery service is particularly important to us, as we are committed to reducing our carbon footprint and promoting eco-friendly practices on campus. We would like to see the use of renewable energy sources, such as solar power or electric batteries, and efforts to minimize packaging waste.

3. **What steps can be taken to reduce the impact of drone delivery services on the environment, such as minimizing noise pollution or reducing packaging waste?**
   We would recommend perfecting delivery routes to reduce the number of drones in the air and minimize noise pollution. Additionally, it would be helpful to have a system in place to collect and recycle drone packaging materials. There has been recent investment in better propellers for the drones to reduce the noise levels they produce.

As UT Dallas Student:

4. **How would you like the delivery period to be perfected to better suit your needs? Would you prefer a shorter or longer delivery window?**
   We would appreciate a relatively short delivery time from the moment the order is placed, ideally within 15 to 30 minutes. This would allow us to receive our food quickly and conveniently, without having to wait too long for delivery.

5. **Are there any added safety concerns that you have not mentioned yet? What measures would you like to see put in place to address these concerns?**
   The safety concerns would include the possibility of drones colliding with other objects, such as buildings, trees, or power lines. We would also be concerned about drones flying too close to our windows or balconies or causing noise disturbances. It would be important to have safety regulations and guidelines in place to prevent these types of incidents from occurring.

6. **Are there any circumstances under which you would be more likely to use the drone delivery service more often, such as during harsh weather or peak delivery hours?**

We would expect to use a drone delivery service on a regular basis, particularly during peak delivery hours or inclement weather conditions when it may be more convenient to receive our items by drone than by traditional means.

7. **What would be a fair and reasonable added fee for the convenience of a drone delivery service?**
   We would be willing to pay a slightly higher fee for the convenience of a drone delivery service, provided that the service is reliable, efficient, and safe for all parties involved.

8. **In addition to proof of delivery, what other security measures would you like to see implemented, such as tracking or secure packaging? Are there any concerns related to privacy or data protection that need to be addressed?**
   We would like to see measures in place to prevent theft or damage to delivered items, such as secure packaging and real-time tracking. We would also be concerned about the collection and use of personal data related to the drone delivery service and would want to ensure that all privacy and security measures are in place to protect our information.

As Northside Apartments Residents:

9. **Are there any areas that you would like to see chosen as no-fly zones for drones, such as near schools or hospitals?**
   We would not want drones flying too close to our buildings or outdoor communal areas, as this could pose a safety hazard or cause disruptions. It would be important to have clear guidelines in place for drone flight paths and designated no-fly zones to address these concerns.

10. **How do you see drone delivery services being integrated with traditional delivery methods, such as bike messengers or delivery trucks? Are there any potential synergies or conflicts that need to be addressed?**
    We see drone delivery services as a complementary addition to traditional delivery methods, rather than a replacement. By offering both options, we can get greater convenience and flexibility for us as customers, while also ensuring that all delivery needs are met.

Syed Murtaza Questions

Restaurant Representative Lead:

1. **What are the main competitors in the food delivery market on and around campus, and how can we differentiate ourselves from them?**
   The main competitors of the food delivery service include services like Door Dash, UberEATS, and Starship's own ground vehicles. The goal of implementing a drone delivery service is to allow for faster delivery to decrease delays that would otherwise occur because of ground vehicle deliveries.

2. **What are the current restrictions in the UT Dallas area that may affect the operation of drone delivery services?**
   The main restrictions with drone delivery services are that they must be able to avoid obstacles such as powerlines, birds, and other aerial drones. The Starship system must be designed to allow for enhanced safety while in flight to detect and avoid obstacles with ample time.

3. **How can Starship Industries ensure the security and privacy of personal information, such as delivery addresses and payment information?**
   Starship Industries makes sure its user's privacy is protected by ensuring that their user's personal information such as name, address, and payment are stored in protected databases and cannot be accessed by other users.

4. **What are the range and battery limitations of the Starship drones?**
   The drones typically have a range that's within the limits of the UT Dallas area and depending on the payload, the battery can last up to 4 hours on a single charge before requiring another charge, The drones can typically travel a total cumulative distance of 100 miles on a full charge.

5. **How will quicker delivery times be guaranteed with drones as opposed to ground delivery vehicles?**
   All drones run within the UT Dallas area/network and will be programmed with pre-planned flight routes to all the major residences on-campus. Given this, the drones have been programmed with the best routes for the fastest delivery times while also supporting a safe distance from any obstacles such as power lines and buildings.

6. **Are there any local/state permits needed for the operation of a drone delivery service on campus?**
   To run a drone delivery service, permits are needed to ensure that the airspace around the network that the drones will run under is always clear. Starship has taken measures to ensure all the legal paperwork is following local and state regulations.

7. **What, if any, measures are in place for drone safe recovery if one suffers a complete system failure?**
   All drones are equipped with safety sensors to ensure that all components are working

in proper order. If one fails or a complete system failure is detected, the fleet manager will be notified and measures such as a parachute will be deployed to ensure a safe landing for the drone. Additionally, the customer will also be notified to inform them of the delay in their order and measures will be taken to reprocess their order for a delayed delivery.

8. **Will the customer pay when they place their order or after they receive their food?**
   The customer will pay at the time of order placement and if there was an issue with their order, they will be able to contact customer service about potentially processing a refund.

9. **Will the Starship Drone Delivery app be single sign-on, or will the user have to login every time they open the app?**
   The Starship Drone Delivery app will be single sign-on and will allow users to choose from various authentication methods to allow for their personal information to be protected. Authentication methods will include setting a passcode, using Face ID, using their fingerprint, or typing their password. These authentication methods will be used to verify the user every time they open the app.

10. **Which restaurants are available to order from using the drone delivery service?**
    Restaurants within a 4–5-mile radius around the UT Dallas campus are available and eligible to be ordered from. All restaurants that are compatible with the drone delivery service will be listed in the app for users to select from.

