# Employee Management System

**Progress Report**

By

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A report submitted in partial fulfillment of the requirements
of SYSC-4907 Engineering Project

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**Abstract**

Managing employee records could be a challenging task. It also varies from one company to another depending on many factors such as department, divisions, levels of management. Also, at some point an employee in any organization may be faced with issues or challenges that could be personal or family related, and it requires them to take time off of work. Managing human resource management plays an important role in any institution and it is concerned with hiring, salary generating, yearly feedback, promotions, attendance management and storing employees' details.

The main problem being addressed is to build an employee management system that includes key features such as managing employees 'records, time and attendance management, vacation and leave management, HR and management services, an employee database, and an employee portal. The system is meant to address multiple problems such as reducing labor and manual work, increasing security, and building a user-friendly environment that allows easy access to all of its views at many different levels. Our system is still in the early development phases and the first problem addressed was building an efficient database that is secure and allows remote access to run our application on any type of windows operating machine. The second problem that is currently being addressed is to build the user interface with all the different features and functionalities. After finishing the development of the GUI (Graphical User Interface) and the database, we plan on moving into addressing the remaining problems which is the automation of the HR administrative tasks [B1].

**Acknowledgments**

My partner and I would like to acknowledge and thank our Supervisor Prof. Lynn Marshall who made this project possible. The advice and the feedback given by her have helped us through all the stages of the project. We would also like to acknowledge and thank Prof. Hala for her intake and feedback on our GUI (Graphical User Interface) which has helped a lot in our designing phases.

A special acknowledgement to Pat Fairs for his effort in helping us in the financial part of our project which made it possible for us to create our database on Amazon RDS and use Lucidcharts drawing tool to create our diagrams.

We also would like to give a special thank you to the people who took the time to participate in our interviews and offered their input and suggestions such as Youssef Hojeij, Kim Plourde, and Terrance Odin.

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# 1. Introduction

## 1.1. Problem Motivation

Our motivation to do this project came from our workplaces, both of us have experienced using employee management systems and we have noticed may flaws and insufficiencies such as not having an easy user interface, information not being updated regularly since it has to be entered manually to the system, records of previous employees being lost, things are not easily found because they are structured in a poor matter as seen in our in person interview with Kim Plourde [A3]. We have also done many interviews with people from the HR department to see their intake and feedback about their own management system and we found that the problems addressed were very similar to what we have seen [A2].

## 1.2. Problem Statement

The main objective of this project was to build an enterprise resource system that deals with managing the company's employees' structure in terms of storing, managing and displaying information in the most efficient way possible. As stated in the proposal the desktop application will enable employees to access any administrative information they require while also allowing managers and Human Resources (HR) to manage and store this information [A2].

## 1.3. Proposed Solution

We focused on addressing three main problems in our application, first we made our application a desktop application rather than a website so that it is more secure and apply more restrictions since employee's information is considered sensitive data, although there are many other ways to minimize the risk for web application, but they can vary and might come with a cost [23]. The second problem is designing an easy user interface that displays all information in an efficient way and offers easy navigation where everything is clear and presented properly in the website. The third problem is minimizing the manual work for the users by automating some of the tasks on the website to make it easier and faster to use [A10].

## 1.4. Overview of Remainder of Report

This report will cover the progress made on the development of the system. Engineering professionalism and responsibilities will be discussed first. Section three will cover the progress of development and team accomplishments as of the end of the fall semester.

Further plans of development including an updated timeline will also be covered followed by the reflection on what could have possibly been done better.

## 2. The Engineering Practices

### 2.1. Health and Safety

Covid is the only health and safety risk that has been identified in the project thus far. To mitigate the risk of covid, meetings have been held online through zoom between the professor and students. This has not impacted the project in any negative way and has made it convenient to always be able to attend the meetings. After carefully going over the risks mentioned in the health and safety manual [1] provided by Carleton, the employee management system does not have any of the mentioned physical risks involved. This is primarily due to the system being a software only project. Use of lab equipment is not required for this system beyond access to a computer.

The system will be required to go through testing by people who are not involved in the development of this project. This is to find problems, bugs, and user interface issues in the system. It has been recommended by Professor Hala to fill out an ethics form as testing the project can uncover unexpected risks [A1]. The ethics form [2] will be filled out before testing the product between January and April.

### 2.2. Engineering Professionalism

Building the employee management system comes with responsibilities that need to be adhered to as hopeful future professional engineers. The most important responsibility is following the code of ethics and avoiding professional misconduct. Professionalism towards the team and other relevant members is also a very big responsibility while working on this project including proper communication, written or verbal.

Following the code of ethics for this system involves ensuring that the system is safe to use by the public. As stated in the code of ethics: “[Professional Engineers] … hold paramount the safety, health and welfare of the public” [3]. The employee management system must be tested to confirm it causes no adverse affects on its users. To mitigate this risk, the project will be tested by people before potential deployment. The testers themselves will be chosen after receiving approval by Carleton University to allow human research through the ethics form. The project will also be thoroughly tested by the team before making it available to others.

Professional misconduct is another big issue that needs to be considered while working on the system. Professional misconduct is failure to make reasonable provision towards

safeguarding people [4]. The employee management system will hold sensitive data about the employees of the company. This data if available to someone with malicious intent can result in identity theft, loss of income and safety issues. It is very important that this information stays safe. The system will have built in safeguards such as password protected accounts and secure sin number display. This system will also not hold any real sensitive information as the database being used is open for public access.

Professionalism towards fellow team members and other members of the project is also a major professional engineering responsibility. Professionalism includes abiding by deadlines whether internal or external including keeping all parties up to date on any delays and changes in the progress of the project. This is maintained through following the deadlines and meeting times created. Further communication is maintained outside of meeting times to discuss the progress of development and any changes to the project are mutually agreed upon. This also includes professional communication through email. Reports are also written to reflect the guidelines of professional report writing.

### 2.3. Project Management

The main techniques and tools that were used to work with each other are creating a timeline for us using a Gantt chart [A6] and identifying what are the things that must be done together and what things that we need to work on individually. We set up a timeline that helped us to keep track of things that needed to be done, although there were some challenges in following this timeline, but it was definitely helpful to use [B1]. We also used both online and in person meetings to work together and stay in touch to update each other especially during the database research phase since we had to explore and do a lot of technical research to find which database works with our application at the least amount of cost with most efficiency as well as connecting it to our application which required effort from both ends. The GitHub repository was used to manage and share our code so that we can easily identify who worked on what and merge our parts easily.

### 2.4. Justification of Suitability for Degree Program

The relevant degree for this project is B.Eng. in Software Engineering. Both the team members are currently enrolled in B.Eng. in Software Engineering and have taken the same courses. This section will summarize the relevant skills that were learned in this program and the methods being utilized from the courses. The project is a software-only project involving the use of Java and a database. Both Java and SQL were studied to this degree. The relevant skills can be broken down into three categories: project planning, Java development and database.

### 2.4.1. Project Planning

Project planning refers to organizing the project to ensure that the necessary features are included and have been set with realistic deadlines. It also refers to gathering all the information needed to implement the project in a way that is useful to the users and researching any technical requirements. The relevant courses are SYSC 3120 and SYSC 4106.

