Project Management Information System

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Information Technology Capstone (ITSS-440-M01)

Summer 2024

August 18, 2024

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Capstone Draft 1: Project Management Information System

Abstract/Executive Summary

The purpose of this capstone project was to develop a lightweight, standalone project management information system (PMIS). The system offers essential project management tools without requiring subscriptions or network connections. The aim of this project was to focus on ease of use and adherence to industry standards. This software is intended for project managers who need a simple, offline tool to manage projects without relying on other services or infrastructure.

The application uses a basic technology stack to deliver powerful features and functionality. The application utilizes the C# language and .NET frameworks to utilize the following technologies: Windows Forms (frontend), Entity Framework (backend), SQLite (backend), and QuestPDF (report generation). These technologies add value to the project by simplifying business objectives for project managers: creating, reading, editing, and removing project data; managing resources, stakeholders, requirements, and milestones; sequencing and managing tasks; document management. The program handles errors by using try-catch statements, flow logic, and preventing null value errors by initializing certain objects with a value.

The project was developed over the course of the capstone project class at the University of the Cumberlands. The fifteen weeks spent developing this project included time spent on drafts of these works, learning professional working methods, and devoting specific time to the creation of this software.

Introduction/Problem

There is a lack of lightweight, standalone software for project management. To increase the number of tools available to project managers, the product of this capstone project aims to create an easy-to-use project management information system that provides a valuable tool to anyone who manages projects. This section will define the project's goals, process, final product, and timeline.

This project aims to produce an easy-to-use project management information system. In the current market, many leading project management information systems require subscriptions and accounts and are only available through online services (Capterra Inc., 2024). While there are existing, open-source solutions for project management that run on desktop computers, they require specific hosted setups or are marketed as alternatives to other software. This project will offer an original solution that is easy to use, incorporates standards set by the Project Management Institute, and performs without error.

This project will follow standards set by the Project Management Institute. According to the Project Management Institute, a document management component is often incorporated with the project management information system (Project Management Institute, 2022, pg. 276). This project will focus on capturing this component, as many available solutions do not offer a document management component. To be specific, this application program will work towards generating documents that are common to project management. By utilizing frameworks established by the Project Management Institute, this application program will provide a tool that follows best practices for the field of work in which this tool will be used and run without error.

Another function of the product will be to facilitate project management by providing an information system. This information system will allow users to add, view, update, and delete

project data, following the standard CRUD (create, read, update, and delete) operations. This information system will not implement the following technical features: identity and authorization, network connectivity, and paywalls.

The technology stack for this information system will use standard frontend and backend components for applications. The information system will be developed in the Visual Studio 2022 integrated development environment using the C# programming language. Utilizing the built-in graphical user interface (GUI) designer, the information system will use Windows Forms as the frontend framework. The Entity Framework Core will be used to communicate between the program and the database to map objects in the program to a database. Entity Framework Core will allow CRUD (create, read, update, and delete) operations against the database to process data and actions entered by the end user. User interactions will be processed against the database by Entity Framework Core. The program will integrate the database to create a simplified solution. SQLite is the integrated database solution that will be used for this information system. Microsoft has implemented a package that contains SQLite and Entity Framework Core to simplify development (NuGet, 2024). Incorporating libraries like QuestPDF into the project's development environment will allow the product to produce reports in a portable document format (PDF). This combination of frameworks will create a lightweight solution to project management information systems by being a standalone solution.

This project will have a timeline constrained by the length of the capstone course at the University of the Cumberlands. The information system will be developed over fourteen weeks. Based on the weeks organized by the class, three weeks will be spent creating and designing the GUI and backend for the first draft, providing basic functionality to view an existing database and simple functionality. The three weeks following the first draft will refine the GUI and

backend based on information relevant to project management frameworks. At the end of those three weeks, a second draft of the project will be turned in. In the four weeks following the second draft, a third draft will consist of advanced functionality like exporting to PDF, updating project data, and assigning project tasks. The two weeks following the third draft will consist of debugging, testing, seeking user feedback, and refining existing features to create the final draft of this information system.