Functional Requirements

Functional Requirements List

ID	Description	Author
Drone Requirements		
1	The drone shall fly no higher than 200ft from the ground.	Naxel S.
2	The drone's Cruising height shall be 100ft from the ground.	Naxel S.
3	The drone shall fly no lower than 75ft from the ground.	Naxel S.
4	The drone's minimum safety height shall be 25ft from the ground.	Naxel S.
5	The drones shall only lower and then hover at the DSH when they drop to make a delivery.	Naxel S.
6	If a drone goes below the DSH they shall be considered crashed and deploy their crash safety system.	Naxel S.
7	The drones will deploy a parachute if they crash.	Naxel S.
8	The drones will sound a slight siren to tell pedestrians that the drone is crashing (falling).	Naxel S.
9	The drones will come equipped with a food pod attached to the bottom of the drone.	Naxel S.
10	The drone shall come equipped with cameras to watch all activities.	Naxel S.
11	The food pod shall come equipped with cameras to watch all activities.	Naxel S.
12	The food pod will be lowered via a pulley system while the drone is at the DSH.	Naxel S.
13	The drones shall run on a set of rechargeable batteries.	Adarsha D.
14	The drones shall use the latest ultramodern propeller design that reduces noise pollution, created by the company Zipline.	Adarsha D.
Drone Pick-up Requirements		
15	Restaurants will require a drone pod chute for the drone to pick-up food from that restaurant.	Naxel S.
16	The food pod shall open from the top to receive the food during pick-up. This is done from inside the restaurant's drone pod chute.	Naxel S.
Drone Delivery Requirements		
17	The food pod shall have a horizontal fan on the side for directional steering when lowering the food pod for delivery.	Naxel S.
18	The drone shall be able to hover still at the DSH without moving while the pulley is lowering the food pod.	Naxel S.
19	The food pod shall open from the bottom to deposit the food during delivery.	Naxel S.
20	Both the drone and food pod will use the cameras to continuously scan their surroundings while lowering the food	Naxel S.

	to ensure that all is processing smoothly.	

Drone AI Requirements		
21	The drones shall use the most efficient routes to minimize drone pollution in the air.	Adarsha D.
22	Drone legal flight zones shall be decided by the FAA government map.	Naxel S.
23	Drone flight licenses shall be obtained in compliance with the FAA regulations.	Syed M.
24	Drones shall be able to reach further destinations than the Starship bots since they can cross busy intersections.	Syed M
Drone Warehouse Requirements		
25	The drone warehouse shall have charging pads for the drones to recharge their batteries automatically when they land on them.	Naxel S.
26	The drone maintenance team shall be tasked with retrieving crashed drones.	Naxel S.
App Requirements		
27	The app shall have a sidebar that appears when the user swipes from the right side of the screen towards the center.	Logan D.
28	The sidebar shall show the user's active delivery GPS location, for both drones and bots.	Logan D.
29	Users shall have the ability to communicate with the Fleet Manager if they wish to do so, a "chat with drone pilot" option will be displayed on the sidebar.	Logan D.
30	The customer shall be notified if their delivery drone experiences some form of crash or system failure. A new order will be sent their way.	Syed M
31	The system shall process the order's charge as soon as the order is placed.	Syed M
32	If a user wants a refund, they shall contact customer services.	Syed M
33	The application shall use single sign-in functionalities.	Syed M
System Requirements		
34	The system shall send the drone its route when the system receives the customer's order.	Logan D.
35	The system must send the fleet manager a notification for any issues with active drones.	Logan D.
36	When the system sends out an inclement weather notice, all drones are to finish their deliveries and return to the drone warehouse for storage.	Naxel S.
37	Once the system receives an inclement weather notice, no more orders will be accepted.	Naxel S.

Database Requirements		
38	A user's order history should only be kept in the database for no longer than one month.	Logan D.
39	The order history shall record the order's: customer full name, prices, taxes, what item they ordered, what time they ordered, what time the drone arrived and the drone route.	Logan D.
40	The database shall only include the necessary information about the user, and it will not be shared with 3rd party organizations.	Syed M
Restaurant Requirements		
41	The drones shall be capable of delivering to all current Starship Technologies partner restaurants.	Adarsha D.
42	In the case of a drone crash, the restaurant shall be required to prepare a new order, Starship Technologies will cover the cost.	Syed M

Snow Cards

Logan Dane's Functional Snow Cards

Requirement #: 27 **Requirement Type:** F **BUC/PUC #:** 1/2
Description: The app shall have a sidebar that appears when the user swipes from the right side of the screen towards the center.
Rationale: The customer needs an easy gesture to access the menu to keep the app simple and easy to use.
Originator: Logan Dane
Fit Criterion: The average user shall be able to access the menu using at most 2 swipes.
Customer Satisfaction: 3 **Customer Dissatisfaction:** 2
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Requirement #: 28 **Requirement Type:** F **BUC/PUC #:** 1/2
Description: The sidebar shall show the user's active delivery GPS location, for both drones and bots.
Rationale: The customer should be able to access the location of the drone so that they will be able to know where the drone is at and how much longer the delivery will take, so that they can be prepared to take the order.
Originator: Logan Dane
Fit Criterion: The average user should be able to access the GPS location of the drone within 6 seconds using only the 1 swipe motion.
Customer Satisfaction: 4 **Customer Dissatisfaction:** 3
Dependencies: Requirement 27 (Implementation of the sliding bar) **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Requirement #: 29 **Requirement Type:** F **BUC/PUC #:** 10/11

Description: The users shall have the ability to communicate with the Fleet Manager if they wish to do so, a “chat with drone pilot” option will be displayed on the sidebar.

Rationale: If the user’s order has a complication during it’s delivery, the user should be able to communicate with the fleet manager to keep trust between the customer and Starship.

Originator: Logan Dane

Fit Criterion: The average user shall be able to locate the communication button and access it using no more than 2 actions from the home screen.

Customer Satisfaction: 2 **Customer Dissatisfaction:** 2

Dependencies: None **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Requirement #: 34 **Requirement Type:** F **BUC/PUC #:** 2/12

Description: The system shall send the drone its route when the system receives the customer’s order.

Rationale: Having the system calculate the route and then sending it to the drone reduces processing time on the drones, which could help improve battery life.

Originator: Logan Dane

Fit Criterion: The system will calculate and send the route to the drone within 10 seconds of receiving the order.

Customer Satisfaction: 5 **Customer Dissatisfaction:** 5

Dependencies: None **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Aadarsha Dhungel's Functional Snow Cards

Requirement #: 21 **Requirement Type:** F **BUC/PUC #:** 3/3

Description: The drones shall use the most efficient routines to minimize drone pollution in the air.

Rationale: Drones are being used to minimize the wait time as well as to use the renewable source of energy for maximum efficiency of both time and energy.

Originator: Aadarsha Dhungel

Fit Criterion: The drone shall use a pair of rechargeable Li-ion batteries.

Customer Satisfaction: 1 **Customer Dissatisfaction: 1**

Dependencies: Req 4 (The drone's minimum safety height shall be 25ft from the ground.) **Conflicts: None**

Supporting Materials: FAA

History: March 24th, 2023

Volere

Requirement #: 41 **Requirement Type:** F **BUC/PUC #:** 4/4

Description: The drones shall be capable of delivering to all current Starship Technologies partner restaurants.

Rationale: If drones can be picked up from all the restaurants, then we can deliver all kinds of items to the customers.

Originator: Aadarsha Dhungel

Fit Criterion: The drone pod shall descend correctly into the drone pod chute and have 99.9% accuracy while lowering.