SYSC 3120: Software Requirements Engineering outlines how to research any project and model its requirements [18]. This course helped with finding the right people to interview and what kinds of questions to ask them. As the system is an employee based system, multiple HR and technical individuals who have worked with similar systems were chosen to be interviewed to fill in the gaps in the team's knowledge. This course has also taught us how to model these requirements, the main model we will be using is the UML diagram. Further models such as sequence diagrams and use cases will be used if the system requires them.

SYSC 4106: The Software Economy and Project Management is a course that outlines project management. The course showed team management and how to plan the project [18]. Using the skills learned in this course, the project has been set to be developed using an incremental model [A2][A3]. After the initial research phase, the project will be developed to a simple system that allows the user to send and receive requests. Which will be followed by the testing phase. After the first version of the system is completed, any further features being added will follow the same research, develop and test phase [19]. The main features for each phase are sending and receiving requests based on a notification system, generating charts and reports, automation, adding necessary employee system pages with the last feature being improving the UI design.

### 2.4.2. Database

The most important part of the project is the database. As an employee system can contain information about thousands of employees, the project requires a database. COMP 3005: Database Management System [22] taught the basics of a database and running SQL commands [25]. This project will be using a SQL database. The main concepts that will be used from this course are designing a database using the entity relationship model [24] and creating a database.

### 2.4.3. Java Development

The largest part of the development is going to involve programming in Java. There are multiple courses in the software engineering program that not only have been purely in Java but also demonstrated coding standards and methods to implement code in an efficient manner.

Starting with SYSC 2004: Object Oriented Development taught the basics of object oriented programming, showing how to make the code modular and using iterative development [18]. The main concepts that are going to be applied in the project from this course are object oriented programing and test driven development. This course also introduced Java swing GUI which will help create the GUI of this project.

Next relevant course is SYSC 2100: Algorithms and Data Structures. This course was really important in introducing different collections, data structures, recursive and sorting algorithms [18]. The main skills learned from this course are effective use of data structures and algorithms that will play a big part in the development of the project. The relevant algorithms and data structures to use from this course will be decided during the research/implementation phase of each feature in the project.

SYSC 3110: Software Development Project is a course teaching different patterns, refactoring and writing readable and reusable code [18]. The model-view-controller pattern is going to be used as the model will be interacting with this system's database and will not be impacted by the view [20]. Other methods such as inheritance and template methods are going to be implemented whenever needed to make sure the code remains easy to read and edit. The biggest skill gained from this course is proper writing of code and refactoring to ensure the code is reusable, easy to debug and be used by others.

SYSC 3303: Real-Time Concurrent Systems course included concepts of concurrency, and real time systems. The use of datagram sockets will be used to implement the notification system which will involve sending and receiving requests [21].

## 2.5. Individual Contributions

### 2.5.1. Progress Report Contributions

- Abstract - Zinah
- Acknowledgements - Zinah
- Section 1: Background
    - Problem statement - Zinah

    - Motivation - Zinah
    - Solution - Zinah
    - Overview - Tooba
- Section 2: The Engineering Practices
    - Health and safety - Tooba
    - Engineering Professionalism - Tooba
    - Project Management - Zinah
    - Suitability for the program degree - From proposal
    - Individual contributions - Both
- Section 3: Progress
    - Research - Both
    - Database - Tooba
    - GUI - Both
- Section 4: Future Progress
    - Notification - Zinah
    - Charts - Tooba
    - Updated Gantt Chart - Both
- Section 5: Reflection section
    - Objectives Met - Zinah
    - Changes - Tooba
    - Reflection of Decisions - Tooba
    - Teamwork Challenges -Zinah
- Section 6: Conclusion - Tooba

#### 2.5.2. Proposal Contributions

- Title (both)
- Table of Contents (both)
- Objectives (both)
- Background (Tooba)
- Description (Zinah)
- Degree (Tooba)
- Proposed Timeline (Gantt Chart and internal deadlines) (Both)
- Risks (Zinah)
- Special components and facilities (Tooba)
- References (Both)
- Interviews (Both)
- Appendix (Both)

#### 2.5.3. Project Contributions

- Diagrams - Both:
    - GUI Design
    - UML
    - Entity Relation Diagram
- Database:
    - Database creation and set up - Both
    - JDBC connection - Both
    - Creating the SQL tables - Zinah
    - Queries (get full table and individual attributes from sql to java) - Tooba
- Java Application:
    - MVC and Main GUI Frame - Both
    - Menubar - Tooba
    - Login Page - Tooba
    - Page Template (CardLayout) - Zinah
    - Table Template - Zinah
    - Employee Information GUI Frame - Tooba
    - Creating Notes (GUI and model) - Tooba
    - Employee Dashboard - Zinah
- Other features in progress

## 3. Progress

### 3.1. Research

After deciding to develop a desktop application instead of a website we came across the issue of choosing the proper database that would allow multiple people to access and populate data at the same time from multiple machines. That has led to learning about the local SQL server and we considered developing our database locally and connecting it to our website [21]. The local server would run on one machine and other users can connect remotely to that local server, but after doing more research and more learning about this type of connection, it was found that as soon as the machine that runs the main server shuts down the server will shut down as well and all connection will be lost [21]. This doesn't serve the purpose of having an efficient employee management system and we can't have a full product depending on one machine especially in cases where the machine could run into issues.

This problem was solved using a remote server instead where our database is hosted online and accepts all types of connections from many different devices at different

times which will guarantee that the database is live and running at all times [22]. These servers are hosted by different vendors such as Amazon AWS [18], Microsoft Azure [20], Hostpapa [19], and many others. We considered using Microsoft Azure [20] but after reading more about this solution we found that it may not provide the type of connection we want, which is a remote server connecting to a desktop application and it was more enterprise based as seen from their pricing plans which we didn't really need for our project [20]. Hostpapa was our second option but we found out that it only accepts connections from web applications and not desktop so that did not serve our project purpose[19]. Amazon AWS worked perfect for us since it accepted connection from desktop applications and it had the lowest cost while offering a 12 month trial and that worked for our project [18]. Then we processed into researching how to create the database instance and connecting it to mysql Workbench, the database instance was configured on Amazon RDS and then we both connected to it using our Mysql Workbench [15].

Research also involved looking into connecting the database to the SQL server. The highest recommended way to connect to a java application is using JDBC [6]. JDBC (Java Database Connectivity) is a library that offers connection with a SQL database. Using the configuration information of the database, JDBC connects to the SQL server and allows the developers to run queries through the java code. This will be used for functionality such as getting, adding, removing, updating, and verifying the data for the employee management system.

The diagramming tool to create entity relationship diagrams and UML was also researched. The first attempt was to use Violet UML Editor [10] which was dropped due to not being able to share live with partners. The next one was drawSQL [9] which was also not used due to it not offering ER diagram templates with relationships. It only offered drawing the schema out in table format. LucidChart was picked because of its easily available templates and live editing between teammates [11]. Lucid Chart also has an easy-to-use interface and can be used to create many different diagrams.

