AirPizza

Software Project Plan

CSSE 372

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Version of Changes

Version	Date	Comments
1.0	10/26/2023	**Initial Draft for TA review**
2.0	11/2/2023	**Final Draft for Submission**

1 Introduction

The AirPizza project seeks to revolutionize pizza delivery by using drones for cost-effective and efficient services. The vision behind this project is to simplify that user experience and guarantee quick delivery. Through the use of drones, deliveries can be made that will circumvent traffic and other extenuating circumstances that may othewise hinder fast deliveries. Customers can order through an app or website, and the goal is to deliver high-quality pizzas within 15 minutes. The project will initially focus on Terre Haute with plans for expansion to similar regions. The user will be able to make these orders using either a web client or a dedicated mobile app. The app will function similarly to UberEats or other food delivery services where the user will select the food they wish to order, submit their address (or have it stored by our systems), and submit credit card information (or have it stored by our systems).

The scope encompasses software development, hardware setup, and server infrastructure. Constraints include delivery region limitations, drone payload capacity, delivery timeframes, weather dependencies, recharging, scalability, a budget of $300,000, and a three-month timeline. Known risks involve regulatory approvals, drone reliability, customer interaction, an aggressive timeline, location precision, and communication interference. This project aims to provide an innovative and convenient pizza delivery service. This document intends to inform the reader of the potential risks of the development of the project as well as to lay out a rough plan for development and successful completion of the project.

1.1 Goals and Objectives

Goals/Objectives associated with this project include:

1. Achieve an average delivery time of 15 minutes for pizzas.
2. Maintain a budget of $300,000 for the project.
3. Secure all necessary regulatory approvals for drone operations.
4. Prices will be the competitive (within +/- $3) with other similar pizza delivery services.
5. AirPizza will save the user time on delivery. The ordering process should take less than 5 minutes.
6. AirPizza will be implemented for deliveries within the Terre Haute area (city limits).

1.2 Project Scope

The following are the required and planned features for the AirPizza Project

1.2.1 Major Features and Benefits

For Customers (Pizza Consumers):

- **Efficient Ordering:** Customers can quickly and conveniently order pizzas via the mobile app or website, saving time and effort.
- **Menu Customization:** Users can customize their pizza orders by selecting ingredients and requesting special modifications.
- **Payment Options:** The system offers a variety of payment methods, including debit, credit, coupon codes, and gift cards.
- **Account Management:** Customers can create accounts, securely save their details, and access order history for easy future ordering.
- **Order Tracking:** The system allows customers to monitor the location of their drone delivery and direct it to the final drop point.

For Drone Fleet Management:

- **Drone Monitoring:** The system includes real-time monitoring of drone locations, battery status, and other operational parameters.

- **Maintenance Management:** Drones that require charging or repairs are taken out of service and indicated as ready for operations once again.
- **Customer Analysis:** The system tracks and analyzes customer orders to identify usage patterns and trends, which inform menu updates and location adjustments.
- **Predictive Ordering:** AirPizza uses past order data to predict future orders, enabling targeted coupon and discount offers to enhance customer experience.

Mobile App and Web Interfaces:

- The system supports both iOS and Android mobile devices, ensuring a consistent user experience across platforms.

Drone Features:

- The drone fleet will feature security measures to protect against wireless attacks and denial of service threats.
- Drones will be equipped with the capability to detect loss of contact with the servers and navigate back to the home base or re-establish communication.
- The drones can transmit video from their location to both the home base and customers.
- Drones will require minimal control from the home base and are designed for self-navigation, optimizing delivery efficiency.

Overall System Architecture and Technologies:

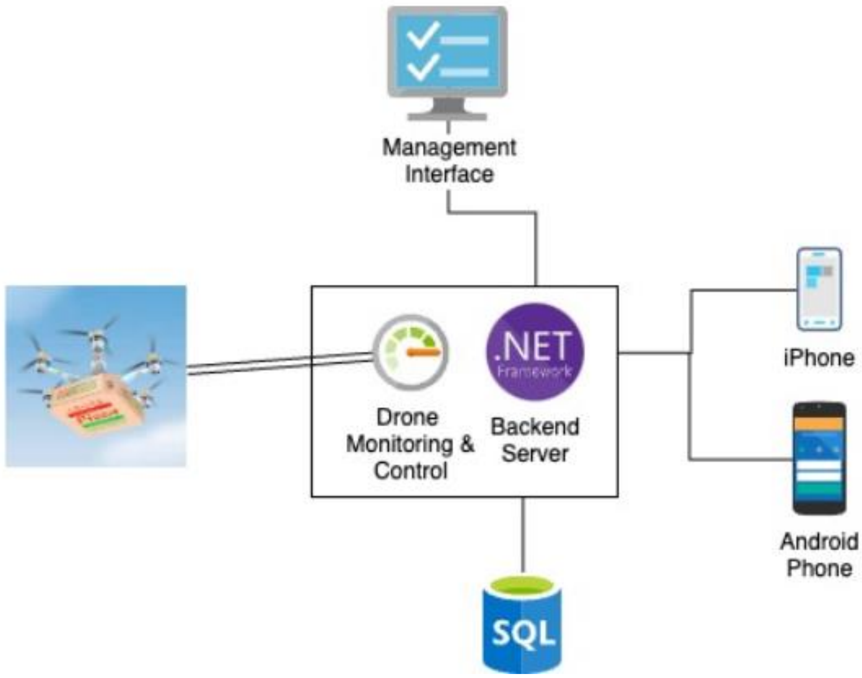
The system will consist of four major components, including user interfaces for mobile apps and web, a server, drones, and a management interface. Technologies used will include Flutter and Dart for mobile app and web development, Microsoft platform for the server (utilizing .Net and SQL Server on Azure), and 4G/5G cellular data services for drone communication. The user interfaces will not store transient data locally and will retrieve data from the server as needed.

