Dog-E-DayCare System

Software Project Plan

CSSE 372

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TEAM E Software Team Members:

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Version of Changes

Version	Date	Comments
1.0	10/26/2022	**Initial Draft with minimal modifications (Includes 1.0)**
1.1	10/27/2022	**Revision for TA Feedback (Includes 1.0-1.4, 2.0-2.1, 3.0-3.2, 4.0, 5.0-5.2; Excludes 2.2-2.3, 3.3, 4.1-4.2, 5.3)**
1.2	11/01/2022	**Revision from TA Feedback (Includes 1.3-1.4, 2.0-2.1, 2.3, 3.1-3.3, 5.0-5.2 edits; Excludes 2.2, 4.1-4.2, 5.3)**
1.3	11/02/2022	**Pre-Final Revision (Includes 2.2, 5.3, Excludes 4.1-4.2)**
1.4	11/03/2022	**Final Revision (Includes 4.1-4.2; All Sections Completed)**

1 Introduction

The goal of this project was to create a software project management plan (SPMP) for the development of the Dog-E-DayCare System (DEDC), a web-based brokerage service for dog owners. DEDC aims to be a one-stop shop for all of a dog's needs, and to build a reputation of top quality service prioritizing their dog's happiness. The client wishes to capitalize on this perceived gap in the market with the DEDC, believing that dog owner's desire a more centralized location for fulfilling their pet's needs. Thus the stakeholders for this project include the client company and the personnel of our team, Team E. Before beginning the project, our team was provided a software requirements specification (SRS) document detailing key requirements, usage, models, and various constraints. From this document, our team constructed an SPMP that covers the project's scope, context, constraints, estimates, risks, schedule, and key tracking & control mechanisms. The SPMP was designed to employ an iterative agile-based approach, as the relatively small $250,000 budget will encourage us to focus on key deliverables in earlier iterations.

This document will first cover the key project goals and objectives to determine the project's success. To help define the project's success, the document firstly covers the key scope and context of the project, along with any major constraints. Next, the SPMP will generate estimates using COCOMO-II and an additional process estimate. Risks will then be calculated and mitigated using a risk table and risk sheets. From there a project schedule will be constructed using Gantt charts with the Critical Path Method, and lastly control and tracking mechanisms will be discussed to ensure that the product meets quality assurance.

1.1 Goals and Objectives

The key goals of DEDC:

- Connect dog owners to dog services in any part of the world.
- Give vendors (contractors) an attractive and lucrative way to reach customers.
- Provide staff an automated web system for an easy way to handle personnel matters and provide a method for handling administration associated with DEDC.
- Deliver as many of the requested features as possible without exceeding the $250,000 budget
- Ensure that the duration of the project does not cause the budget to be exceeded

1.2 Project Scope

In an online environment, DEDC will accept and retain dog and owner information, permit inquiry for service, schedule appointments, and track rendered services as defined by the client.

1.2.1 Major Features and Benefits

The following are the list features obtained from the Dog e-Daycare Statement of Scope provided by the customer.

1.2.1.1 For Dog Owner

F1) Convenient online inquiry and scheduling for any service provided directly by DEDC or through a vendor.

F2) Communication between clients in a real time environment

F3) Online articles of interest to dog owners and access to a wealth of resources designed to help dog owners locate vendors, review vendor ratings, peruse client dogs available as studs, etc.

1.2.1.2 For Employees

F4) Online registration and maintenance of dog and owner information
F5) Tracking of all services ever provided through DEDC.
F6) A staff support area so that staff can oversee the DEDC system and also take care of personnel issues such as time reporting.
F7) Marketing techniques aimed at increasing sales by suggesting other products or services to clients.

1.2.1.3 For Vendors

F8) Vendor registration and payment.
F9) Online customer and vendor billing and payment
F10) Vendors can advertise services across the platform

1.2.2 Additional Enhancements

Below is a list of planned enhancements for the initial implementation of DEDC if additional funding becomes available. These potential enhancements will stem from obtaining new vendors that are offering new services or from enhancements to the brokerage system itself. The enhancements to the system itself are listed below.

- Page where people can locate dog friendly parks and stores.
- Dog toy and treats catalog links.
- Links to pest control services to handle problems like fleas.
- Links to city services for dogs such as Animal Control by location.
- Links to information and documentation on properly licensing dogs as well as links in an area based on zip.
- Public access page where people can search or post dog lost and found information in their area.
- Public access page where people can look for and set up playdates in their area so their pets can play together.
- Travel information for people who are planning on traveling with their pets. Could be links to airline restrictions about pets and /or companies that will ship a pet for you.
- A ‘for sale’ and ‘wanted to buy’ section dedicated to dog related items.
- “Tip of the day” section on dogs.
- Customer humor stories. People can share their pet experiences, funny stories, what tricks worked or didn’t work for them, etc.
- Photo of the day or week. Periodically host contests for cutest dog, ugliest dog, etc. Winner could win a free service
- Email advisory service about missing and found dogs in a person’s zip code.
- Email advisory service that relays city warnings about rabid animals in an area.
- Email reminders when your dog is due for routine care.
- Based on purchase habits, send emails of services that the dog owner might want.

1.3 Context

The DEDC system will be a brokerage service that will provide dog owners with a central online location for them to schedule daycare services and purchase general products for their pets. It will also be an attractive platform for various vendors to reach a greater population, as it will allow them to handle matters on their own or with the support of DEDC administration. The key goal is that all vendors and customers agree that DEDC is the ideal way for them to settle all matters with their canine friends.

As the system will track key payment and identifying information from its users, and so security is of high concern for the project. Additionally it will track all products and services purchased in order to better provide targeted marketing which will further increase commerce on the platform.

To accomplish this, the software will be primarily sectioned into front-end web programming, back-end web programming, and database sections. They will be developed using

1.4 Major Constraints

The Dog e-DayCare Statement of Scope emphasizes convenience and marketability. Key constraints that will heavily influence the DEDC system are described through relevant business constraints, technical constraints, and performance constraints.

1.4.1 Business Constraints

1. The maximum budget provided by our client is $250,000, features are to be dropped or their scope reduced in order to stay under this amount.
2. The product scope is limited to exclusively dog services.

1.4.2 Technical Constraints

1. Data in the database like customer’s address, paymention information, or phone number are private information.
2. Data in the database about vendor information must be managed such that vendors are not put at risk.
3. When data is transferred, 128-bit SSL encryption or TLS encryption must be utilized to ensure data security.
4. Users will need a modern web browser and internet access to be able to utilize the DEDC.
5. Users should have access to a proper GUI for most common screen sizes with consistent systems

1.4.3 Performance Constraints

1.4.3.1 Reliability of System

1. The reliability of the system will be measured by mean-time-between-failure (MTBF). This measurement represents the amount of time between breakdowns of the DEDC.
2. MTBF will be calculated by dividing the mean-time-to-failure (MTTF) by the mean-time-to-repair (MTTR). Where MTTF is the average time before breakdown and MTTR is the time to repair the system.

1.4.3.2 Availability of System

1. The DEDC will have an availability of 99%, with any downtime being scheduled in advance to occur during low usage hours.

2. Availability will be measure by : Availability % = MTTF / MTBF * 100%
3. The MTTF to failure will be six months at minimum

1.4.3.3 Maintainability of System

The maintainability of the system will be calculated using the Maintainability Index (MI). The MI will provide a score, the larger the better, measuring how easy it is to maintain the current code. For more information on MI, the following website can be used as reference.

2 Project Estimates

For the DEDC project, historical data was used to estimate the staffing costs while developing process-based and parametric estimates. A triangulated final effort estimate was obtained. Then hardware and software requirements were assessed for a resource cost estimate for the project.

For the estimation approaches, we will first derive some sample salary data from the internet to form an initial estimate of the employees' salaries. From there, we derived the subsystems to individually estimate from the SRS document's requirements. Using these, we created the process-based estimate by estimating the effort of the 8 distinct tasks and activities for each subsystem. Additionally, we utilized the same subsystems to generate the parametric estimation with COCOMO-II, a tool that generates an estimate based on our system lines of code (SLOC) estimates for the subsystems and other factors including labor hours. Our goal is to compare these estimates in order to determine a final reasonable estimate for the project given the defined scope.

2.1 Historical Data Used for Estimates

The salary information used to calculate estimates was obtained from https://www.indeed.com. Since the information is based on the US national average, the salaries were adjusted for the low cost of living in the Southern Indiana area. Salaries were reduced by 20% (80% of listed) of the average base salary to calculate the yearly compensation. Acknowledging the duty of the service as a resource to connect these dog services with dog owners, the format of a web platform with large data storage capabilities will be necessary. This format then encourages the usage of a database engineer, front-end developer, and back-end developer. Assuming there are no additional needed resources beyond databases and web programming, these three roles provide the skill set to successfully implement this project. In addition, a software project manager was added to manage the three workers and ensure consistent work and alignment with an iterative spiral process.

