



ALEXANDRIA UNIVERSITY

FACULTY OF ENGINEERING

COMPUTER AND SYSTEMS ENGINEERING

DEPARTMENT

GRADUATION PROJECT

HR Data Warehousing Management System

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August 06, 2020

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1- CHAPTER ONE: INTRODUCTION

1.1 Preamble

The trend of workforce management processes began during the 1970s. Due to limited technology and mainframe computers, companies were still relying on manual entry to conduct employee evaluation and to digitize reporting.

Now, HRMS technologies have allowed HR professionals to shy away from their traditional administrative work and have inserted them as strategic assets to the company. For example, these roles include employee development, as well as analyzing the workforce to target talent-rich areas.

1.2 Project motivation

The workforce is the basic element of any corporation that if correctly analyzed and managed accurately can lead to prosperity of this entity and revolutionary predictions that may save resources or achieve massive profits if analytics were accurate enough to read the future.

1.3 Problem Statement

The amount of data is massive and highly variant and distributed over many databases that are not connected or mapped in a clear way that helps extracting valuable information , in addition the scatter of this data makes it more difficult for hr employees to analyze them for certain purposes which waste unnecessary time and analysis might not be very accurate which might lead latter on to taking wrong decisions that would cost the corporation an unnecessary cost whether as using unneeded resources (recruiting , time consuming ,...) or waste of already existed resources (an excellent employee skills unused or a project with high profit gets rejected for wrong predictions based on inaccurate analytics).

This data must be gathered in a Data-Warehouse that connects all variant aspects of the corporation where it can be managed dynamically viewed, updated and analyzed applying data mining techniques with trusted predictions for better decision making and less HR employees.

1.4 Project aim and objectives

Aim:

We aim to build a human resources management system to collect all corporation data to one system which connects all variant aspects of the corporation to perform data mining and analysis.

Objectives:

1- Employee self service : This module allows employees to login to the system, view their personal data, view but not modify time sheets, attendance, and performance reports.

2- Attendance : This module keeps track of dates and exact time of attending and leaving the office for any employee, also absence and permissions ... etc.

3- Feedback : Analyze the feedback data for skill ranks for every employee on each project as well as project success analysis based on employees feedback on projects they've worked on.

4- Tasks` time tracking and scheduling : Time tracking for tasks assigned to each employee including time duration , business weight of this task to serve performance analysis , ranking based on difficulty , skills needed.

5- Talent Management : This module uses the data available for the skills rating and progress of the workforce to assign tasks to the employees.

7- Training module : This module recommends suitable training programs for employees based on their skill ranking.

8- Performance Evaluation : This module evaluates the performance of each employee based on several attributes: attendance, task completeness, time of completing the task, skill ranking and training taken.

9- Predict Strength and Weakness Fields : This module defines the reason behind project failure based on data represented by project performance evaluation function.

10- Recruitment : This module analyzes the data of candidates from the cv pool and compares the given data with the already stored data of current and previous employees to determine most suitable candidates to fit or fulfill the shortage of specific skills needed.

1.5 Project Scope

- Web Application provides several services for HR(s) and Managers to help them manage all aspects of the workforce in an efficient manner.
- Provide interfaces for employees to be more involved with Hr and Managers in a transparent mechanism to guarantee integrity and a healthy work environment.
- Use data warehousing to provide better performance and data analytics for decision making and prediction.

1.6 Project Schedule

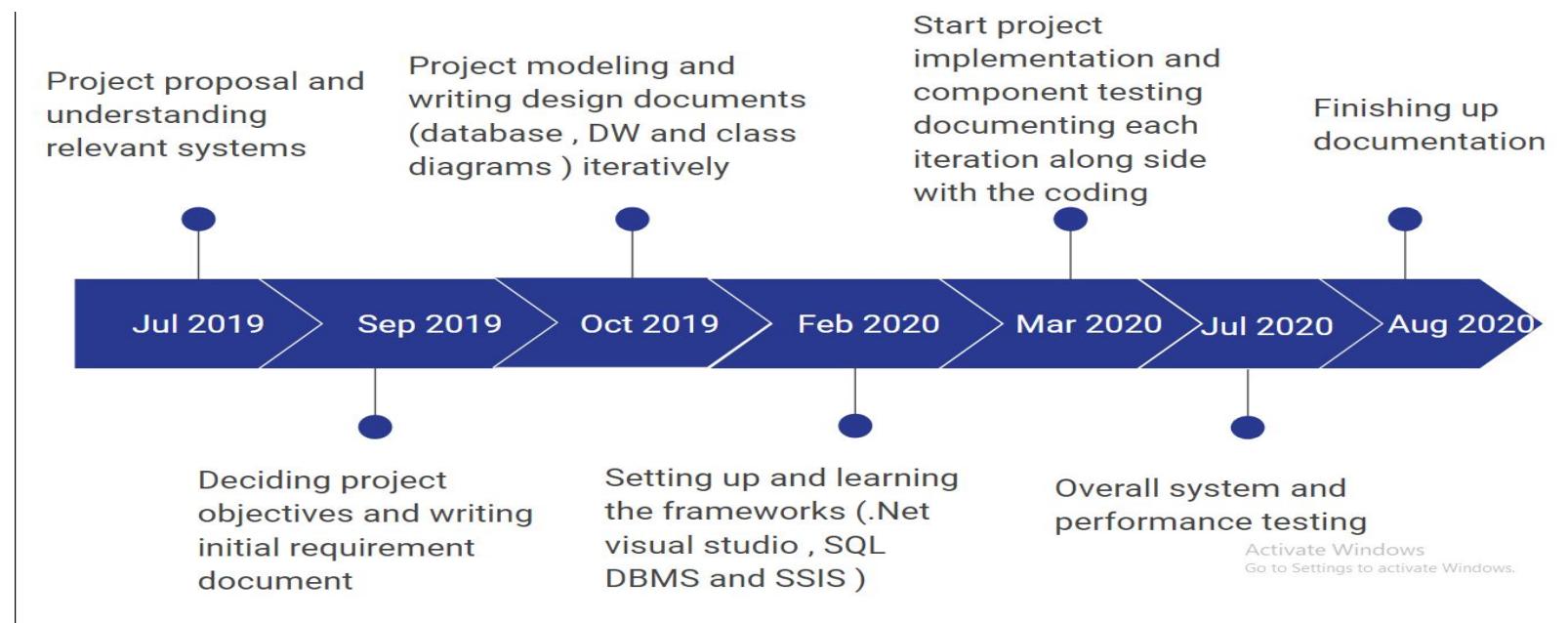


Figure 1: Time Schedule of the Project.

The software process we used is based on [software engineering reference \[12\]](#)

2- CHAPTER TWO: RELATED EXISTING SYSTEMS

2.1 Introduction

The trend of automating payroll and workforce management processes began during the 1970s. Due to limited technology and mainframe computers, companies were still relying on manual entry to conduct employee evaluation and to digitize reporting , but it was not organized or in the correct form that we can benefit from.

The first enterprise resource planning (ERP) system that integrated human resources functions was SAP R/2 (later to be replaced by R/3 and S/4hana), introduced in 1979. This system gave users the possibility to combine corporate data in real time and regulate processes from a single mainframe environment. Many of today's popular HR systems still offer considerable ERP and payroll functionality.

The first completely HR-centered client-server system for the enterprise market was PeopleSoft, released in 1987 and later bought by Oracle in 2005. Hosted and updated by clients, PeopleSoft overtook the mainframe environment concept in popularity. Oracle has also developed multiple similar BPM systems to automate corporate operations.

Beginning in the late 1990s, HR vendors started offering cloud-hosted HR services to make this technology more accessible to small and remote teams. Instead of a client-server, companies began using online accounts on web-based portals to access their employees' performance. Mobile applications have also become more common.

2.2 Existing systems

The function of human resources departments is administrative and common to all organizations. Organizations may have formalized selection, evaluation, and payroll processes. Management of human capital has progressed to an imperative and complex process. The HR function consists of tracking existing employee data, which traditionally includes personal histories, skills, capabilities, accomplishments, and salary. To reduce the manual workload of these administrative activities, organizations began to electronically automate many of these processes by introducing specialized human resource management systems.

The table below (Table 2.1) shows common features that human resources management systems uses nowadays:

Feature's Name	Description	Analytics / Management / UI
Employee Self Service	Control panel reserved to help employees manage and view specific type of data: 1- Employee Login. 2- Employee modify personal data(Address – Phone Number – Mail,...). 3- Employees can view but not modify time sheets, attendance, payment, and performance reports.	Management feature, data input and use of analytical features such as performance reports.
Time & Attendance	Keeps record constantly updated of employees` attendance , arrival and leaving time in addition to vacations and holiday times.. data can be entered manually using an HR employee and a control panel or through specialized hardware configured to construct and update the database record.	Management Feature , including data input and further used in analytical purposes
Leave Management	Keeps track of employees leaving the	Management Feature , including data input

	workforce for different reasons (retirement , death , illness , other ethical reasons).	and further used in analytical purposes.
Skill Management	Keeps track of ranked value for skills for both employees and needed rank of skill for each task and project based on self and external evaluations.	Extracted from existing data (data categorizing and classifying).
Payroll	Very complex feature can even be considered a separate system by itself , it includes financial information for each individual (tax , overtime , net salary , frequency of payment , traveling fees for employees working abroad , etc also financial information of the company including accounts and net profit and tax types ,..etc.	Managing Feature requires highly secure protocols and three level authorization also used for analysis of the company's profits and its relation to local currency and national economic growth.
Recruitment	Predict the need for new employees based on skills needed in company projects and find suitable candidates based on a pool of skills extracted from the resume of applicants.	Analytical
Employee Feedback	Each task assigned would have an evaluation form to rank the skill of the employee on this task and time taken to complete the task vs the time estimated.	Used for analytics purposes in estimating performance and the need for training.
Performance Evaluation	- Evaluate the performance of each employee based on several attributes (attendance , task (completeness , time of completing the task , skill ranking , training taken. - Evaluate the overall performance of the company on a project basis ,financial basis , project basis ,...etc.	Analytical features that can also predict and take future decisions (promotion decisions , consistency of bonuses with performance , annual progress reports for employees and departments.
Time Tracking and Scheduling	Time tracking for tasks assigned to each employee including time duration , business weight of this task to serve performance analysis , ranking based on difficulty ,skills needed.	Managing features for analytical purposes.
Visualization	Create visualizations (pie charts , histograms , scatter diagrams ...etc) used to better view the analytics extracted from the system.	UI
Training	Track training taken by each employee , the requesting department for this training , the evaluation for employees that have taken this training , the skills included in this training , time consumed by this training to analyse the effect of this training.	Managing features for analytical purposes.
Talent Management	Use the database available for employees evaluations and rankings in each skill and map that to the degree of skills needed on the target project to select qualified employees to be assigned on that project also taking their time scheduling into consideration to save resources and not to recruit non needed workforces.	Analytical and decision making.

Appealing user interfaces	For better user experience and faster surfing between different features of the system.	UI
Propose promotions and bonus	- Get use of performance of employees and their productivity to suggest promotions and bonus for the suitable employees. - Rank the employees to get the best ones and those who are at risk.	Analytical
Need for training	Based on performance and feedback the system suggests training for employees whose skills need to be improved.	Analytical
Predict strength and weakness fields	Based on overall performance, predict strength and weakness fields in company's projects.	Analytical

Table 2.1**Examples of covered human resources systems:**

- Rexx HR System.
- People Qlik HR System.
- Fresh Works.
- Zoho People System.
- PeopleBook HR.
- Orange HRM.
- Trio Codes.
- Cezanne HR Software.
- Millennium HRMS.
- Fuse HR.

The table below (Table 2.2) shows features coverage for each system and our system which is AFM HR:

Features	Rexx HR System	People Qlik HR System	Fresh Works	Zoho People System	PeopleBook HR	Orange HRM	Trio Codes	Cezzane HR Software	Millennium HRMS	Fuse HR	AFM HR
Employee Self Service	✓	✓		✓	✓	✓	✓	✓			✓
Time & Attendance	✓	✓		✓	✓	✓	✓		✓	✓	✓
Leave Management		✓		✓	✓	✓	✓			✓	
Skill Management	✓	✓	✓	✓			✓	✓		✓	✓
Payroll		✓		✓	✓		✓	✓	✓	✓	
Recruitment	✓	✓	✓			✓	✓		✓	✓	✓
Employee Feedback	✓	✓		✓							✓
Performance Evaluation	✓	✓		✓	✓	✓	✓	✓	✓		✓
Time Tracking and Scheduling	✓	✓	✓	✓					✓	✓	✓
Visualization	✓	✓	✓	✓	✓	✓	✓			✓	✓
Training		✓			✓	✓	✓	✓			✓
Talent Management		✓	✓	✓			✓	✓	✓	✓	✓
Appealing user interfaces	✓	✓	✓	✓	✓	✓	✓		✓		✓
Propose promotions and bonus				✓							✓
Need for training				✓							✓
Predict strength and weakness fields		✓		✓							✓
Feature coverage	56.25%	87.5%	37.5%	87.5%	50%	50%	68.75%	37.5%	43.75%	56.25%	87.5%

Table 2.2

System comparison we used is based on systems websites included in this book [Resources](#).

2.3 Problems with existing systems

- Each mentioned system doesn't cover most of the above features.
- Some systems don't provide good performance.
- Some systems don't provide good user interfaces.

2.4 Solution approach

- Make an application that provides maximum possible features.
- Apply the concepts of data-ware-houses to the application.
- Make performance better as much as possible.
- Provide an appealing user interface.

Our system (AFM HR) provides the following features :

- (Employee Self Service, Time & Attendance, Skill Management, Recruitment, Employee Feedback, Performance Evaluation, Time Tracking & scheduling, Visualization, Talent Management, Appealing User Interfaces, Propose Promotions & Bonus, Need For Training, Predict Strength & Weakness Fields).

3- CHAPTER THREE: SYSTEM REQUIREMENTS ENGINEERING AND ANALYSIS

3.1 Introduction

The requirements analysis process was iterative and incremental as the requirements were adjusted and modified many times based on our survey on existing systems and according to time limits and capabilities, therefore this is our final requirements documentation after feasibility and reality checking.

3.2 Functional requirements

3.2.1 Objective 1: Employee self service

Function

Help employees to view and keep track of their data without the need of the system admin.

Description

An employee can:

- 1- Login to the system by entering username and password.
- 2- View his profile details, attendance log, performance reports.

Inputs

Personal data (Username and password).

Source

Employee.

Output

Attendance log, performance and personal information.

Destination

-

Action

The employee logs into the system and then he can update his information and view his attendance log and performance reports. After finishing he can log out from the system.

Requires

-

Precondition

HR admin registers the employee and gives him initial username and password.

Postcondition

-

Side effect

-

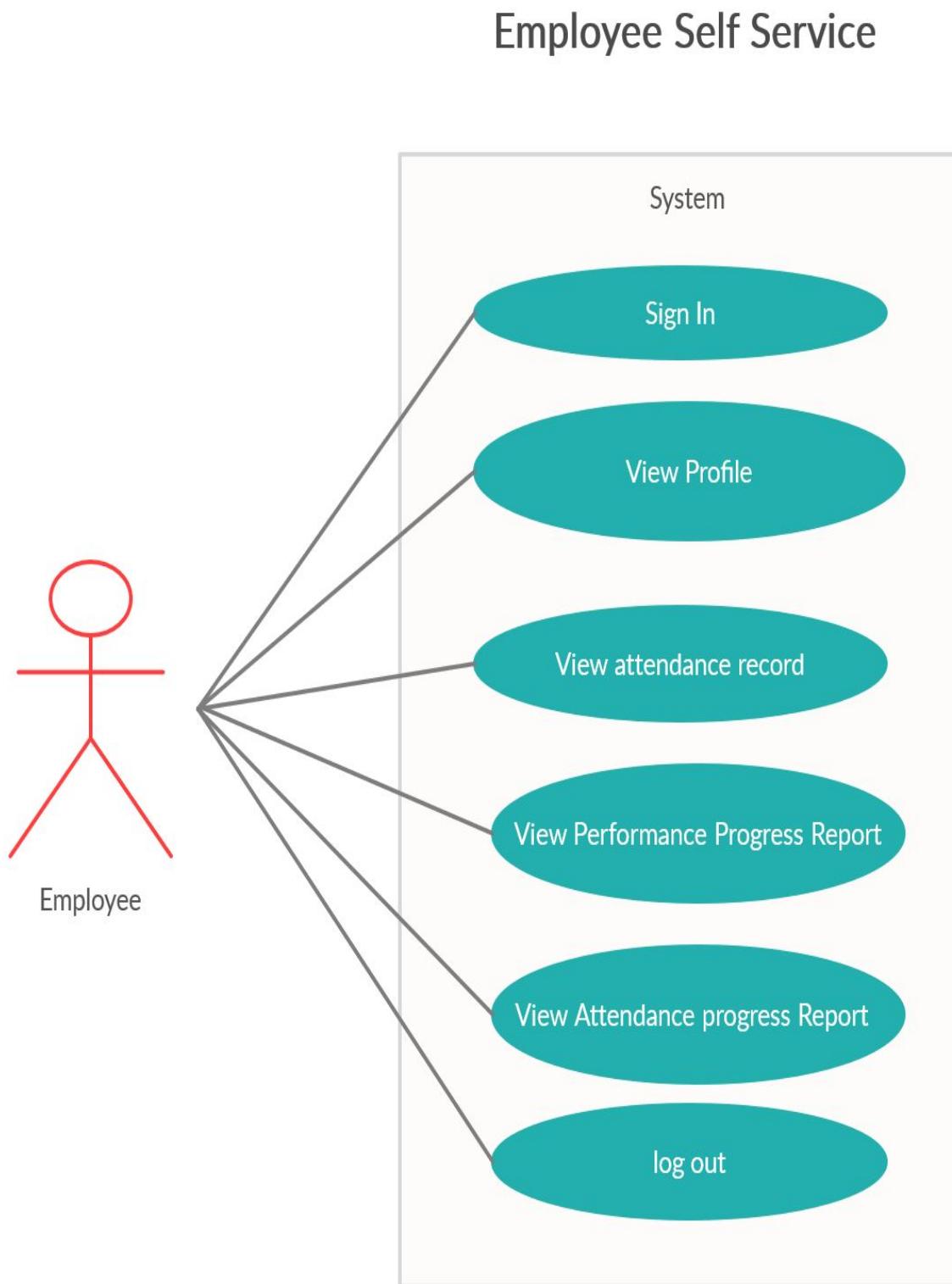


Figure 3.1 : Employee Self Service Use Case

3.2.2 Objective 2 : Attendance

1- Attendance record

Function 1:

Attendance record.

Description:

Keep track of dates and exact time of attending and leaving the office also absence and permissions ... etc.

Input:

Exact arrival time of each employee daily and leaving time in addition to any permissions taken or work out of perimeter situations ... etc.

Source:

Data already recorded previously in data bases or automatically updated daily by a reception employee or hardware device.

Output:

Analysis of absence and presence rate over a specific time period for each employee independently as well as overall reporting for the edge cases when overall absence rate is extremely higher or lower than usual.

Destination:

- Input to the employee overall performance evaluation function.
- Visualizations as charts and reports periodically or on demand for absence rate and outliers.

Actions:

Periodically compute the presence rate , absence with or without permission rate for each employee and report any unusual behavior with respect to individuals or as group behavior of attendance with respect to the workforce as a whole.

Requires:

Constantly updated input information about attendance exact time arrival and leaving ...etc.

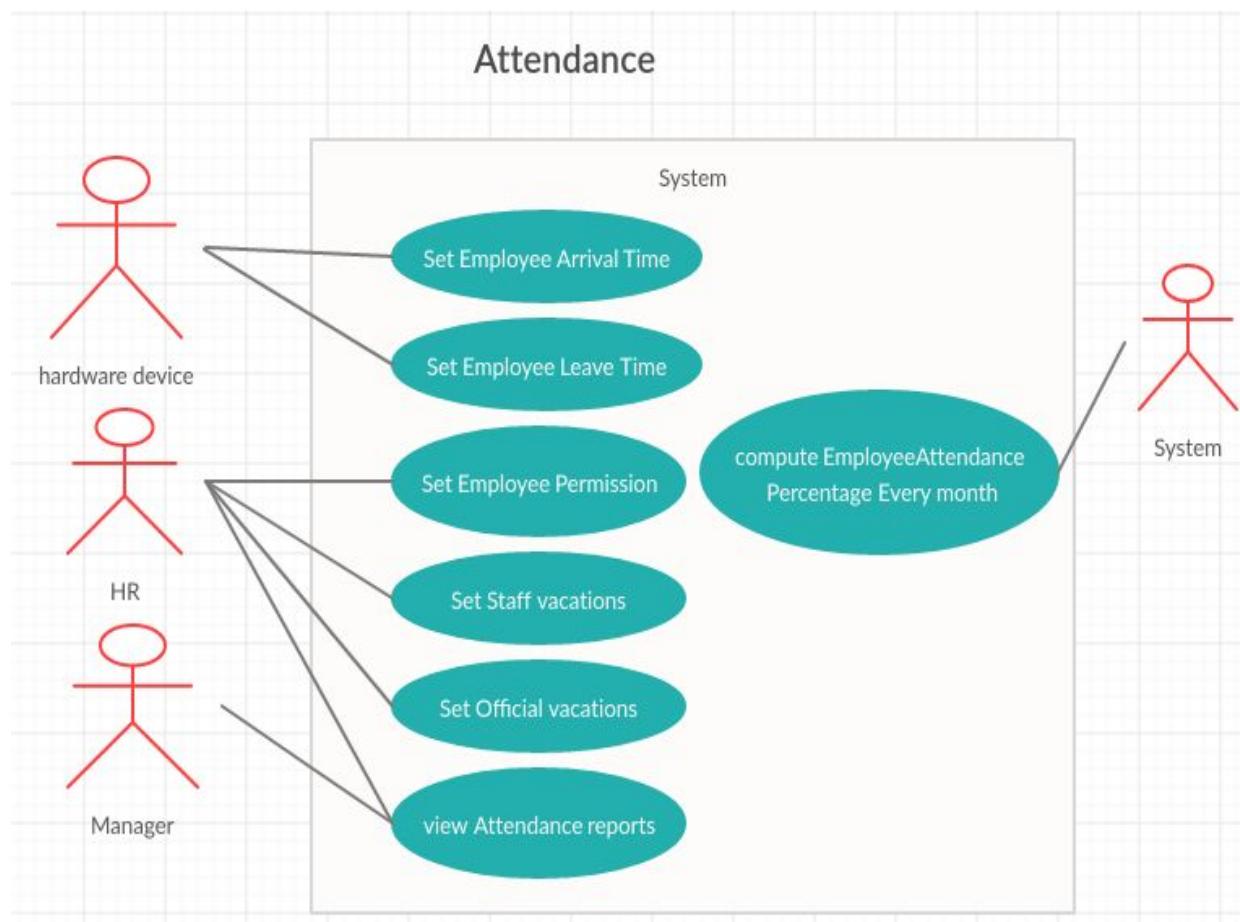


Figure 3.2 : Attendance Use Case

3.2.3 Objective 3 : Feedback

1 - Feedback input

Function Name:

Feedback input.

Description:

Allow each employee to provide feedback regarding employees and managers involved with them in the same project , department or task (depends on the company organization).

Input:

Take data about the feedback mentioned in the description in the form of surveys questionnaires ... etc regarding each skill practiced in the project for each employee involved and for the project as a whole.

Source:

Employees and managers working with each other for personal feedback and employees working on the projects for project organization and product feedback.

Output:

Quantitative and qualitative data are collected from surveys and questionnaires , saved in data bases to be manipulated and analyzed.

Destination:

Input to the Feedback analysis function.

Requires:

Employees taking these surveys and questionnaires seriously for the data integrity to be as useful for analysis as possible.

2 - Feedback analysis

Function Name:

Feedback analysis.

Description:

Analyze the feedback data for skill ranks for every employee on each project as well as project success analysis based on employees feedback on projects they've worked on.

Source:

Feedback input function.

Output:

Analysis of feedback data in the form of average skill score for each employee on project basis based on team feedback as well as average project assessment based on employees feedback.

Destination:

Input to the performance evaluation functions (employee and project).

Requires:

Employees taking these surveys and questionnaires seriously for the data integrity to be as useful for analysis as possible skills to assess must be predetermined either for project, department or employee.