1.2.2 Additional Enhancements

While the project includes a comprehensive set of features, there are plans for future enhancements beyond the final release of AirPizza:

- **Additional Locations:** Eventually, there are plans to expand AirPizza out to a larger client base by supporting multiple locations. This will require support within the infrastructure for multiple starting locations as well as updated calculations for viable routes to deliveries based on altitude, geolocational data, etc.

1.3 Context



Shown above is a high level overview of the systems involved in the design of AirPizza. The Project will allow users to access the delivery service through a mobile app, meaning we will need to require support for both iPhones and Android Phones. When connecting through the app, the intended design will use .NET to handle API calls and data manipulation by users. Additionally, once orders are placed using .NET the records will be propogated to the SQL server and instructions will be sent to the Drone Monitoring and Control software. The Drone Monitoring and Control software will process order data (geolocation data, items ordered, estimated weight) to determine if the delivery is possible, and if so, dispatch drone(s) to complete the order.

The project will also rely heavily on 4G/5G (depending on coverage in areas) that will allow the drones to communicate back to the drone monitoring and control software.

1.4 Major Constraints

The AirPizza project will face a few primary constraints, as detailed below.

1.4.1 Business Constraints

The project must be completed within 3 months and have a budget under $300,000.

1.4.2 Technical Constraints

Due to the confidential information stored by the system (personal addresses and financial information) additional care must be taken to ensure data integrity within the system and maintain proper access control.

1.4.3 Performance Constraints

1.4.3.1 Reliability of System

The reliability of the system will be measured by mean-time-between-failure (MTBF), aiming for an MTBF in the first year of approximately 3,000 hours.

1.4.3.2 Availability of System

For the availability of the system, AirPizza will have an availability of 98%. This measure for availability (during active delivery hours) will ensure that most users face no major outages and are able to use the system effectively.

1.4.3.3 Maintainability of System

There is no direct way to measure the maintainability of the system. Therefore, the project will use mean-time-to-change (MTTC). Due to the “startup-style” development team. The MTTC should be relatively low as decisions can be made quickly through conversations with the entire team to ensure safe design decisions.

2 Project Estimates

This section will detail the data used and assumptions made to generate reasonable and meaningful estimates for the project. By checking historical data, using software estimation tools, and laying out estimated costs for individual person-hours, we can more accurately predict the outcome of the final project.

2.1 Historical Data Used for Estimates

According to Glassdoor Data, Software Engineers at Pizza Hut earn between $91,000 and $149,000 per year. Due to the geographic region of the project we will lean toward the lower side of salaries for this project and start our junior software engineers (2) at $85,000 per year. The team will also have an additional Senior Software Engineer as well as a Database Manager for data handling. Based on the prior average salaries, we will provide the senior members of staff with an additional $20,000 in base salary (resulting in $105,000 base salary for the Senior Software Engineer and the Database Manager).

2.1.1 Descriptions

Job Title & Project Specific Responsibilities	*Job Description*	*Salary (year)*
Junior Software Engineer Project Responsibilities: 1) Programming	“A junior software engineer working on the AirPizza project would have various responsibilities to contribute to the successful development and deployment of the system. Their primary duties would include assisting in the design, development, and maintenance of the software components that are essential for the project's operation. This would encompass working on the software required for drones, the ordering and purchasing system, customer account management, and drone tracking and monitoring. Additionally, the junior software engineer may be involved in developing the user interfaces for both mobile apps (iOS and	**$85,000**