2.1.1 Descriptions

Job Title & Project Specific Responsibilities	*Job Description*	*Salary (year)*
Back-End Developer Project Responsibilities: 1) Technical Lead 2) Programming Functionality Source: https://www.indeed.com/career/back-end-developer/salaries	"A back end developer is responsible for building and maintaining the back end of a website including the server, application code and database. The back end developer works as a team with clients, front end developers and software engineers to create web applications." [https://www.indeed.com/] The back-end developer will be creating a	**$95,472 * 0.8 = $76,377.60**

Job Title & Project Specific Responsibilities	*Job Description*	*Salary (year)*
	functional web page while connecting the database work of the database engineer with this web page.	
Database Engineer Project Responsibilities: 1) Database Design and Management Source: https://www.indeed.com/career/database-engineer/salaries	"Database developers are computer and technical experts who create, implement and maintain computer databases. They are responsible for understanding their client or company's information collection, retrieval and storage needs and devising a way to store and retrieve data in a way that is safe and accessible." [https://www.indeed.com/]	**$117,527 * 0.8 = $94,021.60**
Front-End Developer Project Responsibilities: 1) UI Design 2) Customer Interaction 3) Communications Source: https://www.indeed.com/career/front-end-developer/salaries	"Front end developers implement the visual and audio elements of a web design and include them in a web format. They build web products and develop user experiences." [https://www.indeed.com/] The front-end developer will be responsible for designing our web page's UI and UX working with the back-end developer to create a functional page.	**$92,870 * 0.8 = $74,296.00**
Software Project Manager Project Responsibilities: 1) Scheduling 2) Project Scope 3) Budget Management 4) Quality Testing as Product Owner Source: https://www.indeed.com/career/software-project-manager/salaries	Identifying parameters, estimating efforts, allocating resources, ensuring communication, quality testing, identifying and limiting scope, leading and guiding team, supervising, delivering product updates, and leading communications with the client. The Software Project Manager will be primarily ensuring the success of the other three members while maintaining the quality and budget limitations of the project.	**$96,436 * 0.8 = $77,148.80**
Average Monthly Rate (No Overhead)		**$26,820.00**
Average Monthly Rate (With Overhead)		**$39,425.40**

For the project, we will be utilizing a Back-End Developer, a Front-End Developer, Software Project Manager and a Database Engineer. The labor rate was calculated for each job from the indeed.com URLs above, and we currently plan to hire them for 5 months. This puts **$134,100.00** of the budget into their salary, and leaves **$115,900.00** for other resources throughout the project if we do not account for overhead and benefits.

The labor rate was averaged using the following equation:

$ / Week = ($76,377.60 + $94,021.60 +$74,296.00 + 77,148.80) * 0.25 / 12 ≈ **$6,705**

This labor rate (i.e. salary) is then multiplied by **147%** to account for overhead, benefits, and the like. Therefore, the burdened labor rate is **$9,856.35**/week. At this rate, the 5 months of budget with overhead totals $197,127.00. Risk contingency costs and project resources necessitates an additional **$39,035.96** of the budget. This totals to **$233,162.96** of the **$250,000** budget. The remaining **$13,837.04** should be allocated to additional resources, employee overboarding, unexpected project resource costs, or additional risk contingency.

2.2 Estimation Techniques Applied and Results

This subsection covers the two estimation techniques used to generate independent results for higher accuracy of the overall estimate. The first estimation method used was a process-based estimation, where it was based around an incremental AGILE based model. We then compared it to the source lines of code (SLOC) estimation using COCOMO-II. Both arrived at a similar time and cost estimation for the project, with COCOMO-II expecting a slightly longer and more expensive project.

2.2.1 Process-Based Estimation

For our software life cycle process, the project will be approached with an AGILE-based incremental process model. Many of the requirements listed below are categorized through priority and by predecessors to understand how each process interacts with one another. Because of the individual actions of our employees, these activities can happen concurrently, and would benefit from tackling within the creation of these categorized tasks through individual systems and merging them together as the builds are completed. This is similarly supported through AGILE with month long iterations to maintain progress through the various builds. Project management is the main life cycle activity, as most other processes are included throughout individual subsystems.

For process-based estimation (Table 1), the system was decomposed into a smaller set of subsystems. The subsystems are as follows:

- Doggie Security (DS)
- Doggie Registration & Maintenance Center (DRMC)
- Vendor Info (VI)
- Vendor Payment Services Selection (VPSS)
- Vendor Client Access (VCA)
- Vendor Peak Search Engine (VPSE)
- Doggie Billing and Payment Center (DBPC)
- Doggie Pay (DP)
- Doggie Track History (DTH)
- Doggie Action Center (DAC)
- Doggie Administration Center (DAdminC)
- Doggie Support Center (DSC)
- Doggie Research Center (DRC)
- Doggie Chat (DC)
- Doggie News (DN)
- Doggie Vendor Look-See (DVLS)
- Doggie Breeding Post (DBP)

Priority (1 - High) (5 - Low)	Activity	Planning	Risk Analysis	Implementation				Cust. Eval.	Internal Review	Totals
	Task →			Analysis / Elicitation	Design	Code	Test (Both Integration & Unit Testing)			
	Subsystem	(in months)								
1	Doggie Security (DS)	0.01	0.06	0.47	0.23	0.23	0.47	0.01	0.01	1.49
1	Doggie Registration & Maintenance Center (DRMC)	0.01	0.02	0.23	0.23	0.47	0.11	0.03	0.01	1.11
1	Vendor Info(VI)	0.05	0.03	0.60	0.60	0.35	0.78	0.05	0.07	2.53
2	Vendor Payment Services Selection(VPSS)	0.08	0.12	0.16	0.14	0.66	0.90	0.03	0.06	2.15
1	Vendor Client Access(VCA)	0.11	0.15	0.45	0.60	0.40	1.22	0.05	0.04	3.02
1	Vendor Peak Search Engine(VPSE)	0.10	0.05	0.78	0.56	0.45	0.59	0.04	0.04	2.61
3	Doggie Billing and Payment Center (DBPC)	0.10	0.05	0.55	0.67	0.80	0.11	0.05	0.06	2.39
2	Doggie Pay (DP)	0.04	0.10	0.70	0.60	0.66	1.20	0.05	0.04	3.39
4	Doggie Track History (DTH)	0.14	0.05	0.50	0.60	0.54	0.90	0.06	0.06	2.85
1	Doggie Action Center (DAC)	0.15	0.40	0.50	0.56	0.68	0.36	0.06	0.10	2.81
1	Doggie Administration Center (DAdminC)	0.12	0.09	0.23	0.50	0.46	0.36	0.06	0.10	1.92
2	Doggie Support Center (DSC)	0.01	0.01	0.15	0.20	0.20	0.10	0.03	0.03	0.73
3	Doggie Research Center (DRC)	0.03	0.02	0.42	0.51	0.42	0.66	0.02	0.02	2.10
5	Doggie Chat (DC)	0.03	0.04	0.27	0.38	0.27	0.60	0.03	0.03	1.65
4	Doggie News (DN)	0.07	0.09	0.75	0.93	0.63	0.87	0.03	0.04	3.41
2	Doggie Vendor Look-See (DVLS)	0.09	0.05	0.72	0.77	0.57	0.96	0.06	0.10	3.32
3	Doggie Breeding Post (DBP)	0.02	0.01	0.12	0.36	0.24	0.42	0.03	0.01	1.21
	Total	1.16	1.34	7.6	8.44	8.03	10.61	0.69	0.82	38.69
	% effort	3.00%	3.46%	19.64%	21.81 %	20.75 %	27.42%	1.78%	2.12%	100%

Table 1- Process-based Estimation Table

Based on the estimated effort for the activities, the estimated effort of the project will be **38.69** person-months. As the project has four members, the project duration would have to be approximately **9.67** months. Combining this with our calculated monthly salary for employees, the personnel cost would be 9.67 * $39,425.40 = **$381,243.62**. Lastly, bringing in the hardware and software costs the project would come to an estimated total cost of **$398,595.62**. Due to these high costs, the project cannot accommodate all features given the current total budget of $250,000.

2.2.2 SLOC-Based COCOMOII Estimation

The following SLOC based estimation used COCOMOII to determine the total cost and duration of the DEDC software project. The SLOC estimates were derived using a consensus of individual estimations by analogy based on former web programming and database projects. Each module was broken down into portions whether it corresponded to front-end or back-end web based programming and databases. From there, TEAM E compared these portions to similar projects to determine the estimated SLOC for it. TEAM E's members then came to a consensus based on our individual estimates for the portion's SLOC to determine the SLOC estimate for the entire project.

Subsystem	Estimated SLOC (Third Generation)	Estimated SLOC (JAVA)	Estimated SLOC (Database)	Total SLOC
Doggie Security (DS)	0	600	0	600
Doggie Registration & Maintenance Center (DRMC)	400	400	400	1200
Vendor Info(VI)	200	300	400	900
Vendor Payment Services Selection(VPSS)	300	700	200	1200
Vendor Client Access(VCA)	300	400	200	900
Vendor Peak Search Engine(VPSE)	300	300	350	950
Doggie Billing & Payment Center (DBPC)	350	750	400	1500
Doggie Pay (DP)	200	600	400	1200
Doggie Track History (DTH)	300	300	200	800
Doggie Action Center (DAC)	350	300	350	1000
Doggie Administration Center (DAdminC)	300	400	200	900
Doggie Support Center (DSC)	200	200	0	400
Doggie Research Center (DRC)	400	300	200	900
Doggie Chat (DC)	200	150	100	450
Doggie News (DN)	200	800	200	1200
Doggie Vendor Look-See (DVLS)	300	400	400	1100
Doggie Breeding Post (DBP)	300	100	100	500
totals	4600	7000	4100	15700

Table 2- SLOC based from Historical Data

Using the above estimates for the SLOC in Table 2, the COCOMO-II model had a module filled for each nonzero entry. Listed below are the factors that were adjusted to reflect the DEDC project circumstances. These factors, known as "**Multipliers**", were adjusted in COCOMO-II for all modules, as we felt each module had equal ratings based on our hiring and constraints.