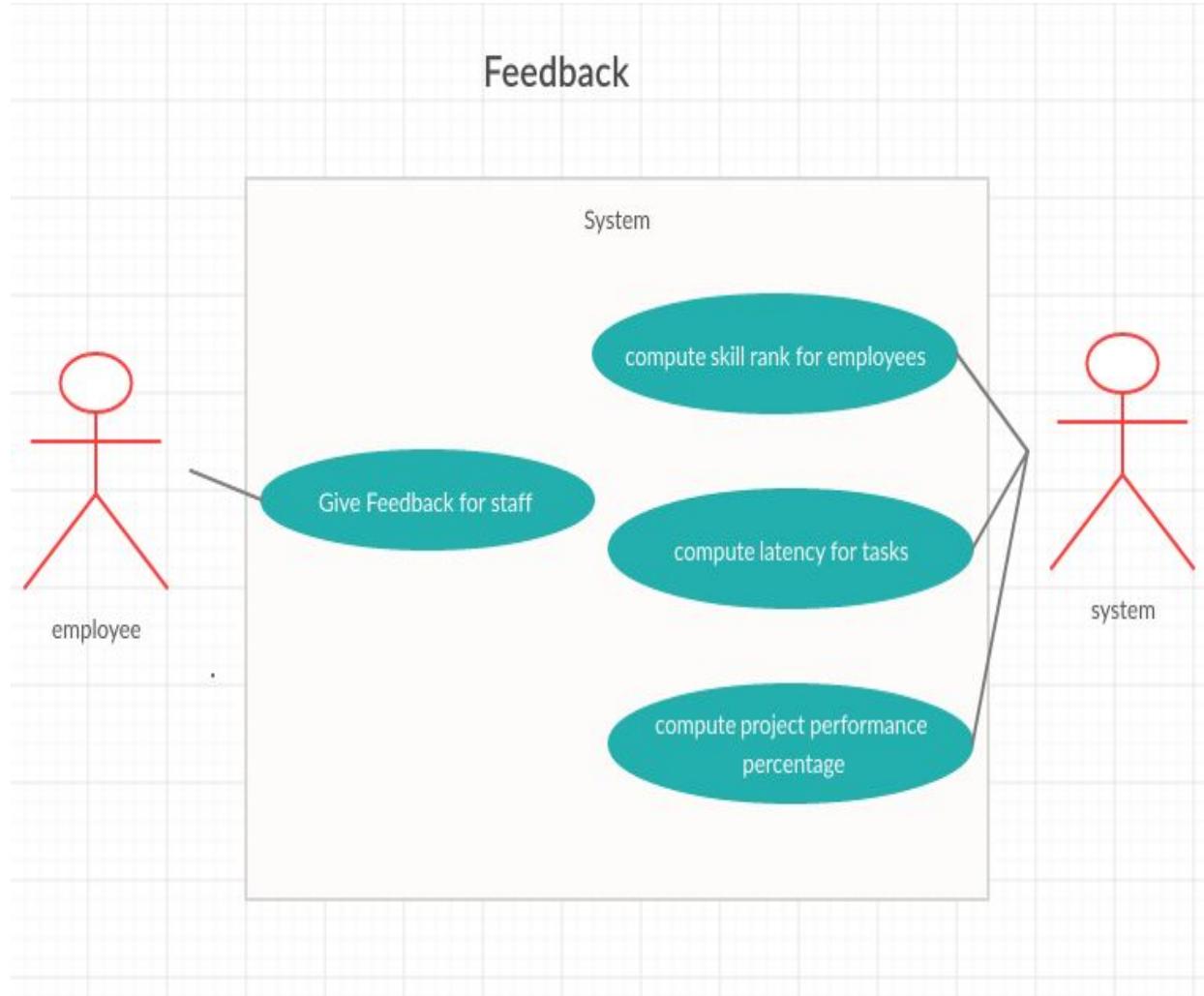


Figure 3.3 : Feedback Use Case

3.2.4 Objective 4 : Time tracking and Task scheduling

Function

Scheduling and time tracking of the tasks.

Description

Scheduling new tasks assigned to an employee and tracking the deadline of each assigned task.

Inputs

Schedule of tasks of the system(S0), task name, schedules (E0) of the chosen employees by Task Assignment and estimated time to complete the task.

Source

Employees are chosen by Task Assignment, the task and its estimated time is calculated by the users and the schedules are already saved in the system.

Outputs

Updated schedules (S1 and E1) after adding the new deadline. Information about upcoming deadlines.

Destination

Employee and Team Leader Schedule View.

Action

Depending on the estimated time to complete the task and the free time of the employees it adds the new assigned task and the employees that will work on it to the appropriate period of time in the schedule of tasks(S0) and modifies each employee's schedule (E0). It also informs the user and the employees about upcoming deadlines.

Requires

Schedules of tasks(S0 and E0) and the Task Assignment entity.

Precondition

The chosen employees are not overwhelmed with tasks.

Postcondition

Schedule is updated.

Side effects

None.

Time Tracking and Task scheduling

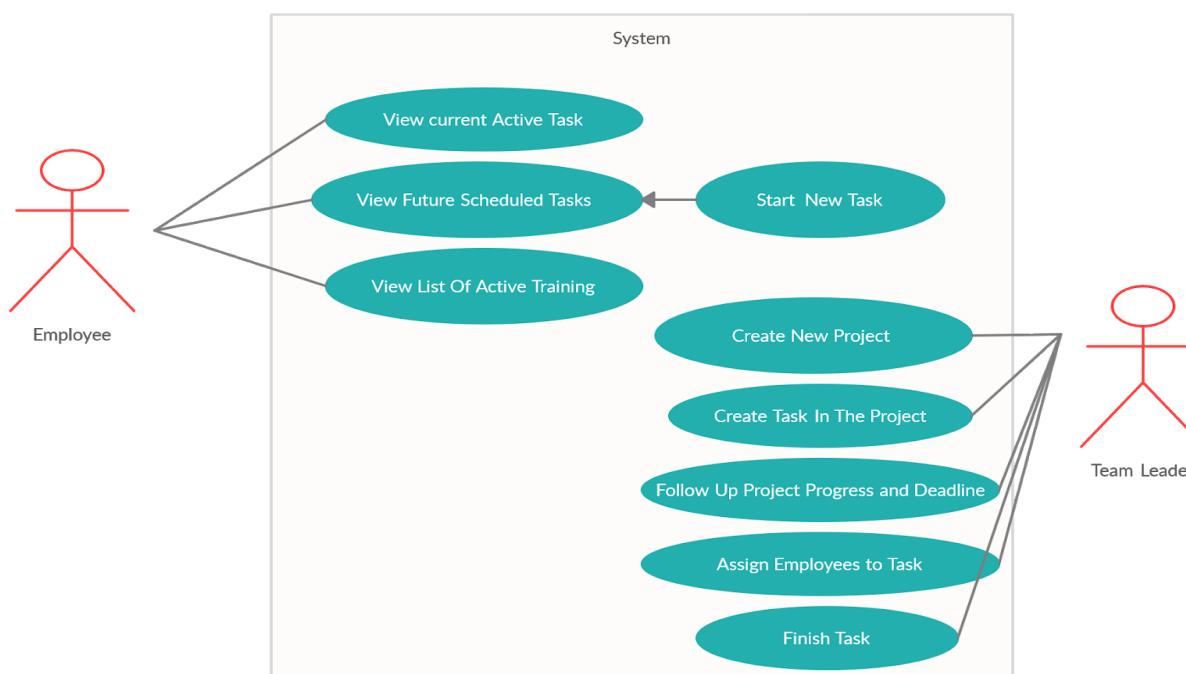


Figure 3.4 : Tasks` Time Tracking And Scheduling Use Case

3.2.5 Objective 5 : Talent Management

Function:

Task Assignment to employees.

Description:

This function uses the data available for the skills rating and progress of the workforce to assign tasks to the employees based on the skills demanded to accomplish the task and the free time and schedule load of employees.

Input:

Data about employees' time tracking and task scheduling , data about the rating of employee performance at each skill in addition to data about the desired task to be assigned ; due date and skills needed.

Source:

- Data about time tracking from the time tracking and task scheduling function.
- Data about performance from the employee performance evaluation function.
- Data about the task to be assigned as input from the time tracking and scheduling project requesting for the employee assignment.

Output:

List of best suited employees for the task arranged by priority attached with unoccupied times in their schedules for the task to be assigned.

Destination:

The time tracking and scheduling of the project being initialized that requested the task assignment for the given task.

Actions:

- Take a list of skills needed for the task to be accomplished and the threshold (min performance rank) that any employee must at least have to fit this task.
- Analyze the list of employees based on evaluated performance on these given skills also can use other factors (harmony and preferability between employees altogether and between employees and project manager ... etc).
- Analyze the unoccupied time for best fit employees and compare these results with due date and deadlines assigned for the task.
- Make the decision based on previous actions and produce a list of employees most suited to fit the role or the task given.

Requires:

Enough data for the task needs assignment (skills and rank required any constraints on employees chosen if any ... etc).

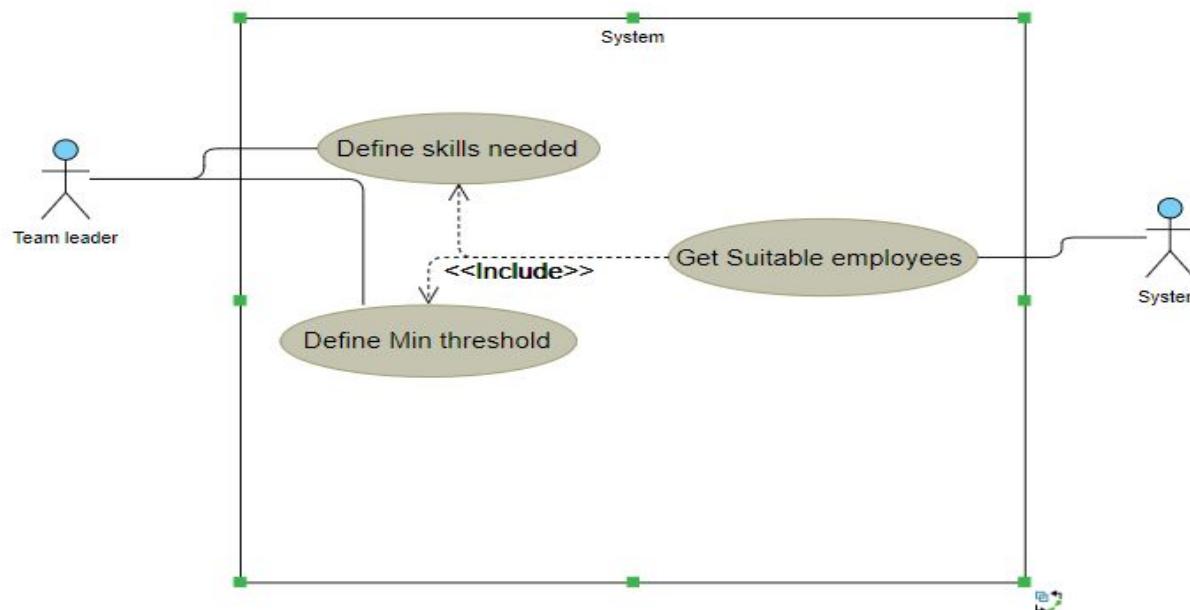


Figure 3.5 : Talent Management Use Case

3.2.6 Objective 6 : Propose promotions and bonus

Function

Bonus and promotions prediction function.

Description

Predicts the employees deserving certain bonus or fit in a certain promotion or position based on analyzed data of their performance , training taken , skills progress and overtime logged hours.

Inputs

- Performance evaluation report for each employee.
- Certain criteria to determine when a bonus and promotions are granted.
- Higher Positions open for employees and skill rank needed for the position.

Source

Employee performance evaluation function and training feedback as well as observations might be made by the weakness and strength fields function.

Output

List of employee deserving bonus based on prespecified criterion or list of most suitable employees for an opened promotion or higher position.

Destination

Reporting to management and HR.

Action

- Match the pre-specified criterion for bonus earning or promotion earning with performance records of employees to get a list of employees that earn bonus.
- In case of position competence or promotion choice between more than one employees ties can be resolved based on skill description for the position and analysis of employees occupying similar positions and their previous behavior to predict any patterns that could break ties in the determination process.

Requires

Access to employee's performance evaluation records Specified criteria for bonus earning and skill rating required for a promotion.

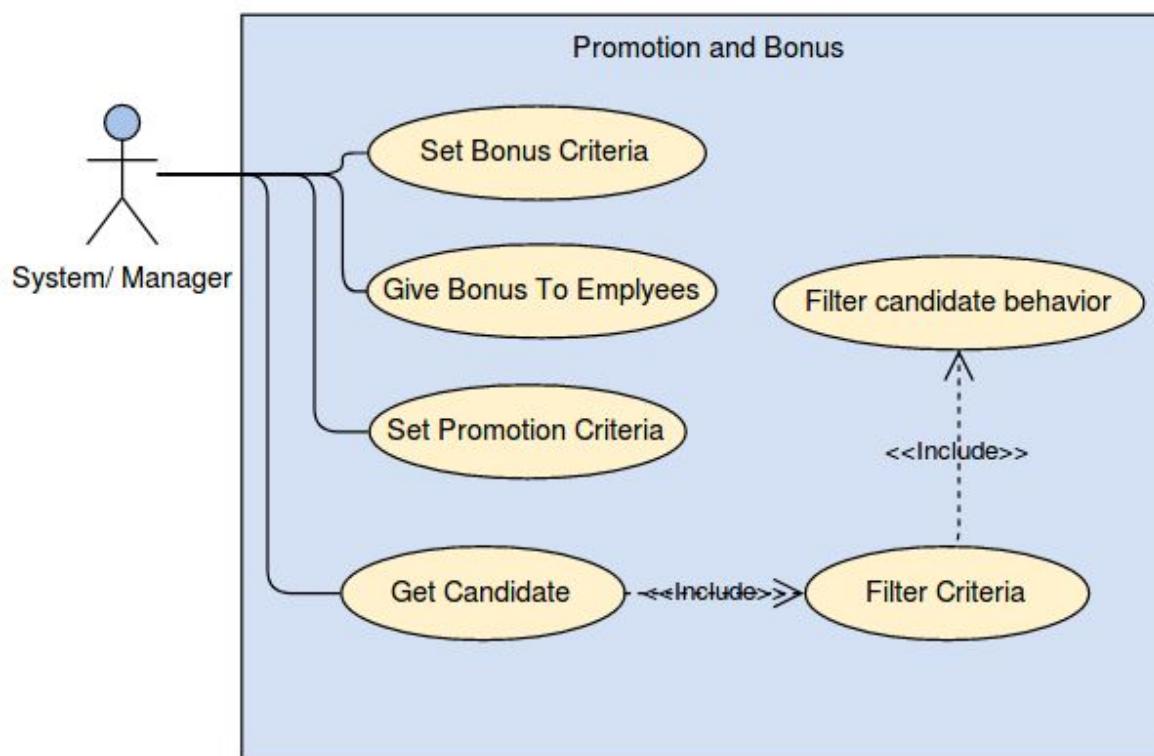


Figure 3.6 : Propose Promotions And Bonus Use Case

3.2.7 Objective 7 : Need for training

1 - Recommend training

Function Name:

Recommend training.

Description:

Recommend a suitable training program for employees based on their skill ranking.

Input:

- Skill ranking report and task scheduling for employees.
- In addition to a list of training programs labeled for different skill ranks or employees categories.

Source:

- The employees performance evaluation results.
- Classified Database of training programs.
- Output of Time schedule function for each employee.

Output:

Training program recommendations for employees.

Destination:

- Time Schedule for the employee to assign slots for training.
- Reports and visualizations for training taken to analyze percentage of training recommendations acceptance and employee categories most targeted.

Actions:

React to reports of skill rank unsatisfying of certain employees or even periodically recommend training programs to employees and in case of acceptance assign training sessions to their time schedule and record it for further analysis.

Requires:

List of training programs , access to employees time schedule , specified max allowed time for training assignment based on employee category.

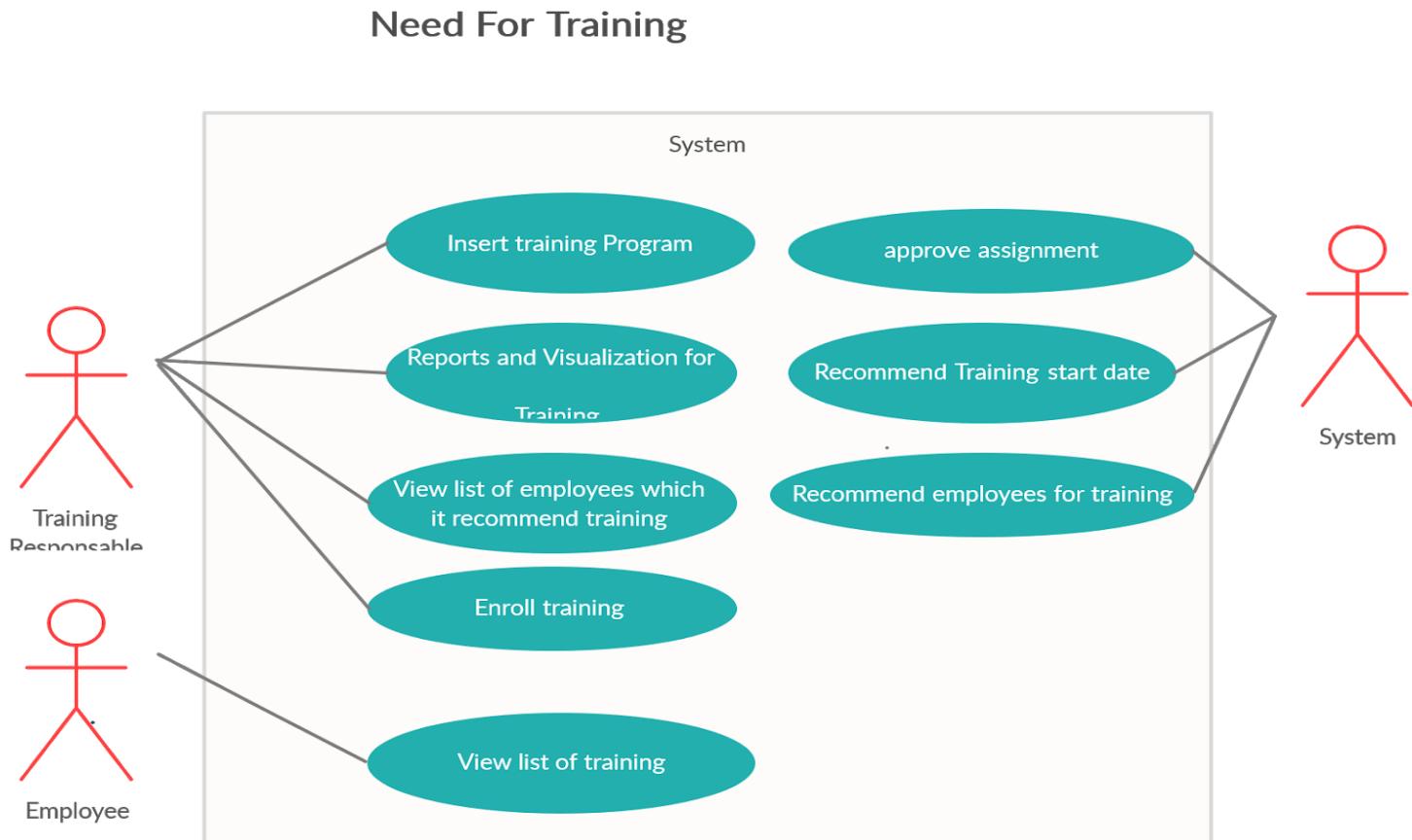


Figure 3.7 : Need For Training Use Case

3.2.8 Objective 8 : Performance evaluation

1 - Employee performance

Function:

Employee Performance evaluation.

Description:

Evaluate the performance of each employee based on several attributes: attendance, task completeness, time of completing the task, skill ranking and training taken.

Inputs:

Attendance percentage, logged hours, Employee feedback for each skill ,time schedule per task and contribution rate for every task taken.

Source:

- Attendance percentage, logged hours from the output analytics of the attendance feature.
- Employee feedback for each skill per project from the feedback system.
- Time schedule per task and contribution rate for every task taken from time tracking and scheduling analysis.

Outputs:

- Rate of each skill.
- Overall employee performance.

Destination:

- Input for the task assignment system.
- Input to decide the need for training.
- Input for bonus and promotion decision taking.
- Input for overall performance of the work force and the company growth.

Action:

- Calculate weighted average of skills rating for this employee on all projects that it has been assigned to produce the Rate for each skill of this employee.
- Takes the skills Rating already calculated with other attributes (attendance percentage , logged hours, contribution and time passed for completing tasks for each project) to produce overall performance classification for this employee.

Requires

Data for the attendance , feedback and time tracking already observed and analyzed ready for being used.

2 - Overall workforce performance

Function:

Overall workforce performance evaluation.

Description:

Evaluate the performance of all the employees based on the performance evaluation and growth of each employee.

Inputs:

Overall employee performance rate for all employees.

Source:

Output of the employee performance evaluation function.

Outputs:

Progress rate and growth for the overall workforce performance rating as percentages and as visualizations for each period of time determined by user.

Destination:

- Input for the Recruitment system.
- Input to weakness and strength fields determining.

Action:

- Calculate weighted average of overall skills rating for all employees on all projects during a specified period of time and compare it with the previous value to calculate progress rate.
- Report any shortage in specific skills or any remarkable skill rate that indicates a strength in this skill and deliver those cases to the weakness and strength fields assessment system to analyze.

Requires:

Overall analysis for each employee performance.

3 - Project performance**Function:**

Project performance evaluation.

Description:

Evaluate the performance of each project based on the completeness and feedback on skills needed to complete the project's tasks.

Inputs:

Time tracking and task scheduling for this project in addition to total feedback for all participants in this project.

Source:

Output of the time tracking and task scheduling at the end of the project and the feedback output analysis of this project.

Outputs:

Performance rating for the project , observe any skill shortage or overqualified for the task given.

Destination:

- Input for the company performance evaluation system.
- Input to weakness and strength fields determination.

Action:

- Calculate weighted average of overall skills rating for all employees on this project to produce an estimated value that determines the rank of each skill needed during the project and in case of any shortage or over presence of any skill report it to the weakness and strength fields determination systems for analyzing the reasons of this flaw.
- Decide an overall ranking value expressing the performance of this project based on completeness, time tracking and task scheduling for an insight of the satisfaction degree of this project as a future reference for other projects.

Requires:

The project already completed or dropped in case of incompleteness and all data present as the output the time tracking systems.

4 - Company performance analysis**Function:**

Company performance analysis evaluation.

Description:

Evaluate the performance of overall company assets and behavior based on the both project performance and employee growth and rate of progress.

Inputs:

The overall performance of all projects and the progress rate of the work force over a specific period of time.

Source:

Output of the overall project evaluation and the overall employee performance evaluation.

Outputs:

Predicting the overall progress rate of the company as a whole over different periods of time.

Destination:

Reports or visualizations and diagrams on demand.

Action:

- Calculate the weighted average of overall progress rate of the company as a whole over different periods of time using the employee's overall ranking and the projects ranking as periodic reports or visualizations and diagrams on demand.
- Report and observe if any setbacks happened to analyze and find out reasons and also the period of prosperity to analyze how to repeat the factors leading to that in the future.

Requires:

Overall analysis of overall project performance and overall employee performance.