Tool Selection and Evaluation

This section provides identification and justification for the tools selected to solve the problem topic of this capstone project. The process of tool selection and evaluation will be explained. The tools for this project are utilizations of existing tools, frameworks, and libraries for the C# programming language. Considering that these are existing tools, frameworks, and libraries, the justification is to follow existing practices and documentation.

The programming language chosen for this assignment is C#. C# is a popular language due to its ties with the .NET platform and modernity (Troelsen & Japikse, 2022, p. 46). Because C# is recognized as a modern programming language, it is widely used to produce libraries and applications. Ties to the .NET platform allow integration into many frameworks. Windows Forms (WinForms), Entity Framework Core, Blazor, and many other frameworks are popular choices for development that can be used with the C# programming language and .NET platform.

The .NET platform is software for building applications and services for Windows, iOS, and Linux operating systems (Troelsen & Japikse, 2022, p. 47). By utilizing the .NET platform with the C# programming language, the project can access powerful frameworks used to create and build applications. The product of this capstone project can utilize frameworks like WinForms and Entity Framework Core. Beyond framework integration, the .NET platform provides a comprehensive base class library and a simplified deployment model. These factors improve the ability of developers to create software.

Windows Forms, commonly known as WinForms, is a framework for creating visuals that allow users to interact in a graphical user interface (Andy De George, 2023). According to Andy De George with Microsoft Learn, the Windows Forms framework utilizes XML as a

markup language for defining visual controls. To simplify the development of Windows Forms visual controls, developers can use Microsoft Visual Studio to design the visual controls. This allows developers to design and program graphical user interfaces in a single tool. For example, developers double-click the visual control in the editor to bring up the code for the class interacting with the program's visuals to assign a click function to visual controls.

Entity Framework Core is an object-relation mapper that lets developers build data access layers in applications utilizing C# and the .NET platform (Microsoft Learn, n.d.). Entity Framework Core is a package of features that interact between a .NET application and a database. It allows the developer to create a model and functions within the program's code that allows essential database functions: create, read, update, and delete (CRUD) (Microsoft Learn, 2022). By utilizing Entity Framework Core as an object-relation mapper, the project can perform CRUD operations against a database, create a database, provide annotations to data in the database, and much more.

SQLite is a library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine (SQLite, 2019). This project will be more agilely developed using an embedded database with simple, serverless features. SQLite is open-source and uses a compact library to offer developers a free, low-resource cost experience. Entity Framework Core also supports SQLite by utilizing a database plugin package (Microsoft Learn, 2022).

The targeted system for this project is desktop computers. To maintain the simplicity of this application program, the program will be developed for Windows desktop computers only. According to Microsoft documentation, the Windows Forms frontend framework is designed to run on Windows (Microsoft Learn, 2023). Utilizing the Windows Forms framework simplifies the development and helps meet goals related to time constraints for this project.

Planned Logic/Program Design

The purpose of this section is to convey the methodology, planned logic, and program design of this software development project. By conveying pseudocode, user workflow mapping, and sections of the Institute of Electrical and Electronics Engineering (IEEE) guideline 830 Essential Software Requirements Specifications (SRS). The listed tools will aid in describing how this software development project will solve the problem that this project attempts to solve and how unpredicted events will be handled.

Workflow Mapping

Workflow mapping is a form of processes that accomplish a specific goal (Faulkner, 2018, pg. 157). Relating the functions of this software solution will enable workflow mapping of project management tasks to typical processes that project managers follow. The following tasks are from Project Management Institute (PMI) regarding process groups that identify tasks performed by project managers:

- Initiating Process Group:
    - Develop project charter
    - Identify stakeholders
- Planning Process Group:
    - Define and Sequence Activities
    - Resource Management

(Project Management Institute, 2022, pg. 69 & 77)

Considering the tasks as they are related to project management deemed by PMI, a workflow mapping can be created to implement a workflow for how the program for this project will operate.