Multipliers	Rating	Rationale/Assumptions
RCPX	Very High	The overall product complexity in most facets could be considered nominal, except for some subsystems that may require investigation into machine learning. However, the reliability for the product is near 24/7 so we gave a very high rating.
RUSE	Low	No reuse was specified by the client or determined to be necessary so the rating was set to low.
PDIF	Nominal	No time constraints or memory constraints were set or have been discovered so the rating was set to nominal.
PERS	Very High	The short duration of the project and the specialized hires for the project made it comfortable to set the rating to very high.
PREX	Very High	The specialized hires along with the high quality software purchases allowed the rating to be set to very high.
FCIL	High	The high quality software tools along with basic multisite development support made us comfortable setting the rating to high.
USR1,USR2	Nominal	No additional custom parameters were set

From there, a labor rate was estimated for each subsystem type based on the primary language / section of the subsystem. This is because to complement our AGILE based approach, we hired specialists to focus on specific portions of the overall system. Therefore, the monthly labor rate was estimated based on the monthly pay of the associated specialist, with overhead. The specialist will not solely focus on that portion of the overall system, but as they will be doing the majority of the labor we felt it was safe to base the estimate on it.

Project Name: DogEDaycare | Scale Factor: 18.97 | Schedule

Project Notes | Development Model: Early Design

X	Module Name	Module Size	LABOR Rate ($/month)	EAF	Language	NOM Effort DEV	EST Effort DEV	PROD	COST	INST COST	Staff	RISK
	DS-BE	S:600	9356.26	0.74	JAVA	2.3	1.7	351.2	15983.82	26.6	0.1	0.0
	DRMC-UI	S:400	9101.26	0.74	Third Generat	1.5	1.1	351.2	10365.46	25.9	0.1	0.0
	DRMC-BE	S:400	9356.26	0.74	JAVA	1.5	1.1	351.2	10655.88	26.6	0.1	0.0
	DRMC-DB	S:400	11517.65	0.74	Database Defa	1.5	1.1	351.2	13117.49	32.8	0.1	0.0
	VI-UI	S:200	9101.26	0.74	Third Generat	0.8	0.6	351.2	5182.73	25.9	0.0	0.0
	VI-BE	S:300	9356.26	0.74	JAVA	1.2	0.9	351.2	7991.91	26.6	0.1	0.0
	VI-DB	S:400	11517.65	0.74	Database Defa	1.5	1.1	351.2	13117.49	32.8	0.1	0.0
	VPSS-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	VPSS-BE	S:700	9356.26	0.74	JAVA	2.7	2.0	351.2	18647.79	26.6	0.2	0.0
	VPSS-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	VCA-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	VCA-BE	S:400	9356.26	0.74	JAVA	1.5	1.1	351.2	10655.88	26.6	0.1	0.0
	VCA-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	VPSE-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	VPSE-BE	S:300	9356.26	0.74	JAVA	1.2	0.9	351.2	7991.91	26.6	0.1	0.0
	VPSE-DB	S:350	11517.65	0.74	Database Defa	1.4	1.0	351.2	11477.81	32.8	0.1	0.0
	DBPC-UI	S:350	9101.26	0.74	Third Generat	1.4	1.0	351.2	9069.78	25.9	0.1	0.0
	DBPC-BE	S:750	9356.26	0.74	JAVA	2.9	2.1	351.2	19979.77	26.6	0.2	0.0
	DBPC-DB	S:400	11517.65	0.74	Database Defa	1.5	1.1	351.2	13117.49	32.8	0.1	0.0
	DP-UI	S:200	9101.26	0.74	Third Generat	0.8	0.6	351.2	5182.73	25.9	0.0	0.0
	DP-BE	S:600	9356.26	0.74	JAVA	2.3	1.7	351.2	15983.82	26.6	0.1	0.0
	DP-DB	S:400	11517.65	0.74	Database Defa	1.5	1.1	351.2	13117.49	32.8	0.1	0.0
	DTH-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	DTH-BE	S:300	9356.26	0.74	JAVA	1.2	0.9	351.2	7991.91	26.6	0.1	0.0
	DTH-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	DAC-UI	S:350	9101.26	0.74	Third Generat	1.4	1.0	351.2	9069.78	25.9	0.1	0.0
	DAC-BE	S:300	9356.26	0.74	JAVA	1.2	0.9	351.2	7991.91	26.6	0.1	0.0
	DAC-DB	S:350	11517.65	0.74	Database Defa	1.4	1.0	351.2	11477.81	32.8	0.1	0.0
	DAdminC-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	DAdminC-BE	S:400	9356.26	0.74	JAVA	1.5	1.1	351.2	10655.88	26.6	0.1	0.0
	DAdminC-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	DSC-UI	S:200	9101.26	0.74	Third Generat	0.8	0.6	351.2	5182.73	25.9	0.0	0.0
	DSC-BE	S:200	9356.26	0.74	JAVA	0.8	0.6	351.2	5327.94	26.6	0.0	0.0
	DRC-UI	S:400	9101.26	0.74	Third Generat	1.5	1.1	351.2	10365.46	25.9	0.1	0.0
	DRC-BE	S:300	9356.26	0.74	JAVA	1.2	0.9	351.2	7991.91	26.6	0.1	0.0
	DRC-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	DC-UI	S:200	9101.26	0.74	Third Generat	0.8	0.6	351.2	5182.73	25.9	0.0	0.0
	DC-BE	S:150	9356.26	0.74	JAVA	0.6	0.4	351.2	3995.95	26.6	0.0	0.0
	DC-DB	S:100	11517.65	0.74	Database Defa	0.4	0.3	351.2	3279.37	32.8	0.0	0.0
	DN-UI	S:200	9101.26	0.74	Third Generat	0.8	0.6	351.2	5182.73	25.9	0.0	0.0
	DN-BE	S:800	9356.26	0.74	JAVA	3.1	2.3	351.2	21311.76	26.6	0.2	0.0
	DN-DB	S:200	11517.65	0.74	Database Defa	0.8	0.6	351.2	6558.75	32.8	0.0	0.0
	DVLS-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	DVLS-BE	S:400	9356.26	0.74	JAVA	1.5	1.1	351.2	10655.88	26.6	0.1	0.0
	DVLS-DB	S:400	11517.65	0.74	Database Defa	1.5	1.1	351.2	13117.49	32.8	0.1	0.0
	DBP-UI	S:300	9101.26	0.74	Third Generat	1.2	0.9	351.2	7774.09	25.9	0.1	0.0
	DBP-BE	S:100	9356.26	0.74	JAVA	0.4	0.3	351.2	2663.97	26.6	0.0	0.0
	DBP-DB	S:100	11517.65	0.74	Database Defa	0.4	0.3	351.2	3279.37	32.8	0.0	0.0

	Estimated	Effort	Sched	PROD	COST	INST	Staff	RISK
Total Lines of Code: 15700	Optimistic	30.0	10.8	524.2	294890.44	18.8	2.8	
Hours/PM: 152.00	Most Likely	44.7	12.3	351.2	440134.98	28.0	3.6	0.0
	Pessimistic	67.1	14.0	234.1	660202.47	42.1	4.8	

Using COCOMOII we came up with an optimistic result of 30.0 person-months at a cost of $294,890.44 or most likely **44.7** person-months at a cost of **$440,134.98** to complete DEDC. Since we have a team of 4 project members, continuing with the most likely estimate, we will have a project duration of approximately 11.2 months. Adding in software and hardware costs, the approximate cost for a fully completed system would be **$457,486.98.** This estimate is again over the $250,000 total budget.

2.2.3 Triangulate Process-Based and COCOMOII for Final Estimates

The process based estimate for the total cost was **$398,595.62,** and the COCOMO-II estimate was **$457,486.98**. This places the estimates roughly 15% apart, at a difference of **$58,891.36**. We believe these estimates are reasonably close and thus recommend using an average of the two for our final estimate. This places the final project estimate at **$428,041.30**, which is again over our initial **$250,000** initial budget, therefore certain features will need to be prioritized to deliver a DEDC system with some functionality within the budget.

2.3 Project Resources

Project resource costs of minimal hardware and software requirements total $15,645. This is broken down below.

2.3.1 People

Two developers and an engineer will be needed to develop the system, a Front-End Developer, a Back-End Developer, and a Database Engineer. They will all have several years of experience to ensure the small team runs smoothly. A Software Project Manager will act as the project lead, as they will be handling the primary key functional requirements, conforming to the agile process, and will need to direct the three developers/engineers as needed for support.

2.3.2 Minimal Hardware Requirements

The project will be leveraging HP Enterprise hardware infrastructure such as desktop computers and web servers. The minimum total cost for hardware will be approximately $15,600. The breakdown is below.

2.3.2.1 WorkStation Server

A server will be needed to house the code and serve the web content for the DeDC system. The server will be optimized to handle high traffic. The server chosen delivers big data and cloud storage functionality for web services.

8 HPE Cloudline CL2200 G3 Servers, each with the following configurations:

- Intel Xeon Scalable 6200 series processors
- 4x 1GbE embedded NIC, 10GbE SFP+ NIC
- 16 DDR4 DIMM slots.

Estimated $5,600

2.3.2.2 Business Computers

Operations will need to be performed on work computers. The workers will be provided with HP ENVY All-in-One PCs to perform their actions.

4 HP ENVY All-in-One PCs, each with the following configurations:

- Windows 11 Home
- Intel Core i&
- 16GB RAM
- 1TB SSD
- NVIDIA GeForce RTX 3060

Estimated $10,000

2.3.3 Minimal Software Requirements

The project will be utilizing a combination of cheap or free software for simple general tasks, more expensive high quality software for each project team member's specialty. The total costs for the software will be approximately **$**1,752**.**

2.3.3.1 Development

- Firefox 106.0.3 (free)
- Visual Studio Code (free)
- Intellij IDEA ($599 for the duration of the project)
- SQL Server and License ($1108 for the duration of the project)
- Slack Business+ software ($15 for the duration of the project)
- Microsoft Office 365 basic ($30 for the duration of the project)

On the workstation server, some additional software will be needed to ensure system functionality, availability, maintainability, and reliability.