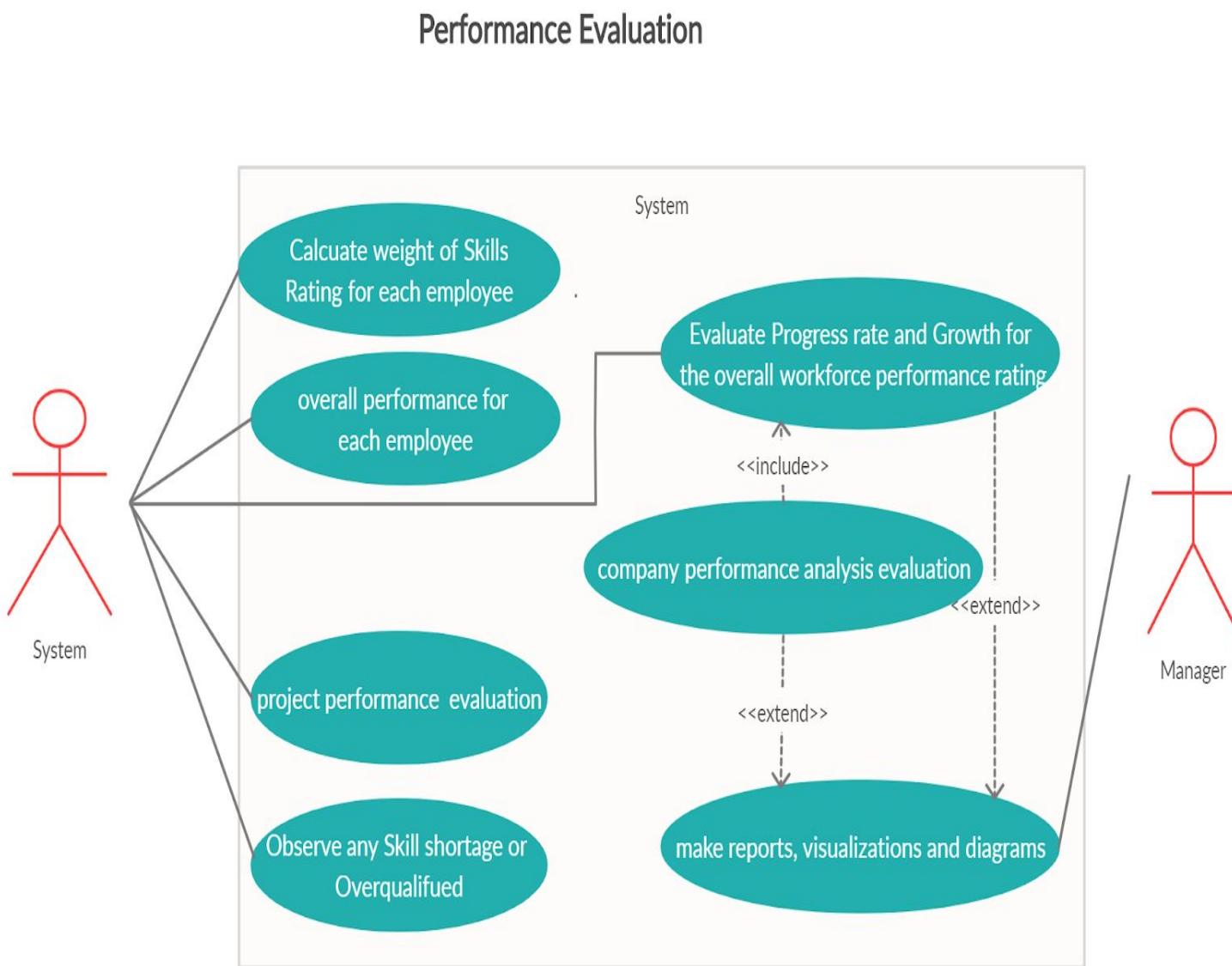


Figure 3.8 : Performance Evaluation Use Case

3.2.9 Objective 9 : Predict strength and weakness fields

1 - Explore weakness fields

Function Name:

Explore the weak department and skills.

Description:

Defines the reason behind project failure based on data represented by project performance evaluation function.

Input:

- Time tracking and Task Scheduling for each employee.
- Project performance evaluation for projects that have exceeded certain higher prespecified threshold of rating or that have been ahead of schedule.
- Employee feedback for each skill as well as overall workforce performance evaluation for each skill.

Source:

- Time tracking and schedule for each employee already stored as records in the database.
- Output Reports that come constantly from project performance evaluation function in case of any project failure observations based on the function's explained analysis.
- Feedback provided by employees appears in the project performance percentage.

Output:

Report the reason for each project reported major failure as one of three reasons :

1. Some skills appear in the most failing projects in the department as an indicator of the weakness of these skills in this department.
2. All project performances that take place in a certain department are very low which indicates that this department is not doing very well and needs some attention.
3. The project tasks weren't often done within the deadlines specified which also indicates some weakness in the team put up together on the project.

Destination:

Reports for the manager and the HR to help them diagnose the key problems , inspect more then take decisions.

Actions:

For each project reported by project performance evaluation function use data provided by time tracking and task scheduling in addition to employees and skills rating evaluations to determine cause of failure by listing the departments in order of the most failing ones and the skills that appeared in the most failing projects of this department.

Requires:

Project's accurate data that helps reporting performance problems (including feedback and time tracking ...etc).

2 - Explore the strength Fields

Function Name:

Explore the strong department and skills.

Description:

Defines the reason behind project success based on data represented by project performance evaluation function.

Input:

- Time tracking and Task Scheduling for each employee.
- Project performance evaluation for projects that have exceeded certain higher prespecified threshold of rating or that have been ahead of schedule.

- Employee feedback for each skill as well as overall workforce performance evaluation for each skill.

Source:

- Time tracking and schedule for each employee already stored as records in the database.
- Output Reports that come constantly from project performance evaluation function in case of any project success observations based on the function's explained analysis.
- Feedback provided by employees appears in the project performance percentage.

Output:

Report the reason for each project reported major success as one of three reasons :

1. Some skills appear in the most successful projects in the department as an indicator of the strength of these skills in this department.
2. All project performances that take place in a certain department are very high which indicates that this department is doing very well and needs some attention.
3. the project tasks were often done within the deadlines specified which also indicates some strength in the team put up together on the project

Destination:

Reports for the manager and the HR to help them diagnose the key advantages, inspect more then take decisions.

Actions:

For each project reported by project performance evaluation function use data provided by time tracking and task scheduling in addition to employees and skills rating evaluations to determine cause of failure by listing the departments in order of the most successful ones and the skills that appeared in the most successful projects of this department.

Requires:

Project's accurate data that helps reporting performance problems (including feedback and time tracking ...etc).

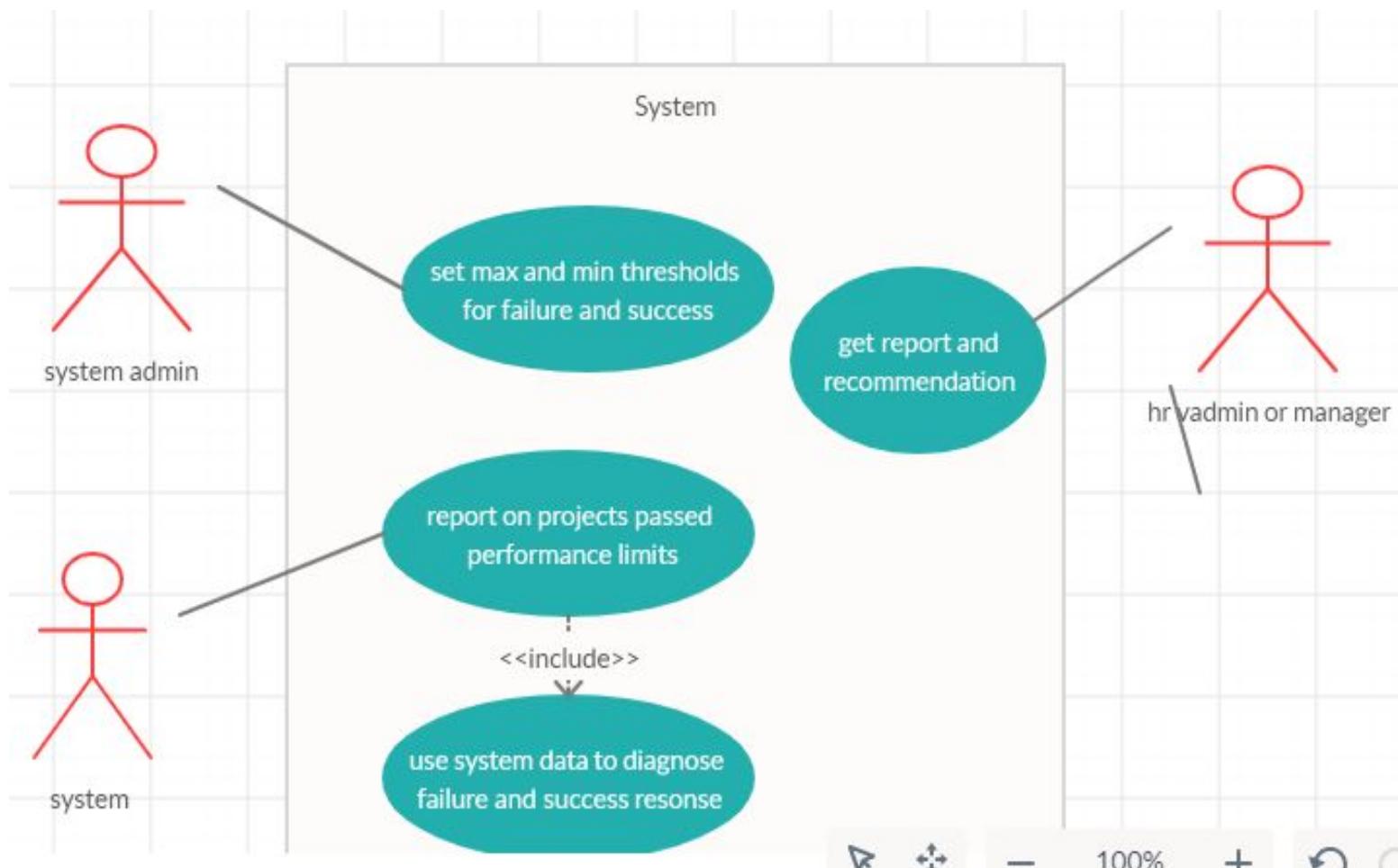


Figure 3.9 : Predict Strength And Weakness Fields Use Case

3.2.10 Objective 10 : Recruitment

Function Name:

Recruitment.

Description:

Analyze the data of candidates from the application and compare the given data with the job desired skills provided by the HR to determine most suitable candidates to fit or fulfill the shortage of specific skills needed.

Inputs:

- Skill needed (reason for new recruitment need).
- Full data about candidates : personal, professional, skill ...etc.

Source:

- Applicant fills a form with required data (personal info, professional experience, educational background and skills).
- Information about skills needed for the job from HR admin.

Outputs:

List of most suitable acceptable applicants.

Destination:

HR employees.

Action:

- Analyze data of candidates with skills as close as possible to the required ones and make a list of them.
- Filter the candidate data with the provided skill for the job by the HR to get the most suitable candidate select.

Requires:

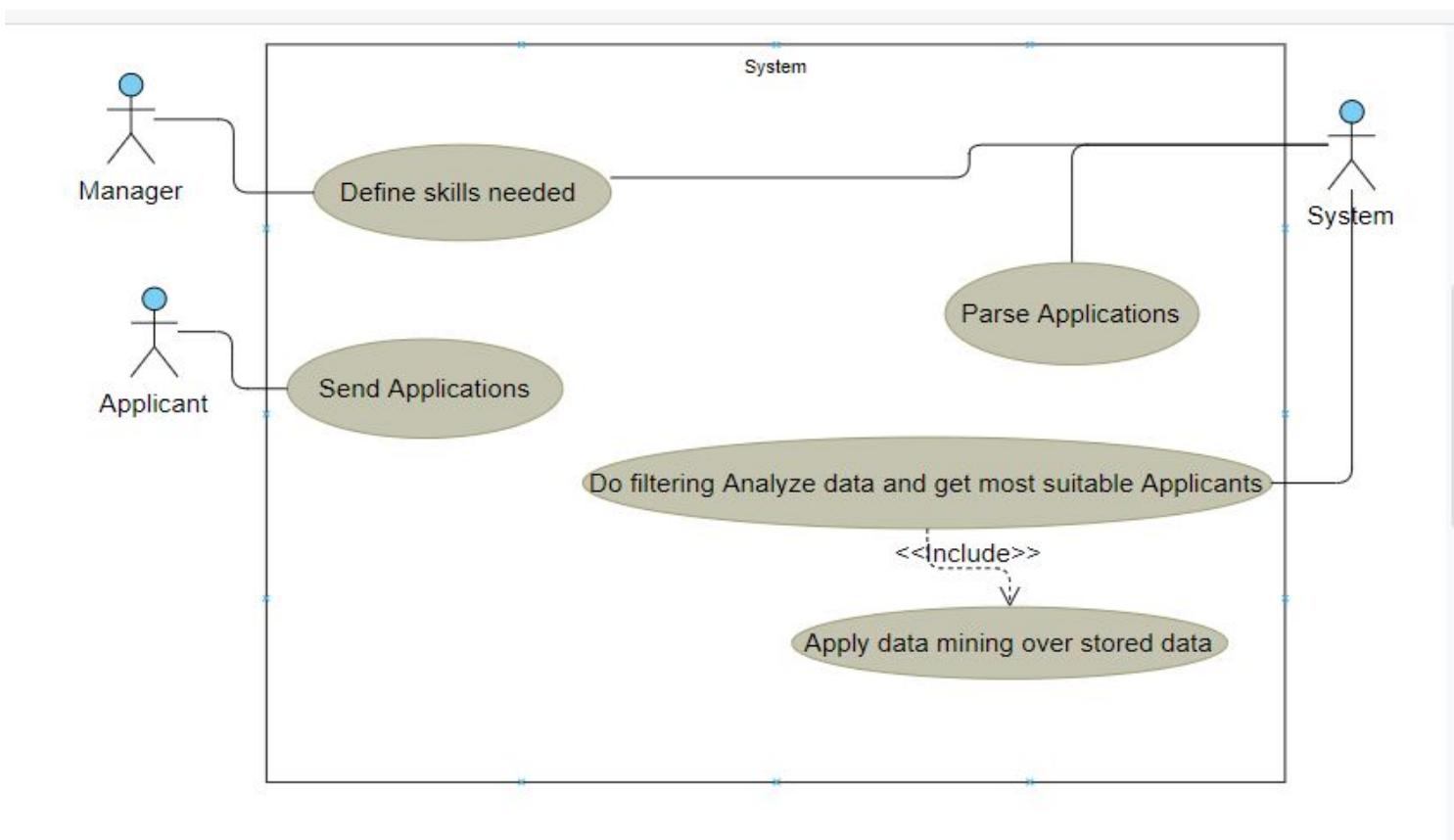


Figure 3.10 : Recruitment Use Case

3.3 Non-Functional Requirements

Usability : The system shall have an easy interface that will not cause any problems for the company's members at the beginning of using the system , another thing is the company shall not have problems when running the system on their devices .

Security : The system shall be secure as it has data for the whole entity which must be secure and not everyone can access it .

The system shall contain priority for different kinds of users who will use it , passwords shall be encrypted when added to the database so no one can access any account which doesn't belong to him/her.

Efficiency :

- **Space :** Although the system will contain a huge amount of data and many databases, it shall not misuse the memory of devices that it will run on .
- **Performance :** The system shall do what it is asked for in a reasonable time , and no conflicts should happen. The system also should have high maintenance in the face of any abnormal behaviour and it shall not fall down at any case.
The data shall be uploaded efficiently and in a reasonable time and updated frequently at the end of each day .

Dependability : The system shall operate as users expect and that it will not 'fail' in normal use, if there is any problem with this the system shall be developed .

Information and data loss shouldn't happen in any case , the system shall have a backup for critical cases.

Environmental :

- **Physical Environment :** Any entity that has employees who are working in projects, have tasks and if that entity needs to monitor its work and performance shall use the system .
- **Platforms Required :** The system shall run on computers with windows operating system as it is the common used OS .

Reliability :

- System shall have high reliability and it shall produce similar results under consistent conditions.
- Reliability in statistics and psychometrics is the overall consistency of a measure. A measure is said to have a high reliability if it produces similar results under consistent conditions.

4- CHAPTER FOUR: SYSTEM DESIGN & MODELING

4.1 Introduction

One of the most important and critical aspects of making a system is the design and modeling phase. During the Design Phase, the system is designed to satisfy the requirements identified in the previous phases. The requirements identified in the Requirements Analysis Phase are transformed into a System Design Document that accurately describes the design of the system and that can be used as an input to system development in the next phase. In this chapter, we discuss how the system is designed.

This includes the high level architecture of the system and how the data flow across our system components. System architecture subsection shows the high level components of the system and how they are organized and what are the aspects of the system.

4.2 Context Modeling

Our system interacts with outside systems such as: Attendance and login device, Interview and recruitment process, Payroll system.

Data interaction is the type of the interaction between our system and outside systems.

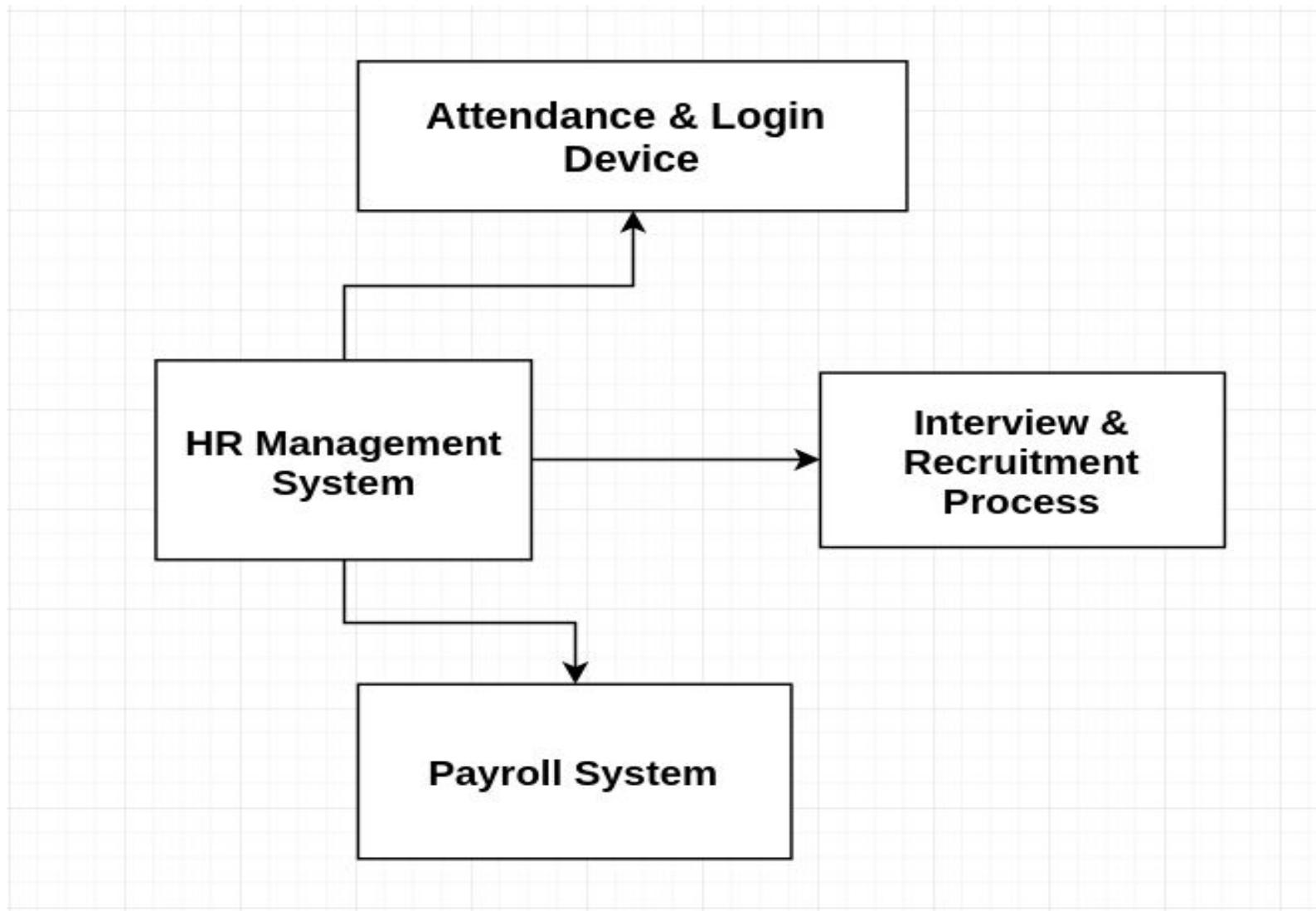


Figure 4.1: HRMS Context Modeling.

4.3 Interaction Modeling

4.3.1 External Interaction

The next table (Table 4.1) shows system stakeholders with the description for each person's operations.

Manager	<p>A Manager is a person who manages the system. Managers can control everything in the application and Managers must often make decisions about things.</p> <p><u>What Manager can do:</u></p> <ul style="list-style-type: none"> ● Get performance progress reports for employees , projects , departments and positions. ● Get Strength and Weakness Fields reports. ● Set promotion criteria and get recommended employees for promotion. ● View attendance reports for employees , departments and positions. ● Update the data warehouse to add the new months records and update performance and skill ranks .
HR Admin	<p>An HR administrator, is responsible for a wide range of duties, including payroll and compensation, recruiting and staffing, performance and training, labor relations, administering employment benefits and organizational development.</p> <p><u>What HR administrator can do:</u></p> <ul style="list-style-type: none"> ● Set employee vacation ,permission and official holidays. ● View attendance reports for employees , department and positions. ● Insert training program and get recommended available employees. ● Enroll employees into training. ● Enter job requirements and get applicants recommendations ● Set bonus criteria and get employees that earn the bonus then grant bonus
Employee	<p>An Employee, is an individual who was hired by an employer to do a specific job. The employee is hired by the employer after an application and interview process results in his or her selection as an employee. Employees have normal access to the Application.</p> <p><u>What Employee can do:</u></p> <ul style="list-style-type: none"> ● Sign into the system and logout from the system. ● View his/her profile and personal information. ● Give feedback on tasks. ● View current active tasks. ● View future scheduled tasks. ● View performance progress report. ● View attendance progress report. ● View his/her attendance record. ● View list of active and available training.
Team Leader	<p>A Team Leader is someone who provides guidance, instruction, direction and leadership to a group of individuals (the team) for the purpose of achieving a key result or group of aligned results. Team Leader is responsible to assign tasks and manage projects and give feedback to others.</p> <p><u>What Team Leader can do:</u></p> <ul style="list-style-type: none"> ● Create a new project. ● Create a task in the project. ● Follow up project progress and deadlines. ● Assign tasks to employees. ● Mark tasks as finished.
IT Administrator	<p>An IT System Administrator, is responsible for the upkeep, configuration, maintenance and reliable operation of the HR System.</p> <p><u>What IT Administrator can do:</u></p> <ul style="list-style-type: none"> ● Configure and maintain the system. ● Fix any issues with the system environment.

Table 4.1

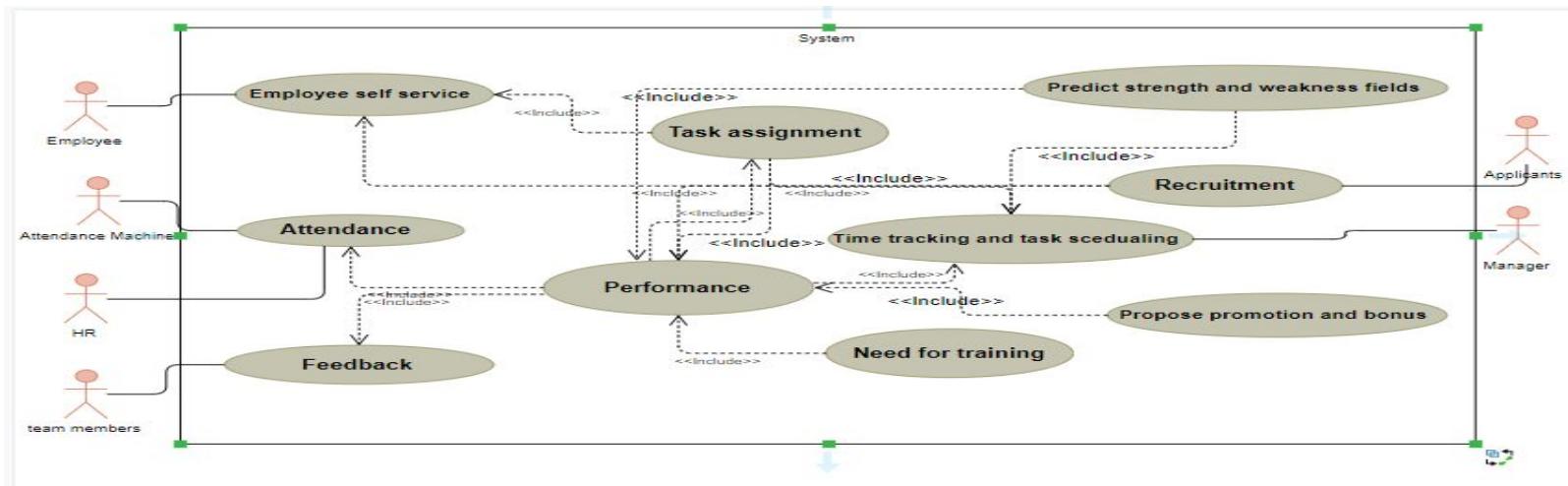


Figure 4.2: Overall Use Case Diagram.

4.3.2 Internal Interaction

In Figure 4.3: TaskAssignment & Scheduling & FeedBack Sequence Diagram:

The Team leader starts with creating the project and the system inserts it inside the DB and then the System returns an ID for the project, The Team leader then can create tasks and then inserts the tasks inside the DB and the System returns the ID for the task, The team leader then can view a list of candidate employees so the team leader sends a request to the System and then the System response by list of employees, The Team leader then can assign tasks to employees and the System store task assignment inside the DB.

The Employee can get a list of tasks assigned to him/her and he/she can update task time for start and end time for each task assigned to him/her and then the employee can give feedback of the assigned tasks.

The Manager can get performance for the project and get a visualization for the overall performance.