Customer Satisfaction: 1 **Customer Dissatisfaction: 1**

Dependencies: None **Conflicts: None**

Supporting Materials: None

History: March 24th, 2023

Volere

Requirement #: 13 **Requirement Type:** F **BUC/PUC #:** 3/3

Description: The drone shall run on a set of rechargeable batteries.

Rationale: The Li-ion batteries are bio-degradable as well was it can be charged with the electricity through various methods so any issues can be fixed easily as well as for cheap compared to other alternatives.

Originator: Aadarsha Dhungel

Fit Criterion: The drones can reduce up to 80% of the pollution caused by the cars while being used for the food delivery.

Customer Satisfaction: 2 **Customer Dissatisfaction:** 1

Dependencies: None **Conflicts:** None

Supporting Materials: Li-Ion batteries Manual

History: March 24th, 2023

Requirement #: 14 **Requirement Type:** F **BUC/PUC #:** 3/3

Description: The drones shall use the latest ultramodern propeller design that reduces noise pollution, created by the company Zipline.

Rationale: The drones are super quiet so they can be used over night for the delivery as the noise generated from it would not disturb the residents living nearby.

Originator: Aadarsha Dhungel

Fit Criterion: The drones would create sound of 10dB which is 80% lower compared to the usual drones made by other companies.

Customer Satisfaction: 5 **Customer Dissatisfaction:** 1

Dependencies: None **Conflicts:** None

Supporting Materials: Zipline Drone Manual

History: March 24th, 2023

Naxel Santiago's Functional Snow Cards

Requirement #: 5 **Requirement Type:** F **BUC/PUC #: 5/5**

Description: The drones shall only lower and then hover at the DSH when they drop to make a delivery.

Rationale: Drones must remain at the DSH and hover when making a delivery and not go below it. They will only lower to DSH while making a delivery, otherwise they should be at cruising height for following safety protocols.

Originator: Naxel Santiago

Fit Criterion: The drone shall remain in the same hovering spot and not move more than 2.5ft from the hover spot.

Customer Satisfaction: 1 **Customer Dissatisfaction: 1**

Dependencies: Req 4 (The drone's minimum safety height shall be 25ft from the ground.) **Conflicts: None**

Supporting Materials: FAA

History: March 24th, 2023

Volere

Requirement #: 15 **Requirement Type:** F **BUC/PUC #: 9/9**

Description: Restaurants will require a drone pod chute for the drone to pick-up food from that restaurant.

Rationale: A drone pod chute will facilitate restaurants with loading up the food pod with orders.

Originator: Naxel Santiago

Fit Criterion: The drone pod shall descend correctly into the drone pod chute and have 99.9% accuracy while lowering.

Customer Satisfaction: 1 **Customer Dissatisfaction: 1**

Dependencies: None **Conflicts: None**

Supporting Materials: None

History: March 24th, 2023

Volere

Requirement #: 17 **Requirement Type:** F **BUC/PUC #: 5/5**

Description: The food pod shall have a horizontal fan on the side for directional steering when lowering the food pod for delivery.

Rationale: The fan will help the food pod lowering be more accurate, which helps with deliveries.

Originator: Naxel Santiago

Fit Criterion: The food pod shall be able to lower within 1ft accuracy of the target.

Customer Satisfaction: 3 **Customer Dissatisfaction: 1**

Dependencies: Req 9 (The drones will come equipped with a food pod attached to the bottom of the drone.) **Conflicts: None**

Supporting Materials: None

History: March 24th, 2023

Requirement #: 6 **Requirement Type:** F **BUC/PUC #: 5/5**

Description: If a drone goes below the DSH they shall be considered crashed and deploy their crash safety system.

Rationale: This implementation is for safety reasons, if drones are working correctly they shouldn't be at the DSH for whatever reason. Therefore it is safer to assume that a drone that is at this height has something wrong with them and simply stop their flight. The drone maintenance team shall recover them.

Originator: Naxel Santiago

Fit Criterion: The crash safety system shall deploy within 1ms of detecting a crash.

Customer Satisfaction: 2 **Customer Dissatisfaction: 4**

Dependencies: Req 4 (The drone's minimum safety height shall be 25ft from the ground.) **Conflicts: None**

Supporting Materials: FAA

History: March 24th, 2023

Requirement #: 20 **Requirement Type:** F **BUC/PUC #: 5/5**

Description: Both the drone and food pod will use the cameras to continuously scan their surroundings while lowering the food to ensure that all is processing smoothly.

Rationale: The cameras are for safety and evidence reasons. If something happens to the drone, the cameras will record it. This can also be helpful for detecting the fault for a drone crash or tampering with the drones. Cameras are also responsible for the sensor feedback when lowering the drones.

Originator: Naxel Santiago

Fit Criterion: The cameras shall operate as long as the drones is in flight/making a delivery.

Customer Satisfaction: 1 **Customer Dissatisfaction: 3**

Dependencies: Req 9 (The drones will come equipped with a food pod attached to the bottom of the drone.) **Conflicts: None**

Supporting Materials: None

History: March 24th, 2023

Requirement #: 36 **Requirement Type:** F **BUC/PUC #: 6/10**

Description: When the system sends out an inclement weather notice, all drones are to finish their deliveries and return to the drone warehouse for storage.

Rationale: This is to prevent both the drones and customers from being in danger due to harsh weather. Including things such as lightning and hail, both would be harmed in the presence of these.

Originator: Naxel Santiago

Fit Criterion: The drones shall return to the warehouse as soon as they finish the delivery.

Customer Satisfaction: 1 **Customer Dissatisfaction: 5**

Dependencies: None **Conflicts: None**

Supporting Materials: Weather Radars

History: March 24th, 2023

Syed Murtaza's Functional Snow Cards

Requirement #: 23 **Requirement Type:** F **BUC/PUC #:** 1/2

Description: Drone flight licenses shall be obtained in compliance with the FAA regulations.

Rationale: Drone operation must be compliant with all federal and local regulations and regulatory agencies such as the FAA in order to ensure safety for all.

Originator: Syed Murtaza

Fit Criterion: The fleet manager will maintain records of all flight paths taken by drones to ensure their GPS system is in sync with FAA compliant flight paths.

Customer Satisfaction: 4 **Customer Dissatisfaction:** 2

Dependencies: Requirement 22 (Drone legal flight zones and routes are decided by the FAA) **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Requirement #: 30 **Requirement Type:** F **BUC/PUC #:** 7/7

Description: The customer shall be notified if their delivery drone experiences some form of crash or system failure. A new order will be sent their way.

Rationale: In order to maintain customer satisfaction, the drone delivery service will guarantee order delivery via alternative means even in the event of a drone crash or failure.

Originator: Syed Murtaza

Fit Criterion: A notification regarding the incident and an alternative method of order fulfillment must be communicated to the customer within 10 minutes of the crash or failure.