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 risk. Risks commonly lie within the range of our human resources and concerns regarding the frequent sprints through the Agile process.

The risk project contingency cost is $8,870.72 (RS1) + $985.64 (RS2) + $3,942.54 (RS3) + $7,885.08 (RS4) = $21,683.98

3.1 Risk Categorization

3.1.1 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 the budget will be maintained for the project.
3. **Support Risks:**
   This risk concerns whether the end product will be easy to maintain.
4. **Schedule Risk:**
   This risk concerns whether the project schedule will be maintained and the deadline met.
5. **Process Risk:**
   This risk concerns whether scope creep can impact a project due to unknowns.
6. **Compliance Risk:**
   This risk concerns whether the project conforms to government or business regulations.
7. **External Risk:**
   This risk concerns whether external sources such as business competitors or external world events can affect the project's progress.

3.2 Risk Table

The following table lists the top 10 risks associated with DEDC, with each being categorized with its probability of occurrence (P) and impact (I) on project and sorted by its risk value (RV = P*I).

Risk	Category	Description	Assumption	Impact	Probability	Risk value
Software Unfamiliarity	Performance Risk	Employees must learn a new unfamiliar platform to complete their work.	When hiring people, we will be hiring domain experts on the system type, whether it be databases or something else. This doesn't guarantee the employee will know the language(s) chosen for their system in the project, but they should be able to learn quickly.	1	60%	0.6
Capabilities & Features (RS1)	Performance Risk	With set effort schedules, some capabilities and features may need cut to meet deadlines and prioritize features	Due to our brief total development time, it's quite likely that we will not have the time to implement one or more desired features. However, the AGILE based approach should ensure key features are implemented first.	2	60%	1.2

Training Costs (RS2)	Cost Risk	Employees may need additional training which has not yet been accommodated in the budget.	It's possible that the employees are not familiar with our development environment and tools. Training tools may need to be purchased to familiarize them.	3	50%	1.5
Upkeep Costs	Cost Risk	Networking, web, or database systems may bring out-of-scope maintenance costs	Project may spend extra money on paid membership for some development tools like the enterprise edition of a cloud database. But we assume this expense shouldn't be too big.	2	40%	0.8
Limited Budget (RS3)	Cost Risk	There is a very limiting budget for this project, leaving little room for error and little flexibility to hire many developers and team members.	Budget is restricted to $250,000	4	95%	3.8
Changing Web Programming Requirements	Support Risk	The website and frameworks may be outdated and require updates in a few years to manage standards	The development tools may not support some function/syntax we used during development in a few years due to their frequent update.	1	90%	0.9
Project Process Delays (RS4)	Schedule Risk	Any delays that come from specialized program solutions which do not benefit from the schedule	Project team cannot meet the schedule every single time, likely from other risks occurring.	2	60%	1.2
Underdeveloped Requirements and Features (RS5)	Process Risk	Difficulty in implementing the limited scope of features and whether all software requirements are met.	Assuming the team only have limited time for developing and completing the system based on the assigned budget.	3	40%	1.2
Data Management	Compliance Risk	Additional security testing needed to ensure confidentiality of user information. Specifically using 128-bit SSL encryption or TLS encryption on data passage.	Assuming encryption and data protection laws apply to our project due to managing financial transactions and personal information.	3	30%	0.9

Competition	External Risk	Value of the project may drop when additional projects completed impact the necessity for our project	There are some similar purpose projects going on at the same time as the team is developing the product.	1	30%	0.3

Table 3- Risk Analysis Table

Impact Values	Description
4	Catastrophic - Risk holds monumental consequences resulting in the failure of the product, business, or a loss of life. Project completely ends and holds a large impact beyond the project's scope.
3	Critical - Risk holds potential for the project to delay or collapse and impact the progress of the business. Can include project failure or inability to capitalize on time-sensitive business opportunities.
2	Marginal - Risk impacts the overall quality or scheduling of the project. Project is not at risk of failure, but significant delays or loss of features.
1	Negligible- Risk may need to be reviewed and accommodated, but its impact is not expected to impact the progress of the project.

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

From the Risk table above, the project has developed Risk Information Sheets for the risk with a risk value of greater than 1. The other risks were deemed less than the cost of risk mitigation, therefore mitigating the risk is not warranted. Risks with a value of 1 or less will be monitored and if their risk value becomes greater than 1, the project will develop a Risk Information Sheet.

3.3.1 Risk Information Sheet for RS1 …

Risk ID: RS1	**Date: 10/26/22**	**Prob: 60%**	**Impact: Marginal**	**Risk Value: 1.2**

Description:

With set effort schedules, some capabilities and features may need cut to meet deadlines and prioritize features

Refinement/context

Subcondition 1: Short timeline for this project may force discussions of removing some anticipated features for the software.
Subcondition 2: Delays in the project occur or not all features are able to be planned on a timeline.

Mitigation/Monitoring

1) Features are prioritized by importance earlier.
2) Weekly review of progress on software to identify timeline delays and the potential for this risk.

Management/Contingency Plan/Trigger

If our ability to satisfy the client needs cannot be reasonably met, re-evaluate the feature prioritization with the client. Ensure the client can have input on what features must be included and what is capable of the team with the time left. Revisit updated plan after some time (2 days) to ensure success is still viable.

The risk exposure cost is approximately $6000 (RE= 60% * 10000). $10000 is the estimated cost to the team from failure to meet all needs of the client. Allocate this amount into project contingency costs.

Alternatively, overtime opportunities from the employees could allow more features to be satisfied, if this is a necessity to deliver a functional project. This exposure cost is approximately $2,217.68 (RE = 60% * (9856.35 * 1.5 / 4)). This is the cost from 10 hours of overtime per week for each employee as a maximum investment. Four times this amount should be allocated to the project contingency cost to account for overtime throughout four weeks of the project - though not all is expected to be used.

3.3.2 Risk Information Sheet for RS2 …

Risk ID: RS2 Date: 10/26/22 Prob: 50% Impact: Critical Risk Value: 1.5

Description:

- Inexperinced or hired employees may necessitate training which has not yet been accommodated in the budget.

Refinement/context

Subcondition 1: Employees are new to the company
Subcondition 2: Employees will be using software not previously worked with or with unfamiliarity
Subcondition 3: Software or tools have been updated to incorporate new features which should be assessed for utility in our software.

Mitigation/Monitoring

1) Onboarding processes should be supported and prioritized for employees
2) Initial meeting between team at beginning of project to assess the tools, identify path of least resistance software/development-wise, and identify sources of concerns among the employees so they can be addressed.

Management/Contingency Plan/Trigger

If a strenuous amount of personal development is necessary to address inexperience using some softwares, the Software Project Manager should focus time for the inexperienced individual to train themselves in the software. The Software Project Manager should also guide the other individuals to work on sections of the software independently of the individual getting trained - do the work that can be done without the individual. If necessary, overtime will be allocated to resolve this training, though the risk should be resolved through manipulation of the schedule.

The risk exposure cost is approximately $985.64 (RE = 50% * ($9,856.35 * 4 / 40)). This is the cost of 4 hours of overtime for training as necessary for 3 employees. It is not expected that all three employees will need this training, so this maximum risk exposure cost should be allocated to the project contingency cost.

3.3.3 Risk Information Sheet for RS3 …

Risk ID: RS3 Date: 11/02/22 Prob: 75% Impact: Catastrophic Risk Value: 3.8

Description:

There is a very limiting budget for this project, leaving little room for error and little flexibility to hire many developers and team members.

Refinement/context

Subcondition 1: Budget allocated towards risk contingency is expended.
Subcondition 2: Schedule is delayed beyond buffers and budget capabilities (5.4 months)
Subcondition 3: Additional requirements and tasks as the project continues

Mitigation/Monitoring

1) Monitor task progress and risk assessments
2) Maintain risk mitigation plans
3) Ensure communication with the client to confirm workload

Management/Contingency Plan/Trigger

1. At the point of project quality decline and when budget has been expended to a point limiting capabilities, communications with the customer is necessary to identify the minimal viable product possible and actively pursue to deliver the minimal viable product. Because of the overarching realm of possibilities for this risk to trigger, no balance has been appended to the project contingency cost. There are anticipated losses of profit from the client based around our payment for the project.
2. At the point of imminent project failure and expended budget, the software project manager may be relocated to another department within our company, and we maintain the agile process and team management through our back-end developer. This will save around $9,450.63 per month that the software project manager is not included in the project. No balance is appended to the project contingency cost for this risk.

3.3.4 Risk Information Sheet for RS4 …

Risk ID: RS4	**Date: 10/26/22**	**Prob: 60%**	**Impact: Marginal**	**Risk Value: 1.2**

Description:

Any delays that come from specialized program solutions which do not benefit from the schedule

Refinement/context

Subcondition 1: From the natural acknowledgement that some tasks are larger than others, Agile prevents these tasks from succeeding effectively.
Subcondition 2: A task is not completed within a sprint, yet progress has been made on it.
Subcondition 3: Tasks, when assessed for conformity with our planned software, necessitates a unique software or newly designed solution.

Mitigation/Monitoring

1) Look to break down tasks to consumable jobs that can be completed within a sprint.
2) Maintain frequent brainstorming sessions to identify options for solutions of tasks.

Management/Contingency Plan/Trigger

1. Delay the schedule to the limit that buffer still allows. This has no risk exposure cost as the buffer is available preemptively.
2. If tasks are unable to be provided for the client within the deadline due to missed sprints, ask the client to extend the final product delivery date. This risk exposure cost is $3,942.54 (RE = 40% * $9856.35) representing the cost of overhead labor per week as a result of delayed schedule. Allocate twice this amount to the project contingency cost.