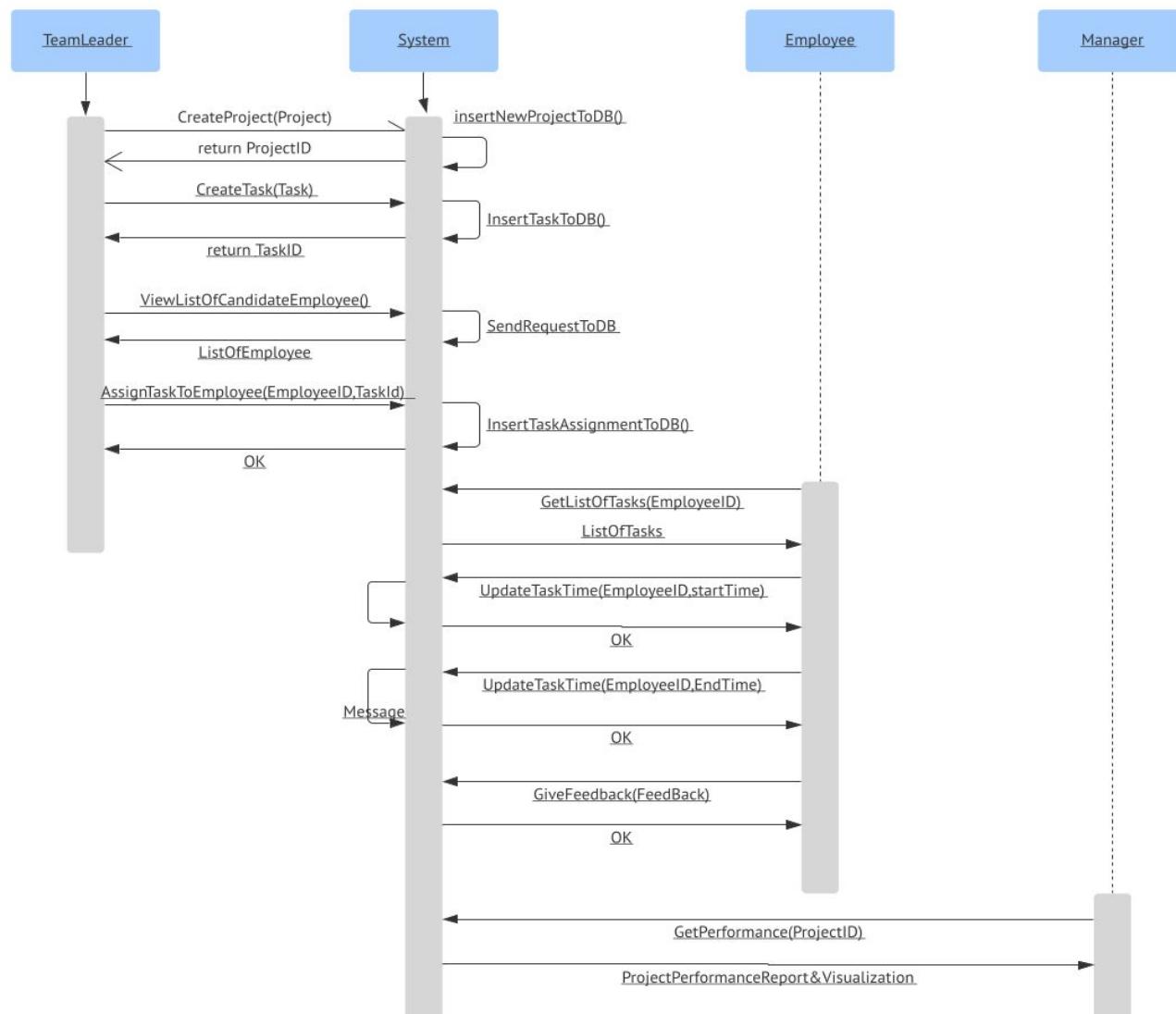
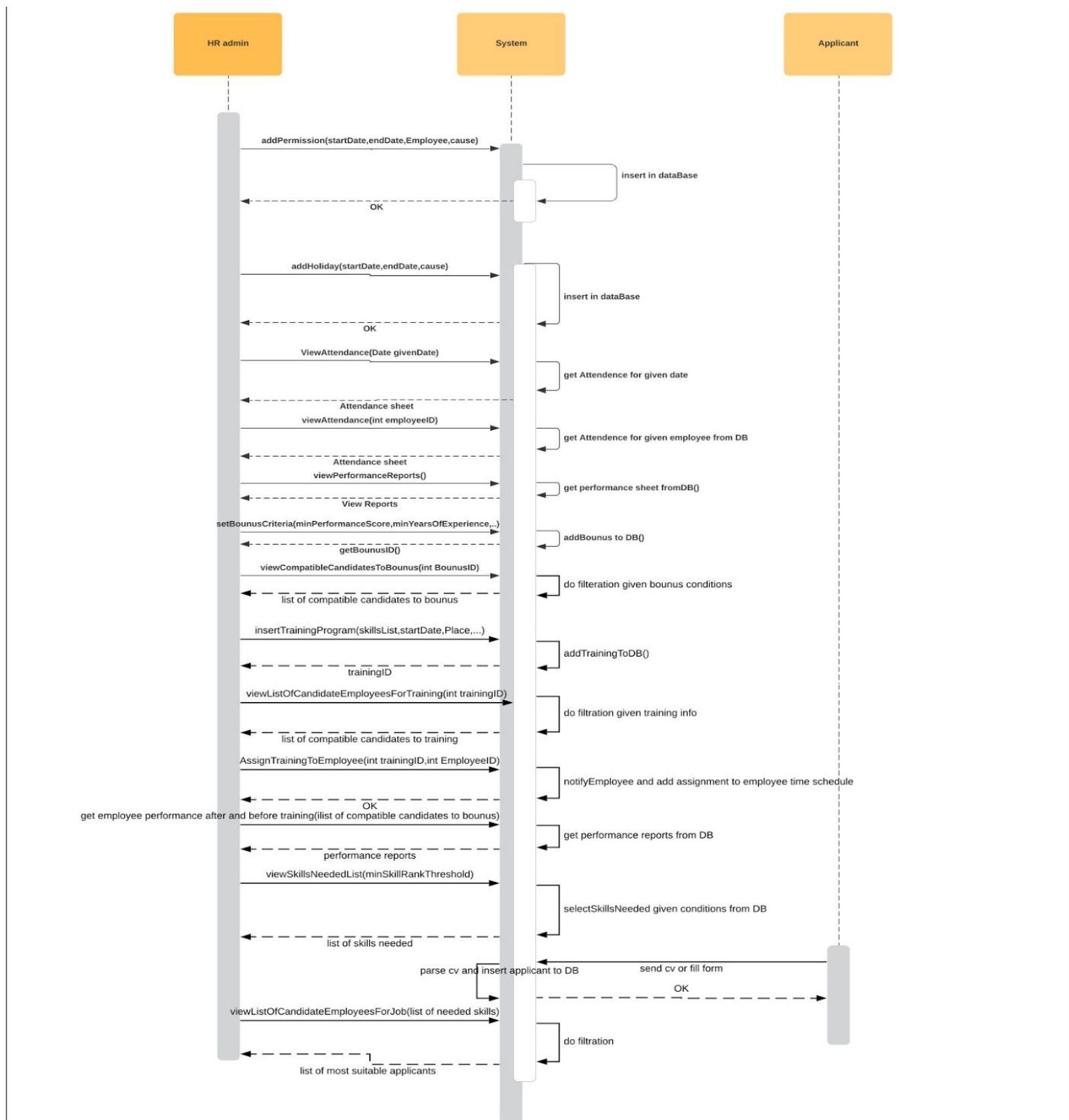


Figure 4.3: TaskAssignment & Scheduling & FeedBack Sequence Diagram.

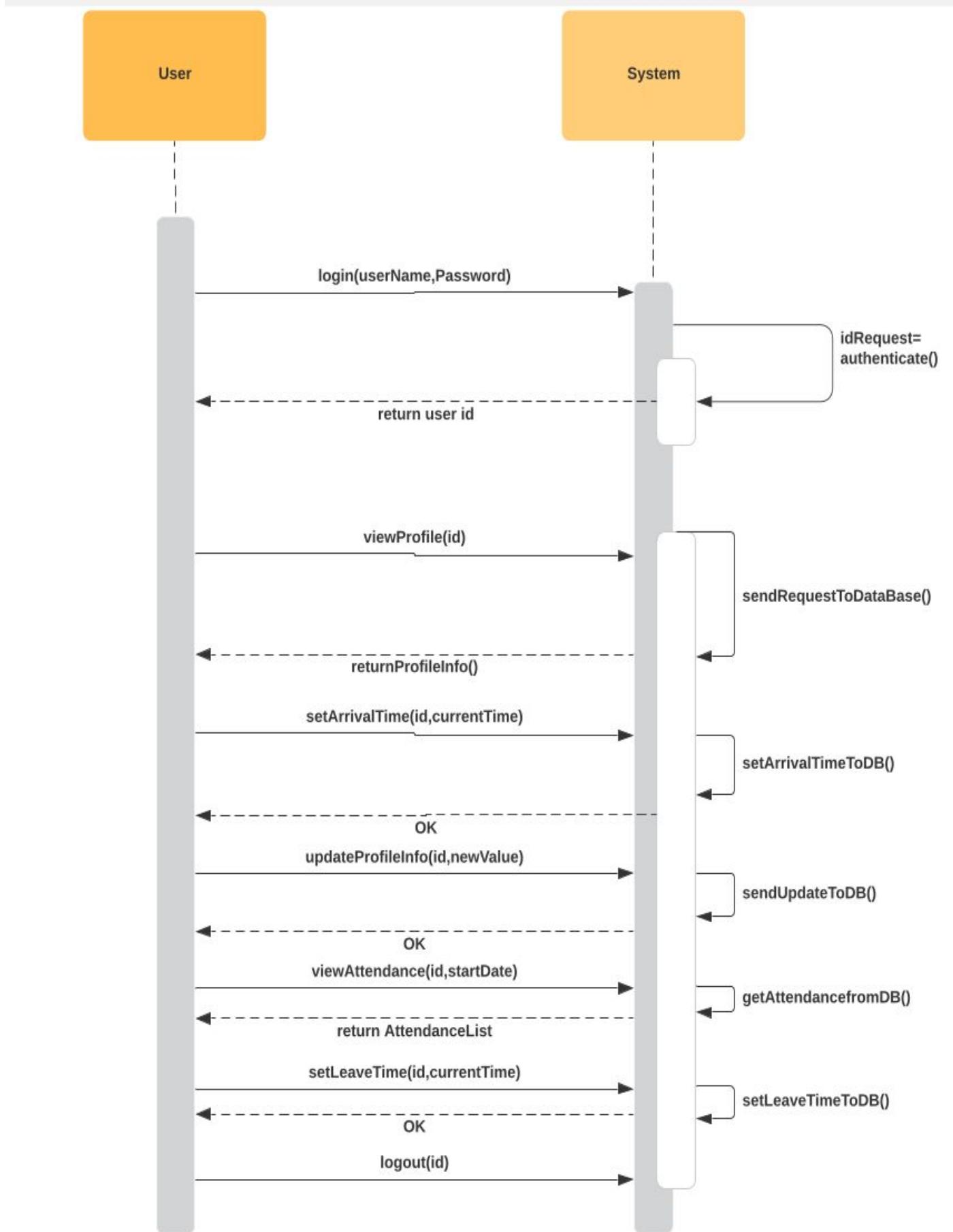
In Figure 4.4: HR Operations Sequence Diagram Diagram:

- The **HR Admin** can add permission for the employee which contains start & end time for the permission and employee with the case for each permission, The system inserts the record in DB.
- The **HR Admin** can add holidays inside the DB, with start, end time and cause for each holiday.
- The **HR Admin** can view attendance for a given date and the system returns attendance for the given date.
- The **HR Admin** can view attendance for a given employee and the system returns this for the given employee.
- The **HR Admin** can view performance reports from the DB.
- The **HR Admin** can do filtration, add bonus criteria and give bonus to specific employees.
- The **HR Admin** can add training programs, do filtration for given training and notify employees and assign training programs to employees.
- The **Applicant** can send a CV for the system and then the **HR Admin** can select the candidate employee for the required position.

**Figure 4.4: HR Operations Sequence Diagram.**

In Figure 4.5: User Self Service Sequence Diagram :

- The **User** login and logout to the system and the system authenticates the user request and then returns an ID for the user or logout the user.
- The **User** can view and update his/her own profile and the system sends a request to the DB and after that returns the profile information to the User.
- The **User** can set his/her arrival time and leave time to the system and then the system stores this record inside the DB.

**Figure 4.5: User Self Service Sequence Diagram.**

4.4 Structural Modeling

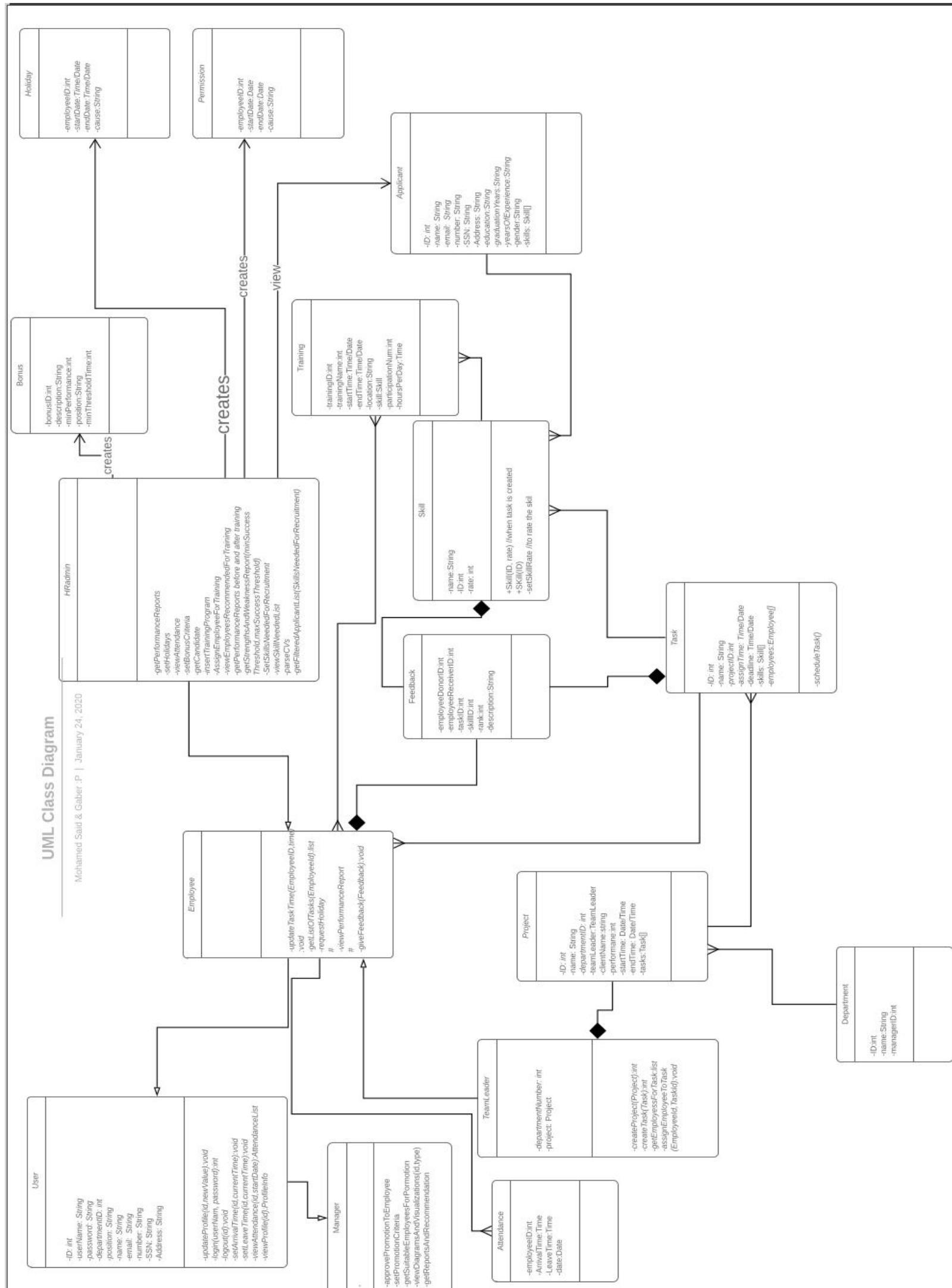


Figure 4.6: UML Class Diagram.

4.5 Behavioral Modeling

We use Data driven modeling as our Behavioral modeling, the data flows between processing and analysis processes to be stored and retrieved for even further analysis anytime.

Data flows between models, database tables and data warehouse:

The Data Flow of the Dimension tables:-

- Position dimension
- Skill dimension
- Employee dimension
- Date dimension

The data flow from the source which can be a table in the HR DB (position table , skill table , employee table) or a transaction as source (date) to the destination which is the DW dimension tables based on the identified dynamic as slowly changing attributes; if new records were introduced it will add them if an old record was modified it will be overwritten and the old value is no longer stored which matches the nature of the previous dimensions.

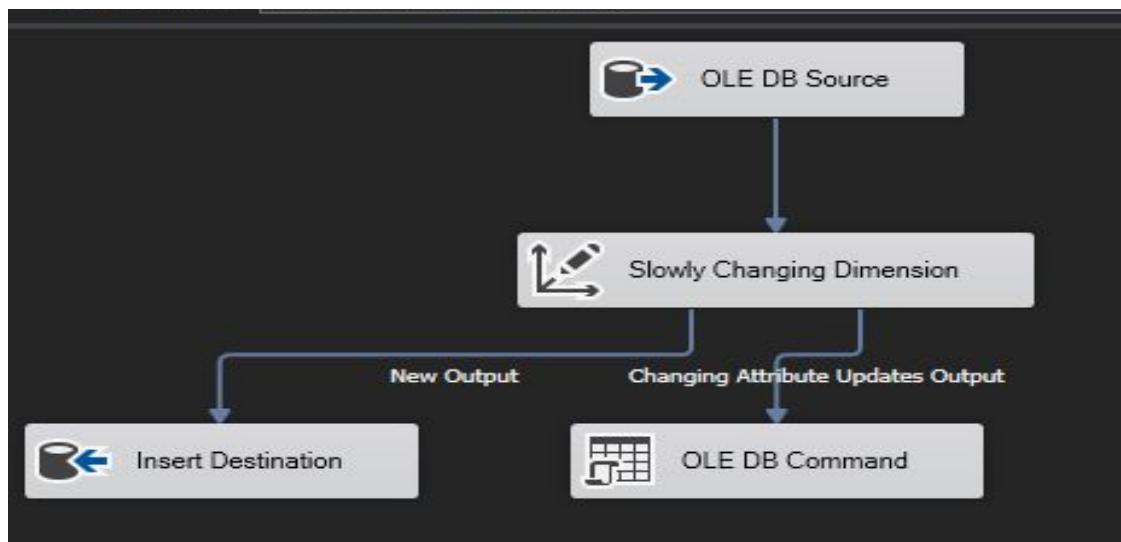


Figure 4.7: Data Flow of the Dimension.

Department dimension :

The data flow from the source which is a table in the HR DB (department table) to the destination which is the DW dimension tables based on the identified dynamic as for the attributes , the manager id is identified as a historical attribute ; if new records were introduced it will add them if an old record was modified it will store the old value with its expiration date and store the new data with the new date which matches the nature of the manager attribute as we need to track the managers performances on their time of managing departments.

The Data Flow of the Fact tables:-

- Fact Employee Behavior

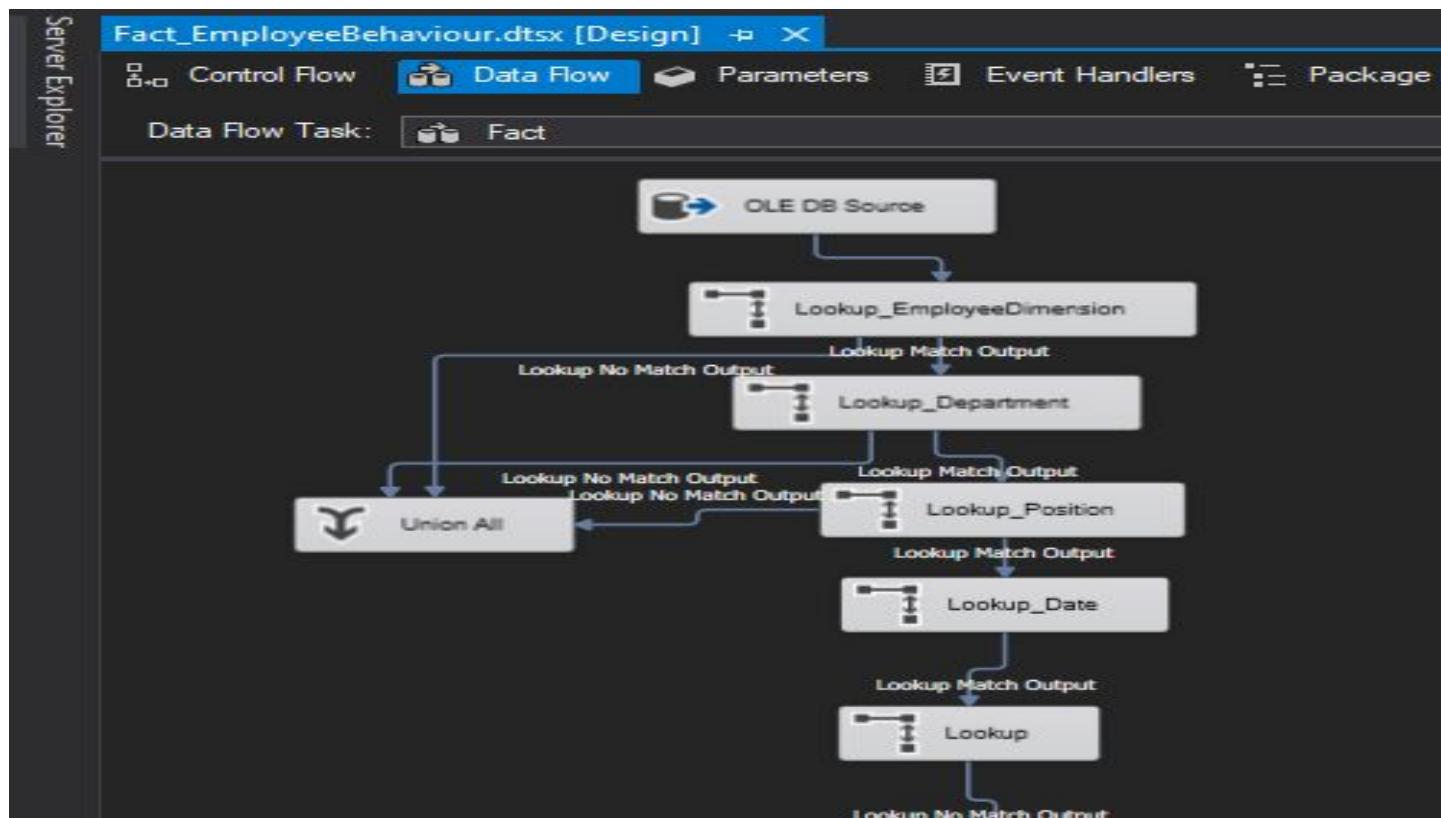


Figure 4.8: Data Flow of the Fact tables.