Customer Satisfaction: 5 **Customer Dissatisfaction:** 3

Dependencies: None **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Requirement #: 31 **Requirement Type:** F **BUC/PUC #:** 3/3

Description: The system shall process the order's charge as soon as the order is placed.

Rationale: The customer will be charged to their method of payment as soon as they place an order to ensure that the payment method is valid and not expired.

Originator: Syed Murtaza

Fit Criterion: The system will process the customer's method of payment within 60 seconds of order placement.

Customer Satisfaction: 5 **Customer Dissatisfaction:** 3

Dependencies: None **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Requirement #: 42 **Requirement Type:** F **BUC/PUC #:** 7/7

Description: In the case of a drone crash, the restaurant shall be required to prepare a new order, Starship Technologies will cover the cost.

Rationale: In order to maintain dedication to excellent customer service and satisfaction, Starship Technologies will replace a customer's order, free of charge, in the event that a drone crashes mid-flight while in-route to complete a delivery.

Originator: Syed Murtaza

Fit Criterion: The restaurant must receive a new replacement order request from Starship Technologies within 10 minutes of the drone crash.

Customer Satisfaction: 4 **Customer Dissatisfaction:** 2

Dependencies: None **Conflicts:** None

Supporting Materials: None

History: March 24th, 2023

Non-Functional Requirements

Non-Functional Requirements List

ID	Description	Author
Look and Feel Requirements		
1	The Drone Delivery System must be user-friendly, with an intuitive and easy-to-use interface for managing and monitoring deliveries.	Adarsha D.
Usability and Humanity Requirements		
2	The application should be designed to be compatible with other systems, technologies, and interfaces, such as iOS, Android, and web to enable easy integration with the existing infrastructure.	Adarsha D.
3	Users shall receive their order within 15 to 30 minutes from placing the order.	Adarsha D.
4	Once at the delivery location, the drone shall wait 5 minutes for the user's signal to lower the food. If the user does not signal within 5 minutes the food will be returned to the drone warehouse where it must be picked up by the user.	Naxel S.
5	Inclement weather, which is the weather at which the drones will be asked to return home, shall be defined as winds above 25mph, rain, thunder, snow or any harsher weather conditions.	Logan D.
Reliability Requirements		
6	The Starship's application should be available 24/7 with an elevated level of uptime to ensure that deliveries can be made on time and users can access their order history, payment, and customer service at any time.	Adarsha D.
7	The drone delivery system should be operational if any partner restaurants is in operating hours.	Naxel S.
Performance Requirements		
8	The Drone Delivery System should be designed to perform efficiently, with minimal delays or disruptions during delivery.	Adarsha D.
9	The system shall update the Fleet Manager's map GPS location of all drones every 5s.	Logan D.
10	The system shall update the user's drone GPS location every 30s.	Logan D.
11	The drone batteries shall be able to run for a minimum of 4 hours.	Syed M.
12	The drone shall be able to travel up to 100 miles on a full charge.	Syed M.
13	The drone shall be able to lower the pulley and deliver the food from the DSH within 5s, the faster the better to avoid	Naxel S.

	unnecessary pulls and tugs from bystanders/wind currents.	
Security Requirements		
14	The Drone Delivery System must incorporate robust security measures including user authentication and password changes to protect against unauthorized access.	Adarsha D.
15	If a drone has crashed, the parachute must slow the drone's fall to through the application.5mph or slower.	Adarsha D.
16	The scanning during food delivery shall scan the nearby environment to make sure that the drone is no closer than 10ft from the nearest object (horizontally). This is raised to 20ft during winds higher than 15mph.	Naxel S.
17	The scanning during food delivery shall scan the nearby environment to make sure that the food pod is no closer than 5ft from the nearest object (horizontally). This is raised to 10ft during winds higher than 15mph.	Naxel S.
18	The database data shall be encrypted so that the user's data is secure.	Syed M.
19	The database Schema shall be constructed such that information is not easily accessible more than necessary.	Syed M.
20	The application shall have firewalls to protect user information as it is transmitted.	Syed M.
21	The application shall use login security features such as password, 2FA, face-id and email verification.	Syed M.

Snow Cards

Logan Dane's Non-Functional Snow Cards:

Requirement #: 9 **Requirement Type:** NF **BUC/PUC #:** 1/2
Description: The system shall update the Fleet Manager's map GPS location of all drones every 5 seconds.
Rationale: The fleet manager needs to know where the last location of the drones is in case one goes missing or there is an accident with the drones.
Originator: Logan Dane
Fit Criterion: The fleet manager's system will record the updates from the drones to ensure that the GPS information is updating the correct amount.
Customer Satisfaction: 3 **Customer Dissatisfaction:** 4
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Requirement #: 10 **Requirement Type:** NF **BUC/PUC #:**1/1
Description: The system shall update the user's drone GPS location every 30s.
Rationale: The user needs to have an up to date reading of the drone's location so that they know how much longer their delivery will take so they can be prepared to pick it up.
Originator: Logan Dane
Fit Criterion:
Customer Satisfaction: 4 **Customer Dissatisfaction:** 5
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Aadarsha Dhungel's Non-Functional Snow Cards:

Requirement #: 14 **Requirement Type:** NF **BUC/PUC #:** 4/4

Description: The Drone Delivery System must incorporate robust security measures including user authentication and password changes to protect against unauthorized access.
Rationale: The user account of customers should not be easily hackable as it would result in a economic loss for customers and reputational loss for the company.
Originator: Aadarsha Dhungel
Fit Criterion: The application shall use the login feature of 2FA.
Customer Satisfaction: 4 **Customer Dissatisfaction:** 4
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Requirement #: 15 **Requirement Type:** NF **BUC/PUC #:**3/3

Description: If a drone has crashed, the parachute must slow the drone's fall to through the application 5miles/hour or slower.
Rationale: The fleet manager needs to have the correct location of the drone so if any issue arises on the drone, they can find it and do what needs to be done for streamlined delivery of the ongoing delivery.
Originator: Aadarsha Dhungel
Fit Criterion: The fleet manager's system will record the updates from the drones to ensure that the GPS information is updated to the correct location.
Customer Satisfaction: 4 **Customer Dissatisfaction:** 2
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Naxel Santiago's Non-Functional Snow Cards:

Requirement #: 7 **Requirement Type:** NF **BUC/PUC #: 9/9**

Description: The drone delivery system should be operational if any partner restaurants are in operating hours.

Rationale: We want the app to be operating if any restaurant is still operating so that users can make orders whenever possible, as long as the restaurants are open.

Originator: Naxel Santiago

Fit Criterion: The app will grayscale any restaurants that are closed, and the system will go dormant if no restaurants are open.

Customer Satisfaction: 1 **Customer Dissatisfaction: 5**

Dependencies: None **Conflicts: None**

Supporting Materials: Weather Radars

History: March 24th, 2023

Volere

Requirement #: 16 **Requirement Type:** NF **BUC/PUC #: 5/5**

Description: The scanning during food delivery shall scan the nearby environment to make sure that the drone is no closer than 10ft from the nearest object (horizontally). This is raised to 20ft during winds higher than 15mph.