3.3.5 Risk Information Sheet for RS5 …

Risk ID: RS5 Date: 10/26/22 Prob: 40% Impact: Critical Risk Value: 1.2
Description:
Difficulty in implementing the limited scope of features and whether all software requirements are met.
Refinement/context
Subcondition 1: Since the team only has 4 people and 5 months to develop the whole project. The team may meet unexpected technical difficulties which could hinder the schedule significantly, also its possible in the early stage for reasons like bad choice of development tool like database to cause the team fails to implement a certain feature derived from clients' need. Subcondition 2: Since we don't have a professional software requirement engineer in our team, the initial requirements and features derived from our client's needs might not be thorough. Due to the same reason, some requirements may be neglected or assumed to be satisfied but actually not during the development. Subcondition 3: Team's lower-than-expected productivity could also affect the progress of implementing the features and requirements.
Mitigation/Monitoring
1) During the training stage of the project, provide some requirement engineering review for the front-end developer. And make sure he have enough knowledge in this area before actually deriving requirement and feature from client's need 2) Research thoroughly when choosing the developing language or environment. Make sure the selected language/ database is capable of implementing all the features. 3) Include a review section for requirement and feature at the end of every sprint.
Management/Contingency Plan/Trigger
Trigger: chosen language or database doesn't support implementing a feature Contingency Plan: Can use another language or database for the purpose of just implementing this feature. The risk exposure cost was negligible despite some slight time delays. Features may potentially be removed or project steers in another language maintaining the same project plan. Trigger: Unmet Requirement found in any stage of the development: Contingency plan: postpone the schedule and implement the requirement or cut the requirement/feature off. The risk exposure cost is $3,942.54 (RE = 40% * $9856.35) representing the cost of overhead labor per week as a result of delayed schedule. Allocate twice this amount to the project contingency cost.

4 Project Schedule

The project schedule described in this section provides the basis for deliverable dates and expected resources to be available. Cross Life Cycle Activities (CLC) include project management, planning, analysis/elicitation, and customer evaluation. Agile assessment meetings will look to maintain these iterations of one month. Tasks were categorized through predecessors and prioritized by importance and necessity to a potential minimal viable product. This minimal product is represented through the pessimistic scheduling, while the product with all enhancements and requirements identified is represented through the optimistic scheduling.

Tasks were divided by the 17 existing requirements (as found in Section 2.2), where planning, risk analysis, analysis/elicitation, design, code, integration testing, unit-based testing, customer evaluation, and internal review were made into these nine sections. There was an additional isolated, cross-life-cycle This work breakdown was created through Microsoft Project to recognize start and end points, which the optimistic and pessimistic scheduling was a guess based around one month iterations and predecessors. The project is estimated to begin November 3rd, 2022 and should last up to the budget capabilities of 5.4 months - though scheduling went until March 6th, 2023. The Gantt Chart timeline and CPM has a scheduling estimate beyond this 5.4 month capability - ending July 7th, 2023.

Optimistic Scheduling

Priority (1 - High) (5 - Low)	**Activity** Subsystem	**Notes**	**Predecessors**
Iteration 1: November 3rd, 2022 - December 2nd, 2022			
1	Doggie Security (DS)		N/A
1	Doggie Registration & Maintenance Center (DRMC)		DS
1	Vendor Info(VI)		DS
Iteration 2: December 3rd, 2022 - January 2nd, 2023			
2	Vendor Payment Services Selection(VPSS)		DRMC
1	Vendor Client Access(VCA)		DRMC, VI
1	Vendor Peak Search Engine(VPSE)		DRMC
3	Doggie Billing and Payment Center (DBPC)		DRMC, VI
1	Doggie Action Center (DAC)		DRMC, VI
Iteration 3: January 3rd, 2023 - February 2nd, 2023			
2	Doggie Pay (DP)		DBPC
4	Doggie Track History (DTH)	This is a Stretch Goal and could be removed from the schedule if necessary	DBPC
2	Doggie Support Center (DSC)		DS
3	Doggie Research Center (DRC)	This is a Stretch Goal and could be removed from the schedule if necessary	DS
Iteration 4: February 3rd, 2023 - March 5th, 2023			

5	Doggie Chat (DC)	This is a Stretch Goal and could be removed from the schedule if necessary	DRC
4	Doggie News (DN)	This is a Stretch Goal and could be removed from the schedule if necessary	DRC
2	Doggie Vendor Look-See (DVLS)	This is a Stretch Goal and could be removed from the schedule if necessary	DRC
3	Doggie Breeding Post (DBP)	This is a Stretch Goal and could be removed from the schedule if necessary	DRC
Iteration 5: March 6th, 2023 - April 5th, 2023			
1	Doggie Administration Center (DAdminC)	This should be completed to the ability of what predecessors were completed. It is a critical system and will end the project after 38.69 person-months.	DTH, DN,DBPC, DRC, VCA

Pessimistic Scheduling

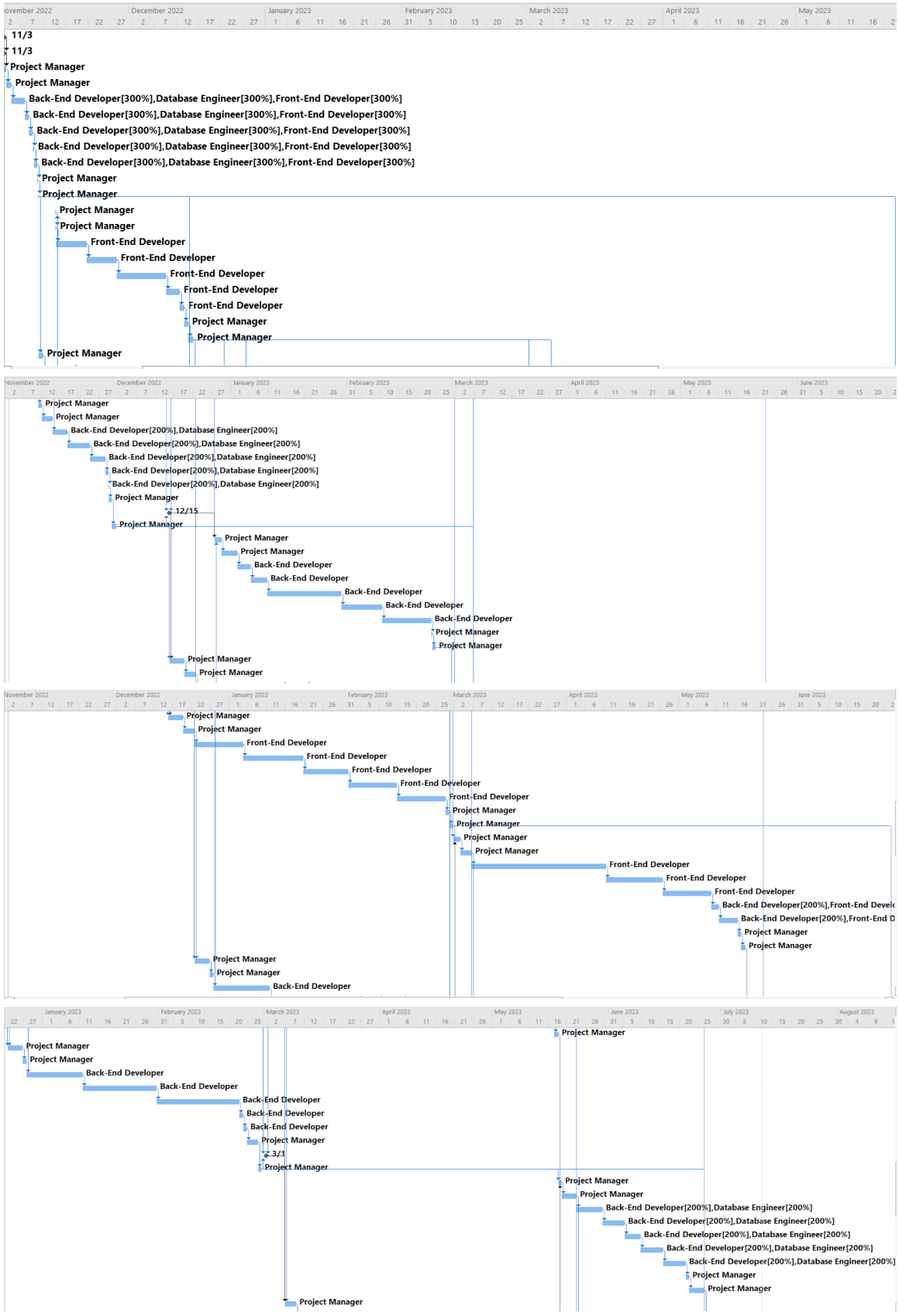
Priority (1 - High) (5 - Low)	**Activity** Task →	**Notes**	**Predecessors**
	Subsystem		
Iteration 1: November 3rd, 2022 - December 2nd, 2022			
1	Doggie Security (DS)		N/A
1	Doggie Registration & Maintenance Center (DRMC)		DS
1	Vendor Info(VI)		DS
Iteration 2: December 3rd, 2022 - January 2nd, 2023			
2	Vendor Payment Services Selection(VPSS)		DRMC
1	Vendor Client Access(VCA)		DRMC, VI
3	Doggie Billing and Payment Center (DBPC)		DRMC, VI
Iteration 3: January 3rd, 2023 - February 2nd, 2023			
1	Doggie Action Center (DAC)		DRMC, VI
1	Vendor Peak Search Engine(VPSE)		DRMC
Iteration 4: February 3rd, 2023 - March 5th, 2023			
2	Doggie Pay (DP)		DBPC
2	Doggie Support Center (DSC)		DS
Iteration 5: March 6th, 2023 - April 5th, 2023			
1	Doggie Administration Center (DAdminC)	This should be completed to the ability of what predecessors were completed. It is a critical system and will end the project after 20.76 person-months.	DBPC, VCA

4.1 Project Gantt Chart

The Gantt Chart representing the timeline relevant to work that can possibly be done within the budget constraints was derived from a project task table based on prioritized features for the DEDC. The chart displays the duration of the tasks, along with the resources/personnel assigned to them, assuming tasks start as soon as their predecessor(s) finish. Below is the task table used to generate the chart and the chart itself.