### 3.2. Database

After researching the database, the database and entity relation diagram (ER diagram) needed to be created. There were two issues involving this which delayed the progress on the database. To create an Amazon AWS account, credit card information was required although the free trial was being used. Similar issue with creating the ER diagram; the tool Lucid chart that was used to create the diagram had limited use and required a premium account for full access. The IT department was contacted with the

help of Professor Lynn and both issues were resolved through putting in a purchase request for these items.

After creating the Amazon RDS account, the database was created and connected to MySQL workbench. The ER diagram for the database was created as well [A7]. After setting up the database, the database needed to be connected to the java application. JDBC (Java DataBase Connectivity) was used for this purpose [6]. The connection required a SQL connector library which was linked through the amazon help page [5] and was added to the project structure in IntelliJ [7]. At this point, the database has successfully been created and connected to the Java application. Dummy data was written in the form of sql queries to fill the database and test out the connection to the application in IntelliJ.

### 3.3. GUI

The application development started with creating a simple UML diagram [A8]. This was followed up by creating an MVC structure. The menu bar, login page and card layout [8] were implemented next to set up the basic layout of the GUI. Basic commands were also added to the model to implement some functionality. A lot of research is currently ongoing in terms of the frontend part such as figuring out how to navigate between tabs, figuring out different ways to reuse frontend components such as JTable, and researching ways to read data from the database and display it in our application [16]. We are looking to finish adding many different pages to the GUI and be prepared to add functionality to the sending and receiving request features by December 9.

## 4. Future Progress

### 4.1. Notification

Notification system setup was moved to be developed during the holidays due to the refining of the schedule and prioritizing other deadlines. The development of this part was supposed to be done by November 30 but it is now moved to be finished during the winter break.

### 4.2. Charts

Due to the delay in the timeline, development of the notifications feature has moved into the winter break. This time was allocated to developing the charts feature. The charts are a live updating graph that will have filters to select and edit the data points. This feature will be moved further into January because of the change in the timeline.

The charts feature will be set to be completed by the first week of January to help keep the rest of the semester on track with the created deadlines.

### 4.3. Updated Gantt Chart

The Gantt chart has been updated to show the new timeline [A6]. Changes include moving the deadlines forward to show actual development dates.

## 5. Reflection

### 5.1. Objectives Met

The project's objective for this term was to have a functioning GUI with a notification system running and a database populated with data. Some of these objectives were not met this term such as the GUI is still at the early phases of development, we have a schema and the database is running and connected but the schema is still not reflected in our database. The schedule needs to be refined and new deadlines must be made [A6].

### 5.2. Changes

There are no changes made to any features and development tools as of now. As the project is still in progress, it is difficult to identify whether the objectives have been met. However, there is good progress towards development of the system. Development of the database stayed on track. The database has been successfully created and connected to the application within the deadline. The GUI development on the other hand was slower due to being overlapped with the development of the database and unrealistic deadlines.

### 5.3. Reflection of Decisions

Internal development deadlines would be created differently if the project was to be restarted. The deadlines were created without proper regard to external factors that delay the development. Other course deadlines were completely ignored and writing the project reports were not considered while creating development deadlines. Both team members hold part-time jobs, and this was also not considered as a factor in the deadlines. The only things considered while allocating development time for each feature was the difficulty level of implementing the feature and final exam dates for courses. This has caused problems in being able to maintain the deadlines for GUI development. The GUI was being developed at the same time as the database. With

other course deadlines, it was harder to focus on both GUI and database at the same time.

### 5.4. Team Work Challenges

Our team has been doing good in terms of communication, having a two people group made keeping in touch and synchronized a lot easier. There have been some cases where both team members have disagreed but we always managed to resolve those disagreements and do what's best for our project.

## 6. Conclusion and Recommendations

All in all the project is being developed at a good pace. Even though the actual development timelines set weren't followed, the timeline has been adjusted to keep on track. The current timeline will make sure all the features are still included. There haven't been many challenges in team work. Features and tools have not needed to change since the start of the project and only change would be made towards the timelines. Moving forward the focus will shift to development more than researching as a major part of research is done. The team will also be more mindful of other course loads to ensure completion of the project.

**References**


[1] “Health and Safety Manual,” *carleton.ca*
http://www4.sce.carleton.ca/courses/health-and-safety.pdf

[2] “Forms and Templates - Office of Research Ethics,” *carleton.ca*.
https://carleton.ca/researchethics/forms-and-templates/

[3] “Public Guideline on the code of ethics,” *Engineers Canada*.
https://engineerscanada.ca/publications/public-guideline-on-the-code-of-ethics#-the-code-of-ethics

[4] “Professional Misconduct (Section 72 of the Regulation - O. Reg. 941),” Professional Engineers Ontario.
https://www.peo.on.ca/about-peo/what-peo/acts-regulations-and-laws/professional-misconduct-section-72-regulation-o-reg

[5] “Adding an Amazon RDS DB instance to your Java application environment - AWS Elastic Beanstalk,” *docs.aws.amazon.com*.
https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/java-rds.html

[6] “Java Database Connectivity with MySQL - javatpoint,” *www.javatpoint.com*, 2011.
https://www.javatpoint.com/example-to-connect-to-the-mysql-database

[7] “How to Add JAR file to Classpath in Java?,” GeeksforGeeks, Feb. 11, 2021.
https://www.geeksforgeeks.org/how-to-add-jar-file-to-classpath-in-java/

[8] “java - How to create a swing application with multiple pages,” *Stack Overflow*.
https://stackoverflow.com/questions/27687427/how-to-create-a-swing-application-with-multiple-pages

[9] “DrawSQL - Database schema diagrams,” *DrawSQL*. https://drawsql.app/

[10] “Violet UML Editor,” *SourceForge*. https://sourceforge.net/projects/violet/

[11] Lucidchart, “Online diagram software & visual solution | Lucidchart,” *Lucidchart*, 2022.
https://www.lucidchart.com/pages/

[12] Wikipedia Contributors, “Phoenix pay system,” *Wikipedia*, Jul. 09, 2019.
https://en.wikipedia.org/wiki/Phoenix_Pay_System

[13] LucidChart, “ER diagram tutorial,” Lucidchart.com, 2017. https://www.lucidchart.com/pages/er-diagrams

[14] “Features & Benefits,” *CLEARVIEW*. https://clearviewconnect.com/features-benefits/

[15] “Getting Started with AWS RDS and MySQL | How to Connect AWS RDS with MySQL Workbench,” *www.youtube.com*. https://www.youtube.com/watch?v=fhDhfG9MEF8

[16] “How to Use CardLayout (The Java™ Tutorials > Creating a GUI With JFC/Swing > Laying Out Components Within a Container),” *docs.oracle.com*. https://docs.oracle.com/javase/tutorial/uiswing/layout/card.html

[17] “Java Swing How to - Switch Component with CardLayout,” *www.java2s.com*. http://www.java2s.com/Tutorials/Java/Swing_How_to/Layout/Switch_Component_with_CardLayout.htm