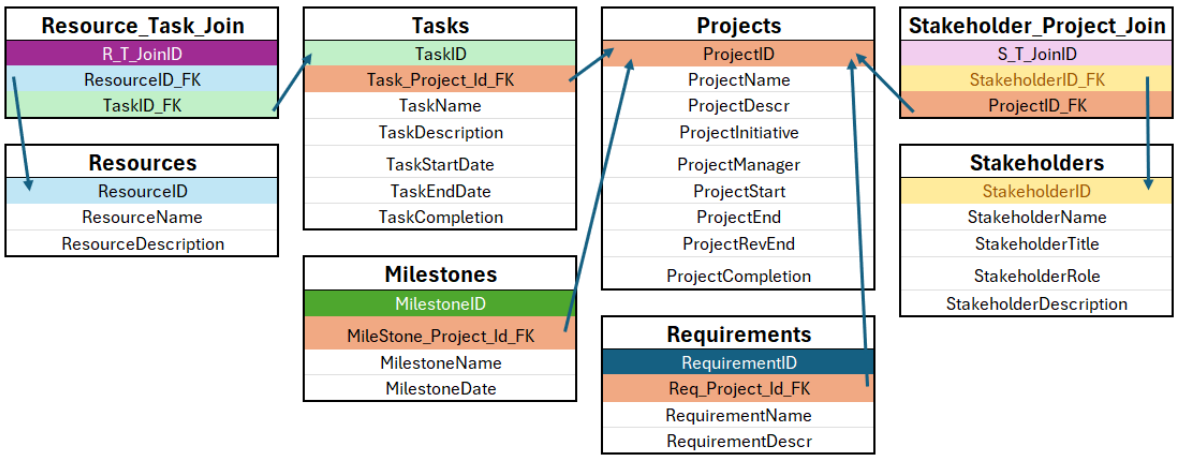
Essential Software Requirements Specification: An Object-Oriented Narrative

The SRS document is a product of requirements engineering and describes the software system (Elliot & Allen, 2013, pg. 124). The Object-Oriented Essential SRS covers the following

domains: Initial Requirements Modeling, Modeling Requirements, and Requirements Specification (Tsui, Karam, & Bernal, 2022, pg. 314). Each domain covers topics related to a methodology by addressing the problem, specifying a process model for the project, listing use cases, defining users, and functional requirements. The following paragraphs detail an objective-oriented SRS in a narrative approach as it relates to this software project.

Initial Requirements Modeling. The initial requirements for this software project will be modeled via a domain and usage model. The project will use entities and attributes as data to form the foundation that will enable project managers to create outputs from inputs. This list of entities and attributes will form the fundamental data for the software:

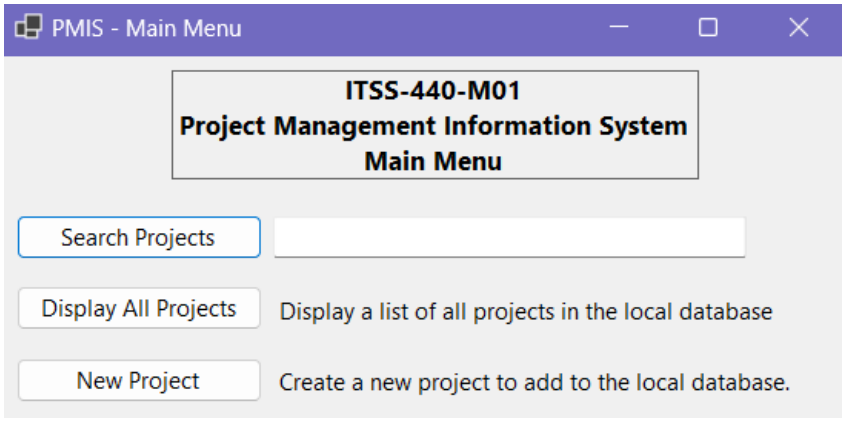
- Initiating Process Group:
    - Project: ID, name, description, initiative, project manager, start date, end date, revised end date, completion, milestones, requirements
    - Stakeholder: ID, name, title, role, description
- Planning Process Group:
    - Task: ID, name, description, start date, end date, completion
    - Resource: ID, name, description