1	Project Start	0 mons	Thu 11/3/22	Thu 11/3/22		
2	Iteration 1	0 mons	Thu 11/3/22	Thu 11/3/22	1	
3	DS-Planning	0.01 mons	Thu 11/3/22	Thu 11/3/22	2	Project Manager
4	DS-Risk Analysis	0.06 mons	Thu 11/3/22	Fri 11/4/22	3	Project Manager
5	DS-Analysis/Elicitation	0.07 mons	Fri 11/4/22	Mon 11/7/22	4	Back-End Developer[300%],Database Engineer[300%],Front-End Developer[300%]
6	DS-Design	0.03 mons	Mon 11/7/22	Tue 11/8/22	5	Back-End Developer[300%],Database Engineer[300%],Front-End Developer[300%]
7	DS-Code	0.03 mons	Tue 11/8/22	Wed 11/9/22	6	Back-End Developer[300%],Database Engineer[300%],Front-End Developer[300%]
8	DS-Unit Test	0.03 mons	Wed 11/9/22	Wed 11/9/22	7	Back-End Developer[300%],Database Engineer[300%],Front-End Developer[300%]
9	DS-Integration Test	0.03 mons	Wed 11/9/22	Thu 11/10/22	8	Back-End Developer[300%],Database Engineer[300%],Front-End Developer[300%]
10	DS-CustEval	0.01 mons	Thu 11/10/22	Thu 11/10/22	9	Project Manager
11	DS-Internal Review	0.01 mons	Thu 11/10/22	Thu 11/10/22	10	Project Manager
12	DRMC-Planning	0.01 mons	Mon 11/14/22	Mon 11/14/22	22	Project Manager
13	DRMC-Risk Analysis	0.02 mons	Mon 11/14/22	Mon 11/14/22	12	Project Manager
14	DRMC-Analysis/Elicitatic	0.23 mons	Mon 11/14/22	Mon 11/21/22	13	Front-End Developer
15	DRMC-Design	0.23 mons	Mon 11/21/22	Mon 11/28/22	14	Front-End Developer
16	DRMC-Code	0.47 mons	Mon 11/28/22	Fri 12/9/22	15	Front-End Developer
17	DRMC-Unit Test	0.06 mons	Fri 12/9/22	Mon 12/12/22	16	Front-End Developer
18	DRMC-Integration Test	0.05 mons	Mon 12/12/22	Tue 12/13/22	17	Front-End Developer
19	DRMC-CustEval	0.03 mons	Tue 12/13/22	Wed 12/14/22	18	Project Manager
20	DRMC-Internal Review	0.07 mons	Wed 12/14/22	Thu 12/15/22	19	Project Manager
21	VI--Planning	0.05 mons	Thu 11/10/22	Fri 11/11/22	11	Project Manager
22	VI-Risk Analysis	0.03 mons	Fri 11/11/22	Mon 11/14/22	21	Project Manager
23	VI--Analysis/Elicitation	0.2 mons	Mon 11/14/22	Fri 11/18/22	22	Back-End Developer[200%],Database Engineer[200%]
24	VI-Design	0.2 mons	Fri 11/18/22	Thu 11/24/22	23	Back-End Developer[200%],Database Engineer[200%]
25	VI-Code	0.12 mons	Thu 11/24/22	Mon 11/28/22	24	Back-End Developer[200%],Database Engineer[200%]
26	VI-Unit Test	0.02 mons	Mon 11/28/22	Tue 11/29/22	25	Back-End Developer[200%],Database Engineer[200%]
27	VI-Integration Test	0.02 mons	Tue 11/29/22	Tue 11/29/22	26	Back-End Developer[200%],Database Engineer[200%]
28	VI-CustEval	0.03 mons	Tue 11/29/22	Wed 11/30/22	27	Project Manager
29	Iteration 2	0 days	Thu 12/15/22	Thu 12/15/22	20,11,30	
30	VI-Internal Review	0.06 mons	Wed 11/30/22	Thu 12/1/22	28	Project Manager
31	VPSS-Planning	0.08 mons	Tue 12/27/22	Thu 12/29/22	20,29,59	Project Manager
32	VPSS-Risk Analysis	0.12 mons	Thu 12/29/22	Mon 1/2/23	31	Project Manager
33	VPSS-Analysis/Elicitatior	0.16 mons	Mon 1/2/23	Fri 1/6/23	32	Back-End Developer
34	VPSS-Design	0.14 mons	Fri 1/6/23	Tue 1/10/23	33	Back-End Developer
35	VPSS-Code	0.66 mons	Tue 1/10/23	Mon 1/30/23	34	Back-End Developer
36	VPSS-Unit Test	0.45 mons	Mon 1/30/23	Fri 2/10/23	35	Back-End Developer
37	VPSS-Integration Test	0.45 mons	Fri 2/10/23	Thu 2/23/23	36	Back-End Developer
38	VPSS-CustEval	0.03 mons	Thu 2/23/23	Thu 2/23/23	37	Project Manager
39	VPSS-Internal Review	0.04 mons	Thu 2/23/23	Fri 2/24/23	38	Project Manager
40	VCA-Planning	0.11 mons	Thu 12/15/22	Mon 12/19/22	20,30,29	Project Manager
41	VCA-Risk Analysis	0.15 mons	Mon 12/19/22	Thu 12/22/22	40	Project Manager