[18] AWS, “Amazon Relational Database Service (RDS) – AWS,” *Amazon Web Services, Inc.*, 2019. https://aws.amazon.com/rds/

[19] B. S. Reviewer, “HostPapa Review,” *WebsiteSetup*. https://websitesetup.org/hosting-reviews/hostpapa/

[20] “Microsoft Azure SQL Database vs. MySQL Comparison,” *db-engines.com*. https://db-engines.com/en/system/Microsoft+Azure+SQL+Database%3BMySQL

[21] chugugrace, “Understanding the Differences between Local and Remote Execution - SQL Server Integration Services (SSIS),” *learn.microsoft.com*. https://learn.microsoft.com/en-us/sql/integration-services/run-manage-packages-programmatically/understanding-the-differences-between-local-and-remote-execution?view=sql-server-ver16

[22] rwestMSFT, “Remote Servers - SQL Server,” *learn.microsoft.com*. https://learn.microsoft.com/en-us/sql/database-engine/configure-windows/remote-servers?view=sql-server-ver16

[23] “Web Application vs. Desktop Application,” *Qulix Systems*, Feb. 05, 2021. https://www.qulix.com/about/web-app-vs-desktop-app/

[24]LucidChart, “ER diagram tutorial,” Lucidchart.com, 2017. https://www.lucidchart.com/pages/er-diagrams

[25]“Basic SQL Commands - The List of Database Queries and Statements You Should Know,” freeCodeCamp.org, Jan. 01, 2020. https://www.freecodecamp.org/news/basic-sql-commands/

**Appendix A**

[A1] Professor Hala - Human Centric Research Expert
[A2] Terrence Odin - Director of Transformation and Technology
[A3] Kim Plourde - Mcdonald's Administrative Manager
[A4] Youssef Hojeij - M365 Technical Analyst
[A5] James Sauve - Senior Programmer Analyst
[A6] Gantt Chart
[A7] ER Diagram
[A8] UML
[A9] Design Iteration 1
[A10] Design Iteration 2

**Appendix B**

[B1] Proposal Page#21

Carleton University
Faculty of Engineering and Design
Department of Systems and Computer Engineering

Project Proposal

# Employee Management System

October 15, 2022

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Prepared by:
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# 1. Objectives

## 1.1. Purpose

The main objective of our project is to design and build an enterprise resource planning (ERP) system to manage and securely store personal and work-related information for employees and managers in a user-friendly interactive environment [33]. The system is meant to provide a portal for employees to access any administrative information they require while also allowing managers and Human Resources (HR) to be able to handle administrative tasks.

## 1.2. Functional Requirements

The system is a desktop application with three main levels of access: employees, managers, and human resources. Each staff member can access the system using personal credentials with different levels of authorizations depending on their position.

The system allows employees to view their own salary related information, schedule and current assigned project. The system allows employees to put in requests for equipment, vacation and to work from the office. The system does not allow employees to edit any information.

The system allows managers and administrative staff (HR) to view employees, respond to requests, make notes in an employee's file and provide yearly feedback. Managers can further keep track of projects and their details. HR has additional access to add, remove and edit employees in the system.

## 1.3. Non-Functional Requirements

The system will be developed using the Java framework Swing[17]. The system will follow a Model View Controller (MVC) design pattern and will run on Windows OS based devices [25]. It will have its own database hosted on an online remote MYSQL server[54]. It is developed using MYSQL [19] on MYSQL workbench [20] and it will be connected to the application using libraries such as Java JDBC[21]. A Github repository will be used to maintain and manage the code[22].

## 1.4. Plan for Measuring Progress

A Gantt chart has been created to show the development deadlines of the project [65]. The project has been divided based on the most important features. The Gantt chart also shows the division of tasks between team members. The aim is to have

60% of the development done by January. The development progress will be further tracked using Github.

Internal deadlines have been set to keep the project deliverables on track. These deliverables include any reports and documents required to be submitted over the course of the project. The deadlines set in the winter semester in January, 2023 are subject to change based on course work.

## 2. Background

The Employee Management System is meant to be an ERP (Enterprise Resource Planning System) which allows any staff member to access the system and handle day-to- day tasks. The idea to develop an ERP came from issues noticed in current ERP systems such as the Clearview[32] and Phoenix[4] systems. After researching and interviewing the users of current systems, our system is being developed to overcome any shortcomings. There are many ways to classify an ERP. ERP are based on company needs, whether the system is on-premise or cloud based, company size and industry specificity [34].

### 2.1. Ellucian Banner System

The banner system is a specialized ERP system made for schools and educational organizations. It has 3 modules: finance, students and human resources. It is also a hybrid on-premise and cloud based system and connects to many adjacent systems [37]. The adjacent systems can include hiring, reporting and pension systems as seen with Carleton university's implementation of the system. After an interview with the Carleton's head of HR, some pros and cons of the system can be defined.The system is extensive and more directly interfaces with the database to get information. One of the biggest drawbacks is the expandability of the system. The system requires multiple years of research and development to implement changes [38]. The system also does not have a proper information intake system such that the hiring system cannot send information to the banner system, requiring employees to be manually added. Employee files at Carleton were being stored physically until recently, and covid had a drastic impact on system's ease of use eliciting the system to be upgraded and employee information being stored in the system as of now [61].

### 2.2. Clearview Panasonic System

The Clearview Panasonic system is a restaurant based ERP system used to track inventory, manage employees, manage payroll, manage accounts receivable and connected to external point of sale systems [32]. The system seems to fall under the cloud based ERP and is also specialized towards restaurant systems [31]. The system is

mainly used by management and HR to handle administrative tasks. The current system works really well with managing employees and inventory. The few drawbacks found were not being able to track who is eligible for benefits, not being paperless and having to connect to external systems to do paystubs. The employee portal does not show any information about schedules or benefits, requiring email for both [62].

### 2.3. Phoenix System

It is the government of Canada's pay and benefits application with self-service features for both employees and managers. Employees can access information such as their pay stubs, paychecks, their schedules, and benefits[4]. Each employee is assigned to a manager and the manager is responsible for assigning the employee's work schedule, approving payable and non payable times, and editing timesheets. Employees have to use another different system to report their overtime requests and days off/vacation which is a major drawback because it is hard to navigate between two systems when everything could be merged into one system since all information is related. In addition to the integration issues, scalability issues make the system expensive to maintain[48].

### 2.4. Latest Technology

The current best ERP systems are Acumatica [48] and Oracle [47]. The Acumatica system is a versatile system which is designed based on the company's needs. The system can be deployed either on premise or cloud based. The company also has a very good set up to provide technical help. While the system is easily scalable, the pricing can be steep and not clear [46]. The Oracle netsuite ERP is a cloud based system [40] that provides very good scalability and has an easy to navigate interface. The Oracle system has very good report generating tools which can provide detailed information to a company [47].