- Fact Employee Skill

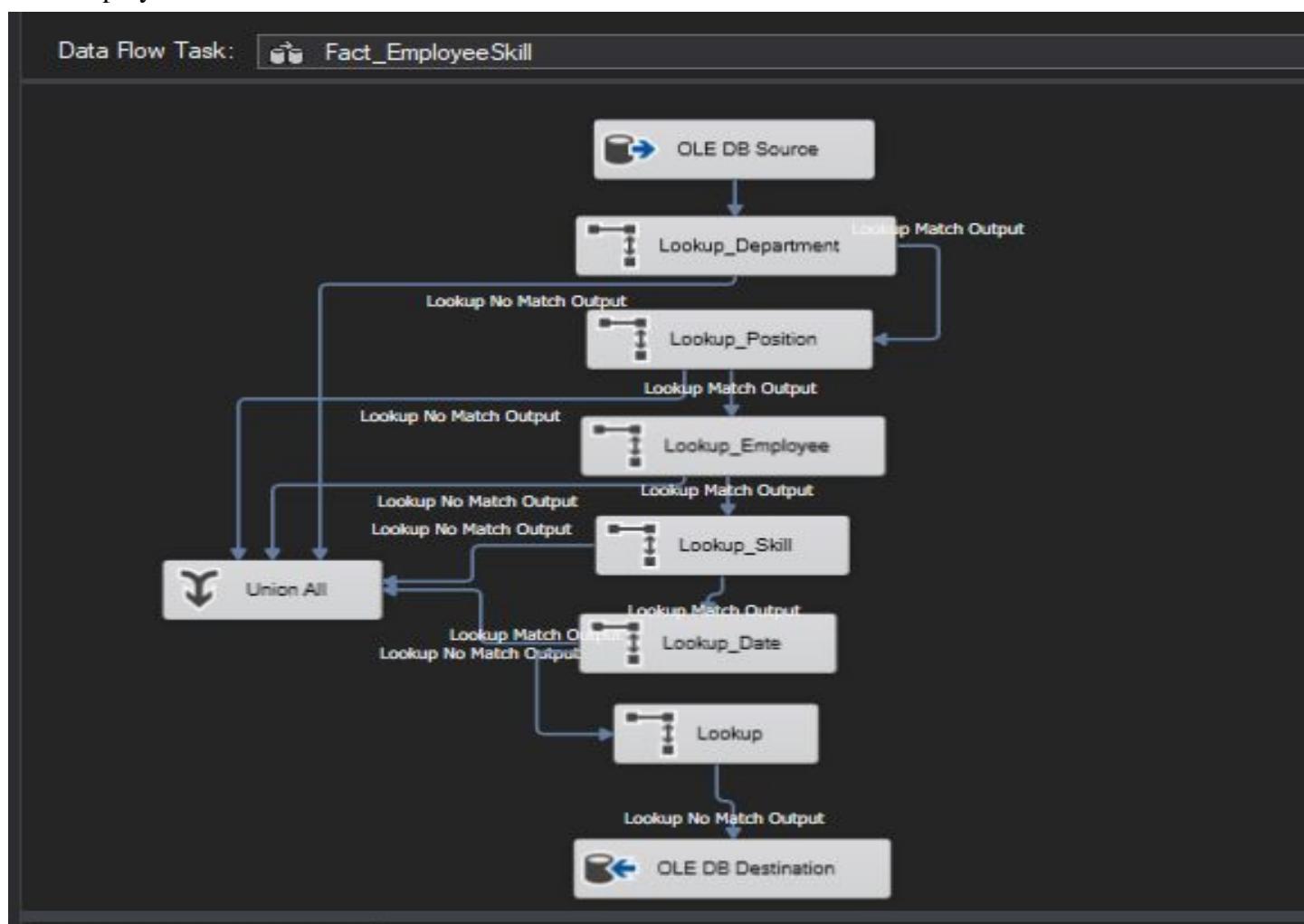


Figure 4.9: Fact Employee Skill tables.

5- CHAPTER FIVE : SYSTEM ARCHITECTURE

5.1 Introduction

The architectural design was done incrementally through multiple discussions and iterations till it was stabilized based on the system objectives and requirements , through these iterations it was changing rapidly and evolving till we got to this final version based on which we started our implementation phase.

5.2 Database Design

Staging Database Design:

This layer contains the database for online transactions, The database schema is shown in figure 3. The main tables in the database are:

1. **Employee:** Table that contains all the employees data, it is used to store and modify personal data for employees (id, user_name, password, full_name, email, position_id, department_id, address, ssd, created_at, country_code).
2. **Feedback:** Table contains all the feedback for each task assigned to employees and it is used to rank the skill of the employee on each task given both time taken vs time estimated (employee_giver_id, employee_receiver_id, task_id, skill_id, rank_skill, description).
3. **Task:** Table that contains all the assigned tasks for different projects(id, task_name, project_id).
4. **EmployeeSkills:** Table that contains all the employees skills with the rank for each skill (employee_id, skill_id, rank_skill).
5. **Project:** Table that contains all the project information (id, project_name, teamleader, department_id, client_name, start_time, end_time, performance).
6. **Position:** Table that contains all the positions with the description for each position for each employee in the company (id, position_name, desc).
7. **Department:** Table that contains all the departments and the manager for each department in the company (id, department_name, manager_id).
8. **Attendance:** Table that keeps record constantly updated of employees attendance and it keeps track of arrival and leave time for each employee (employee_id, arrival_time, leave_time, current_date).
9. **Permission:** Table that contains all the permission for the employees including the causation and start and end time (employee_id, start_time, end_time, causation).
10. **EmployeeTasks:** Table that contains all the tasks for employee (task_id, employee_id, start_time, end_time).
11. **Skill:** Table that contains all the skill for employees (id, skill_name, description).
12. **EnrollTraining:** Table that contains all the required training for all the employees (employee_id, training_id, skill_rank_before).
13. **SkillinTasks:** Table that contains all the required skills for each specific task (task_id, skill_id).
14. **ApplicantSkills:** Table that contains all the skills for the applicant (applicant_id, skill_id, skill_rank).
15. **Training :** Table that contains all the information and descriptions for the training programs (id, name, start_time, end_time, location, participants, hours_per_day, skill_id).
16. **Applicant:** Table that contains all the applicants information and data (id, name, email, number, ssn, address, education, graduation_year, experience_years, gender).

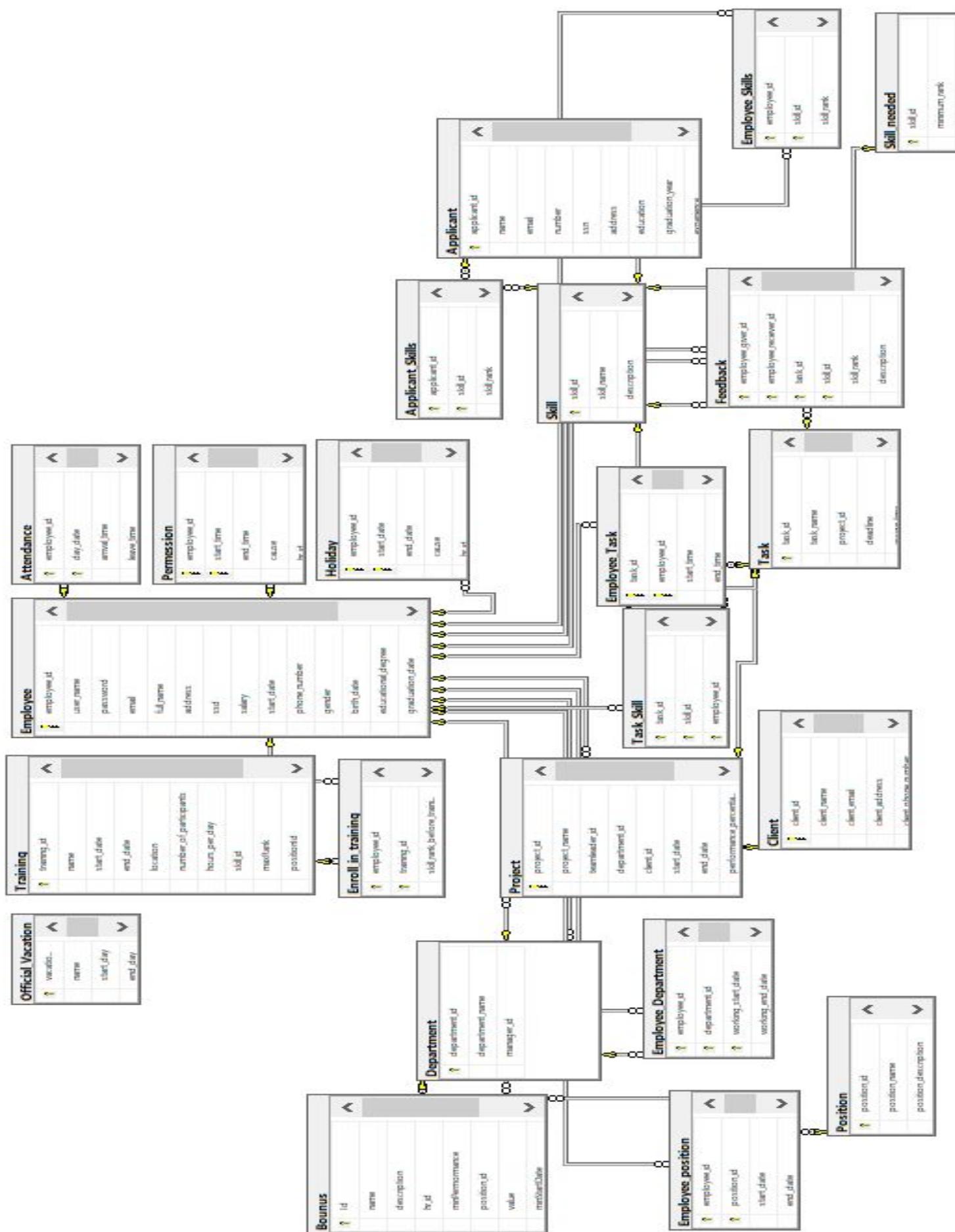


Figure 5.1: Database Schema.

5.3 Data Warehouse Design

Star Schema

`fact_employee_behavior` is a fact table having attributes i.e. (`department_key`, `position_key`, `employee_key`, `date_key`, `skill_id`, `employee_skill_rank`, `attendance_percentage`, `employee_performance`) which references the dimension tables. Employee dimension table contains the attributes: `employeeID`, `user_name`, `password`, `email`, `full_name`, `address`, `ssd`, `salary`, `start_date`, `phone_number`, `gender`, `birth_date`, `educational_degree`, `graduation_date`. *Data dimension table* contains the attributes: `date_key`, Quarter, Year. Department dimension table contains the attributes: `department_key`, `departmentID`, `department_name`, `manager_id`. Position dimension table contains the attributes: `position_key`, `positionID`, `position_name`, `desc`.

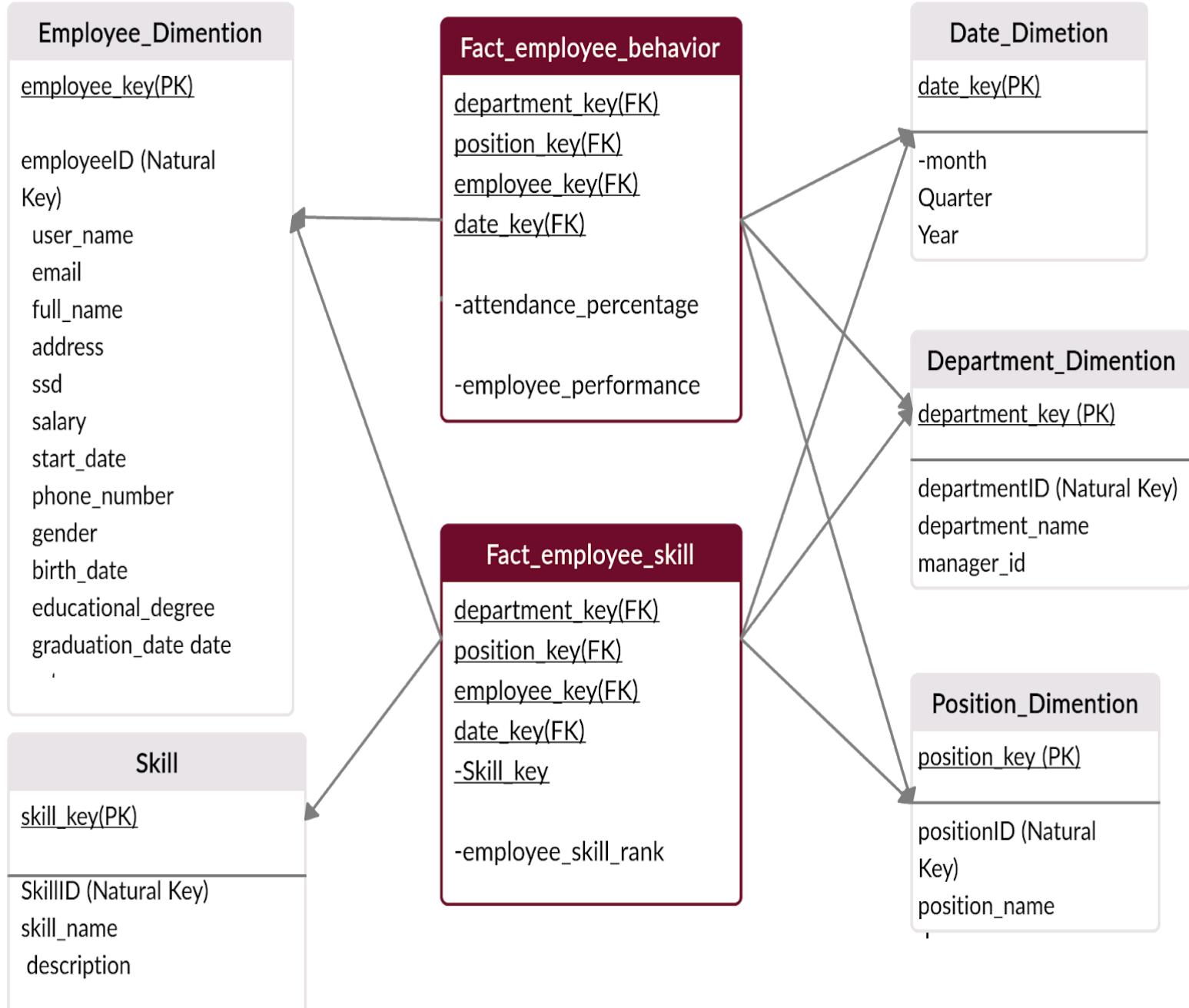


Figure 5.2: DWH Star Schema.

Data warehousing design is based on [The Data Warehouse Toolkit reference \[11\]](#)

5.4 MVC Architecture For Component Interaction

MVC patterns separate the input, processing and output of an application. This model is divided into three interconnected parts

Model:

This level is very important as it represents the data to the user. This level defines where the application's data objects are stored. The model doesn't know anything about views and controllers. So, whenever there are changes done in the model it will automatically notify observers that the changes are made.

The model is represented with a class diagram that shows the model's different object classes and the generalization and composition relation between them .

Views:

A view is a visual representation of the MVC model. This level creates an interface to show the actual output to the user. However, a view will not display anything itself. It is the controller or model that tells the view of what to display to the user. It also handles requests from the user and informs the controller. A view is connected to its model and gets the data necessary for the presentation by asking certain questions. Sometimes, it also updates the model by sending appropriate messages. All these questions and messages are sent back to the model in such an easy terminology that can easily understand the information sent by a model or a controller. The view is represented as web pages but the MVC can support many other representations (desktop application , mobile , .) as the view is separated from the system implementation.

Controller :

The controller is a level that acts as a brain of the entire MVC system. A controller also acts as a link between a user and the system. It provides the user with the input by providing appropriate views to present it appropriately on the screen. The controller understands user output, converts it into the appropriate messages, gets data that's encapsulated in the model objects and passes the same to views.

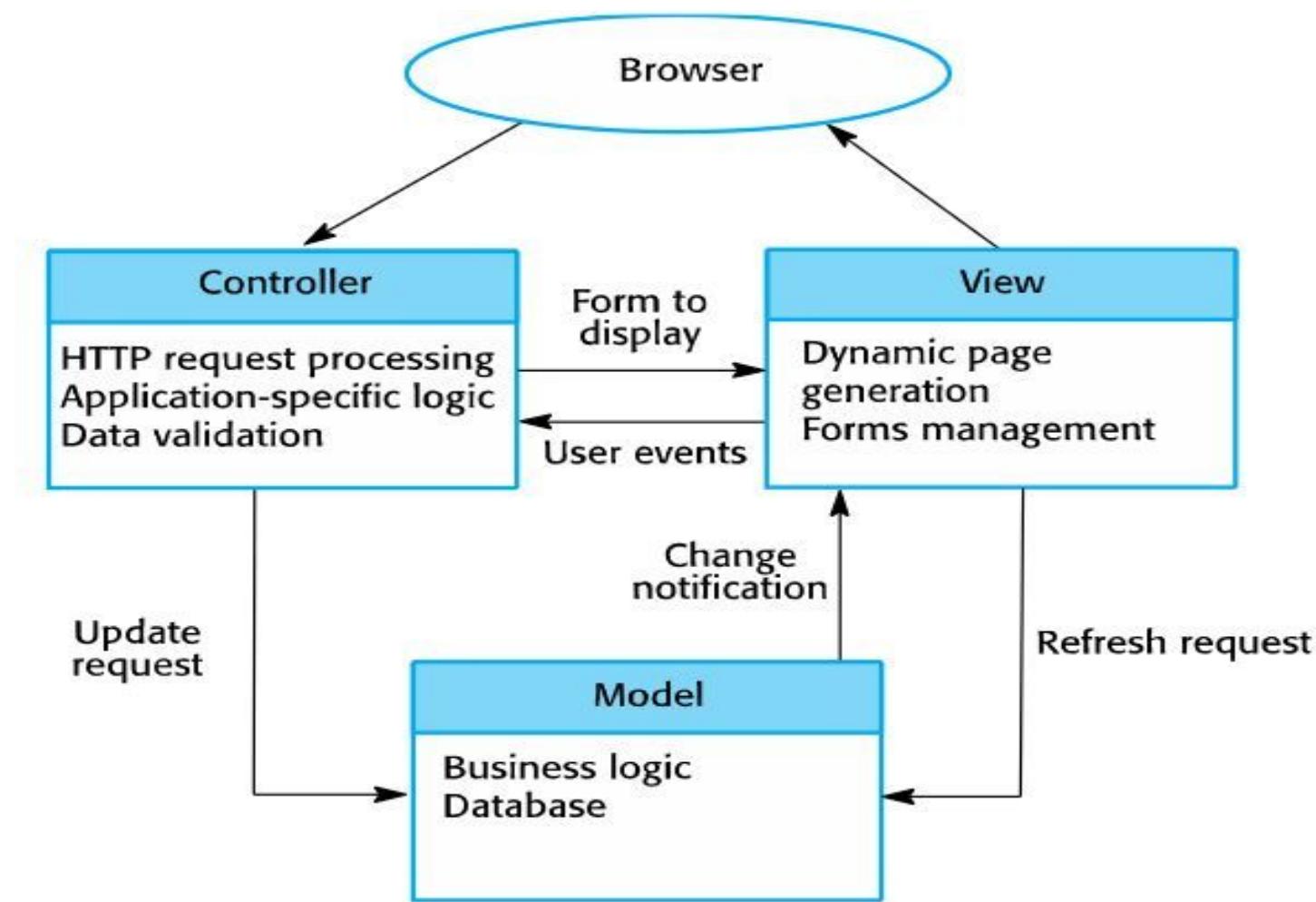


Figure 5.3: MVC Architecture For Component Interaction.

Apart from that MVC is built to handle some specific development aspects of any web or .net application development that we chose as our framework for implementing the projects , there are some other advantages that made us use the MVC pattern :

1. Faster development process:

MVC supports rapid and parallel development. If an MVC model is used to develop any particular web application then it is possible that one programmer can work on the view while the other can work on the controller to create the business logic of the web application. Hence this way, the application developed using the MVC model can be completed three times faster than applications that are developed using other development patterns. And that's exactly the programming strategy that we used in the development process that's why the MVC was the most appealing architectural choice for us .

2. Ability to provide multiple views:

In the MVC Model, you can create multiple views for a model. Today, there is an increasing demand for new ways to access your application and for that MVC development is certainly a great solution. Moreover, in this method, Code duplication is very limited because it separates data and business logic from the display. Which makes the system more maintainable and able to cope with view changes in the future .

3. The modification does not affect the entire model:

For any web application, the user interface tends to change more frequently than the application logic. It is obvious that we made frequent changes in our application like changing screen layouts, and adding new features with new pages incrementally. Moreover, Adding a new type of view is very easy in the MVC pattern because the Model part does not depend on the view part. Therefore, any changes in the Model will not affect the entire architecture.

6- CHAPTER SIX: SYSTEM IMPLEMENTATION AND COMPONENT TESTING

6.1 Implementation procedures

Agility for work and time management

We made use of the agile environment practice in managing the work which made it easier to work in parallel (front end , back end and database) as all phases (requirements identification , design and implementation) were done in iterations and incrementally which made the system embrace the constantly changing requirements and design decisions and also made it maintainable and ready for new additions as additional increments with the minimum modifications.

XP Practices for coding

We used some of the XP (extreme programming) practices such as :

Pair programming : we programmed in pairs so that code reviews are done constantly and it also supports collective ownership to all parts of the system and deep understanding of all aspects and issues.

Repeated refactoring : for the code to be simple and understandable to support the agility of the implementation process.

6.2 Tools

Visual studio 2019

Support web application development for MVC architecture and database connections and manipulations and SSIS for data warehouse analysis in an efficient easy way which matches our project scope.

Microsoft SQL Server Management 2019

Database Management System that manages database implementation ,query manipulation and transaction and scripts execution.

Compatible with the visual studio setting for more consistent implementation.

SSIS

SQL Server Integration tool that supports data flows and implementing the data warehouse star schema design . Also compatible with using SQL server DBMS and visual studio.

6.3 First iteration

- **Inputs :**
 - The architectural design using MVC Architectural Pattern.
 - The database design and schema.
 - The data warehouse design and schema.
 - The class diagram as a guide for the object oriented system nature.
- **Increment chosen Requirements :**
 - Build the database tables as specified in the schema.

- Implement the classes specified in the class diagram with attributes declarations , setters , getters and generalization and composition relations between classes as stated in the chosen design.
- **Increment preconditions :**
 - Development framework which supports the chosen programming language and connection to databases.
 - Database management system supports building relational schemas and processing transactions.
- **Realising preconditions :**
 - .Net Framework installed and ready.
 - MySQL DBMS installed and ready.
 - Connection between a C# project and MySQL is up and ready.
- **Increment duration :**
 - About 2 weeks during which , the schema and class diagram was being constantly edited based on best implementation patterns and discussions between team members.
- **Outputs :**
 - Database tables and relations built and filled with dummy pregenerated data for experimenting.
 - The classes of the model part are generated and methods ready to be implemented.
- **Tests :**
 - Test model to database connection by performing some dummy transactions through the model.
- **Tests results :**
 - Output accepted.

6.4 Second iteration - Implementing feature (Employee self service)

- **Inputs :**

- The functional requirements document along with use cases and sequence diagrams.
- Database tables and relations built and filled with dummy pregenerated data for experimenting.
- The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- An employee can log in to his profile.
- When an employee logs in he can view his profile and his information (name, department, position, contact info).
- Hr can insert new employees and enter his information (name, department, position, contact info) and his permanent username and a dummy password.

- **Increment preconditions :**

- Classes UserInfo,Employee,HrAdmin,Applicant and EmployeeSkill implemented.
- Tables Employee,Applicant,Employee_Skill,Employee_Department,Employee_Position in a database filled with data and ready.

- **Realising preconditions :**

Satisfied in the first iteration.

- **Increment duration :**

- About 2 weeks during which , the schema and class diagram was being constantly edited based on best implementation patterns and discussions between team members.

- **Outputs :**

- 3 web pages.
- **Login** : any employee can log in to his profile using his username and password.
- **Hire employee** : hr can insert new employee and enter his initial data to be able to log in later.
- **View employee personal information** : each employee can see his personal information (name , position , department , contact info and skill scores , ..).

- **Tests :**

Test 1 :

- **Functionality tested** : test log in.
- **Scenario** : choose an employee and try to log in using the correct username and pass make sure it logs in to the chosen employee's profile.
- **Input** :

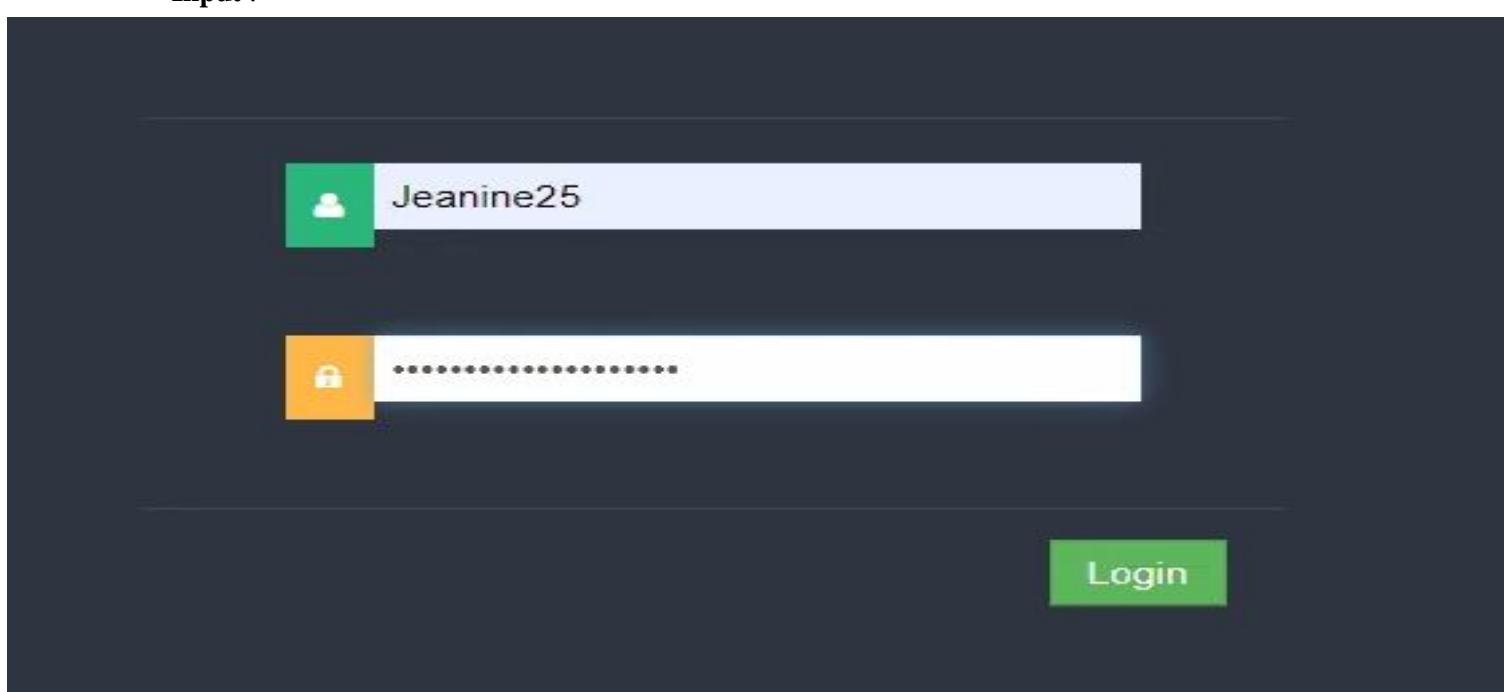


Figure 6.1: Employee self service (Login Operation).