41		VCA-Risk Analysis	0.15 mons	Mon 12/19/22	Thu 12/22/22	40	Project Manager
42		VCA-Analysis/Elicitation	0.45 mons	Thu 12/22/22	Wed 1/4/23	41	Front-End Developer
43		VCA-Design	0.6 mons	Wed 1/4/23	Fri 1/20/23	42	Front-End Developer
44		VCA-Code	0.4 mons	Fri 1/20/23	Wed 2/1/23	43	Front-End Developer
45		VCA-Unit Test	0.45 mons	Wed 2/1/23	Tue 2/14/23	44	Front-End Developer
46		VCA-Integration Test	0.45 mons	Tue 2/14/23	Mon 2/27/23	45	Front-End Developer
47		VCA-CustEval	0.05 mons	Mon 2/27/23	Tue 2/28/23	46	Project Manager
48		VCA-Internal Review	0.04 mons	Tue 2/28/23	Wed 3/1/23	47	Project Manager
49		VPSE-Planning	0.1 mons	Wed 3/1/23	Fri 3/3/23	20,66	Project Manager
50		VPSE-Risk Analysis	0.05 mons	Fri 3/3/23	Mon 3/6/23	49	Project Manager
51		VPSE-Analysis/Elicitation	1.28 mons	Mon 3/6/23	Tue 4/11/23	50	Front-End Developer
52		VPSE-Design	0.56 mons	Tue 4/11/23	Wed 4/26/23	51	Front-End Developer
53		VPSE-Code	0.45 mons	Wed 4/26/23	Tue 5/9/23	52	Front-End Developer
54		VPSE-Unit Test	0.1 mons	Tue 5/9/23	Thu 5/11/23	53	Back-End Developer[200%],Front-End Developer[200%]
55		VPSE-Integration Test	0.16 mons	Thu 5/11/23	Tue 5/16/23	54	Back-End Developer[200%],Front-End Developer[200%]
56		VPSE-CustEval	0.04 mons	Tue 5/16/23	Wed 5/17/23	55	Project Manager
57		VPSE-Internal Review	0.06 mons	Wed 5/17/23	Thu 5/18/23	56	Project Manager
58		DBPC-Planning	0.1 mons	Thu 12/22/22	Mon 12/26/22	20,30,29,41	Project Manager
59		DBPC-Risk Analysis	0.05 mons	Mon 12/26/22	Tue 12/27/22	58	Project Manager
60		DBPC-Analysis/Elicitatio	0.55 mons	Tue 12/27/22	Wed 1/11/23	59	Back-End Developer
61		DBPC-Design	0.67 mons	Wed 1/11/23	Tue 1/31/23	60	Back-End Developer
61		DBPC-Design	0.67 mons	Wed 1/11/23	Tue 1/31/23	60	Back-End Developer
62		DBPC-Code	0.8 mons	Tue 1/31/23	Wed 2/22/23	61	Back-End Developer
63		DBPC-Unit Test	0.06 mons	Wed 2/22/23	Thu 2/23/23	62	Back-End Developer
64		DBPC-Integration Test	0.05 mons	Thu 2/23/23	Fri 2/24/23	63	Back-End Developer
65		DBPC-CustEval	0.05 mons	Fri 2/24/23	Mon 2/27/23	64	Project Manager
66		Iteration 3	0 days	Wed 3/1/23	Wed 3/1/23	67,48,39	
67		DBPC-Internal Review	0.04 mons	Mon 2/27/23	Tue 2/28/23	65	Project Manager
68		DP-Planning	0.04 mons	Thu 5/18/23	Fri 5/19/23	67,85	Project Manager
69		DP-Risk Analysis	0.1 mons	Fri 5/19/23	Tue 5/23/23	68	Project Manager
70		DP-Analysis/Elicitation	0.23 mons	Tue 5/23/23	Tue 5/30/23	69	Back-End Developer[200%],Database Engineer[200%]
71		DP-Design	0.2 mons	Tue 5/30/23	Mon 6/5/23	70	Back-End Developer[200%],Database Engineer[200%]
72		DP-Code	0.22 mons	Mon 6/5/23	Fri 6/9/23	71	Back-End Developer[200%],Database Engineer[200%]
73		DP-Unit Test	0.2 mons	Fri 6/9/23	Thu 6/15/23	72	Back-End Developer[200%],Database Engineer[200%]
74		DP-Integration Test	0.2 mons	Thu 6/15/23	Wed 6/21/23	73	Back-End Developer[200%],Database Engineer[200%]
75		DP-CustEval	0.05 mons	Wed 6/21/23	Thu 6/22/23	74	Project Manager
76		DP-Internal Review	0.1 mons	Thu 6/22/23	Mon 6/26/23	75	Project Manager
77		DAC-Planning	0.15 mons	Mon 3/6/23	Thu 3/9/23	20,30,66,50	Project Manager
78		DAC-Risk Analysis	0.4 mons	Thu 3/9/23	Tue 3/21/23	77	Project Manager
79		DAC-Analysis/Elicitation	0.17 mons	Tue 3/21/23	Mon 3/27/23	78	Back-End Developer[200%],Database Engineer[200%]
80		DAC-Design	0.19 mons	Mon 3/27/23	Thu 3/30/23	79	Back-End Developer[200%],Database Engineer[200%]
81		DAC-Code	0.23 mons	Thu 3/30/23	Thu 4/6/23	80	Back-End Developer[200%],Database Engineer[200%]
81		DAC-Code	0.23 mons	Thu 3/30/23	Thu 4/6/23	80	Back-End Developer[200%],Database Engineer[200%]
82		DAC-Unit Test	0.18 mons	Thu 4/6/23	Tue 4/11/23	81	Database Engineer
83		DAC-Integration Test	0.18 mons	Tue 4/11/23	Mon 4/17/23	82	Database Engineer
84		DAC-CustEval	0.06 mons	Mon 4/17/23	Tue 4/18/23	83	Project Manager
85		Iteration 4	0 days	Thu 5/18/23	Thu 5/18/23	86,57	
86		DAC-Internal Review	0.1 mons	Tue 4/18/23	Thu 4/20/23	84	Project Manager
87		DAdminC-Planning	0.12 mons	Mon 6/26/23	Wed 6/28/23	95,67,48	Project Manager
88		DAdminC-Risk Analysis	0.09 mons	Wed 6/28/23	Fri 6/30/23	87	Project Manager
89		DAdminC-Analysis/Elicit	0.03 mons	Fri 6/30/23	Mon 7/3/23	88	Back-End Developer[300%],Front-End Developer[300%],Database Engineer[300%]
90		DAdminC-Design	0.07 mons	Mon 7/3/23	Tue 7/4/23	89	Back-End Developer[300%],Front-End Developer[300%],Database Engineer[300%]
91		DAdminC-Code	0.07 mons	Tue 7/4/23	Thu 7/6/23	90	Back-End Developer[300%],Front-End Developer[300%],Database Engineer[300%]
92		DAdminC-Unit Test	0.03 mons	Thu 7/6/23	Thu 7/6/23	91	Back-End Developer[300%],Front-End Developer[300%],Database Engineer[300%]
93		DAdminC-Integration Test	0.03 mons	Thu 7/6/23	Fri 7/7/23	92	Back-End Developer[300%],Front-End Developer[300%],Database Engineer[300%]
94		DAdminC-CustEval	0.06 mons	Fri 7/7/23	Mon 7/10/23	93	Project Manager
95		Iteration 5	0 days	Mon 6/26/23	Mon 6/26/23	105,76	
96		DAdminC-Internal Review	0.03 mons	Mon 7/10/23	Tue 7/11/23	94	Project Manager
97		DSC-Planning	0.01 mons	Tue 5/23/23	Tue 5/23/23	11,85,69	Project Manager
98		DSC-Risk Analysis	0.01 mons	Tue 5/23/23	Tue 5/23/23	97	Project Manager
99		DSC-Analysis/Elicitation	0.15 mons	Tue 5/23/23	Fri 5/26/23	98	Front-End Developer
100		DSC-Design	0.2 mons	Fri 5/26/23	Thu 6/1/23	99	Front-End Developer
100		DSC-Design	0.2 mons	Fri 5/26/23	Thu 6/1/23	99	Front-End Developer
101		DSC-Code	0.2 mons	Thu 6/1/23	Wed 6/7/23	100	Front-End Developer
102		DSC-Unit Test	0.05 mons	Wed 6/7/23	Thu 6/8/23	101	Front-End Developer
103		DSC-Integration Test	0.05 mons	Thu 6/8/23	Fri 6/9/23	102	Front-End Developer
104		DSC-CustEval	0.05 mons	Fri 6/9/23	Mon 6/12/23	103	Project Manager
105		DSC-Internal Review	0.03 mons	Mon 6/12/23	Tue 6/13/23	104	Back-End Developer
106		Project Management Activies	6 mons	Fri 11/4/22	Thu 7/6/23		Project Manager
107		End of Project	0 days	Tue 7/11/23	Tue 7/11/23	96	Back-End Developer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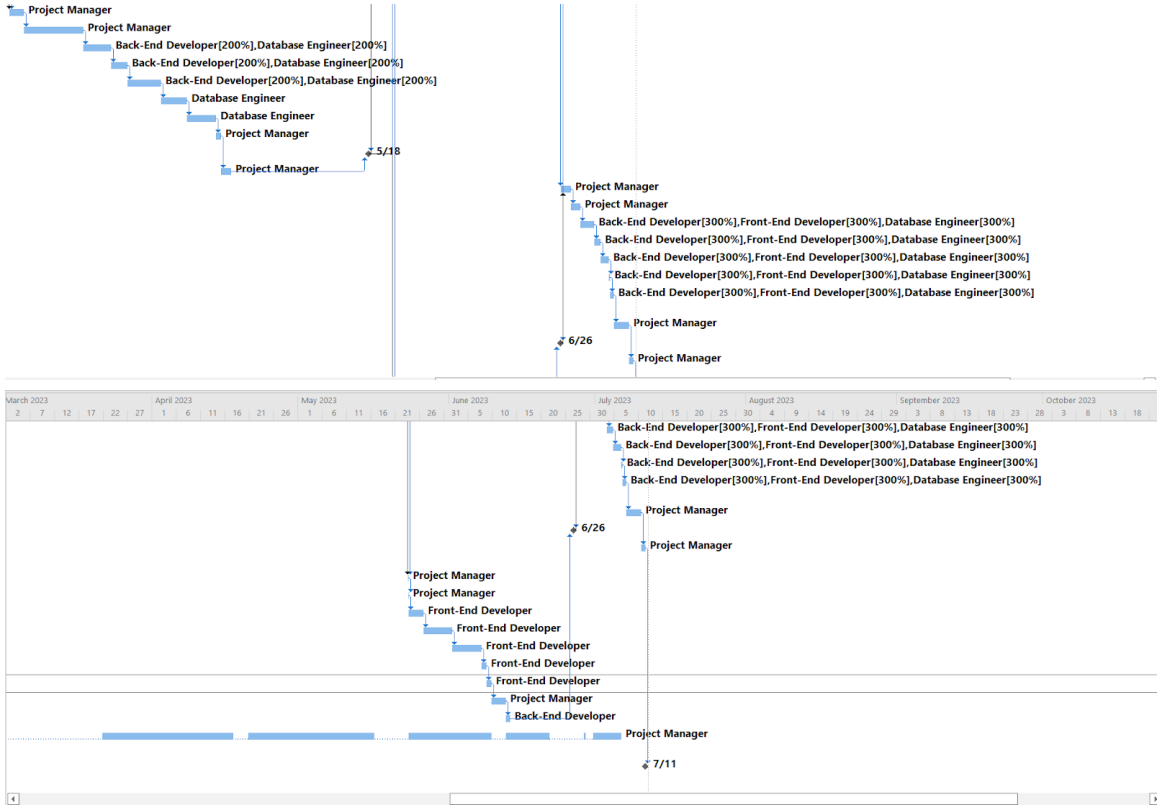
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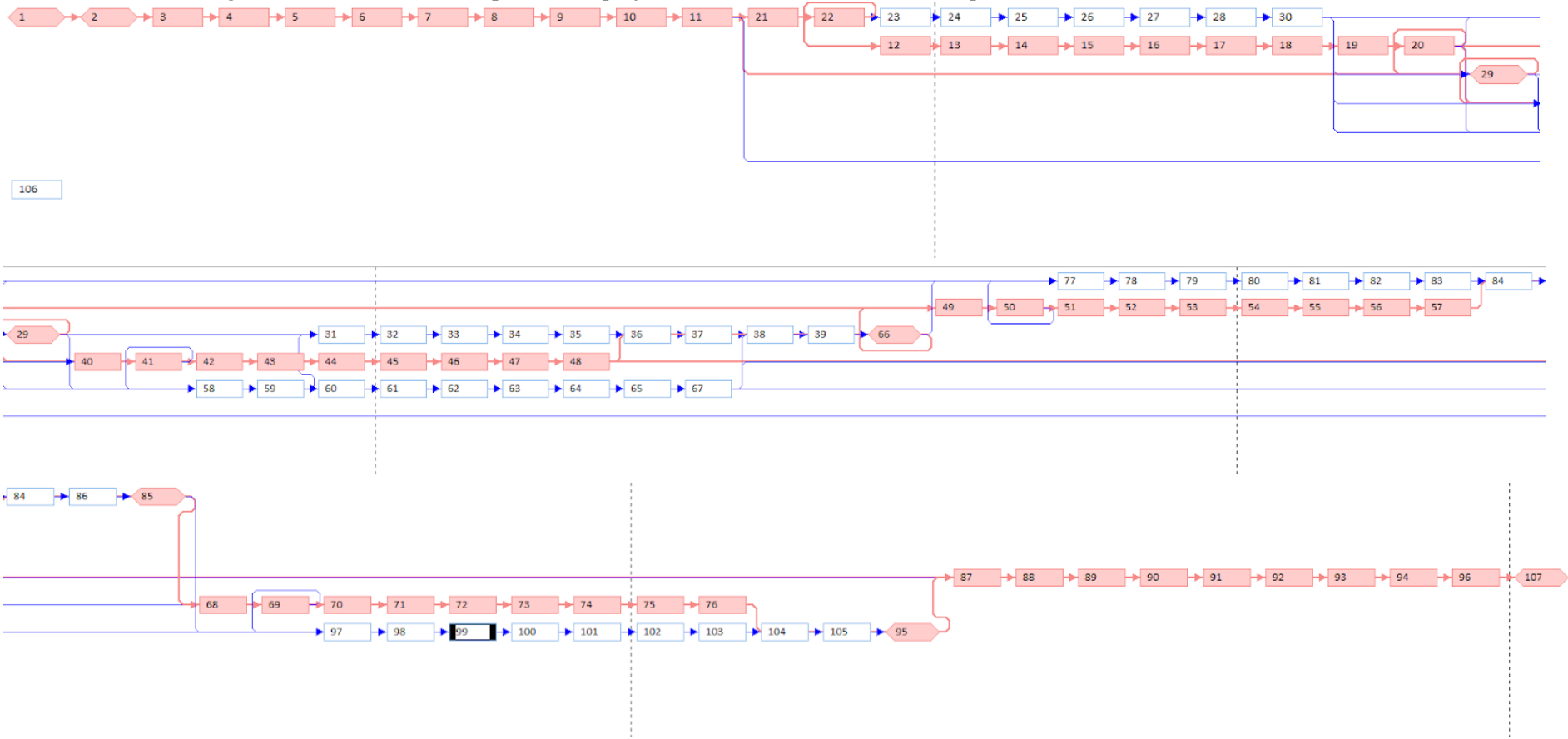
4.2 Critical Path Method (CPM) Analysis