Job Title & Project Specific Responsibilities	***Job Description***	***Salary (year)***
	Android) and the web interface, ensuring a consistent and user-friendly experience. They would work with technologies such as Flutter, Dart, .Net, SQL Server, and Azure to build and maintain the system components. Moreover, they should collaborate with the team to address known risks, such as obtaining necessary approvals and ensuring the reliability and security of the drone software. In summary, their role would involve contributing to the development, testing, and deployment of software components critical to the AirPizza project's success."	
Senior Software Engineer Project Responsibilities: 1) Technical Lead 2) Programming	"A Senior Software Engineer working on the AirPizza project will have several key responsibilities. This role involves overseeing and contributing to the development of the software components necessary for the successful implementation of this innovative pizza delivery service via drones. Key responsibilities include designing and developing the ordering and purchasing system for both the mobile app and web interfaces, ensuring a seamless and user-friendly experience for customers. Additionally, the Senior Software Engineer will be responsible for developing and maintaining customer accounts, allowing for easy and secure future orders. They will also play a critical role in implementing real-time drone monitoring and control systems, which will require expertise in GPS integration, drone communication, and live tracking. Furthermore, this role will involve collaborating with the server team to create and manage databases and APIs necessary for handling orders, menus, and payment processing. Given the ambitious timeline and known risks, the Senior Software Engineer will need to work efficiently, prioritize features, and ensure the system is robust, reliable, and secure. Finally, this role may involve selecting and customizing drones' software to meet the project's unique requirements, which is a critical aspect of ensuring the drones are capable of delivering pizzas safely and reliably. Overall, the Senior Software Engineer will be instrumental in bringing the AirPizza vision to life by creating a seamless, efficient, and cost-effective pizza delivery platform."	**$105,000**
Database Manager Project Responsibilities: 1) Database Management	"The Database Manager for the AirPizza Project is responsible for designing, maintaining, and optimizing the project's database infrastructure, ensuring data integrity, and facilitating seamless data communication between system components. This includes selecting the appropriate database management system, establishing data security protocols, and coordinating with the development team to ensure the user interfaces interact effectively with the database. The manager must also monitor and optimize database performance, consider scalability for potential expansion, and collaborate with the server development team. This role is pivotal in supporting the project's goal of cost-effective pizza delivery and efficient customer service."	**$105,000**

For the project, we will be using two Junior Software Engineers, one Senior Software Engineer, and one Database Manager. The labor rate was averaged using the following equation:

$$(85000/12)*0.5 + (105000/12)*0.25 + (105000/12)*0.25 = \$7960$$

This labor rate is then multiplied by 147% to account for overhead, benefits, and the like. Therefore the burdened labor rate per month is $11,701.

2.2 Estimation Techniques Applied and Results

Below are the <u>two</u> estimation techniques were used to generate independent results for higher accuracy.

- Process-based
- COCOMOII Model – Source Lines of Code (SLOC)

Both arrived at very similar cost and time estimations for the project.

2.2.1 Process-Based Estimation

For process-based estimation, the system was decomposed into a smaller set of subsystems. The subsystems are as follows:

- Mobile App (iPhone)
- Mobile App (Android)
- .NET API
- SQL Server
- Management Console
- Drone Control

Activity	Planning	Risk Analysis	Engineering		Development		Totals
Task	(person months)		Analysis	Design	Code	Test	
Mobile App (iPhone)	0.4	0.2	0.4	1	0.6	0.3	2.9
Mobile App (Android)	0.4	0.2	0.4	1	0.6	0.3	2.9
.NET API	0.8	0.3	0.6	1.4	1	0.4	4.5
SQL Server	0.4	0.3	0.2	0.4	0.4	0.2	1.9
Management Console	0.2	0.4	0.2	0.4	0.4	0.2	1.8
Drone	1	1.2	1	2	2	1	8.2

Control							
Total	3.2	2.6	2.8	6.2	5	2.4	22.2
% effort	14.4	11.7	12.6	27.9	22.5	10.8	100

Based on the table and estimates above, the duration of the project should be about 22.2 person-months. Split between 4 developers, this will result in a project duration of about 5 and a half months. Based on our prior calculated burdened labor rate, the total cost of labor will be 22.2 * 11,701 = $259,762.20. In addition to this estimate we will require an additional $160,000 for drone hardware based on a price of [$8,000 per drone](). This brings the total cost for the project including labor and hardware to $419,762.20.

2.2.2 SLOC-Based COCOMOII Estimation

The following table contains the estimated SLOC for each of the previously detailed subsystems of the project

Subsystem	Estimated LOC
Mobile App (iPhone)	3000
Mobile App (Android)	3000
.NET API	5000
SQL Server	500
Management Console	300
Drone Control	6000
Total Est. Lines of Codes	**17,800**

The estimates for SLOC for each function in the above table were plugged into the COCOMOII model as modules for effort, cost and duration estimation. See COCOMOII printout below for summary.