- **Expected output** : as Actual

- **Actual output :**

The screenshot shows a user interface for viewing a profile. On the left is a dark sidebar with navigation links: My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, and Projects and Tasks. The main content area has a title 'My Profile'. Below it is a table titled 'Information' containing the following data:

User Name:	Jeanine25
Department Name:	Web
Position Name:	TeamLeader
Full Name:	Owen Bates
Email:	araenhou0@yljgj.msusun.com
Salary:	11639
Phone Number:	7839557581
SSD:	876-16-1474
Address:	254 East White Hague Parkway
Start Work Date:	30/01/2013 00:00:00

Figure 6.2: Employee self service (View Profile Operation).

This screenshot shows a continuation of the profile view. It includes a table with four rows of personal information:

Start Work Date:	30/01/2013 00:00:00
Birth Date:	15/08/1971 00:00:00
Educational Degree:	Doctorate
Graduation Date:	13/04/1993 00:00:00

Below this is another section titled 'List Of Skills' with a table:

Skill Name	Skill Rank
Scientific computing	★★★☆☆

Figure 6.3: Employee self service (View Profile Operation).

Test 2 :

- **Functionality tested :** test log in.
- **Scenario :** choose an employee and try to log in using the wrong username or wrong pass make sure it doesn't log in to any profile and show an error message.
- **Input :**
Enter wrong password
- **Expected output :** as Actual
- **Actual output :**

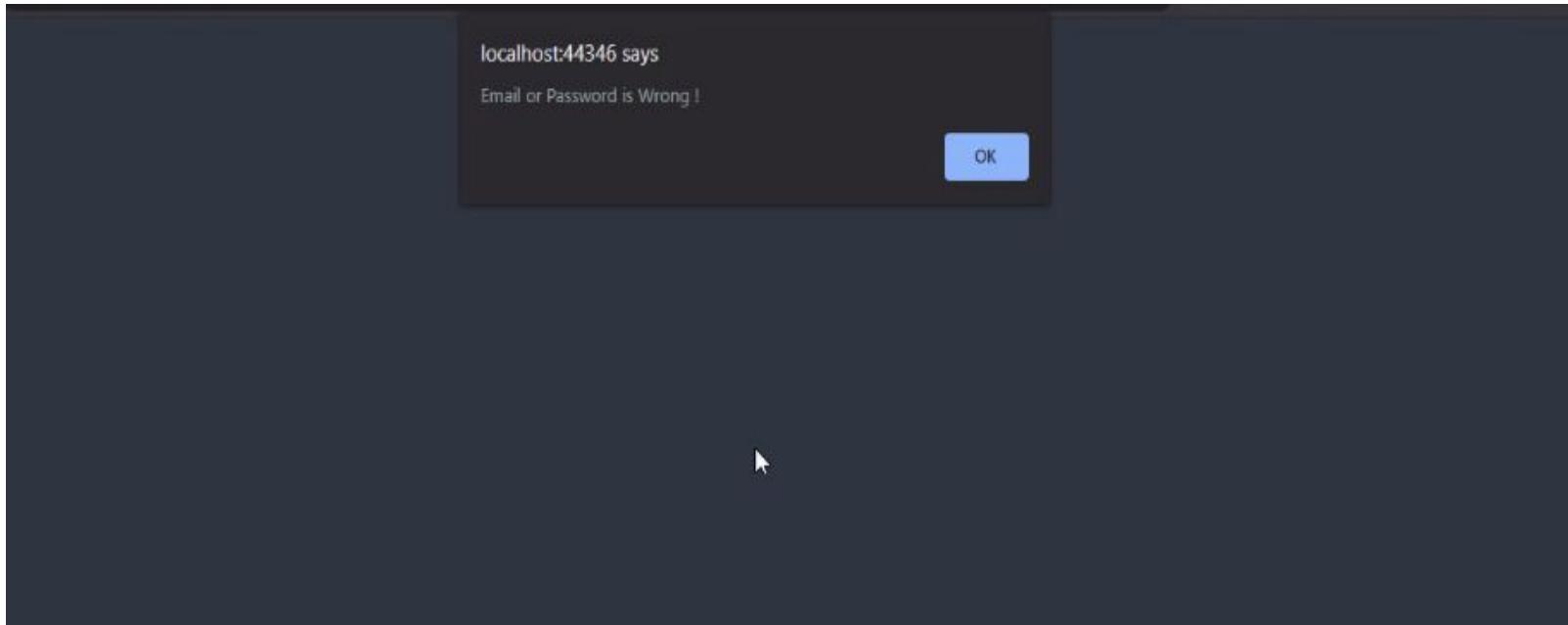


Figure 6.4: Employee self service (Handle Wrong Email Or Password Operation).

Test 3 :

- **Functionality tested :** employee views his information.
- **Scenario :** choose a specific employee then login and view his profile and check if it's compatible with the employee table in the database.
- **Input :**

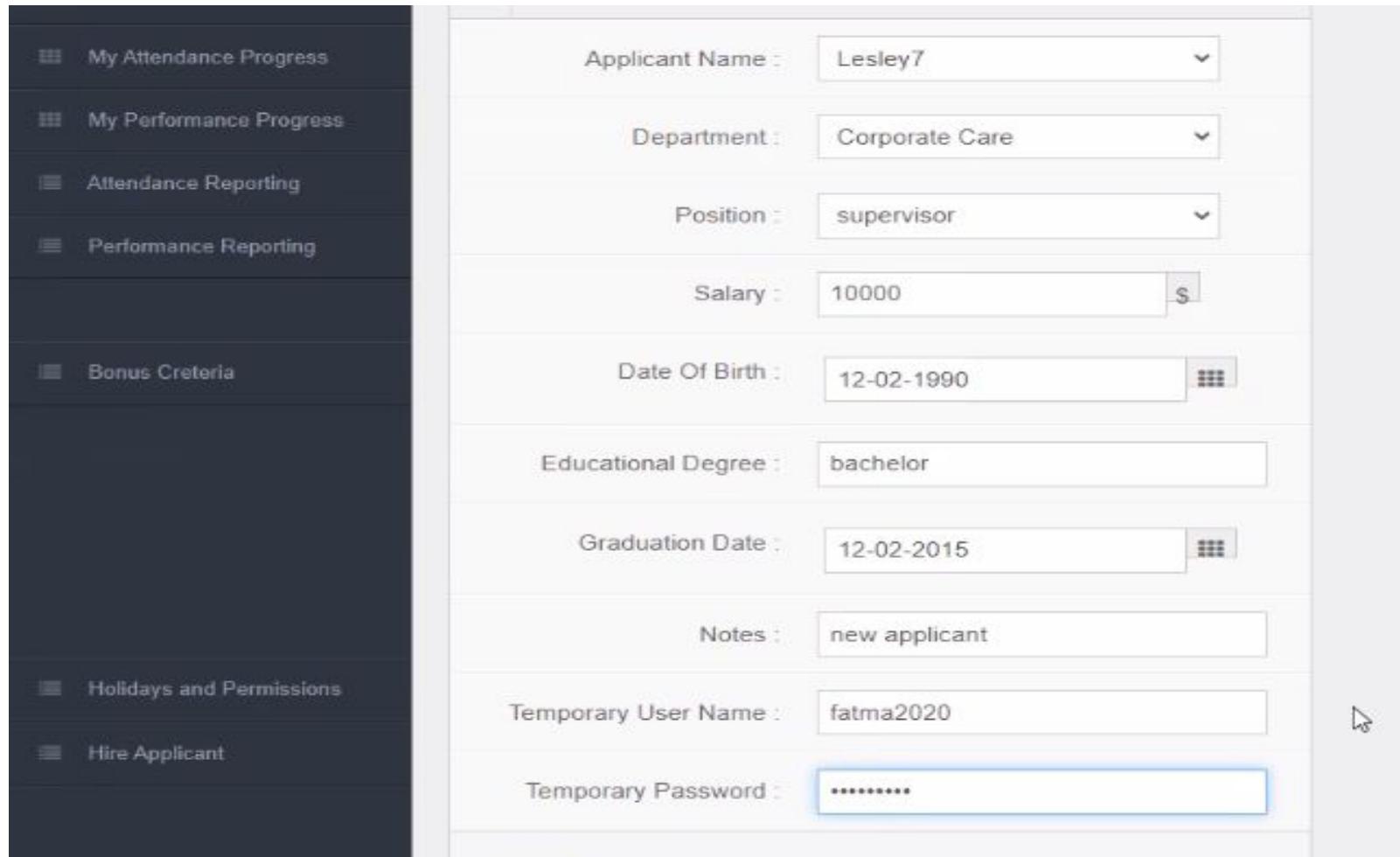
Information	
User Name:	Jeanine25
Department Name:	Web
Position Name:	Quality Testing Officer
Full Name:	Owen Bates
Email:	araenhou0@yljgj.msusun.com
Salary:	11639
Phone Number:	7839557581
SSD:	876-16-1474
Address:	254 East White Hague Parkway
Start Work Date:	30/01/2013 00:00:00
Birth Date:	15/08/1971 00:00:00

Figure 6.5: Employee self service (View Profile Operation).

- **Expected output :** as Actual
- **Actual output :**
Output is compatible with database

Test 4 :

- **Functionality tested :** HR insert employee.
- **Scenario :** log in with an HR account and insert employee name and business information then check if it appears in the employee table in the database then try to log in to the new employee's account using the new added username and password.
- **Input :**



The screenshot shows a user interface for inserting a new employee record. On the left, a dark sidebar lists navigation options: My Attendance Progress, My Performance Progress, Attendance Reporting, Performance Reporting, Bonus Criteria, Holidays and Permissions, and Hire Applicant. The 'Hire Applicant' option is currently selected. The main area contains fields for entering employee details:

- Applicant Name: Lesley
- Department: Corporate Care
- Position: supervisor
- Salary: 10000 \$
- Date Of Birth: 12-02-1990
- Educational Degree: bachelor
- Graduation Date: 12-02-2015
- Notes: new applicant
- Temporary User Name: fatma2020
- Temporary Password: (represented by five asterisks)

Figure 6.6: Employee self service (HR Insert Employee Operation).

- **Expected output :** as Actual
- **Actual output :**

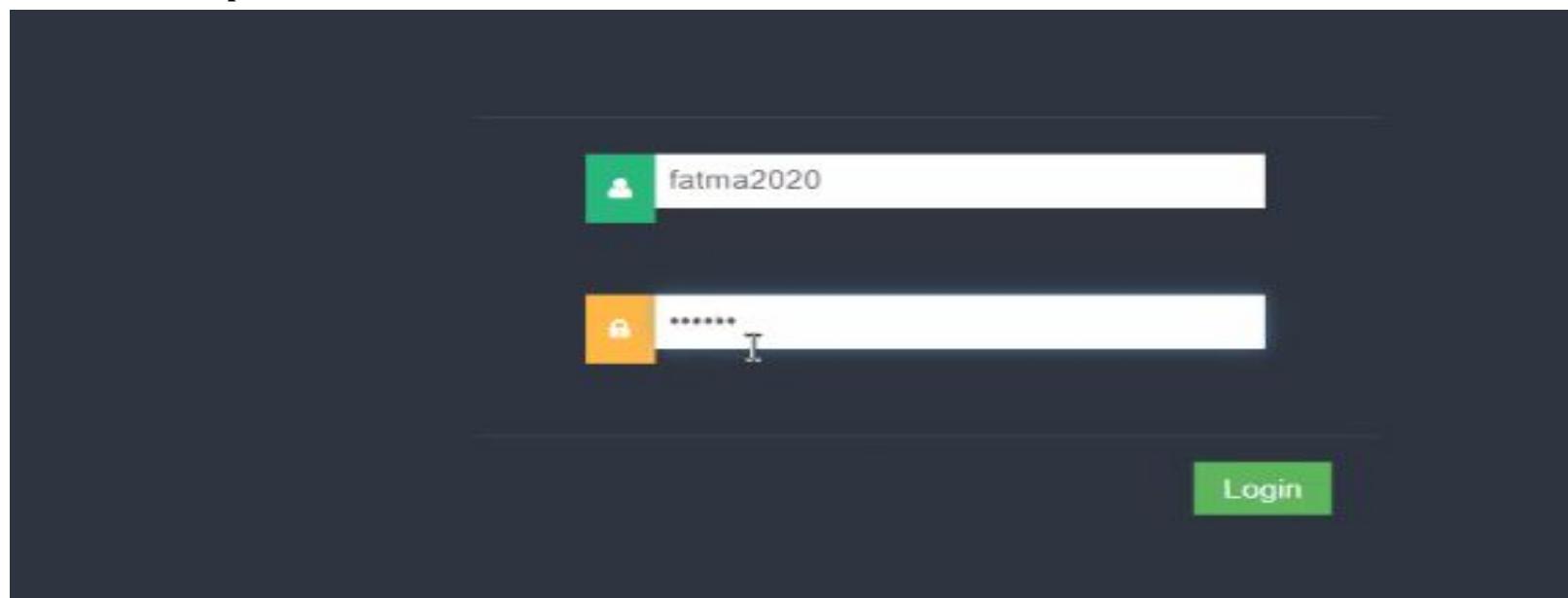


Figure 6.7: Employee self service (Login Operation).

Information	
User Name:	fatma2020
Department Name:	Web
Position Name:	Quality Testing Officer
Full Name:	Jeannie2
Email:	bvui.ppbhxflxu@kleysk.pahuxr.org
Salary:	10000
Phone Number:	42540
SSD:	102-84-0365
Address:	81 South Milton Street
Start Work Date:	04/08/2020 00:00:00
Birth Date:	12/02/1990 00:00:00
Educational Degree:	bachelor
Graduation Date:	02/12/2015 00:00:00

Figure 6.8: Employee self service (View Profile Operation).

Test 5 :

- **Functionality tested :** test reporting progress for employee within time period.
- **Scenario :** choose a specific employee then login then view his attendance progress report in certain time period and check if it's compatible with the attendance table in database
- **Input :**

03/04/1986 Set 03/11/1990

Figure 6.9: Employee self service (Reporting Progress For Employees Within Time Period Operation).

Time from 03/04/1986 to 03/11/1990

- **Expected output :** as Actual
- **Actual output :**

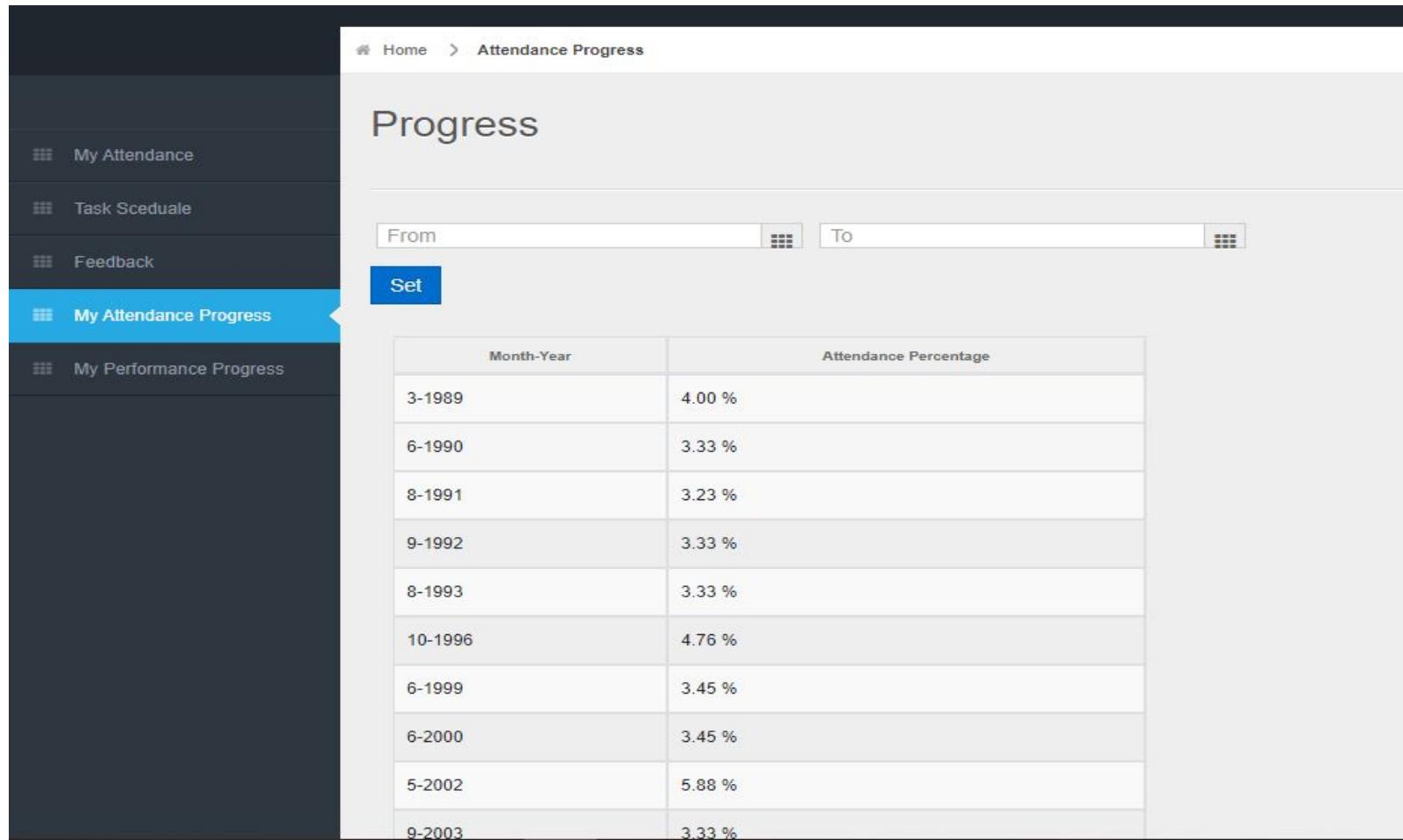


Figure 6.10: Employee self service (Attendance Progress Operation).

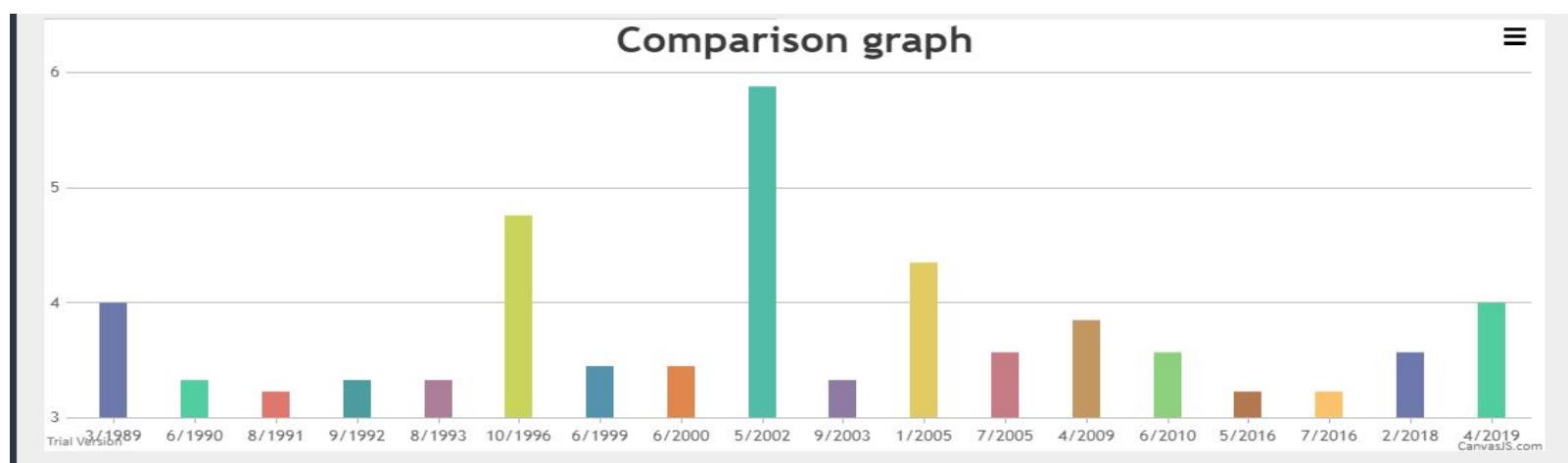


Figure 6.11: Employee self service (Comparison Graph Visualization).

Test 5 :

- **Functionality tested :** test reporting progress for employee within time period.
- **Scenario :** choose a specific employee then login then view his performance progress report in certain time period and check if it's compatible with the attendance table in database
- **Input :**

This screenshot shows a search interface for reporting employee progress within a specific time frame. It features two date input fields: "03/04/1986" and "03/11/1990", each with a "Set" button to its left. The background of the application is light gray.

Figure 6.12: Employee self service (Test Reporting Progress For Employee Within Time Period).

- **Expected output :** as Actual
- **Actual output :**

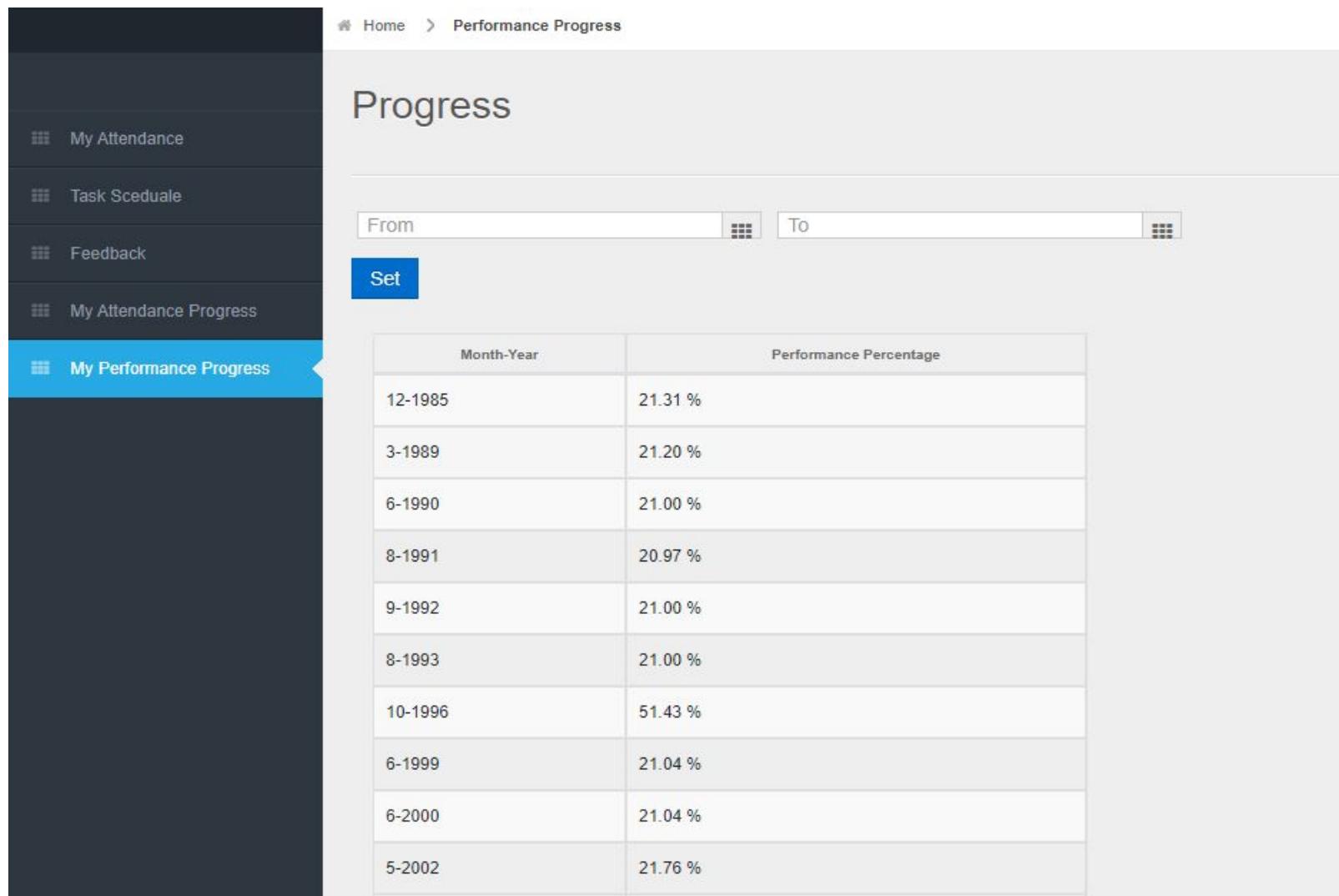


Figure 6.13: Employee self service (View Performance Progress Operation).