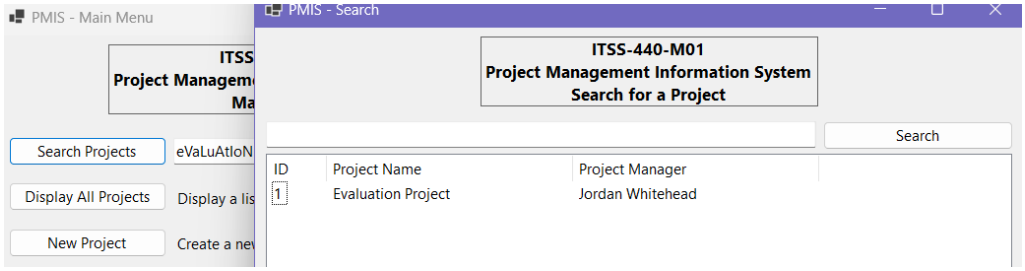
The fundamental data listed will serve as the basis for the creation of records relating to projects that would be executed by project managers in the workflow for the Initiating and Planning process groups. By utilizing data outlined by process groups, this software application will be capable of assisting project managers by maintaining imperative project data and generating necessary documents. Within the database, the tables will be normalized to utilize appropriate design in many-to-many relationships, such as those between the elements of the Task and Resource tables.

Modeling Requirements. This software application is designed to be executed in Windows operating systems by anyone managing a project. Users will use a graphical user interface (GUI) to navigate through windows to manage projects. A use case for this software could be as follows: user opens software, user is prompted to main menu where they can click buttons execute functions (search for, display, and create projects), user clicks button to create a new project, user is prompted to enter initial required data for Project table ("name" and "project manager"), user clicks button to save project, data is committed to the database, and user is directed to a window displaying all entered data for the project. At the window displaying all entered data for the project, the user can click buttons that allow editing and deletion of the project, as well as the option to view or export the charter, stakeholder list, tasks, and assigned resources. Upon clicking the edit button, the user can enter the remaining data for the project. Other buttons on these windows perform the functions that they are named as. The following images depict this process:

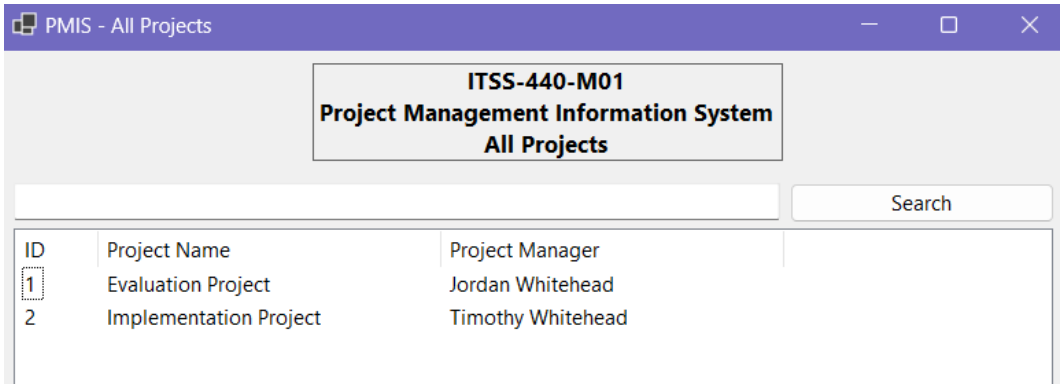
A user is presented with a main menu



A user has searched using the string "eVaLuAtIoN"