### 2.5. Our System

As mentioned before, the system being created is to cover some of the drawbacks found in other systems. The system is an on-premise ERP and is not going to be specialized towards a certain industry. The system is catered towards mid-size companies that work on a project basis. Mid-level ERP’s are cost effective and reasonable for growing small and mid-size companies [42]. The system is going to include an employee portal, to give employees access to all relevant information about their position and workplace in one place. The system is to also automate the adding employees into the system without requiring manual intervention. The system is also built to keep employee information paperless. This system is also going to

include a report generating feature, which can be very useful to companies. Most of the features are meant to be compatible with a small company's needs, and are being developed to be easily specialized for mid-size companies.

## 3. Project Description

The system provides a User-friendly platform to help employees from different levels to manage day to day challenges and achieve the goal of their organization. After doing research and looking into existing management systems such as Phoenix[4], Clearview[32], and Carleton HR [37] and seeing the different features and pros and cons of these systems, it was decided that three levels of access to the system are needed to easily guide and manage information in the right direction. The three main levels of access are Manager view, Employee view, and HR view. Each view will be accessed via a username/password account and each view will have a different level of authorization depending on their position/job title.

Each view will contain standard pages such as Dashboard, Salary, schedule, and Request. As well as a landing page that every user must use to login into the system [67]. Other pages and tabs are designed based on the needs of each view. The system will store and manage the information of the users using a database. In order to make a use of the stored information and provide less manual work for the managers in keeping track of informations such as yearly salaries for each employee or their attendance, a real time generating reports feature will be developed to take the existing stored data and display it in the form of a chart, similar to Excel charts [57] or Microsoft PowerBi [58]. This feature is meant to help managers to keep paperless real time updated records of their employees. This feature will only be available in Manager and HR views as this is part of the managers daily tasks [67].

A major key feature in the HR view is using automation to automate the process of addition of new employees[67]. Most of the management systems we looked at in our research such as Phoenix[4] and Carleton HR system [37], as well as the people that were interviewed such as Terrence [61] and Kim [62] all lacked the automation feature and struggled with the onboarding process of new employees. Most of the work had to be done manually such as creating an account and storing information in the database or getting the employee's signature on forms such as contract and training. The HR manager user will use the Add Employee page to enter all the required information for the onboarding process, then use this information to add the new employees in the database and create a username and a temporary password for them. Also, sending them important forms to be signed, assigning a manager to them, and displaying information in the system which will be later available to the managers to review [67].

Employees from all levels will be able to view their schedule for the day. Also, both employees and managers will be able to keep track of what projects they are currently supervising/working on or have supervised/worked on. A notification system is set up for all three views, as well as other important pages[67].

## 4. Relevance to Degree

The relevant degree for this project is B.Eng. in Software Engineering. Both the team members are currently enrolled in B.Eng. in Software Engineering and have taken the same courses. This section will summarize the relevant skills that were learned in this program and the methods being utilized from the courses. The project is a software-only project involving the use of Java and a database. Both Java and SQL were studied to this degree. The relevant skills can be broken down into three categories: project planning, Java development and database.

### 4.1. Project planning

Project planning refers to organizing the project to ensure that the necessary features are included and have been set with realistic deadlines. It also refers to gathering all the information needed to implement the project in a way that is useful to the users and researching any technical requirements. The relevant courses are SYSC 3120 and SYSC 4106.

SYSC 3120: Software Requirements Engineering outlines how to research any project and model its requirements [23]. This course helped with finding the right people to interview and what kinds of questions to ask them. As the system is an employee based system, multiple HR and technical individuals who have worked with similar systems were chosen to be interviewed to fill in the gaps in the team's knowledge. This course has also taught us how to model these requirements, the main model we will be using is the UML diagram. Further models such as sequence diagrams and use cases will be used if the system requires them.

SYSC 4106: The Software Economy and Project Management is a course that outlines project management. The course showed team management and how to plan the project [23]. Using the skills learned in this course, the project has been set to be developed using an incremental model [29][30]. After the initial research phase, the project will be developed to a simple system that allows the user to send and receive requests. Which will be followed by the testing phase. After the first version of the system is completed, any further features being added will follow the same research, develop and test phase [24]. The main features for each phase are sending and receiving requests based on a notification system, generating charts and reports,

automation, adding necessary employee system pages with the last feature being improving the UI design.

### 4.2. Database

The most important part of the project is the database. As an employee system can contain information about thousands of employees, the project requires a database. COMP 3005: Database Management System [27] taught the basics of a database and running SQL commands [56]. This project will be using a SQL database. The main concepts that will be used from this course are designing a database using the entity relationship model [55] and creating a database.

### 4.3. Java Development

The largest part of the development is going to involve programming in Java. There are multiple courses in the software engineering program that not only have been purely in Java but also demonstrated coding standards and methods to implement code in an efficient manner.

Starting with SYSC 2004: Object Oriented Development taught the basics of object oriented programming, showing how to make the code modular and using iterative development [23]. The main concepts that are going to be applied in the project from this course are object oriented programing and test driven development. This course also introduced Java swing GUI which will help create the GUI of this project.

Next relevant course is SYSC 2100: Algorithms and Data Structures. This course was really important in introducing different collections, data structures, recursive and sorting algorithms [23]. The main skills learned from this course are effective use of data structures and algorithms that will play a big part in the development of the project. The relevant algorithms and data structures to use from this course will be decided during the research/implementation phase of each feature in the project.

SYSC 3110: Software Development Project is a course teaching different patterns, refactoring and writing readable and reusable code [23]. The model-view-controller pattern is going to be used as the model will be interacting with this system's database and will not be impacted by the view [25]. Other methods such as inheritance and template methods are going to be implemented whenever needed to make sure the code remains easy to read and edit. The biggest skill gained from this course is proper writing of code and refactoring to ensure the code is reusable, easy to debug and be used by others.

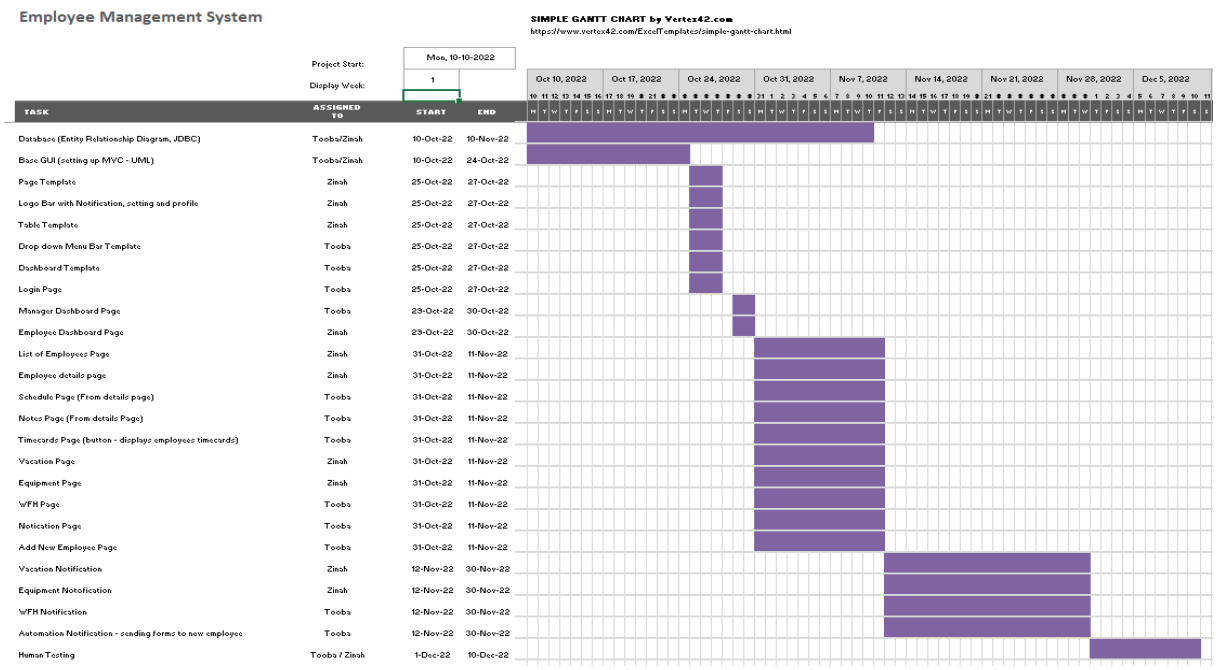
SYSC 3303: Real-Time Concurrent Systems course included concepts of concurrency, and real time systems. The use of datagram sockets will be used to implement the notification system which will involve sending and receiving requests [26].