Rationale: This system detects if anything gets near the food pod or if the food pod moves from the target spot. In either case, this is important for the drone/customer's safety.

Originator: Naxel Santiago

Fit Criterion: The sensors shall be able to detect the objects 95% of the time.

Customer Satisfaction: 1 **Customer Dissatisfaction: 5**

Dependencies: Req 11 (The food pod shall come equipped with cameras to watch all activities.) **Conflicts: None**

Supporting Materials: Weather Radars

History: March 24th, 2023

Volere

Syed Murtaza's Non-Functional Snow Cards:

Requirement #: 11 **Requirement Type:** NF **BUC/PUC #:** 8/8
Description: The drone batteries shall be able to run for a minimum of 4 hours.
Rationale: The drone must be able to run for a minimum of 4 hours on a single charge in order to ensure no delay between orders for charging.
Originator: Syed Murtaza
Fit Criterion: The drone must be able to operate a minimum of 4 hours on a single charge before returning to the base station for charging
Customer Satisfaction: 5 **Customer Dissatisfaction:** 2
Dependencies: None **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

Requirement #: 19 **Requirement Type:** NF **BUC/PUC #:** 1/1
Description: The database Schema shall be constructed such that information is not easily accessible more than necessary.
Rationale: The Starship application will only show users information that is relevant to their request and will not show more information than necessary to protect user and company information.
Originator: Syed Murtaza
Fit Criterion: The database results retrieved will only show users data that is relevant to their request such as order history, drone location, etc.
Customer Satisfaction: 3 **Customer Dissatisfaction:** 4
Dependencies: Requirement 18 (The database data shall be encrypted so that the user's data is secure.) **Conflicts:** None
Supporting Materials: None
History: March 24th, 2023

User Stories

- As a customer, I want to be able to order food from my preferred restaurant through the web application, so that I can enjoy the convenience of online ordering and have my food delivered by a drone. – Logan D.

- As a customer, I want to be able to track the progress of my food delivery in real-time through the Android and iOS applications, so that I can have a clear idea of when my food will arrive. – Logan D.

- As a customer, I want to be able to communicate with the drone operators through the Android and iOS applications, so that I can ask questions or supply added instructions if necessary. – Logan D.

- As a customer, I want to receive notifications when my food is approaching, so that I can be ready to receive it when it arrives. – Naxel S.

- As a Customer Service Representative, I want to be able to receive orders and track the delivery process through the Android and iOS applications, so that I can check the efficiency of food delivery for the food to the customers. – Syed M.

- As a restaurant owner, I want to be able to integrate my menu with the web application, so that customers can easily view and order from my restaurant.

  – Adarsha D.

- As a food delivery customer, I want to be able to rate and supply feedback on the delivery experience through the Android and iOS applications, so that I can contribute to the improvement of the service. – Naxel S.

- As a customer service representative, I want to be able to receive alerts and notifications through the web application, so that I can be informed of any changes or updates related to the delivery. – Syed M.

- As a customer, I want to be able to save my preferred delivery location and payment information on the web application, so that I can easily reorder in the future without entering the same information again. – Logan D.

- As a restaurant owner, I want to be able to receive orders and manage them through the web or mobile application, so that I can efficiently process and fulfill the orders. – Adarsha D.

Requirements Readiness

Requirements Verification Spreadsheet

BUC/PUC/REQ#	Description	Rationale	Fit Criteria	Dependencies	Supporting Materials	Originator	Reviewer	Comments
1/2/27	G	N	G	G	N/A	Logan	Naxel	Expand on the consolidation of order related features in the menu.
1/2/28	G	G	N	G	N/A	Logan	Naxel	Fit criterion could have a stricter time limit.
9/9/29	G	G	G	N	N/A	Logan	Naxel	Missing requirement 27 as a dependency.
2/10/34	G	G	G	G	N/A	Logan	Naxel	This snow card has all the necessary details.
3/3/21	N	G	G	G	G	Aadarsha	Syed	Description could be a bit more detailed and elaborate on the meaning of “efficient routines”
4/4/41	G	G	G	G	N/A	Aadarsha	Syed	This snowcard has all the necessary details.
3/3/13	G	G	G	G	G	Aadarsha	Syed	This snowcard has all the necessary details.
3/3/14	G	G	G	G	G	Aadarsha	Syed	This snowcard has all the necessary details.
5/5/5	G	N	G	G	G	Naxel	Logan	Half of the rationale adds more onto the description (but the other half is solid)
9/9/15	G	G	N	G	N/A	Naxel	Logan	The fit criterion could have more detail/measurement to it (how close is 99.9%?).
5/5/17	G	G	G	G	N/A	Naxel	Logan	Snow card contains everything that is needed.
5/5/6	G	G	G	G	N/A	Naxel	Logan	Snow card is complete with all that is required.
5/5/20	G	G	G	G	N/A	Naxel	Logan	Snow card has all of details that are needed for it to be finished.
6/10/36	G	G	N	G	N	Naxel	Logan	I think the supporting materials is about articles to support the requirement, not systems

								you need to implement
1/2/23	G	G	G	G	N/A	Syed	Aadarsha	The snowcard has all the required details.
7/7/30	G	G	N	G	N/A	Syed	Aadarsha	Fit criterion could have been much shorter with better response time.
3/3/31	N	G	G	G	N/A	Syed	Aadarsha	The description of the functional could have had a numerical value rather than word as soon as.
7/7/42	G	G	N	G	N/A	Syed	Aadarsha	The re-order could be done sooner than 10 minutes.
1/2/9	G	G	G	G	N/A	Logan	Naxel	This snow card has all necessary details.
1/1/10	G	G	N	N	N/A	Logan	Naxel	Fit Criterion is empty. Requirement 27 missing.
4/4/14	G	G	N	G	N/A	Aadarsha	Syed	Fit criterion could incorporate more robust measures such as password length, character types, etc.
3/3/15	G	G	G	G	N/A	Aadarsha	Syed	This snowcard has all the necessary and required details
9/9/7	G	G	G	G	N	Naxel	Logan	Supporting materials should not have implemented systems
5/5/16	G	N	G	G	N	Naxel	Logan	Supporting materials should be to support rationale
8/8/11	G	G	N	G	N/A	Syed	Aadarsha	Fit criterion could be explained a bit better than it currently is.
1/1/19	G	N	G	G	N/A	Syed	Aadarsha	The rationale could be explained better than it currently is.