Listed below are the factors that were adjusted to reflect the AirPizza project circumstances. The following "**Factors**" were adjusted in COCOMOII for the entire project:

Scale Factor	Rating	Rationale/Assumptions
PREC	Nominal	While all of the developers likely have experience coding with some of the technologies, particularly the Senior Software Engineer and Database manager, the concept as a whole is novel and as such is quite unprecedented.
FLEX	High	Due to the unique nature of the product as well as the high potential for increased profits, the team will likely be able to change some requirements where necessary.
RESL	Low	While some general architectural decisions have been made, the overall design can still be adjusted.
TEAM	Very High	Due to the relatively small team, it is unlikely that there will be any lingering difficulties in the interactions as most disagreements will likely be solved early
PMAT	Extra High	Due to the early decision to take a waterfall approach to development, the processes are highly understood and will likely have few isuses moving forward.

Product Cost Drivers	Rating	Rationale/Assumptions
RELY	LOW	Losses will be fairly easily recoverable, only large issues would

		be the loss of a drone, however due to geolocation abilities the vast majority will be kept in the posession of the company.
DATA	Low	All aspects of the system can be sufficiently calculated using only a few hundred entries of data
CPLX	Very High	The drone software will introduce significant complexity to the code, which may make development more difficult
RUSE	Very High	The software developed here is intended to act as a proof of concept that could expand out to larger areas of service. As such, it is important that many of the components are reusable.
DOCU	Nominal	Documentation will be sufficiently complex and complete for the uses of the project.

Platform Cost Drivers	Rating	Rationale/Assumptions
PLEX	Nominal	Due to the drone work, which none of the developers will have worked with before, the experience provided from other ventures will not have as much value leading to a Nominal rating.
LTEX	Nominal	Drone work will slow down development, but not beyond a reasonable level.
TIME	Nominal	There is no reason this tool will take up any significant amount of CPU utilization.
STOR	Nominal	There is no reason this tool will take up any significant amount of RAM utilization.
PVOL	Low	The OS, DBMS, and other tools have already been determined and are very unlikely to change

Personnel Cost Drivers	Rating	Rationale/Assumptions
ACAP	Very High	As half of the team is comprised of experienced engineers, the personnel can be considered well trained and effective.
APEX	High	While the junior engineers are fairly new to this some of the different technologies (.NET, SQL, etc). The experienced developers have many years of experience. As such, we’ll meet in the middle, but trend toward experience as the experienced developers can assist the junior developers where needed.
PCAP	High	Again, due to the mix of highly experienced vs new developers we will trend toward the middle but with an edge towards experienced due to the ability of the senior developers to assist the junior developers.
PCON	High	It is unlikely that any developers will leave the project during development.

Project Cost Drivers	Rating	Rationale/Assumptions
TOOL	Very High	Tools and software processes being used are well defined and industry standard (Visual Studio, SSMS, XCode, etc)
SITE	Extra High	The team will all be working from the same office in Terre Haute.

SCED	Nominal	As of now, the schedule seems to be fairly set in stone.

AirPizza - Detail Report

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Estimate Name:	AirPizza	Estimate ID:	
Model Name:	COCOMO® II 2000	Model ID:	2000
Process Model:	COCOMO® II Model	Phases:	Waterfall

Component Name:	AirPizza	Component ID:	
Increment:	1	Level:	1
Developed Size:	17,800	EAF:	0.3428

Phase	Effort (Person-Months)	Cost (K$)	Duration (Months)	Staffing
RQ -- Requirements	1.6	0.0	1.9	0.9
PD -- Product Design	4.0	0.0	2.5	1.6
DD -- Detailed Design	6.0	0.0	2.2	2.8
CT -- Code & Unit Test	8.0	0.0	2.9	2.8
IT -- Integration & Test	5.5	0.0	2.4	2.3
Development (PD+DD+CT+IT)	23.5	0.0	10.0	
Totals (RQ+PD+DD+CT+IT)	25.2	0.0	11.9	
MN -- Maintenance (per year)	0.0	0.0		0.0

COCOMOII determined that the project should have a duration of approximately 25.2 Person-Months. Based on our prior calculations, the cost for labor can now be calculated at 25.2 * 11,701 = $294,865.20. In addition to this estimate, as stated before we will also require an additional $160,000 for drone hardware based on a price of [$8,000 per drone](). This brings the estimated total for the project from COCOMOII to $454,865.20.

2.2.3 Triangulate Process-Based and COCOMOII for Final Estimates

The Process-Based estimate was calculated at a total cost of $419,762.20 with a duration of 5.55 months and the COCOMOII estimate came out to $454,865.20 with a duration of . In order to consolidate these estimates, we will simply take the average of the two values resulting in an estimated total project cost of $437,313.70.

2.3 Project Resources

2.3.1 People

As previously mentioned, 4 members of staff will make up the personnel for this project. There will be 2 Junior Software Engineers responsible for the majority of implementation of established features as well as support for emerging technologies such as the drone management solution. There will be 1 Senior Software Engineer responsible for overseeing the other engineers and tackling the forefront of the drone management solution. There will also be 1 Database Manager responsible for database and API design. As such, this person will also be responsible for data handling and privacy for location and payment information.