## 5. Timeline

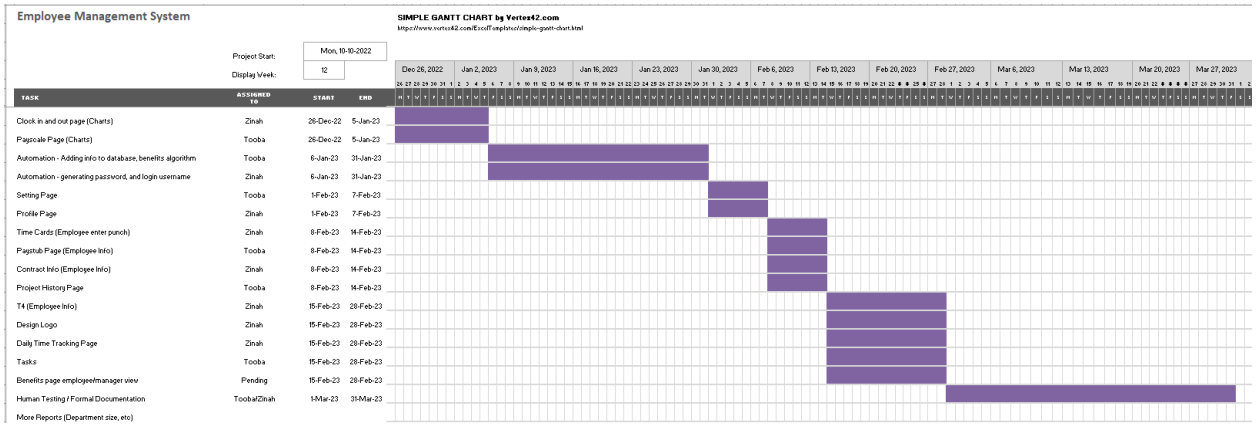
### 5.1. Gantt Chart

The Gantt chart shows the breakdown of the project by feature and shows the development deadline [Gantt Chart].

Semester 1:




Semester 2:



## 5.2. Internal Deadlines

The pink refers to internal deadlines. The orange refers to the actual deadlines. The white rows show the time that has been allotted to work towards the pink and orange deadlines.

| Task | Start Date | End Date |
|---|---|---|
| Project proposal Progress<br>Research<br>Requirements<br>Design | August 22, 2022 | September 30, 2022 |
| Draft Proposal Due | September 30, 2022 | |
| Proposal Due Date | October 21, 2022 | |
| Heavy Development | October 10, 2022 | January 5, 2023 |
| Draft Progress Report Progress | November 7, 2022 | November 13, 2022 |
| Draft Progress Report Due | November 18, 2022 | |
| Progress Report Due | December 9, 2022 | |
| Exam Break + Break | December 10, 2022 | December 25, 2022 |
| Oral Presentation Progress | January 2, 2023 | January 15, 2023 |
| Finalizing Development | January 5, 2023 | March 15, 2023 |
| Oral Presentation Day | January 24, 2023 | |
| First Final Report Draft Progress | February 6, 2023 | February 12, 2023 |
| First Final Draft Progress Due | February 17, 2022 | |
| Poster Fair Progress | February 13, 2023 | March 5, 2023 |
| Poster Fair Due | March 17, 2023 | |
| Second Final Report Draft | March 6, 2023 | March 19, 2023 |
| Second Final Report Draft Due | March 24, 2022 | |
| Final Report Progress | March 20, 2023 | April 9, 2023 |
| Final Report Due | April 12, 2022 | |

## 6. Risks

### 6.1. General Risks

The project includes multiple risk scenarios that could occur during the development phase. These risks include technical issues such as certain features not performing properly, debugging issues or issues with the design that had to be changed. There could also be delays in the schedule such as sickness or personal issues[65]. Due to the fact that most of these scenarios are out of the team's control, certain features were prioritized to be completed in the early phases of the development so that in the case of unexpected circumstances, the project could still have some of its main important features working. These features include the notification system, generating live reports, a fully working database, and manual operating of the HR (human resource) side. That way it is still possible to have a presentable working product even if it doesn't include quality of life features[67]. The phases of development is broken down as follows [65]:

- Phase A involves developing the database along with a basic GUI which communicates with the database.
- Phase B is implementing the notification system along with the basic HR functions in the month of November.
- Phase C is implementing the generating of reports and charts.
- Phase D is automating the addition of employees into the system, and generating their account .
- Phase E is implementing extra functionalities that are useful to an employee management system.

### 6.2. Security

A major risk in our system would be to allow remote control to our database for the purpose of testing. When configuring our database there is an option to allow remote control from different devices that are connected to the same network or from different networks. We might need to enable the option for a certain period of time to allow remote access to the database. This option will be closed when remote access will no longer be required. [13]

### 6.3. Database Backup

Another major risk is the database backup. During our interviews with Kim [62] and Terrence [61] we found that many companies tend to keep records of their previous employees even if those employees no longer work with the company anymore. A

scheduled backup of our database might be needed in order to keep track of the history of employee records. This backup could be done through MYSQL workbench [20] and if the backup fails then the system will be at risk of losing important information[16].

6.4. Duplication During the Automation Process

There is a chance of duplication when doing the automated addition of new employees [11]. If two managers added the same employee at the same time then the system should be able to recognize that it is the same person and not duplicate the information [12].

6.5. Multiple Access to the Database

Multiple access to our database will be enabled, but there is the risk of overwriting [9]. If two users made changes to the database at the same time, then the changes made by the first user can be overwritten by the changes made by the second user. This could cause concurrency problems in the database and affect the flow of the system [9]. One option is to allow only user use to edit the database at time or configure the database to handle conflicts and maybe remove duplicates or add new information without affecting the existing data [10].