Requirements Traceability Flow

Functional Requirements						
Business Event #	**Business Event**	**BUC #**	**BUC**	**PUC #**	**PUC**	**Requirement # / Requirement**
1	A customer wants to view their order history and track the status of their current delivery.	1	Check Location of User's Food	1	The customer requests the location of their drone	27 - The app shall have a sidebar that appears when the user swipes from the right side of the screen towards the center.
						28 - The sidebar shall show the user's active delivery GPS location, for both drones and bots.
						39 - The order history shall record the order's: customer full name, prices, taxes, what item they ordered, what time they ordered, what time the drone arrived and the drone route.
2	The drone travels to the delivery location	2	Automated Drone Delivery	2	Sending route to the drones	21 - The drones shall use the most efficient routes to minimize drone pollution in the air.
						24 - The drones shall use the most efficient routes to minimize drone pollution in the air.
3	A customer places an order for food delivery via the web, Android, or iOS	3	User orders the food	3	A customer wants to track their food delivery in real-time.	31 - The system shall process the order's charge as soon as the

	application.					order is placed.
4	A drone meets an obstacle during delivery.	4	Obstacle Detection and Resolution for Drone Delivery.	4	Customer service receives notification of drone maintenance.	6 - If a drone goes below the DSH they shall be considered crashed and deploy their crash safety system.
						7 - The drones will deploy a parachute if they crash.
						10 - The drone shall come equipped with cameras to watch all activities.
						35 - The system must send the fleet manager a notification for any issues with active drones.
5	Drone arrives at designated delivery location	5	Drone lowers order to customer	5,6	5 - Drone lowers the food pod via the pulley 6 - Food pod detects that the customer has gotten too close to the food pod sensors	5 - The drones shall only lower and then hover at the DSH when they drop to make a delivery.
						9 - The drones will come equipped with a food pod attached to the bottom of the drone.
						11 - The food pod shall come equipped with cameras to watch all activities.
						12 - The food pod will be lowered via a pulley system while the drone is at the DSH.
						17 - The food pod shall have

						a horizontal fan on the side for directional steering when lowering the food pod for delivery.
						18 - The drone shall be able to hover still at the DSH without moving while the pulley is lowering the food pod.
						19 - The food pod shall open from the bottom to deposit the food during delivery.
						20 - Both the drone and food pod will use the cameras to continuously scan their surroundings while lowering the food to ensure that all is processing smoothly.
6	Weather station sends notice of thunderstorm warning	6	Terminate all drone activities due to inclement weather	10	Drones receive weather warning	36 - When the system sends out an inclement weather notice, all drones are to finish their deliveries and return to the drone warehouse for storage.
						37 - Once the system receives an inclement weather notice, no more orders will be accepted.
7	A drone suffers a crash during delivery	7	A drone has crashed, resulting in the potential loss	7	Drone Crash During Delivery	1 - The drone shall fly no higher than 200ft from the

			of a customer's order and property damage.			ground.
						2 - The drone's Cruising height shall be 100ft from the ground.
						3 - The drone shall fly no lower than 75ft from the ground.
						4 - The drone's minimum safety height shall be 25ft from the ground.
						8 - The drones will sound a slight siren to tell pedestrians that the drone is crashing (falling).
						26 - The drone maintenance team shall be tasked with retrieving crashed drones.
						30 - The customer shall be notified if their delivery drone experiences some form of crash or system failure. A new order will be sent their way.
						42 - In the case of a drone crash, the restaurant shall be required to prepare a new order, Starship Technologies will cover the cost.
8	A drone is running low on	8	Return the drone safely	8	Drone Battery Low	13 - The drones shall

	battery during a delivery.		back to the charging station			run on a set of rechargeable batteries.
						25 - The drone warehouse shall have charging pads for the drones to recharge their batteries automatically when they land on them.
9	Drone picks up order from restaurant	9	The drone arrives at the restaurant location and lowers the food pod into the restaurant chute.	9	Drone picks up order from restaurant	15 - Restaurants will require a drone pod chute for the drone to pick-up food from that restaurant.
						16 - The food pod shall open from the top to receive the food during pick-up. This is done from inside the restaurant's drone pod chute.
10	Talk with the fleet manager	10	Customer should get up to date information from the fleet manager about the status of the order.	11	Chat with Fleet Manager	29 - Users shall have the ability to communicate with the Fleet Manager if they wish to do so, a "chat with drone pilot" option will be displayed on the sidebar.

Non-Functional Requirements						
1	A customer wants to view their order history and track the status of their current delivery.	1	Check Location of User's Food	1	The customer requests the location of their drone	1 - The Drone Delivery System must be user-friendly, with an intuitive and easy-to-use interface for managing and monitoring deliveries.
						9 - The system shall update the Fleet Manager's map GPS location of all drones every 5s.
						10 - The system shall update the user's drone GPS location every 30s.
2	The drone travels to the delivery location	2	Automated Drone Delivery	2	Sending route to the drones	3 - Users shall receive their order within 15 to 30 minutes from placing the order.
						4 - Once at the delivery location, the drone shall wait 5 minutes for the user's signal to lower the food. If the user does not signal within 5 minutes the food will be returned to the drone warehouse where it must be picked up by the user.
						8 - The Drone Delivery System should be designed to perform efficiently, with minimal delays

						or disruptions during delivery.
3	A customer places an order for food delivery via the web, Android, or iOS application.	3	User orders the food	3	A customer wants to track their food delivery in real-time.	2 - The application should be designed to be compatible with other systems, technologies, and interfaces, such as iOS, Android, and web to enable easy integration with the existing infrastructure.
						6 - The Starship's application should be available 24/7 with an elevated level of uptime to ensure that deliveries can be made on time and users can access their order history, payment, and customer service at any time.
						7 - The drone delivery system should be operational if any partner restaurants is in operating hours.
						18 - The database data shall be encrypted so that the user's data is secure.
						20 - The application shall have firewalls to protect user information as it is transmitted.

4	A drone meets an obstacle during delivery.	4	Obstacle Detection and Resolution for Drone Delivery.	4	Customer service receives notification of drone maintenance.	13 - The drone shall be able to lower the pulley and deliver the food from the DSH within 5s, the faster the better to avoid unnecessary pulls and tugs from bystanders/wind currents.
						16 - The scanning during food delivery shall scan the nearby environment to make sure that the drone is no closer than 10ft from the nearest object (horizontally). This is raised to 20ft during winds higher than 15mph.
						17 - The scanning during food delivery shall scan the nearby environment to make sure that the food pod is no closer than 5ft from the nearest object (horizontally). This is raised to 10ft during winds higher than 15mph.
5	Drone arrives at designated delivery location	5	Drone lowers order to customer	5,6	5 - Drone lowers the food pod via the pulley 6 - Food pod detects that the customer has gotten too close to the food pod sensors	4 - Once at the delivery location, the drone shall wait 5 minutes for the user's signal to lower the food. If the user does not signal within 5 minutes the