2.3.2 Minimal Hardware Requirements

For the purposes of this project, only drones will be required as additional hardware as all existing employees will have the relevant equipment needed for development.

2.3.2.1 Drones

The drones are 8x Aurelia X6 Max. These models were selected for their carry paylod of up to 13lbs (meeting the project specifications of up to 10lbs), as well as the 70 minutes of flight time allowing for minimal downtime between deliveries.

2.3.3 Minimal Software Requirements

The project will make use of existing enterprise tools

2.3.3.1 Development

- Google Chrome (free)
- Visual Studio Code (free)
- Visual Studio (free, enterprise plan through existing company infrastructure)
- SSMS (free)

3 Risk Management

For this project, the software team will adopt a proactive approach to risk. The following section describes the risk mitigation plan to avoid the top highly probable, high impact risks to the project. For those risks that become a reality, a risk management and contingency plan will be developed to manage the risks.

3.1 1.1 Risk Categorization

3.1.1 1.1.1 Description of Risk Categories

1. **Performance Risk:**

This risk concerns whether software will meet its requirements and fit for its intended use.

2. **Cost Risk:**

This risk concerns whether budget will be maintained for project.

3. **Support Risks:**

This risk concerns whether end product will be easy to maintain.

4. **Schedule Risk:**

This risk concerns whether project schedule will be maintained and deadline met.

3.2 1.2 Risk Table

The following table lists the top 10 risks associated with AirPizza. Each risk has been categorized with its probability of occurrence (P) and impact (I) on project and sorted by its risk value (RV = P*I).

Risks	Risk Category	Probability of Occurrence	Impact	Risk Value
There is expected to be a risk of interference for the drones'	Performance	50%	3	1.5

communication and/or dead spots to be avoided. (RS2)	Risk			
The system depends on getting approval from the FAA and Terre Haute to fly. There may be other approvals needed as well to operate in specific regions. (RS6)	Performance Risk	50%	3	1.5
The drone capabilities are critical to be reliable, able to not drop a pizza, and have consistent battery life. (RS1)	Performance Risk	30%	4	1.2
Training/hiring a large or skilled enough team to work across the breadth of the AirPizza architecture will delay the start date. (RS4)	Schedule Risk	40%	3	1.2
It is unknown how customers will treat the drones and they may damage the drones. (RS5)	Support Risk	30%	3	0.9
The budget is exceeded to pay for drones or salaries. (RS7)	Cost Risk	40%	2	0.8
Precise locations may be difficult to specify for customers with GPS or address alone. (RS3)	Performance Risk	20%	3	0.6
Members of the team leave after development. (RS8)	Support Risk	30%	2	0.6
The noise complaints about drone deliveries result in a local ban. (RS9)	Support Risk	10%	4	0.4
Being unable to find a set of willing participants for the testing of the service. (RS10)	Schedule Risk	10%	2	0.2

Table 3- Risk Analysis Table

Impact Values	Description
4	Catastrophic – This could lead to failure to meet key regulatory requirements, and/or business failure
3	Critical- This could lead to the features (such as repeated travel to random locations) being impossible to implement
2	Marginal- This could harm the quality of the service or the competitiveness of the business or require compromises in the features
1	Negligible- This could lead to minor issues but wouldn’t compromise the service significantly

3.3 Risk Mitigation, Monitoring, and Management Plan (RMMM)

3.3.1 Risk Information Sheet for RS1

Risk ID: RS1 Date: 10/31/23 Prob: 30% Impact: Catastrophic Risk Value: 1.2

Description:

The drones must be able to perform the basic tasks related to the services of drone delivery, consistently, to provide the service at a large enough scale to meet the goals of 15-minute deliveries and cost effectiveness.

Refinement/context

Subcondition 1: The team has reached the stage of performance testing, and the failure rate at tasks and of the drones themselves exceeds the maximum allowable threshold based on requirements.

Subcondition 2: The team is unable to demonstrate significantly improved performance on their own.

Subcondition 3: There are widespread failures at the project’s launch.

Mitigation/Monitoring

1) Purchase drones used in similar industry applications, with known reliability and long-distance flying ability

2) Designate and train pilots for a minimum viable product, a remote-controlled drone delivery

3) Set maximum allowed rates for different failures based on expected costs and total acceptable cost due to damage/failed delivery

4) Begin testing the ability of the drones from the start of the project to catch issues early, e.g., by using remote control in test runs.

Management/Contingency Plan/Trigger

Hire a team member with experience with long-distance drones, if after a month of trying to resolve the issues there is no resolution. If the deadline passes, then a report concerning the future feasibility of the project will be made and used to decide whether to proceed.