## 7. Special Facilities

There are not many special facilities required by this project. Human testing is a definite requirement if the project is to be tested by external individuals. The other facility is the use of a remote MYSQL server which is a paid subscription.

7.1. Human Testing

The system is a software application which is built for users with none to minimum technical experience. This requires the project to be tested by users with no technical background. After the interview with Professor Hala [60] discussing the testing of the project, she recommended getting permission from the faculty as this is considered human testing of the lowest risk [59].

7.2. Database

The main choice for a database is SQL. It is a free database to use. The backup choice for the database is Azure. Azure is a subscription based service which includes access and use of a database that is maintained by Microsoft [46]. The reasoning for a backup database is to mitigate accessibility issues [28].

## 8. References


[1] C. Custer, “SQL vs MySQL: A Simple Guide to the Differences,” *Dataquest*, Feb. 11, 2021. https://www.dataquest.io/blog/sql-vs-mysql

[2]“HR Software for Canadian Businesses - Humi,” *www.humi.ca*. https://www.humi.ca/lp/hr-software?utm_source=technologyadvice&utm_medium=cpc&utm_campaign=software&visitor_id=

[3]“MySQL - The Basics // Learn SQL in 23 Easy Steps,” *www.youtube.com*. https://www.youtube.com/watch?v=Cz3WcZLRaWc&list=RDLV2bW3HuaAUcY&index=7

[4]Wikipedia Contributors, “Phoenix pay system,” *Wikipedia*, Jul. 09, 2019. https://en.wikipedia.org/wiki/Phoenix_Pay_System

[5]“E-Health Care Management System using Java with Source Code | ProjectAbstracts.com – Projects Ideas and Downloads,” *projectabstracts.com*. https://projectabstracts.com/25599/e-health-care-management-system-using-java-with-source-code.html

[6] savjani, “Overview - Azure Database for MySQL,” *learn.microsoft.com*. https://learn.microsoft.com/en-us/azure/mysql/single-server/overview

[7] “Microsoft Azure SQL Database vs. MySQL Comparison,” *db-engines.com*. https://db-engines.com/en/system/Microsoft+Azure+SQL+Database%3BMySQL

[8] *login.microsoftonline.com*. https://answers.microsoft.com/en-us/msoffice/forum/all/multiple-users-accessing-access-database/0cce7491-74cb-43a6-8a08-beb09172d7a9

[9 ]H. Miller, Ed., “How Can Multiple Users Access the Same Database?,” *geneious prime*, Aug. 31, 2021. https://help.geneious.com/hc/en-us/articles/360044628712-How-can-multiple-users-access-the-same-database-

[10] “mysql - Can multiple users insert into a server database simultaneously?,” *Stack Overflow*.https://stackoverflow.com/questions/61871739/can-multiple-users-insert-into-a-server-database-simultaneously

[11]“MySQL concurrency, how does it work and do I need to handle it in my application,” *Stack Overflow*.

https://stackoverflow.com/questions/4828490/mysql-concurrency-how-does-it-work-and-do-i-need-to-handle-it-in-my-application

[12] “Database Concurrency Conflicts in the Real World,” *www.codemag.com*. https://www.codemag.com/article/0607081/Database-Concurrency-Conflicts-in-the-Real-World

[13]“How to Allow Remote Connections to MySQL,” *Help Desk Geek*, Aug. 09, 2021. https://helpdeskgeek.com/how-to/how-to-allow-remote-connections-to-mysql/

[14 ]“Java Database Connectivity with MySQL - javatpoint,” *www.javatpoint.com*, 2011. https://www.javatpoint.com/example-to-connect-to-the-mysql-database

[15]“MySQL: CREATE USER statement,” *www.techonthenet.com*. https://www.techonthenet.com/mysql/users/create_user.php

[16 ]“How to Backup MySQL Database on Windows – SqlBak Blog.” https://blog.sqlbak.com/how-to-backup-mysql-database-on-windows#:~:text=To%20create%20a%20backup%20using

[17]“javax.swing (Java Platform SE 7 ),” *docs.oracle.com*. https://docs.oracle.com/javase/7/docs/api/javax/swing/package-summary.html

[18]Wikipedia Contributors, “Model–view–controller,” *Wikipedia*, Jan. 21, 2019. https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

[19]Wikipedia Contributors, “MySQL,” *Wikipedia*, May 15, 2019. https://en.wikipedia.org/wiki/MySQL

[20]“MySQL :: MySQL Workbench,” *Mysql.com*, 2019. https://www.mysql.com/products/workbench/

[21]“What is JDBC?,” *www.ibm.com*, Aug. 30, 2021. https://www.ibm.com/docs/en/informix-servers/12.10?topic=started-what-is-jdbc

[22] B. Jackson, “What Is GitHub? A Beginner’s Introduction to...,” *Kinsta Managed WordPress Hosting*, Apr. 20, 2018. https://kinsta.com/knowledgebase/what-is-github/

[23]“Systems and Computer Engineering (SYSC) < Carleton University,” *calendar.carleton.ca*. https://calendar.carleton.ca/undergrad/courses/SYSC/

[24]“Incremental Model - javatpoint,” *www.javatpoint.com*, 2011. https://www.javatpoint.com/software-engineering-incremental-model

[25]A. Ulalah, Ed., “Model-View-Controller (MVC) Architecture,” *Academia*, May 2009. Model-View-Controller (MVC) Architecture. https://d1wqtxts1xzle7.cloudfront.net/50526307/MVC-with-cover-page-v2.pdf?Expires=1664635239&Signature=Ku9RwRBeawJZJa5Jr-~f1Eg4UMe~VuI1XYI0SD7TbCrU1BuhRidrLg0FkRz4zdMTpcRSwLz6nZDIThYPCwWkAntOAYTUfIv93Jj4EgGY56E38zNpD0oJuoLmyu2KpRiKr5RgtB4P6-OReeKR9ZBf7VqSMsT6Zzx-uDnwkMVCc3JRqkWD~MsPpkPkPB1xZMYWRdlUkGmzu8g~tcNOk0~dp-ZqQP~jf18yeoPzpMW4k~CbhprYkDLVdeGU-j2pWCSDnE5-Pg3osRG1K1TbYFlRUoGLmPxwrN86BeWBvR4Omrzn3X6FmMZvaHnK5w2Y2eqByvRNpG56QEXxlFs42llF7A__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

[26]“An Advanced Socket Communication Tutorial,” *www.qnx.com*. http://www.qnx.com/developers/docs/qnx_4.25_docs/tcpip50/prog_guide/sock_advanced_tut.html

[27]“Computer Science (COMP) < Carleton University,” *calendar.carleton.ca*. https://calendar.carleton.ca/undergrad/courses/COMP/