						food will be returned to the drone warehouse where it must be picked up by the user.
6	Weather station sends notice of thunderstorm warning	6	Terminate all drone activities due to inclement weather	10	Drones receive weather warning	5 - Inclement weather, which is the weather at which the drones will be asked to return home, shall be defined as winds above 25mph, rain, thunder, snow or any harsher weather conditions.
7	A drone suffers a crash during delivery	7	A drone has crashed resulting in the potential loss of a customer's order and property damage	7	Drone Crash During Delivery	15 - If a drone has crashed, the parachute must slow the drone's fall to through the application.5mph or slower.
8	A drone is running low on battery during a delivery.	8	Return the drone safely back to the charging station	8	Drone Battery Low	11 - The drone batteries shall be able to run for a minimum of 4 hours.
						12 - The drone shall be able to travel up to 100 miles on a full charge.
9	Drone picks up order from restaurant	9	The drone arrives at the restaurant location and lowers the food pod into the restaurant chute.	9	Drone picks up order from restaurant	
10	Talk with the fleet manager	10	Customer should get up to date information from the fleet manager about the status of the order.	11	Chat with Fleet Manager	20 - The application shall have firewalls to protect user information as it is transmitted.
						21 - The application shall use login

						security features such as password, 2FA, face-id and email verification.

Requirements Prioritization Spreadsheet

Requirement	Number	Value to customer	Weight applied	Value to business	Weight applied	Minimize implementation cost	Weight applied	Ease of implementation	Weight applied	Priority Rating	Total
Rubric		1-10	40	1-10	30	1-10	10	1-10	20	1-63	100
F	1	2	0.8	4	1.2	1	0.1	10	2	7	4.1
F	2	3	1.2	4	1.2	1	0.1	10	2	10	4.5
F	3	4	1.6	4	1.2	1	0.1	10	2	13	4.9
F	4	5	2	8	2.4	2	0.2	10	2	42	6.6
F	5	4	1.6	7	2.1	5	0.5	8	1.6	24	5.8
F	6	5	2	9	2.7	8	0.8	6	1.2	43	6.7
F	7	10	4	10	3	6	0.6	6	1.2	59	8.8
F	8	7	2.8	10	3	3	0.3	10	2	51	8.1
F	9	10	4	10	3	10	1	10	2	63	10
F	10	3	1.2	9	2.7	8	0.8	6	1.2	27	5.9
F	11	3	1.2	9	2.7	8	0.8	6	1.2	28	5.9
F	12	10	4	7	2.1	4	0.4	4	0.8	44	7.3
F	13	7	2.8	6	1.8	6	0.6	6	1.2	37	6.4
F	14	8	3.2	7	2.1	10	1	7	1.4	46	7.7
F	15	2	0.8	3	0.9	8	0.8	6	1.2	3	3.7
F	16	1	0.4	1	0.3	3	0.3	10	2	1	3
F	17	6	2.4	6	1.8	8	0.8	8	1.6	40	6.6
F	18	8	3.2	8	2.4	3	0.3	3	0.6	39	6.5
F	19	3	1.2	1	0.3	3	0.3	10	2	5	3.8
F	20	4	1.6	9	2.7	4	0.4	6	1.2	22	5.9
F	21	7	2.8	8	2.4	5	0.5	1	0.2	19	5.9
F	22	5	2	6	1.8	1	0.1	10	2	33	5.9
F	23	5	2	6	1.8	5	0.5	9	1.8	41	6.1
F	24	10	4	10	3	1	0.1	10	2	62	9.1
F	25	7	2.8	7	2.1	2	0.2	4	0.8	32	5.9
F	26	3	1.2	4	1.2	1	0.1	6	1.2	9	3.7
F	27	6	2.4	5	1.5	3	0.3	8	1.6	35	5.8
F	28	7	2.8	3	0.9	7	0.7	6	1.2	25	5.6
F	29	4	1.6	8	2.4	9	0.9	8	1.6	36	6.5
F	30	9	3.6	1	0.3	4	0.4	10	2	38	6.3
F	31	3	1.2	2	0.6	10	1	5	1	6	3.8
F	32	9	3.6	6	1.8	8	0.8	6	1.2	45	7.4
F	33	10	4	2	0.6	3	0.3	4	0.8	34	5.7
F	34	4	1.6	2	0.6	2	0.2	5	1	4	3.4
F	35	1	0.4	6	1.8	2	0.2	4	0.8	2	3.2
F	36	3	1.2	5	1.5	8	0.8	6	1.2	11	4.7

F	37	3	1.2	6	1.8	4	0.4	10	2	23	5.4
F	38	5	2	3	0.9	4	0.4	8	1.6	18	4.9
F	39	2	0.8	4	1.2	3	0.3	8	1.6	8	3.9
F	40	6	2.4	2	0.6	5	0.5	10	2	29	5.5
F	41	10	4	10	3	2	0.2	7	1.4	61	8.6
F	42	10	4	10	3	2	0.2	4	0.8	56	8
NF	1	10	4	8	2.4	7	0.7	5	1	49	8.1
NF	2	8	3.2	8	2.4	4	0.4	7	1.4	47	7.4
NF	3	8	3.2	9	2.7	9	0.9	7	1.4	50	8.2
NF	4	5	2	6	1.8	6	0.6	10	2	30	6.4
NF	5	3	1.2	3	0.9	7	0.7	10	2	12	4.8
NF	6	9	3.6	7	2.1	3	0.3	10	2	52	8
NF	7	9	3.6	6	1.8	4	0.4	10	2	53	7.8
NF	8	6	2.4	6	1.8	1	0.1	6	1.2	26	5.5
NF	9	2	0.8	6	1.8	8	0.8	10	2	21	5.4
NF	10	3	1.2	3	0.9	5	0.5	10	2	15	4.6
NF	11	5	2	4	1.2	5	0.5	6	1.2	14	4.9
NF	12	5	2	4	1.2	10	1	6	1.2	16	5.4
NF	13	7	2.8	8	2.4	2	0.2	4	0.8	31	6.2
NF	14	10	4	10	3	8	0.8	5	1	58	8.8
NF	15	10	4	10	3	9	0.9	7	1.4	60	9.3
NF	16	7	2.8	6	1.8	4	0.4	2	0.4	20	5.4
NF	17	7	2.8	6	1.8	10	1	2	0.4	17	6
NF	18	10	4	10	3	2	0.2	3	0.6	54	7.8
NF	19	10	4	10	3	4	0.4	3	0.6	55	8
NF	20	10	4	10	3	8	0.8	3	0.6	48	8.4
NF	21	10	4	10	3	9	0.9	3	0.6	57	8.5

Project Items

Open Issues

1. **Drone Artificial Intelligence**: Drone AI pathing is still not 99.9% efficient and requires more continuous implementation.