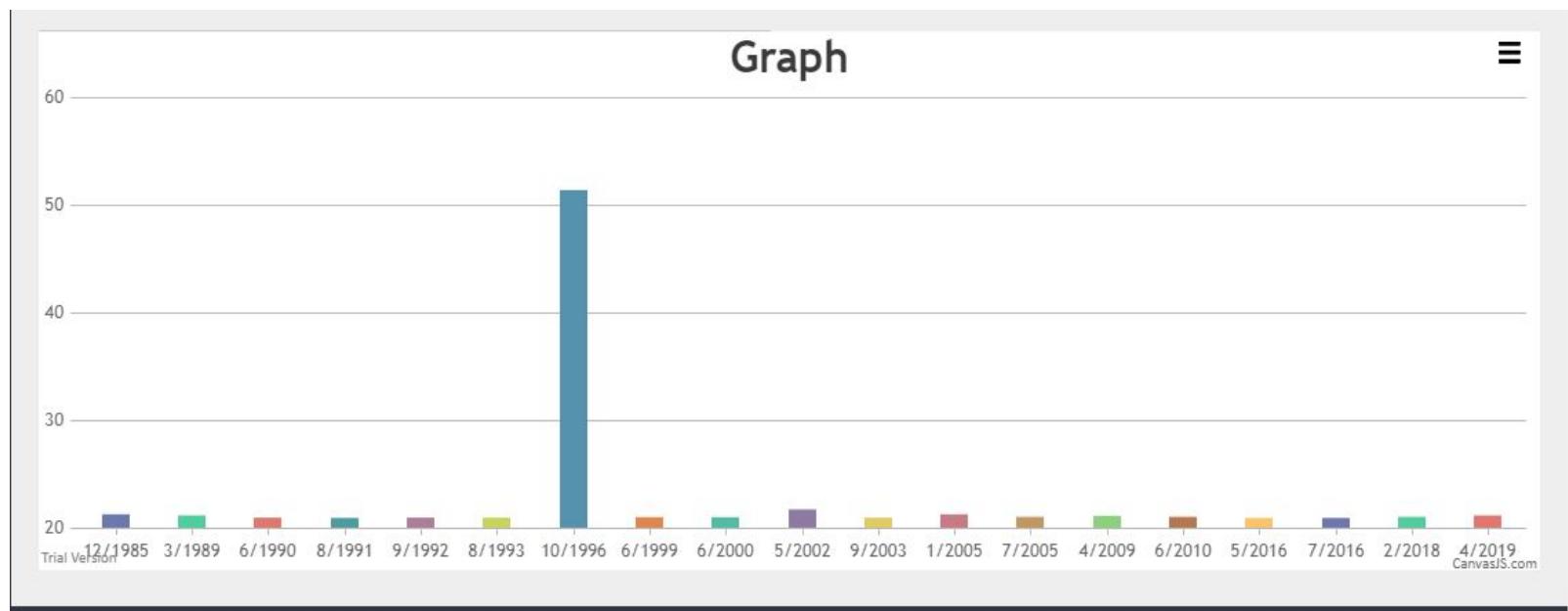


Figure 6.14: Employee self service (View Performance Progress Visualization Graph).

6.5 Third iteration - Implementing feature (Need for Training)

- **Inputs :**
 - The functional requirements document along with use cases and sequence diagrams.
 - Database tables and relations built and filled with dummy pregenerated data for experimenting.
 - The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- The hr admin can insert new training (training name , skill , max rank of skill that would enable the employee to take the training , max number of participants, location , start and end dates of training , position and department to which the training is directed) note : start and end dates could be set or updated later based on the available time of employees assigned to the training.
- Hr admin can view a list of recommended employees that applies to the conditions of the inserted training to choose between them who to assign training to.
- Hr admin can assign training to any of the recommended employees (the system would refuse the assignment if the time schedule of this employee is busy during training or if the training has reached max number of employees).
- Hr admin can choose to assign employees first then set the training time and then the system would recommend the suitable closest time to start training based on the time schedule of preassigned employees.
- In case the hr admin didn't approve to proposed time , he could set a different time that would be granted by the system if no contradictions with schedules of assigned employees otherwise the system would refuse the time and show him list of employees assigned to the training that are busy during chosen time so hr could un assign these employees to that training or set another training time that is compatible with them.
- Eventually , the training can be removed entirely if it was canceled.
- Hr admin can view a list of all training or training for certain employees.
- Employees can view a list of training that he's taken.
- Hr admin can get reports for certain employee progress (difference in skill rank) before taking training and now.
- Hr admin can get reports for all employees progress for certain training.

- **Increment preconditions :**

- Classes Training , HRAdmin , Employees and EmployeeSkills Implemented.
- Tables Training , Employee , EnrollInTraining and EmployeeSkill in the database filled with data and ready.

- **Realising preconditions :**

Satisfied in the first iteration.

- **Increment duration :**

- About 2 weeks during which , the schema and class diagram was being constantly edited based on best implementation patterns and discussions between team members.

- **Outputs :**

- 3 web pages.
- **Add training :** HR can create new training and insert its data.
- **Training board :** HR can view and delete training.
- **View Training Information :** for a single training , HR can view training information , view enrolled employees and assign any of them , view recommended employees based on the skill score and the employee free schedule and assign any of them , add an employee and check their availability.

- **Tests :**

Test 1 :

- **Functionality tested :** test add and view new training.
- **Scenario :** add new training from the add training page then check that it was added in both the training board and the training table in the database.
- **Input :**

Training Name : presentation skills

Start Date : 12-11-2020

End Date : 12-12-2020

Location : Alexandria

Hours Per Day : 3

Skill : Leadership

Maximum Rank : 3

Position : Receptionist

Department : Marketing

Maximum Number Of Participants : 20

Figure 6.15: Need for Training (Add Training Operation).

- **Expected Output :** New training would appear in the training board page and the database.
- **Actual output :**

Rene	19/02/1997 00:00:00	03/03/1997 00:00:00	17	View	Delete
Ty166	07/01/1990 00:00:00	18/01/1990 00:00:00	20	View	Delete
Yvette970	16/01/1990 00:00:00	25/01/1990 00:00:00	18	View	Delete
Shauna9	09/12/2017 00:00:00	20/12/2017 00:00:00	15	View	Delete
Leo8	03/05/1988 00:00:00	11/05/1988 00:00:00	17	View	Delete
Trina8	17/03/1989 00:00:00	09/04/1989 00:00:00	13	View	Delete
Training	12/02/2012 00:00:00	12/02/2012 00:00:00	10	View	Delete
Training	12/02/2012 00:00:00	12/02/2012 00:00:00	10	View	Delete
Training	12/02/2012 00:00:00	12/02/2012 00:00:00	10	View	Delete
Training	12/02/2019 00:00:00	12/03/2019 00:00:00	10	View	Delete
Training3 ,	12/04/2019 00:00:00	12/05/2019 00:00:00	10	View	Delete
presentation skills,	12/11/2020 00:00:00	12/12/2020 00:00:00	20	View	Delete

Figure 6.16: Need for Training (View Training Programs).

Test 2 :

- **Functionality tested :** test recommend employees.
- **Scenario :** choose a training and make sure that recommended employees are as desired based on their skill score and time schedule to match the chosen training.
- **Input :**

Recommended Employees				
Employee Name	Email	Phone Number	Address	
Angela9	bjpagst94@zrnnpvcvd.mkvovt.org	2119783420	53 Nobel Blvd.	<button>Assign</button>
Evelyn74	qtrtz44@wxyx-d.org	8841964090	32 Rocky Cowley Freeway	<button>Assign</button>
Michele46	gvsu.qcjxrkb@yhgaq.upoycg.org	5496311077	101 Green Second Boulevard	<button>Assign</button>
Vernon	bzcdk4@vsepuydu.yoxtis.net	926887-3306	913 Rocky Cowley Boulevard	<button>Assign</button>
Jana557	pmrwysrv.yattvuyou@zqzpnfk.ljyicp.org	670-5709732	149 Green Nobel Way	<button>Assign</button>
Dale354	lhujsk01@bexqqn.org	000-357-9454	163 Cowley Road	<button>Assign</button>
Edith2	pqgwphol.dixonxto@vtzelah.jvbfgt.com	4693657800	706 Clarendon Freeway	<button>Assign</button>
Greg062	dlwjzdkn.hywwgpxmf@bknzia.org	304-7205809	24 White Second Street	<button>Assign</button>
Marisol	xaeauui.jsim@tjjnpnv.riazhj.com	036-059-6738	94 White Second Blvd.	<button>Assign</button>
Timmy417	jfvedyic.acmn@fuqaol.oephdt.ofg	416-169-2620	73 Old Avenue	<button>Assign</button>
Tabitha	mtqzgpb.alrqlhsbe@untpoym.znpehp.com	566-4198024	35 Rocky Hague Avenue	<button>Assign</button>
Rogelio7	nfzc.duner@leaszncjm.yxofoq.net	0353403175	14 South New Avenue	<button>Assign</button>

Figure 6.17: Need for Training (Assign Training Program To Employees Operation).

- **Expected output :** as Actual
- **Actual output :**

The recommended employee is compatible with training skill score and training time schedule

Test 3 :

- **Functionality tested :** test add employee.
- **Scenario :** add an employee that doesn't match the time schedule of the training and see if the system would show a schedule mismatch error.
- **Input :**
- **Expected output :**
- **Actual output :**

Test 4 :

- **Functionality tested :** test add employee.
- **Scenario :** add an employee that matches the time schedule of the training and see if the system would show a schedule mismatch error and if the employee would appear in the enrolled employees list on page and on database.
- **Input :**

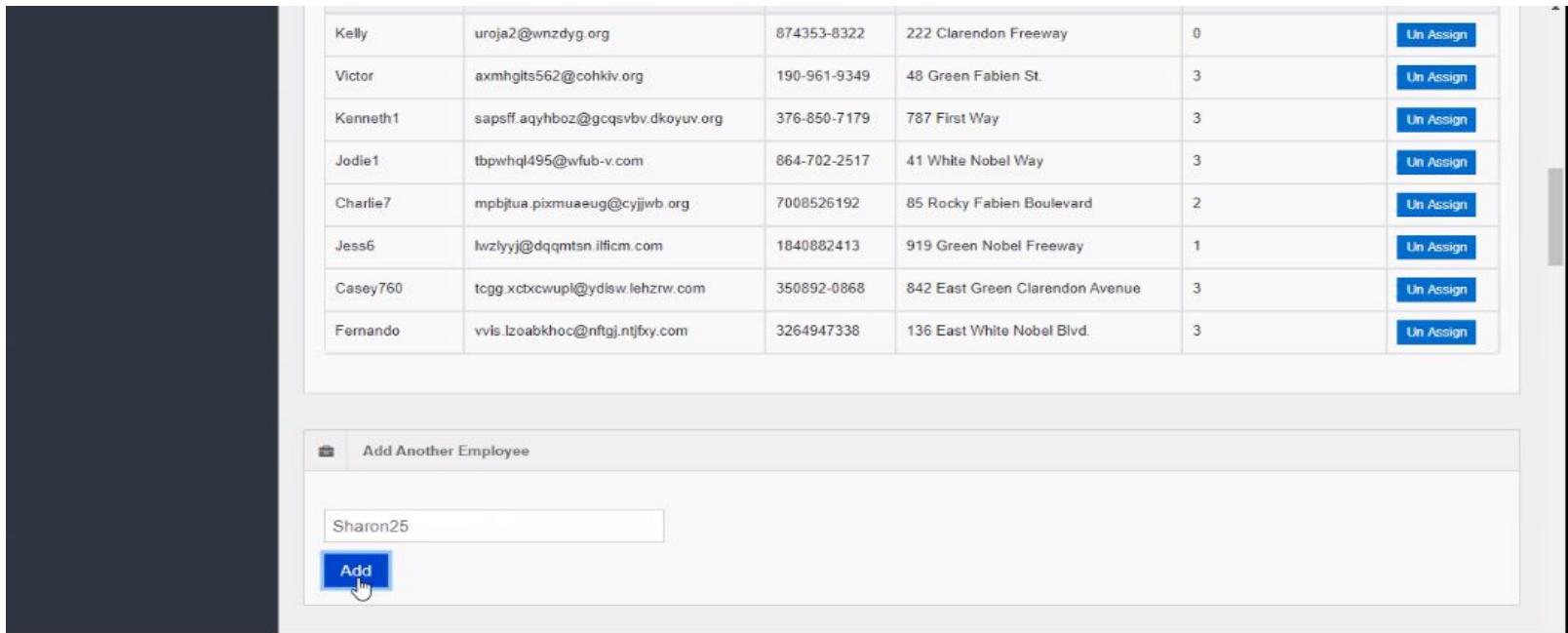


Figure 6.18: Need for Training (Add Employee To A Training Program Operation).

- **Expected output :**
- **Actual output :**

Test 5 :

- **Functionality tested :** test assigned a recommended employee.
- **Scenario :** assign a recommended employee and see if the employee would appear in the enrolled employees list on page and on database and disappear from the recommended list.
- **Input :**
Assign employee Angela9 in recommended employee list
- **Expected output :** as Actual
- **Actual output :**

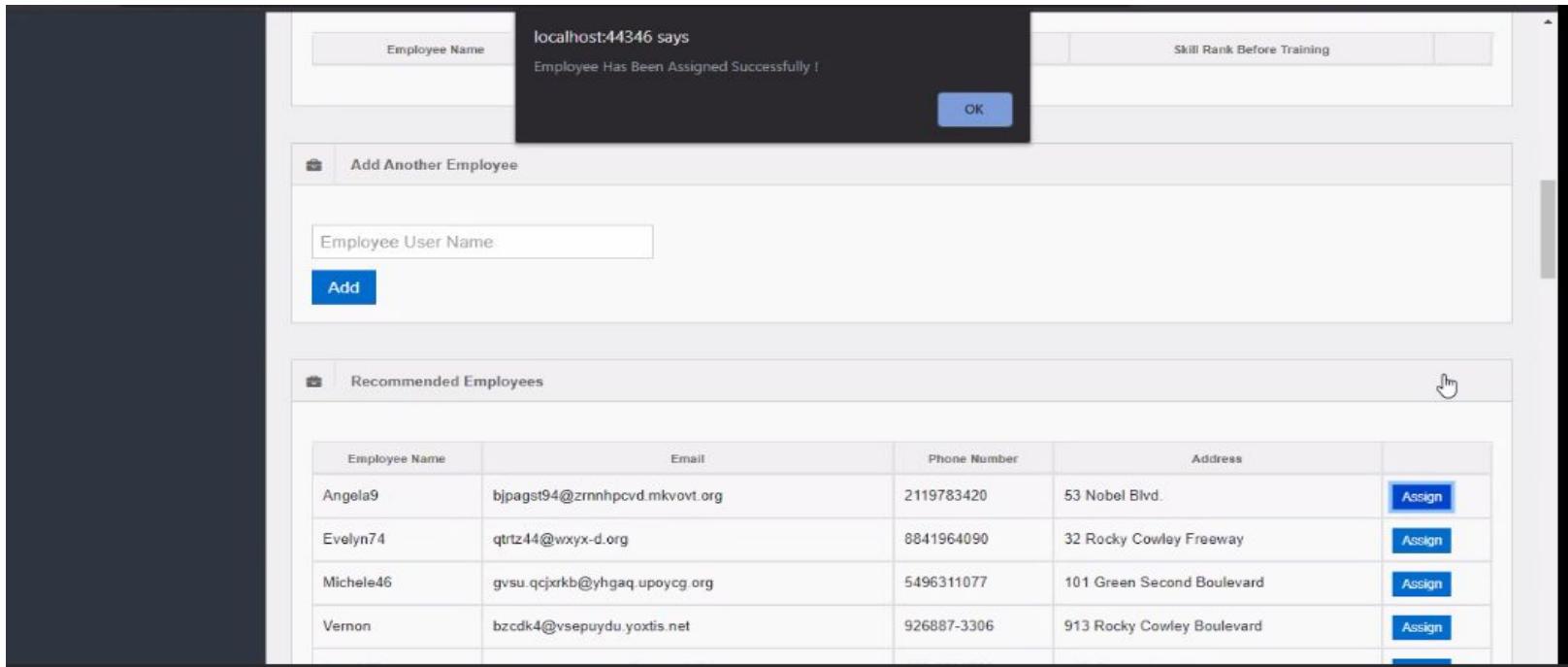
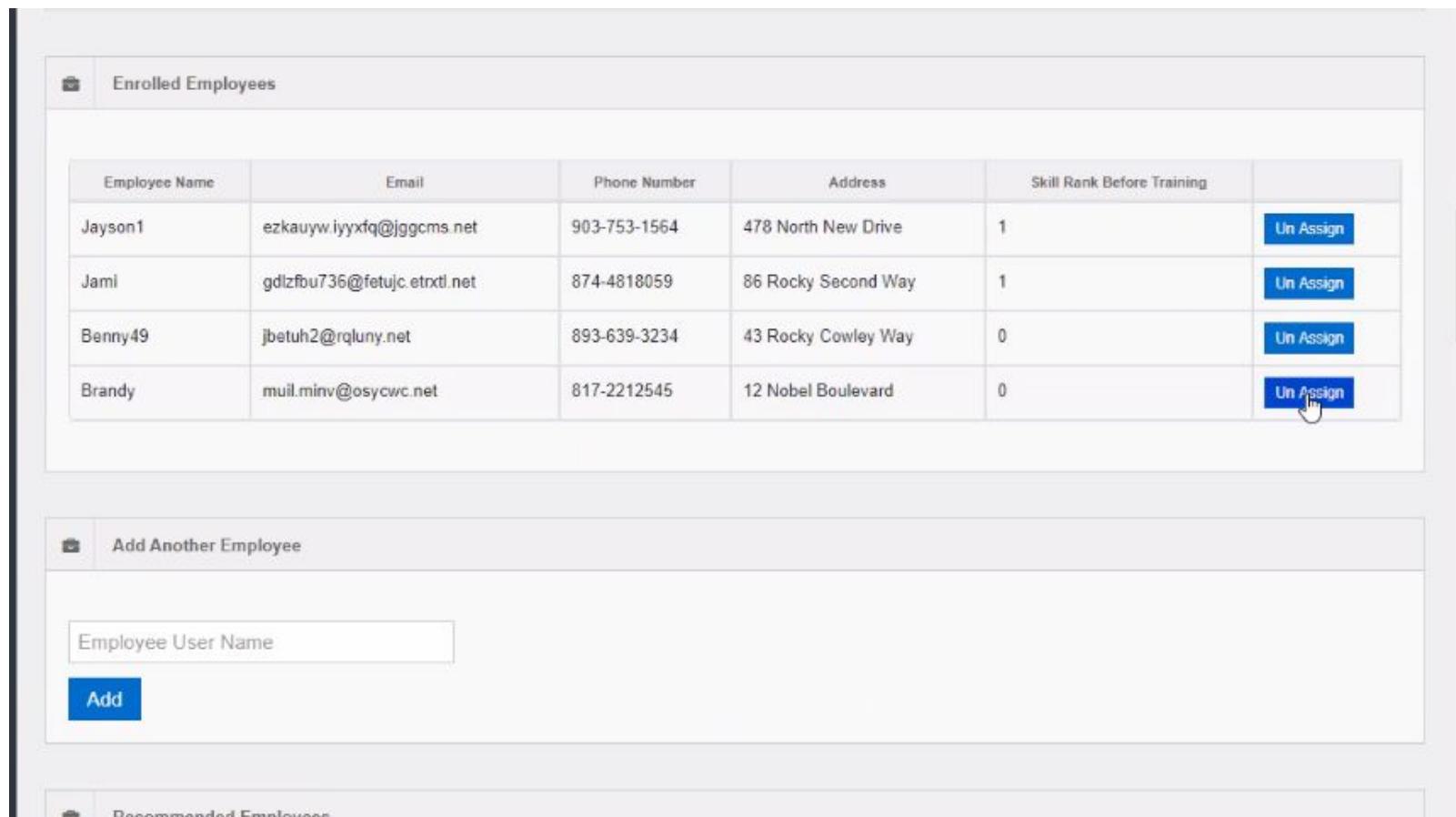


Figure 6.19: Need for Training (Successful Employee Addition Pop-Up).

Test 6 :

- **Functionality tested :** test un assign an enrolled employee.
- **Scenario :** un assign an enrolled employee and see if the employee would disappear in the enrolled employees list on page and on database.
- **Input :**



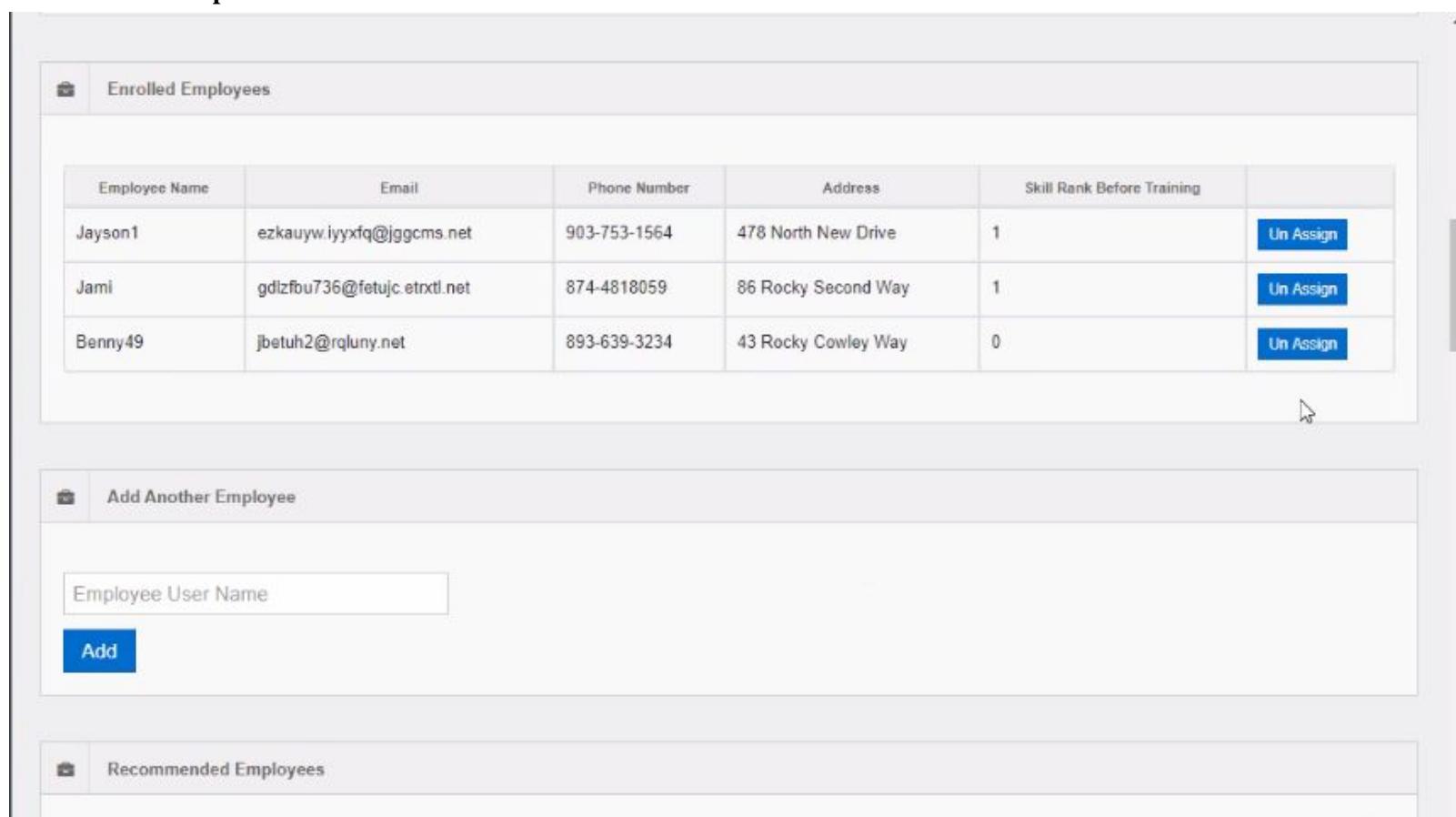
The screenshot shows a web-based application interface for managing employees. At the top, there is a header bar with icons for user profile, search, and other system functions. Below the header, a section titled "Enrolled Employees" displays a table with five columns: Employee Name, Email, Phone Number, Address, and Skill Rank Before Training. Each row contains a blue "Un Assign" button in the last column. The table data is as follows:

Employee Name	Email	Phone Number	Address	Skill Rank Before Training	Action
Jayson1	ezkauyw.iyyxfq@jggcms.net	903-753-1564	478 North New Drive	1	Un Assign
Jami	gdlzfbu736@fetujc.etrxtl.net	874-4818059	86 Rocky Second Way	1	Un Assign
Benny49	jbetuh2@rqluny.net	893-639-3234	43 Rocky Cowley Way	0	Un Assign
Brandy	muil.minv@osycwc.net	817-2212545	12 Nobel Boulevard	0	Un Assign

Below the employee list, there is a section titled "Add Another Employee" with a text input field for "Employee User Name" and a blue "Add" button. At the bottom, there is a section titled "Recommended Employees".