[28]“What is Azure?,” *Azure*. https://azure.microsoft.com/en-ca/resources/cloud-computing-dictionary/what-is-azure/?&ef_id=Cj0KCQjwyt-ZBhCNARIsAKH1175LuIBzuyYO3KLFvUxCi7Oo8Fxe39dfjdtLBJmxuuQZCUFAIjCT-VsaAvaCEALw_wcB:G:s&OCID=AIDcmmqz3gd78m_SEM_Cj0KCQjwyt-ZBhCNARIsAKH1175LuIBzuyYO3KLFvUxCi7Oo8Fxe39dfjdtLBJmxuuQZCUFAIjCT-VsaAvaCEALw_wcB:G:s&gclid=Cj0KCQjwyt-ZBhCNARIsAKH1175LuIBzuyYO3KLFvUxCi7Oo8Fxe39dfjdtLBJmxuuQZCUFAIjCT-VsaAvaCEALw_wcB

[29]“The Types of Software Development Models,” *Insight Canada*. https://ca.insight.com/en_CA/content-and-resources/2016/07152016-types-of-software-development-models.html#iterative-model

[30]E. Chowdhury, A. Bhowmik, H. Hasan, and S. Rahim, “Analysis of the Veracities of Industry Used Software Development Life Cycle Methodologies,” *ResearchGate*, Jul. 12, 2017. https://www.researchgate.net/publication/318779643_Analysis_of_the_Veracities_of_Industry_Used_Software_Development_Life_Cycle_Methodologies

[31]“Back Office & Quick Service Software Solutions | Panasonic North America - Canada,” *na.panasonic.com*. https://na.panasonic.com/ca/food-service-systems/back-office-solutions

[32]“Features & Benefits,” *CLEARVIEW*. https://clearviewconnect.com/features-benefits/

[33]“What is ERP? (Enterprise Resource Planning) | QAD,” *QAD2*. https://www.qad.com/what-is-erp#:~:text=There%20are%20three%20main%20types

[34]“Types of ERP Systems,” *steelkiwi.com*. https://steelkiwi.com/blog/types-of-erp-systems/

[35]“Top ERP Systems: List of ERP Systems,” *www.bluecart.com*. https://www.bluecart.com/blog/top-erp-systems

[36]“What is ERP? | Types, Benefits & Implementation,” *Captivea LLC*. https://www.captivea.com/erp

[37]“Ellucian Banner,” *Ellucian Europe, Middle East, Africa, India, and Asia Pacific*. https://www.ellucian.com/emea-ap/solutions/ellucian-banner

[38]“Background,” *Banner ERP Information*, Oct. 15, 2014. https://erp.louisiana.edu/about/background

[39]“OIT Support Center,” *support.stedwards.edu*. https://support.stedwards.edu/s/article/what-is-banner

[40]“What is Oracle ERP Software? | System Integration Guide | Tipalti,” *tipalti.com*, Sep. 18, 2020. https://tipalti.com/en-eu/erp-integrations/oracle-erp/

[41]“What is ERP?,” *Oracle.com*, 2020. https://www.oracle.com/ca-en/erp/what-is-erp/

[42]Dorothy M. Fisher, Melody Y. Kiang, Steven A. Fisher & Robert T. Chi (2004) Evaluating Mid-Level ERP Software, Journal of Computer Information Systems, 45:1, 38-46, DOI: 10.1080/08874417.2004.1164581

[43]V. Kumar, B. Maheshwari, and U. Kumar, “ERP systems implementation: best practices in Canadian government organizations,” *Government Information Quarterly*, vol. 19, no. 2, pp. 147–172, Jan. 2002, doi: 10.1016/s0740-624x(02)00092-8.

[44] Light, B., Holland, C.P. and Wills, K. (2001), "ERP and best of breed: a comparative analysis", Business Process Management Journal, Vol. 7 No. 3, pp. 216-224. https://doi.org/10.1108/14637150110392683

[45]S. Teotia, S. Panwar, and S. Shukla, “Study of the Implementation of ERP Softwares to Enhance Security,” *SSRN*. https://deliverypdf.ssrn.com/delivery.php?ID=125017092064003017104004024082116112041074054049036036007019124101098126006074097124124027025103026004058022098067008009117095104038028011067080065024094066077105123088041042080026080002083010027085116002070025077119121091098073122014109091075121091112&EXT=pdf&INDEX=TRUE

[46]“The Best ERP Software,” *PCMAG*. https://www.pcmag.com/picks/the-best-erp-software

[47]“The Best ERP Software For Your Business – 2020 Review,” *www.quicksprout.com*. https://www.quicksprout.com/best-erp-software/

[48]“Fixing a Government ERP Fail: When Politics and Technology Clash,” *FreeBalance*, Aug. 08, 2017. https://freebalance.com/en/blog/economic-growth-development/fixing-a-government-erp-fail-when-politics-and-technology-clash/

[49]“Connecting to a database on Microsoft Azure via JDBC,” *community.yellowfinbi.com*, Jun. 04, 2019. https://community.yellowfinbi.com/knowledge-base/article/connecting-to-the-yellowfin-db-on-azure

[50]M. Irfan, “MySQL Error: Too many connections,” *Percona Database Performance Blog*, Nov. 28, 2013. https://www.percona.com/blog/2013/11/28/mysql-error-too-many-connections/#:~:text=By%20default%20151%20is%20the

[51]“How to Remotely Connect to the MySQL Database | HostGator Support,” *www.hostgator.com*. https://www.hostgator.com/help/article/how-to-remotely-connect-to-the-mysql-database

[52]“HOW TO SETUP REMOTE DATABASE CONNECTION - CONFIGURE MYSQL CLIENT ACCESS,” *justhost*. https://my.justhost.com/cgi/help/remote-database-connection-setup

[53]“Connect to a MySQL database remotely -,” *docs.rackspace.com*. https://docs.rackspace.com/support/how-to/mysql-connect-to-your-database-remotely/

[54] rwestMSFT, “Remote Servers - SQL Server,” *learn.microsoft.com*. https://learn.microsoft.com/en-us/sql/database-engine/configure-windows/remote-servers?view=sql-server-ver16

[55]LucidChart, “ER diagram tutorial,” Lucidchart.com, 2017. https://www.lucidchart.com/pages/er-diagrams

[56]“Basic SQL Commands - The List of Database Queries and Statements You Should Know,” freeCodeCamp.org, Jan. 01, 2020. https://www.freecodecamp.org/news/basic-sql-commands/

[57] J. Oetting, “Data Visualization 101: How to Choose the Right Chart or Graph for Your Data,” *blog.hubspot.com*, 2020. https://blog.hubspot.com/marketing/types-of-graphs-for-data-visualization

[58] mihart, “What is Power BI? - Power BI,” *learn.microsoft.com*. https://learn.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview

[59]“Forms and Templates - Office of Research Ethics,” *carleton.ca*. https://carleton.ca/researchethics/forms-and-templates/

## 9. People Interview

[60] Professor Hala - Human Centric Research Expert
[61] Terrence Odin - Director of Transformation and Technology
[62] Kim Plourde - Mcdonald's Administrative Manager
[63] Youssef Hojeij - M365 Technical Analyst
[64] James Sauve - Senior Programmer Analyst

## 10. Appendix

[65] Gantt Charts
[66] Design Iteration 1
[67] Design Iteration 2
[68] Splitting Work