3.3.2 Risk Information Sheet for RS2

Risk ID: RS2 Date: 10/31/23 Prob: 50% Impact: Critical Risk Value: 1.5

Description:

Flying into an area without signal/with interference will prevent the drones from being controlled, potentially leading to the loss of drones, destruction of property, and an inability to navigate to the requested destinations.

Refinement/context

Subcondition 1: At some point during testing the drone's location/response is unavailable.

Subcondition 2: Loss of connection occurs in populated areas (potentially leading to property damage or injury) where deliveries might occur, or an inability to navigate to the destination

Subcondition 3: The crashes caused by a loss of connection could result in the drone being irretrievable

Mitigation/Monitoring

1) A mapping of all of the areas in Terre Haute that have poor connection will be established via random sampling of different square mile patches, and the minimum amount of coverage needed to achieve the quantity of deliveries per minute desired
2) An approach will be devised to address such scenarios, such as increasing the autonomy to the point that patches of missing coverage could be connected easily, preloading the path from the beginning of the journey, automatically backing up if signal is lost, or cutting out large swaths with such issues
3) The terms of service will contain wording to protect AirPizza from lawsuits

Management/Contingency Plan/Trigger

If despite or because of the efforts to mitigate poor connectivity, there is no clear plan by the end of the second month to reach the degree of coverage necessary to meet the minimum required coverage area, then an expert in computer vision could be hired/consulted on to determine a way through GPS dead zone using accelerometer data and obstacle detection. If all else fails, set locations with guaranteed navigable coordinates could be used as destinations, with customers walking to the nearest one for deliveries.

To cover monetary losses due to lost drones or damaged property, loans will be taken out to be recouped later.

3.3.3 Risk Information Sheet for RS6

Risk ID: RS3 Date: 11/01/23 Prob: 40% Impact: Critical Risk Value: 1.2

Description:

The system depends on getting approval from the FAA and Terre Haute to fly. There may be other approvals needed as well to operate in specific regions. The risk is failing to obtain these. (RS6)

Refinement/context

Subcondition 1: Database may not be in SQL standard format.

Subcondition 2: Database venacular not understood correctly by programmer

Subcondition 3: Database may not have direct symptom/diagnosis/treatment linkage necessary to support requirement R2.

Mitigation/Monitoring

1) Contact Database owner to determine format of database
2) If format is not SQL based, determine if conversion is possible to a relational database

3) Upon receipt of database from vendor, run preliminary data checks and reports to ascertain integrity of data

4) Have all members of project attend one day seminar on canine medical terms
5) Contact Database owner to determine if there is symptom/diagnosis/treatment linkage

Management/Contingency Plan/Trigger

Hire expert Veterinarian to help understand database. The risk exposure cost is approximately $2000 (RE=40%*$5000). $5000 is the cost of obtaining the services of veterinarian for 5 days. Allocate this amount into project contingency cost.

Have 2 developers attend needed training to import non-standard formatted database into system database

3.3.4 Risk Information Sheet for RS4

Risk ID: RS3 Date: 11/01/23 Prob: 40% Impact: Critical Risk Value: 1.2

Description:

(for the delay one) Training/hiring a large or skilled enough team to work across the breadth of the AirPizza architecture will delay the start date.

Base on hw4, also mention how the interfaces all have to match each other for subconditions and this being challenging could be an issue (also hw4)

Refinement/context

Subcondition 1: Database may not be in SQL standard format.

Subcondition 2: Database venacular not understood correctly by programmer

Subcondition 3: Database may not have direct symptom/diagnosis/treatment linkage necessary to support requirement R2.

Mitigation/Monitoring

1) Contact Database owner to determine format of database
2) If format is not SQL based, determine if conversion is possible to a relational database

3) Upon receipt of database from vendor, run preliminary data checks and reports to ascertain integrity of data

4) Talk about doing an MVP with manual delivery, making use of

Management/Contingency Plan/Trigger

Hire expert Veterinarian to help understand database. The risk exposure cost is approximately $2000 (RE=40%*$5000). $5000 is the cost of obtaining the services of veterinarian for 5 days. Allocate this amount into project contingency cost.

Have 2 developers attend needed training to import non-standard formatted database into system database

4 Project Schedule <worth 25/100 points of your SPMP grade>

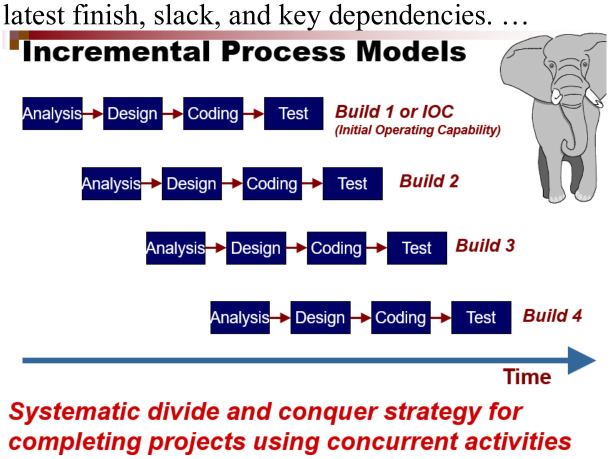
<**Use the MS Project tool** to produce your Gantt Chart and Critical Path Analysis. This is a **very important section** that uses the estimates, risks, and the like to establish the schedule for the project. This will be where you use things like critical path analysis and critical chain scheduling to produce a viable delivery schedule. Start by describing in a paragraph or two how you arrived at the WBS tasks and how they will be used in the Project Gantt Chart to provide a detailed schedule. >