2. **Regulatory and Legal Challenges:** One of the key challenges in drone delivery services is navigating the complex regulatory and legal landscape. This includes obtaining necessary permits, following aviation regulations, and adhering to local, national, and international laws related to privacy, safety, and airspace management.

3. **Urban Navigation and Obstacle Avoidance:** Urban environments pose unique challenges for drone delivery services, including navigating complex and dynamic environments with obstacles such as buildings, vehicles, pedestrians, and other drones. Developing robust algorithms for real-time navigation, obstacle detection, and avoidance is a critical open issue.

4. **Weather Conditions and Environmental Factors:** Adverse weather conditions such as intense winds, rain, and snow can affect the safety and efficiency of drone deliveries. Finding solutions to mitigate the impact of weather conditions and other environmental factors, such as temperature changes, humidity, and air quality, is an ongoing challenge.

5. **Payload Capacity and Range:** Drone payload capacity and range are critical factors that change the feasibility and efficiency of drone delivery services. Increasing payload capacity while supporting range and flight time is a technical challenge that requires continuous innovation in battery technology, propulsion systems, and lightweight materials.

Off-the-Shelf Solutions

It's important to note that off-the-shelf solutions may require customization and integration to meet specific project requirements, and thorough testing and validation should be conducted to ensure safety, regulatory compliance, and performance before deploying a drone delivery service.

1. **Drone Hardware Platforms:** Several commercially available drone hardware platforms, such as DJI, Yuneec, and Parrot, offer off-the-shelf solutions for drone delivery services. These platforms come with integrated flight controllers, GPS systems, cameras, and other sensors, making it easier to develop custom drone delivery solutions.

2. **Flight Control Software:** There are several open-source and commercial flight control software options available, such as Ard pilot, PX4, and DJI SDK, that supply robust flight control capabilities, including autonomous navigation, obstacle avoidance, and mission planning, which can be customized for specific drone delivery requirements.

3. **Geospatial Data and Mapping Services:** Existing geospatial data and mapping services, such as Google Maps, OpenStreetMap, and GIS platforms, provide rich data on terrain, roads, buildings, and other obstacles that can be used for route planning, obstacle detection, and navigation in a drone delivery system.

4. **Communication and Connectivity Solutions:** Reliable communication and connectivity are crucial for remote control, real-time monitoring, and data transmission in a drone delivery system. Existing communication and connectivity solutions, such as 4G/5G networks, satellite communication, and mesh networks, can be used to establish robust and secure communication links between the drones and the ground control station.

5. **Drone Delivery Management Platforms:** There are several off-the-shelf drone delivery management platforms, such as Flytrex, Wing, and Zipline, that supply end-to-end solutions for managing the entire drone delivery process, including order management, route planning, fleet management, and customer notifications. These platforms can be customized and integrated with other components of a drone delivery system.

Risks

- Technical risk:
    - Delayed project timeline leading to increased costs and loss of competitive edge.
    - Poor system performance leads to dissatisfied customers and loss of business.
- Operational risk:
    - Inability to effectively manage drone fleet leading to delivery delays and customer complaints.
    - Inadequate training of drone operators leads to safety incidents and legal liability.
    - Failure of the Drone parachute safety system to deploy leading to unwanted injury in bystanders.
- Market risk:
    - Low customer adoption due to lack of trust in drone technology, leading to reduced revenue and market share.
    - Intense competition from established delivery services, leading to reduced market share and revenue.
- Regulatory and legal risk:
    - Fines and penalties for violating aviation regulations leading to financial losses and damage to reputation.
    - Legal liability for accidents or damage caused by drones, leading to financial losses and damage to reputation.
- Reputational risk:
    - Negative media coverage of drone delivery system failures, leading to loss of trust from customers and damage to brand reputation.
    - Negative public feeling of drone technology, leading to loss of business and difficulty attracting investment.

Costs

Current cost for requirements:

- 8 people, 3 months (13 weeks), $40 average per hour
- Req lead, Req Sr, Req Jr (8)
- $166,400

Reasoning: We realized that it would be better to have more personnel working on requirements than a select few, this is for ease of interviewing multiple stakeholders and discussing the importance and viability of the final requirements.

Ideas for Solutions

- Collaboration with federal, state, and local law enforcement agencies to ensure that all permits, regulations, and other safety requirements are in compliance with all laws pertaining to aerial vehicles and airspace management.

- Invest in and implement autonomous flight systems that allow drones to adapt to unexpected objects or buildings around them while in air. Additionally, conduct periodic calibrations of all drones on all flight paths to ensure their flight system is up-to-date with the latest surroundings and routes.

- Equip drones to receive weather data and automatically adjust course to avoid bad weather or return to the base station. Additionally, implement emergency response measures such as drone safety stations throughout campus in order to allow for drones to navigate to a nearby resting area quickly while bad weather passes.

- Implementation of more powerful propulsion systems that allow drones to operate at faster speeds which increase efficiency and decrease the need for frequent charging. Implementation of swappable battery systems that allow drones to swap batteries autonomously instead of charging throughout the day when order volume is high.

Definition or Acronym Table

Word	Definition
Customers	Students or their relatives in the campus area, who are interested in ordering food through Starship Technologies.
Sponsor / Owner	The owner of the product will be Starship Technologies who have contracted us to create the drone
UAV	Unmanned Aerial Vehicle. A drone that is run without a human pilot on board.
Food Pod	The food container carried by the drone that holds the food and keeps it at an exact temperature. The pod is lowered via a pulley and holds a motorized fan on the side for precision targeting. For pickup, the pod is lowered into a chute on the side of the restaurant and loaded with food from the top. For delivery, the pod is lowered onto the ground and opens from the bottom to leave the food and is pulled up.
Restaurant Pod Chute	A metal slide installed onto the side of the restaurant for the drone pod to be lowered and loaded with the order. The pod is then raised via the drone pulley back into the air. Pods can be loaded with food without the need for a chute as well, this will be in exceptional cases only.
Drone Safety Height (DSH)	A specific height above tree lever decided by the company to be the minimum height that the drones can fly / hover at. The drones must not under any circumstances be below this height. The only exception is during drone crashes.
Cruising Height	The height where drones will remain during active hours and during deliveries.
Drone Crash	A drone will be considered crashed if at any moment in time the drone is below the Drone Safety Height, whether the drone is operational or not does not matter since it will be a liability either way.
Crash Safety System	Drones that have crashed will shut down and deploy their safety parachutes. They are to be retrieved by the Drone Maintenance team.
Complete Operational Failure (COF)	A drone that loses the ability to fly due to excess damage. A drone that has crashed is not automatically considered as Complete Operational Failure.
Drone Operator	The Artificial Intelligence that powers the drones has gone through rigorous amounts of training.
Fleet Manager	The person on the clock whose job is to watch the status of the drones and find them if there are any problems.

CS	Customer Service, Customer Service Team of Starship Technologies