The below network diagram illustrates the critical path of the project, where the task number corresponds to a task from the table.



5 Tracking and Control Mechanisms

5.1 Quality Assurance

As mentioned above, our team intends to use an Agile Development Process. This will consist of individual sprints in which (an) aspect(s) of the project will be fully developed and tested. We intend to use HTTPUnit tests for the frontend testing in each sprint. In addition, code reviews will be done at each milestone to assess code quality. In the code review, maintainability will be assessed using a Maintainability Index (MI). This will be calculated with the following formula:

171 - 5.2 * ln(aveV) - 0.23 * aveV(g') - 16.2 * ln (aveLOC) + 50 * sin(sqrt(2.4 * perCM))

- aveV = average Halstead Volume V per module
- aveV(g') = average extended cyclomatic complexity per module
- aveLOC = the average count of lines of code (LOC) per module
- perCM = average percent of lines of comments per module

Maintainability may also be assessed with the Mean Time Till Failure and the Mean Time Till Repair, with an emphasis on making the system as maintainable as possible (High MI). Readability will also be assessed in the code review by evaluating the comments, number of function calls per line, and lines of code. Integration testing will occur during sprint 9 and will involve manual verification of the requirements. Also, a separate database will be populated with data before each test in order to avoid changes to the original.

5.2 Change Management

All artifacts, documents, source code, and the project plan will be stored in GitHub. GitHub will allow us to view status, logs, differences, etc. of files and directories. This will give us easy and well known change control. Bug management will be handled with GitLab. This will allow bugs to be reported all to one place and allow them to be tracked easily. Due to the iterative nature of the agile process, requirement and feature changes can be handled between each iteration. This is attainable because of the frequency that agile delivers/releases. Emergency changes will be allocated in the project buffer for each iteration.

Changing requirements or features will necessitate review of project schedule and budget. As requirements and features are adjusted, they will be similarly prioritized within our schedule and project planning may be altered to fit in these adjusted features. Only highly prioritized features and requirements can be implemented due to the limited timeline and budget, so the project plan will be strictly adjusted for high priority changes.

5.3 Earned Value

The budget used for the earned value analysis is the $250,000 the client is currently willing to pay for the system, and not the estimated budgets calculated in this document. The timeline used for the analysis is the 5 months determined in the estimation section of the document based on the budget.

Total Budget：250,000
Total time: 5 months
Current development progress: During week 8
Hypothesized Money spent at the end of Week 8: 115,000 (46% of total budget)
Hypothesized Work completed at the end of Week 8: 33% (originally scheduled for 42%)

Process:

PV(Planned Value) = 42% * 250,000= 105,000

AC(Actual Cost) = 115000
EV(Earned Value) = 33% * 250,000 = 82,500
CPI(Cost Performance Index) = EV/AC = 82500/115000 = 0.717
- (Lower than 1 means over budget)
- (only 71.7% of the expense is spent on the work performed to what was planned to have been spent)

SPI(Schedule Performance Index) = EV/PV = 0.786
- (lower than 1 means behind schedule)
- (only 78.6% of the project is to perform work as it was actually scheduled.)

CV(Cost Variance) = EV-AC = 82500 - 115000 = -32500
- (negative means over budget)

CV% = CV/EV = -39%
SV(Schedule Variance) = EV - PV = 82500 - 105000 = -22500
- (negative means behind schedule)

SV% = SV/PV = -21.4%
ETC(Estimate to Complete) = [(BAC - EV) / CPI] = [(250000 - 82500)/0.717] = 233,612.27
- supposed the team can address the cause to the schedule and cost variance and produce as planned production rate:
- Solve : (105000 : **8** weeks = 233612.27 : **?** weeks) => 17.8 weeks
    - Total will be 25.8 weeks. 3.3 weeks behind original completion date.
    - explanation: 105000 is the original planned value at week 8, so we use this 105000<->8 scale to compare to the estimated value left(ETC) so we get the result as how many weeks corresponds to this ETC value.

EAC(Estimate at Completion) = AC + ETC = 348612.27

Conclusion: The project is seriously behind schedule by 21.4%, and seriously over budget by 39% at the end of week 8, the project is currently losing ground. But if the team can address the cause to the schedule/cost variance that happened before week 8, the Team can still finish the project with a time extension of 3.3 weeks and a further funding for $**98,612** if the client is willing to provide so.

The Who Done What Table:

Who Done It: Team Member Names	Section/Part Completed	Task/Comments	# of hours effort
Andrew Kosikowski	1.0	Initial Revision	0.50 hours
Sam Walsh	1.1	Initial Revision	0.50 hours
Jared Krauss	1.2	Initial Revision	0.50 hours
Andrew Kosikowski	1.3	Initial Revision	0.33 hours
Andrew Kosikowski	1.4	Initial Revision	0.33 hours
Andrew Kosikowski	1.0	Second Revision	1.5 hours
Andrew Kosikowski	1.0	Final Revision Edits	0.25 hours
Sam Walsh	1.4	Second Revision	0.25 hours
Sam Walsh	2.0	Initial Revision	0.05 hours
Zhen Yang	2.0	Second Revision	0.50 hours
Andrew Kosikowski	2.1	Incomplete Initial Revision	0.50 hours
Sam Walsh	2.1	Second Revision	1.00 hours
Sam Walsh	2.1	Third Revision	0.25 hours
Full Group	2.2	Initial Revision	3.00 hours
Andrew Kosikowski	2.2	Second Revision	2.00 hours
Andrew Kosikowski	2.2	Third Revision	3.00 hours
Sam Walsh	2.2	Fourth Revision	0.50 hours
Andrew Kosikowski	2.3	Incomplete Initial Revision	0.25 hours
Sam Walsh	2.3	Second Revision	0.50 hours
Andrew Kosikowski	2.3	Third Revision	0.50 hours
Sam Walsh	3.0	Initial Revision	0.33 hours
Zhen Yang	3.1	Initial Revision	0.50 hours
Sam Walsh	3.1	Second Revision	0.25 hours
Zhen Yang	3.2	Incomplete Initial Revision	0.50 hours
Sam Walsh	3.2	Second Revision	1.25 hours
Zhen Yang	3.2	Third Revision	0.75 hours
Zhen Yang	3.3	Incomplete Initial Revision	0.50 hours
Sam Walsh	3.3	Incomplete Second Revision	1.00 hours
Zhen Yang	3.3	Third Revision	1.00 hours
Sam Walsh	3.3	Fourth Revision	0.50 hours
Andrew Kosikowski	3.0	Edits	0.50 hours
Zhen Yang	4.0	Incomplete Initial Revision	0.25 hours
Jared Krauss	4.0	Second Revision	2.00 hours
Andrew Kosikowski	4.0	Edits For Final Revision	1.00 hours
Jared Krauss	4.1	Initial Revision	2.00 hours
Andrew Kosikowski	4.1	Edits For Final Revision	1.00 hours
Jared Krauss	4.1	Second Revision	2.00 hours
Andrew Kosikowski	4.2	Edits for Final Revision	1.00 hours
Jared Krauss	4.2	Edits for Final Revision	2.00 hours
Jared Krauss	5.0	N/A	N/A
Jared Krauss	5.1	Initial Revision	0.25 hours
Jared Krauss	5.1	Second Revision	0.50 hours
Jared Krauss	5.2	Initial Revision	0.25 hours
Jared Krauss	5.2	Second Revision	1.00 hours
Zhen Yang	5.3	Initial Revision	1.00 hours
Andrew Kosikowski	5.3	Second Revision	0.25 hours