The project schedule described in this section provide the basis for deliverable dates and expected resources to be available…

4.1 Project Gantt Chart <15/25 points for section grade>

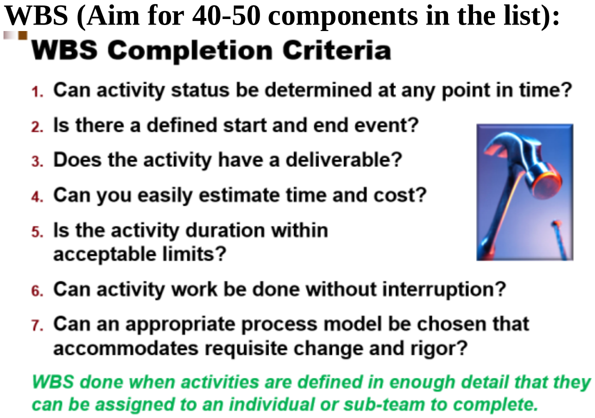
<Use MS Project to produce your WBS tasks in a Gantt chart – remember to include reference the personnel resources for each task.>

The timeline of the project was derived from the tasks in the Work Breakdown Structure (WBS), a critical path analysis, and a critical chain analysis. Staffing resource availability/requirements are shown as well as the durations of the tasks in terms of earliest start, earliest finish, latest start, latest finish, slack, and key dependencies. …

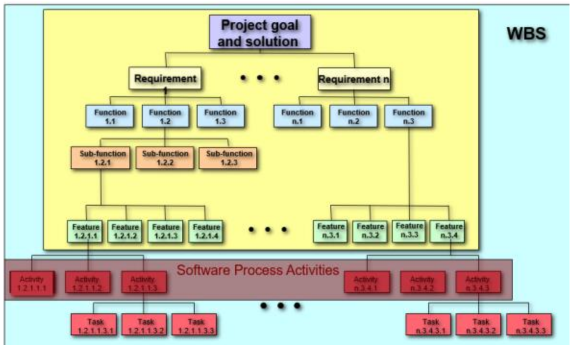


- Chosen process model

WBS (Aim for 40-50 components in the list):



WBS Reflects Goals & Requirements



- **They give us features (System Features section), so we should be able to circumvent the requirements, functions, and sub-functions and just know whether the tasks in the flowchart are possible**

Use standard steps to

Software components:
- User interfaces: iOS and Android mobile apps as well as a Web interface that supports all major browsers (Safari, Edge, Firefox, and Chrome). The interfaces should be as consistent as possible so that a user could switch from one to another and have a similar experience.

- Analysis
  - Create goals for the design
  - Contact restaurants to obtain menu items
  - Research other applications and what our users find useful
- Design
  - Generate wireframe mocks to represent the final designs in web
  - Generate wireframe mocks to represent the final designs on mobile
- Implementation
  - Prototype the design with no functionality
- Test
  - Conduct testing with users to identify potential usability issues
    - **Note: depends on the implementation step of server at the very least**
  - This should be finished chronologically first of the components so only dependent on prior steps

- Server: that supports the storage of the menus, availability of items, user profiles and orders as well as interfaces to external systems (such as the payment system). The server should also support the monitoring and management of the drone fleet and any reporting needs.
Microsoft platform including .Net

and

SQL Server on a cloud-based Azure server.

- Analysis
  - Determine the requirements for creating the API
  - Choose a specific SQL server pricing based on the speed requirements
  - Research how digitized the menu data and availability of items are
- Design

    - Determine what endpoints are necessary for drones, site, and apps
    - Determine what the schema for SQL Server should be
    - Set up the interaction with the payment system and other external systems
- Implementation
    - Enter all of the data for menus, availabilities as needed
    - Write drone backend
    - Write mobile/web app backend
- Test
    -

- Drone: The drones should support the needed functionality which may require adding software to the drone itself, depending on the drones chosen.

- Analysis
    - Research drones used in industrial applications
    - Understand the regulatory requirements involved in piloting multiple drones
- Design
    - Develop plan to generate necessary documentation for regulatory requirements
- Implementation
- Test
    -

- Management interface: A Web interface should be developed for the server with the focus providing the ability to manage the business.