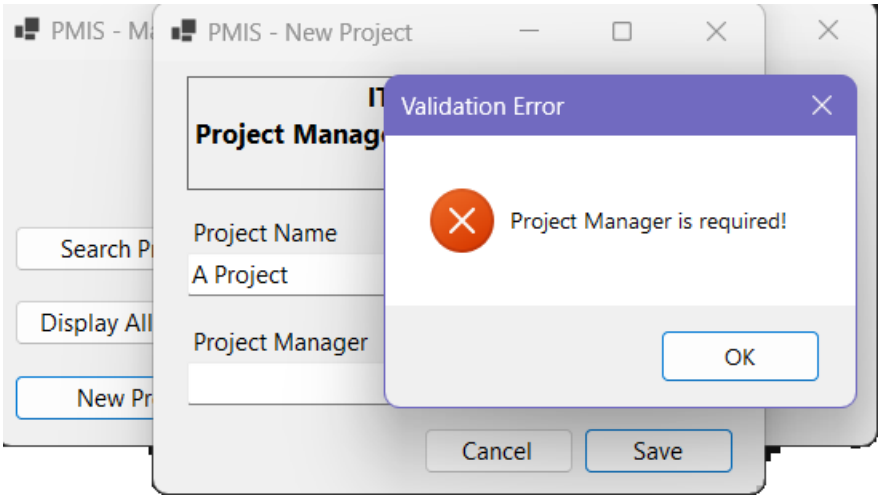


A user has displayed all projects



Error Handling. The application will handle errors by utilizing logical statements when applicable. By utilizing input validation, the application will prevent null values being committed to the database in fields that must not be null. The following pseudocode is an example of how the application will use input validation, preventing database errors or corruption:

```
function clickOkCreateNewProject
    if projectName != null && projectManager != null
        then Add (new Project [projectName, projectManager])
else Alert ("Project Name and Project Manager are required!")
```



Similar logic will be implemented to prevent attempts to load empty or null tables. The project will also use try-catch statements to handle errors when they occur, as pictured above.

Requirements Specification. This project does not require any external interfaces but requires the ability to save a local database file in the location of the executable. Other functional requirements of the project are CRUD operations, functions to display windows when appropriate, error handling, and exporting of data. This project will not connect to any other applications or services via a network. The project will be hosted solely on the system it is executed in.

Documentation

1. System Overview:

A. System Description:

The project management information system is designed to increase the ability of project management professionals based on ideas from the Project Management Institute. It offers functionality like project charter data recording, stakeholder list creation, defining and sequencing activities, and resource management.

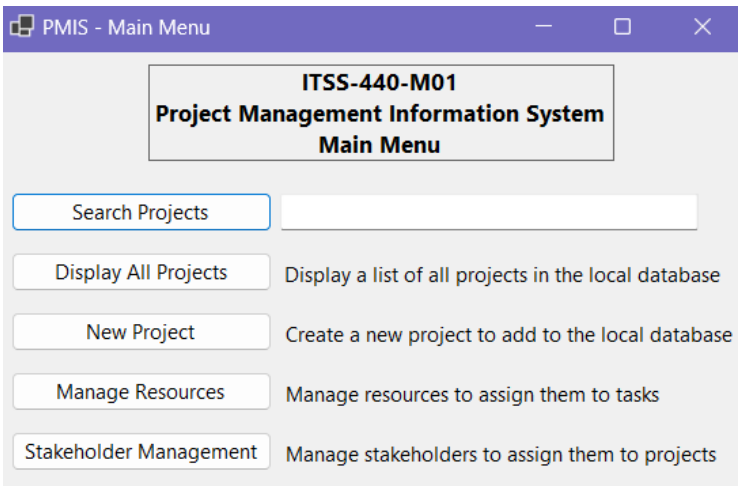
B. Key Features:

i. Project Charter Data Recording: create, read, update, and delete data related to project charters (project name, description, initiative, project manager, start date, end date, revised end date, and completion)

ii. Stakeholder list creation: create, read, update, and delete data related to project stakeholders. Stakeholders can be assigned to projects and linked to the data associated with the project charter.

iii. Defining and sequencing activities: create, read, update, and delete data related to activities, called “Tasks” in this information system. Tasks are created and linked to projects.

iv. Resource management: create, read, update, and delete data related to resources. Resources are created and can be linked to Tasks.



2. Functional Requirements:

A. Role Definitions:

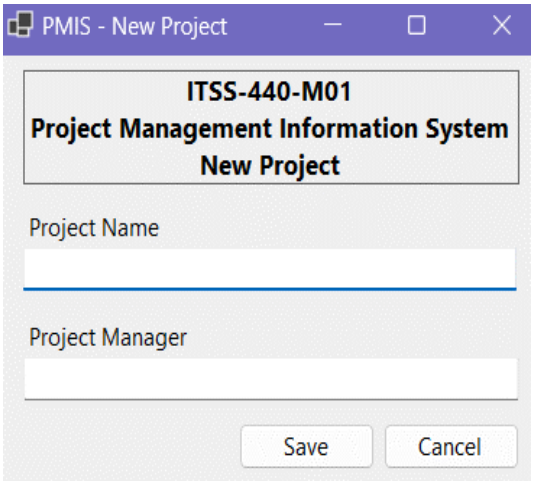
i. Project Manager: a person who is assigned a project; manages tasks, resources, and scheduling; creates reports of project work

ii. Resource: a person who completes assigned tasks and provides progress reports

iii. Stakeholder: a person who reviews project status updates and reports and provides executive support