- Analysis
- Design
- Implementation
- Test
    -

Have final integration testing performed at the end

4.2 Critical Path Method (CPM) Analysis <10/25 points for section grade>

<Use MS Project to do your CPM analysis – remember to ensure that dependencies are listed (e.g., personnel resources for each task have availability). This analysis should indicate the tasks in the critical path and other threads, their respective durations, early/late start times, early/late finish times, and slack. Note that this may be a lengthy diagram, so it may be worth putting it as an appendix.>

The critical path analysis …

Basic Section 4 Rubric:

An excellent section 4 forms a workable and evolvable schedule of activities that will lead to a successful project and product delivery. This schedule is based on a defensible work breakdown structure (WBS) described in the Gantt chart in subsection 4.1 that lists and organizes the major (quantifiable) elements/components of the software system and the software process activities that act on them. The clusters of work derived from the WBS will be allocated to staff/team members and organized into a timeline or Gantt chart, which in turn, depicts clearly the progression of the planned project from a concurrent activities perspective. Each personnel resource is allocated a scheduled segment of time for their respective tasks and slack is managed in the process. The timeline/Gantt chart connects resources to the work and takes into account the temporal dependencies (i.e., a task may need outputs from a previous task). The formulation of the schedule into a cohesive plan of concurrent tasks based on a systematic software process is the hallmark of an excellent schedule section. The CPM analysis in section 4.2 provides an ordering and timing for the tasks along with charts that depict the network of tasks. An excellent analysis will provide a summary of the analysis with the respective assumptions and rationale.

A good section 4 forms a workable schedule of activities that will lead to a reasonably successful project and product delivery. This schedule is based on a defined work breakdown structure (WBS) that lists and organizes the major elements/components of the software system and the software process activities that act on them. The work derived from the WBS will be allocated to staff/team members and organized into a timeline or Gantt chart depicted in subsection 4.1. This depicts the progression of the planned project activities (based on an algorithmic approach such as critical path). Each resource is allocated a scheduled segment of time for their respective tasks. The timeline/Gantt chart connects resources to the work. The formulation of the schedule into a plan of tasks based on a reasonable software process is the indicator of a good schedule section. The CPM analysis in section 4.2 provides an ordering and timing for the tasks along with charts that depict the network of tasks.

An unsatisfactory section 4 may fall short of one or more of these above elements and probably lacks in clarity and detail necessary to manage the time and staff resources associated with the project.

5 Tracking and Control Mechanisms

5.1 Quality Assurance

The quality assurance for the AirPizza project will ensure that all aspects of the project meet established standards and expectations. This will include regular reviews, inspections, and testing to guarantee that the software, hardware, and drones function correctly and align with the project's objectives. The project team will also be responsible for verifying that all project deliverables meet the defined quality criteria. Any discrepancies or deviations from the established standards will be documented and addressed promptly. This process will help maintain the high quality of the AirPizza system and ensure customer satisfaction.

5.2 Change Management

The change management process will be critical in ensuring that any modifications to the project scope, schedule, or requirements are properly evaluated and controlled. It will involve a formal process for requesting, evaluating, approving, and implementing changes. Change requests will be documented, and their impact on the project's timeline, budget, and resources will be thoroughly assessed. Only approved changes will be implemented to avoid scope creep and ensure the project stays on track. The change management process will help in maintaining project stability and preventing unexpected disruptions.

5.3 Earned Value <worth 3 points extra credit towards your SPMP grade>

< Using the earned value approach presented in class and your work breakdown structure (WBS) calculate the planned value (PV), actual value (AV), and earned value at the present point in the CSSE 371 project. Start with your budget, assume you have completed the first 8 weeks of the project to calculate your PV, AC, EV, SPI, SV, CPI, CV, EAC, and ETC. From these numbers

calculate the schedule variance (SV) and the cost variance (CV). Then calculate the Cost Performance Index (CPI) and describe briefly the good/bad news. Then calculate the Schedule Performance Index (SPI) and describe briefly the good/bad news. Based on these, what is your estimate of the time to completion (ETC) and why? >
It is expected that you will need to be creative about the budget and time expended. My objective is to see if you understand how to use earned value not to generate a contrived exercise here. Each of your projects are different and reflect varied rates of progress and cost. Good luck!>

This section requires the full WBS to complete. Once this is completed, let me (Aidan) know and I will complete this section tomorrow morning. If the WBS is not completed by then, just delete this entry and get rid of section 5.3 entirely.

The Who Done What Table:

Team Member Names	Section/Part Completed	Task/Comments	# of hours effort
Aidan Matthews	1.1, 1.2, 1.3, 2.1	Wrote	3 hours
Gaurav Gajavelli	3.1, 3.2, 3.3	Wrote	3 hours
Aidan Matthews	1, 2, 5.1, 5.2	Wrote/Edited	4 hours