B. Project Charter Data Recording:

i. New Project:



- From the Main Menu, click on the "New Project" button
- Once the "New Project" window opens, enter the project name and project manager into their respective textboxes
- Click "Save" to save the initial project data to the database or click "Cancel" to return to the Main Menu
- If a save is successful, you will be prompted with a dialog box stating that the project has been saved and returned to the Main Menu

ii. Searching Projects:

- From the Main Menu, enter search criteria into the textbox next to the "Search Project" button
- From the Main Menu, enter search criteria into the textbox next to the "Search Project" button
    - *To display all projects, do not enter anything into the textbox*

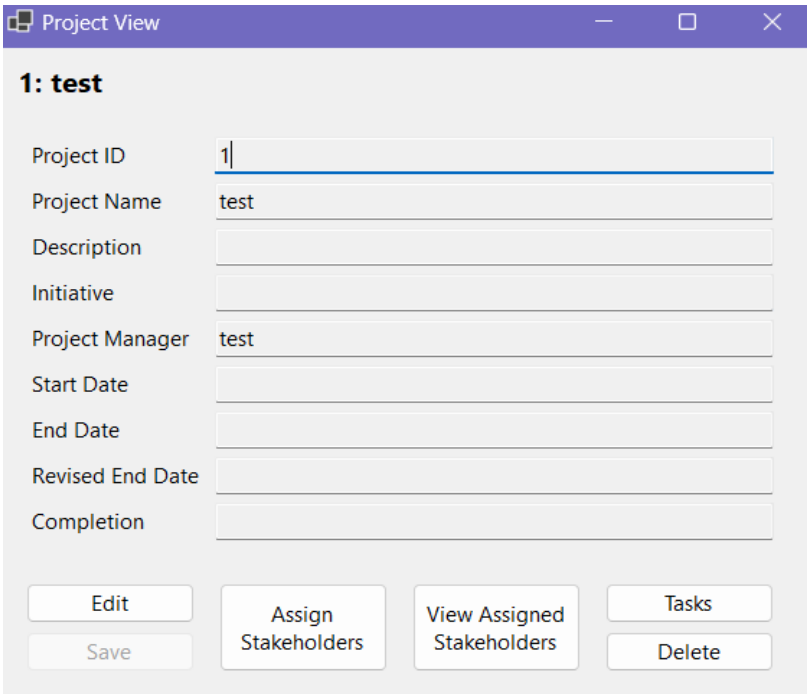
- Click the “Search Projects” button to search
- You will be presented with the Search window, which displays a list of projects, if any are found

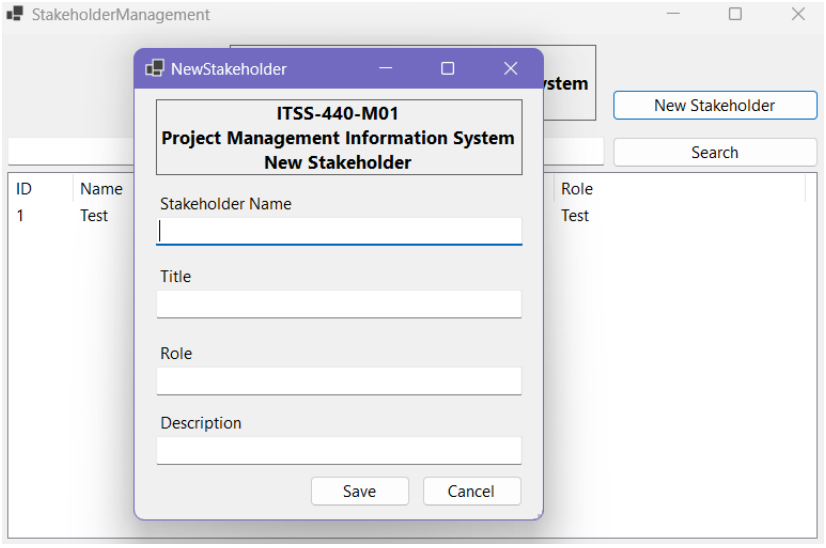
iii. Display All Project:

- To display all projects in a list, click the “Display All Projects” button from the Main Menu
    - This is the same as clicking the “Search Projects” button with no text in the textbox
- You can search for projects once this window has been opened

iv. View Project Data:

- To view the data associated with a project, search for a project or display all projects
- From the list of projects, double-click on the project you wish to view
- The Project View window will be opened
    - *This view is common with many other views in the information system*
- The Project View window allows the entering, editing, and deletion of basic data associated with the project charter





C. Stakeholder List Creation:

i. New Stakeholder:

- From the Main Menu, click the "Stakeholder Management" button
- On the Stakeholder Management window, click the "New Stakeholder" button
- When the New Stakeholder window appears, enter data into the appropriate fields: name, title, role, and description

ii. Assign Stakeholder to Project:

- While on a Project View, click the "Assign Stakeholders" button to assign stakeholders to the project
- Clicking the radio buttons by the desired stakeholders' names will prepare them to be linked to the project
- Click "Save" when done assigning stakeholders to the project

iii. Edit and Delete Stakeholders:

- To edit a stakeholder, navigate to the Stakeholder Management window

- From the list of stakeholders, double-click the one you wish to edit to open the Stakeholder View window
- Click the “Edit” button to enable editing the fields
- Click the “Save” button when finished editing
- To delete a stakeholder, open the Stakeholder View window of the stakeholder you wish to delete
- Click the “Delete” button and “Yes” when prompted or “No” to go back to the Stakeholder View window

D. Defining and Sequencing Activities:

i. Create a new Task:

- Navigate to the Project View of the project you want to create a task for
- Click on the “Tasks” button from the Project View to open the Task List window
- Click the “New Task" button on the Task List window to create a new task
- Enter the appropriate fields for the task: name, description, start date, end date, completion, sequence

ii. Edit and Delete a Task:

- From the Task List window, double-click on the task you wish to edit or delete
- To delete the task, click the “Delete” button on the Task View window
- To edit the task, click the “Edit” button and make the desired changes

E. Resource Management:

i. New Resource:

- From the Main Menu, click the “Resource Management” button
- On the Resource Management window, click the “New Resource” button
- When the New Resource window appears, enter data into the appropriate fields: Name, description

ii. Assign Resource to Task:

- While on a Task View, click the “Assign Resources” button to assign resources to the task
- Clicking the radio buttons by the desired resources’ names will prepare them to be assigned to the task
- Click the “Save” button when done assigning resources to the task

iii. Edit and Delete Resources:

- To edit a resource, navigate to the Resource Management window
- From the list of resources, double-click the one you wish to edit to open the Resource View window
- Click the “Edit” button to enable editing the fields
- Click the “Save” button when finished editing
- To delete a resource, open the Resource View window of the resource you wish to delete
- Click the “Delete” button and “Yes” when prompted or “No” to go back to the Resource View window

Conclusions

The creation of this project management information system successfully met the goals of the project. The output of this project has been the creation of an application that adheres to industry standards, uses an established technology framework, is standalone, is easy to use, and allows users to use the software free of charge.

Throughout this project, many lessons were learned regarding the creation of software. Most of the challenges related to this project were due to a skill gap in technology development. These were overcome by reading official documentation of technologies used and review of materials for similar technologies.

The project can be improved to provide enterprise-wide benefits to an organization. By utilizing enterprise standards such as authentication, networking protocols, and data access, this project could evolve into a connected system that provides observable, centralized project management for many project managers. Services like Tableau and Microsoft PowerBI can connect to the database that this software creates, allowing detailed reporting of projects. This adds complexity to deployment, making it less practical for the problem that this project attempts to solve. However, the project provides an excellent starting point for anyone who wishes to create such features.

This project management information system development project demonstrates the effectiveness of using modern development frameworks to create practical, industry-aligned solutions. This project highlights simplicity and functionality by demonstrating the rapid development of information systems to solve a business problem.

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