Figure 6.20: Need for Training (UnAssign Task From Employee).

- **Expected output :**
as Actual
- **Actual output :**



This screenshot shows a similar web application interface to Figure 6.20, but it displays a section titled "Recommended Employees" instead of "Enrolled Employees". The layout includes a header bar, a "Recommended Employees" section with a table, and sections for adding new employees and viewing recommended employees.

The "Recommended Employees" table has the same structure as the one in Figure 6.20, with columns for Employee Name, Email, Phone Number, Address, Skill Rank Before Training, and Action. The data is identical to the table in Figure 6.20:

Employee Name	Email	Phone Number	Address	Skill Rank Before Training	Action
Jayson1	ezkauyw.iyyxfq@jggcms.net	903-753-1564	478 North New Drive	1	Un Assign
Jami	gdlzfbu736@fetujc.etrxtl.net	874-4818059	86 Rocky Second Way	1	Un Assign
Benny49	jbetuh2@rqluny.net	893-639-3234	43 Rocky Cowley Way	0	Un Assign

Below the table, there is a section titled "Add Another Employee" with a text input field for "Employee User Name" and a blue "Add" button. At the bottom, there is a section titled "Recommended Employees".

Figure 6.21: Need for Training (UnAssign Employee From Training Program Operation).

6.6 Fourth iteration - Implementing the feature (Data Warehouse)

- **Inputs :**
 - The functional requirements document along with use cases and sequence diagrams.
 - Database and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
 - The classes of the model part are generated and methods ready to be implemented.
- **Increment chosen Requirements :**
- **Increment preconditions :**
 - Database management system supports building relational schemas and processing transactions.
 - Analysis tool that supports the data warehouse operations and transactions.
- **Realising preconditions :**
 - MySQL DBMS installed and ready.
 - SSIS (SQL Server Integration Service) installed and ready.
- **Increment duration :**
 - About 2 weeks.
- **Outputs :**
 - ETL done from the database.
 - Data flow for each dimension.
 - Department Dimension

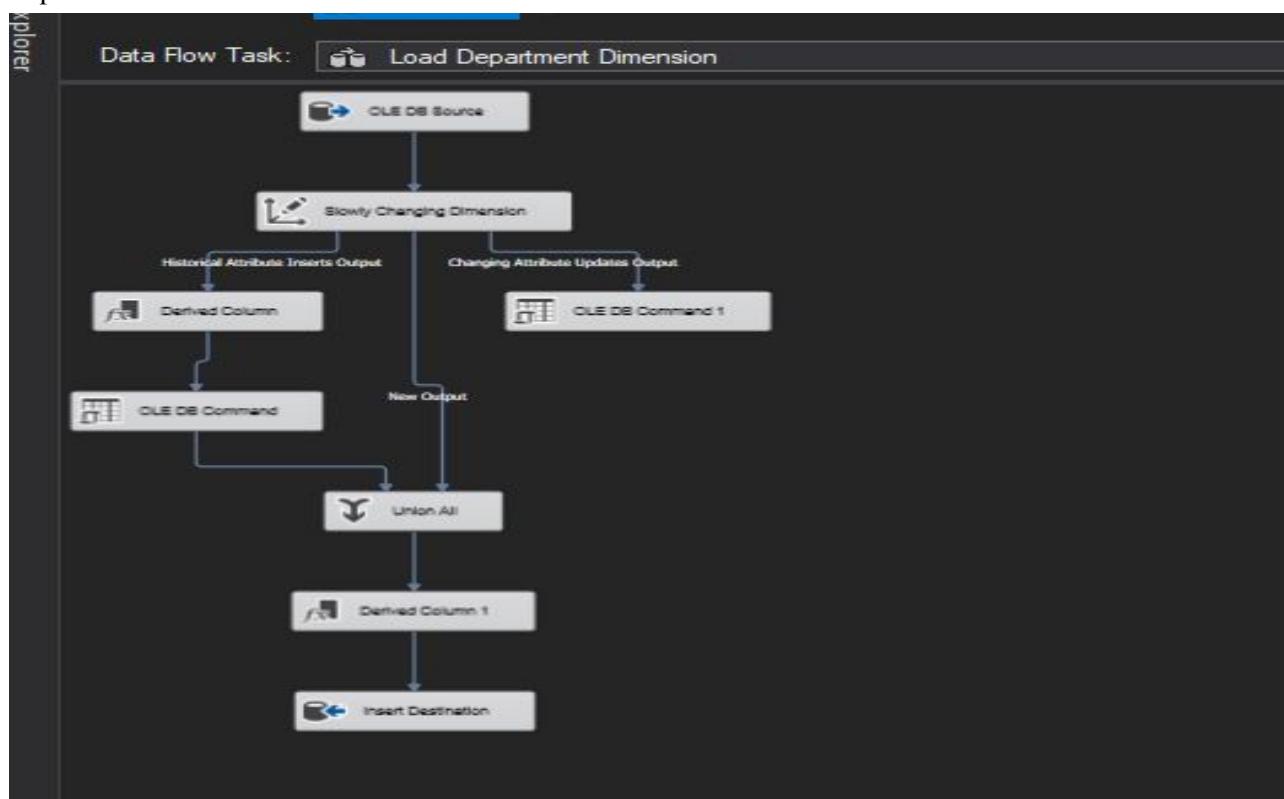


Figure 6.22: Data Warehouse (Data Flow For Load Department Dimension).

- Employee Dimension

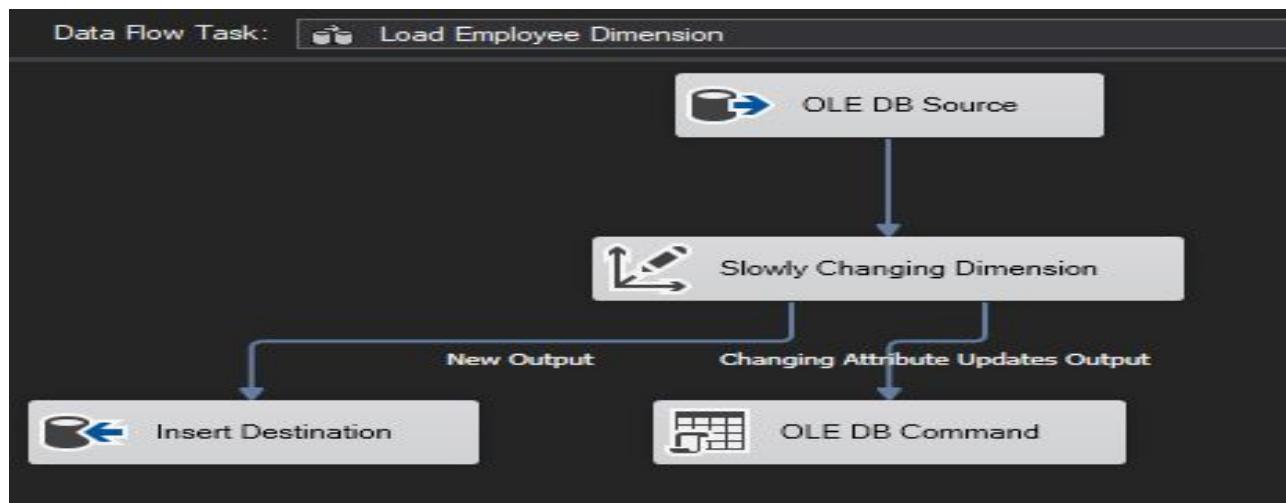


Figure 6.23: Data Warehouse (Data Flow For Load Employee Dimension).

- Position Dimension

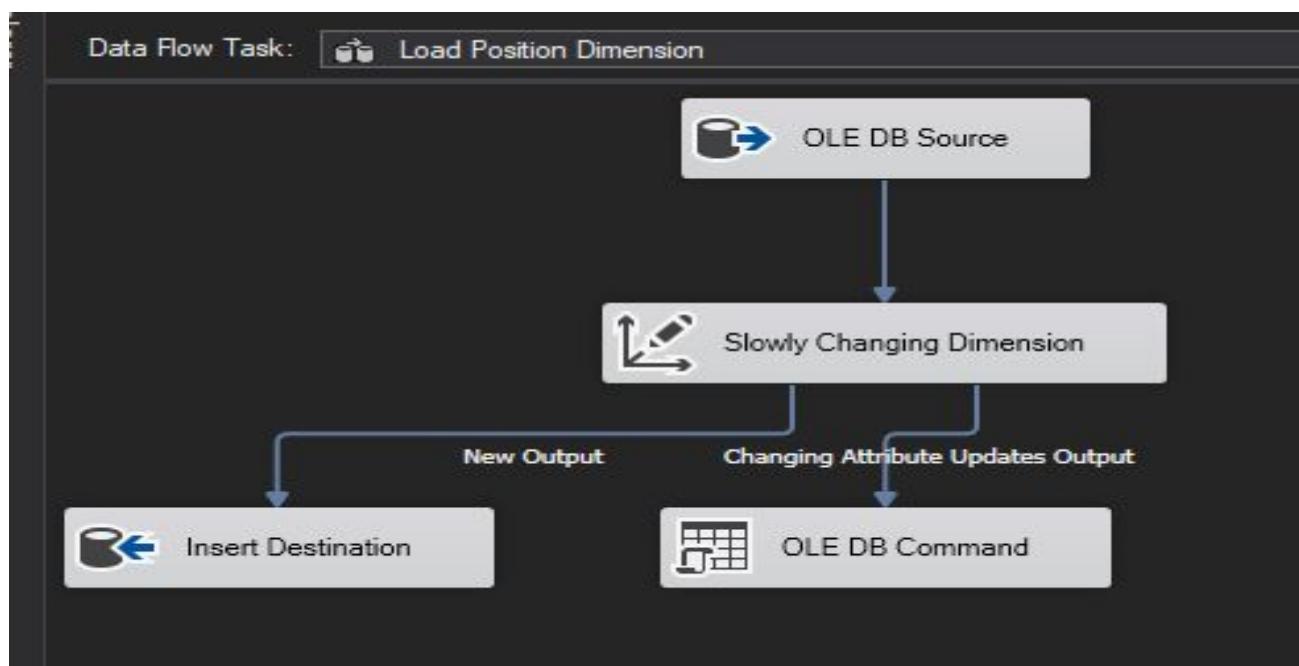


Figure 6.24: Data Warehouse (Data Flow For Load Position Dimension).

- Date Dimension

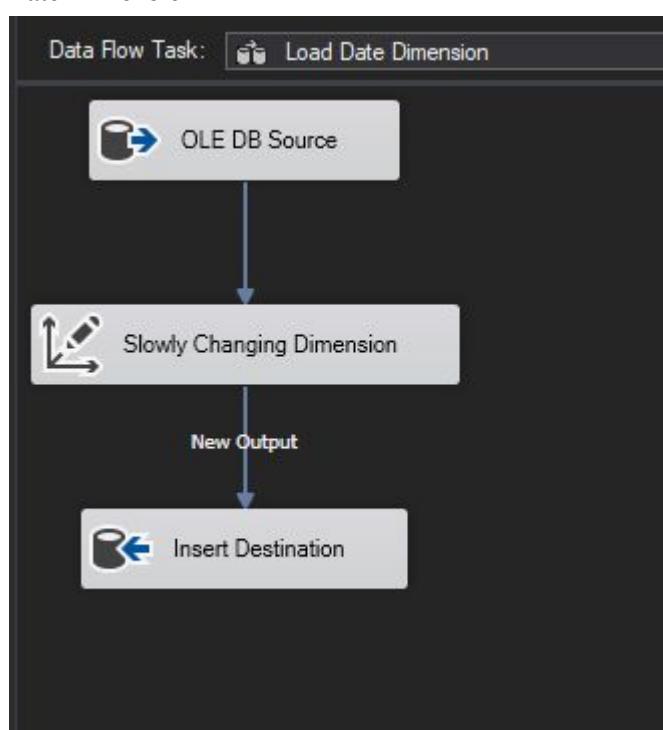


Figure 6.25: Data Warehouse (Data Flow For Load Date Dimension).

-Skill Dimension

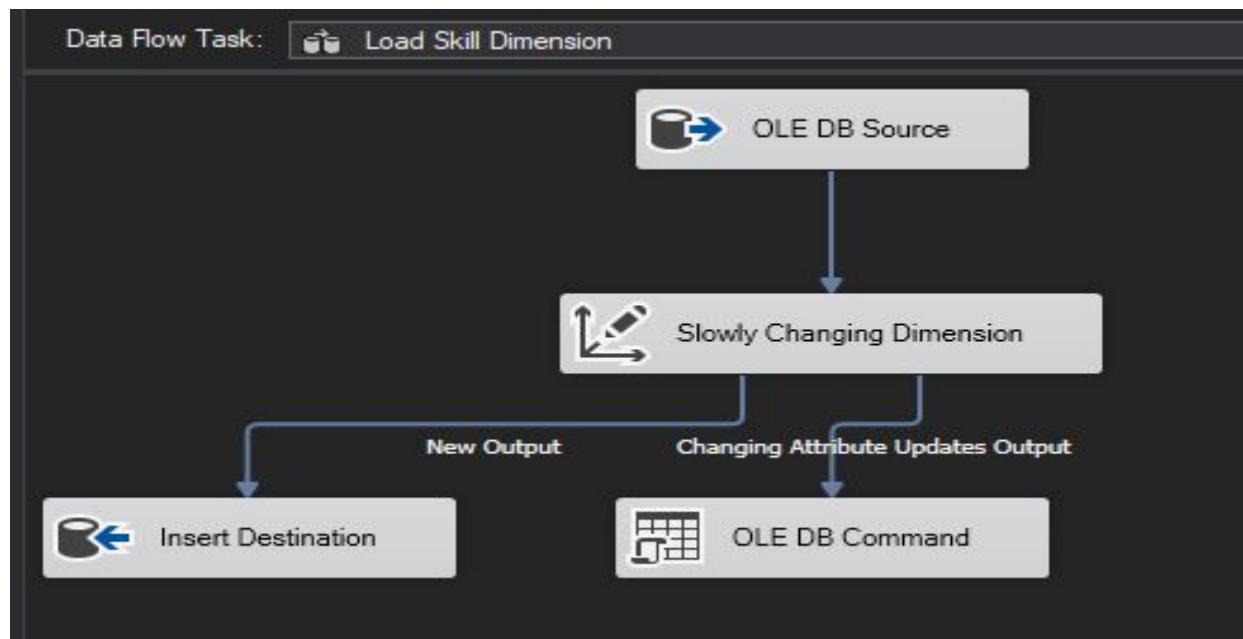


Figure 6.26: Data Warehouse (Data Flow For Load Skill Dimension).

- Two Fact tables implemented as specified in the star schema:

- Fact Employee Behavior

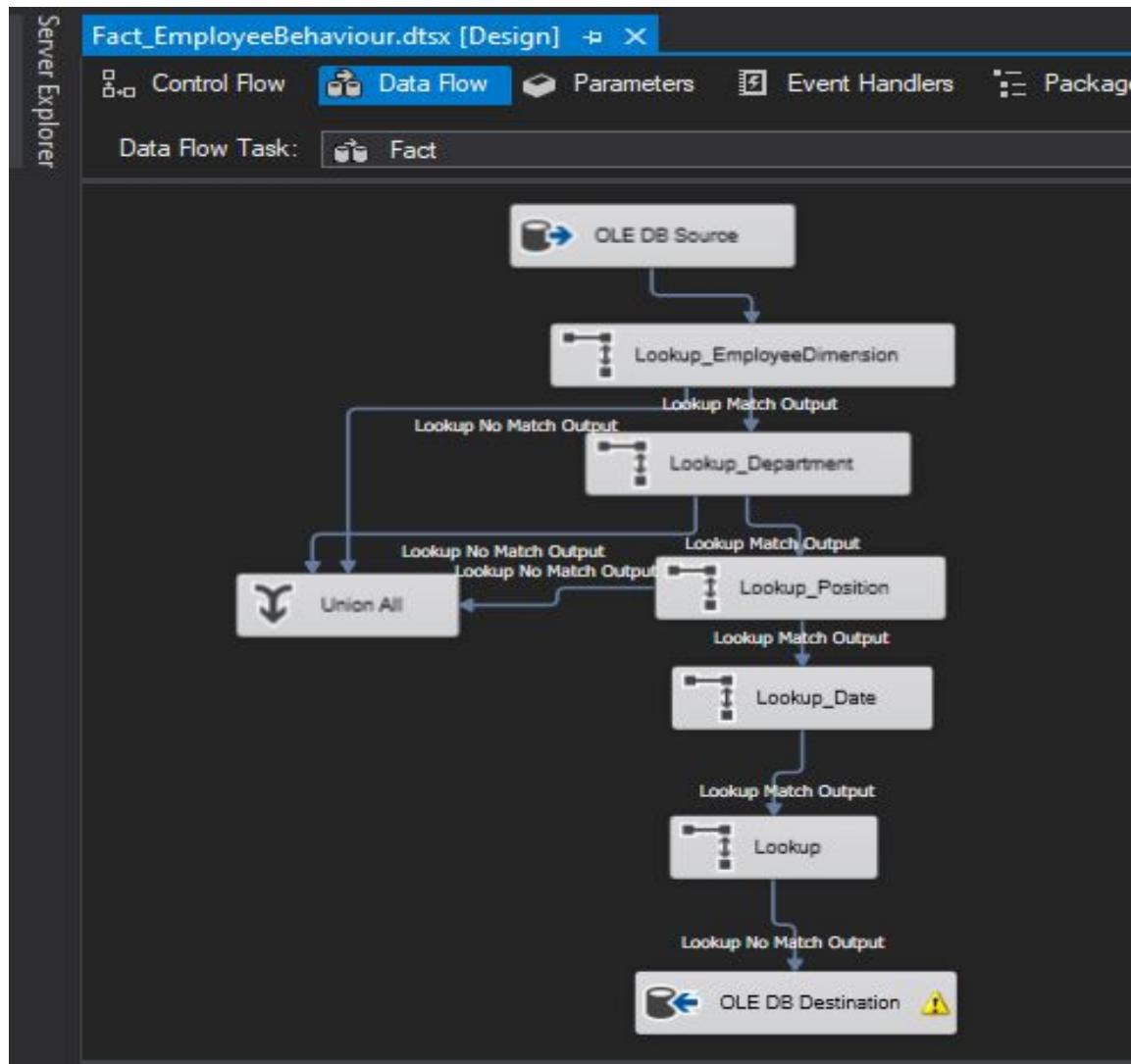


Figure 6.27: Data Warehouse (Data Flow For Fact Employee Behaviour Tables).

- Fact Employee Table

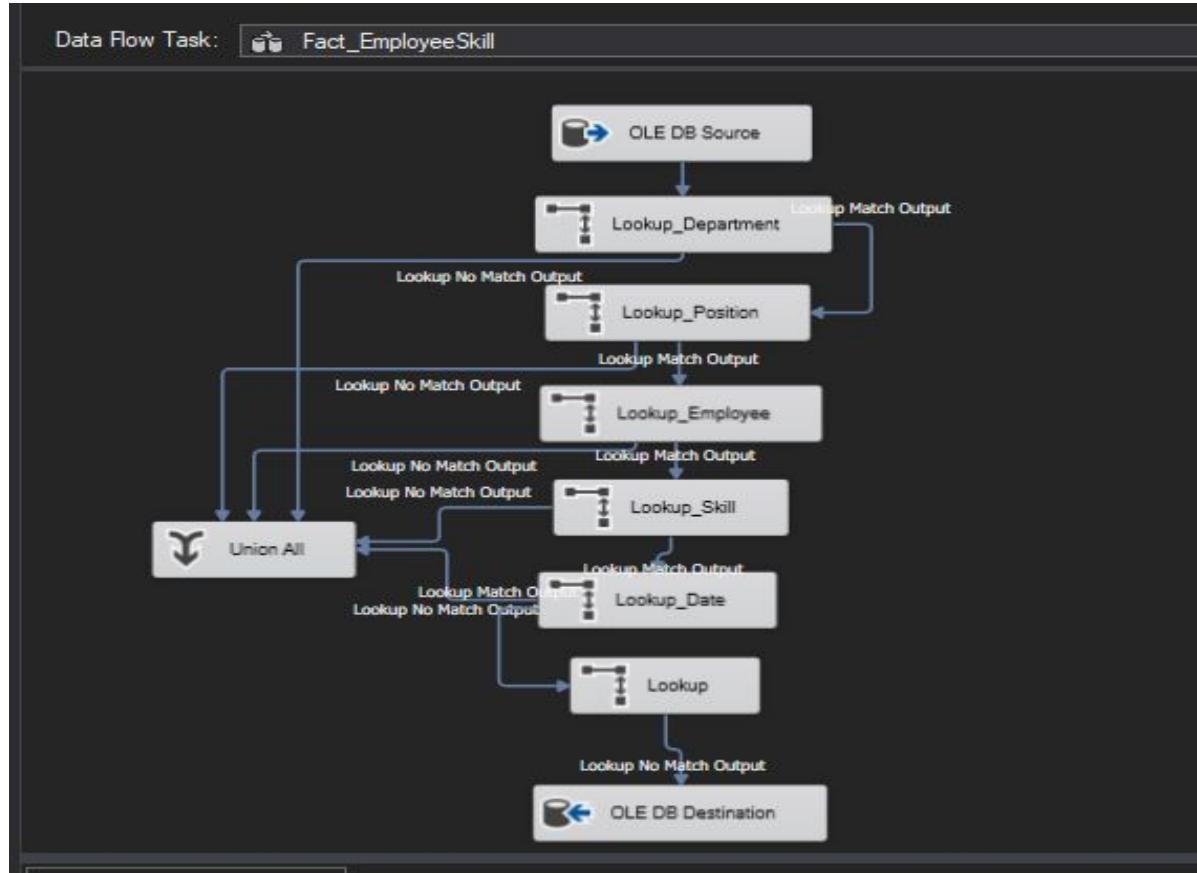


Figure 6.28: Data Warehouse (Data Flow For Fact Employee Skill Tables).

- Data Warehouse ready to file reports waiting for queries to be determined.
- **Tests :** output accepted.

6.7 Fifth iteration : Implementing the feature (Employee Attendance)

- **Inputs :**

- The functional requirements document along with use cases and sequence diagrams.
- Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
- The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- Hr admin can view attendance of employees through any period of time.
- Hr admin can insert an official vacation to the system to be taken into consideration when calculating attendance percentage of employees.
- Hr admin can also insert permissions and holidays for certain employees (system keeps track which HR_Admin granted which permission to be accessible when needed).
- Attendance records are stored with arrival and leave time.
- Calculate attendance percentage for employees every month based on their attendance records , holidays and permissions granted by the hr admin and update the monthly attendance percentage accordingly in the data warehouse.
- Hr admin can view attendance reports for employees , departments and positions ,... based on the percentage stored in DW.

- **Increment preconditions :**

- Classes Attendance, Permission, Holiday ,Official Vacation , department , position and employee Implemented.
- Tables Attendance, Permission, Holiday ,Official Vacation and employee in database filled with data and ready.
- Fact table Employee behavior in the data warehouse.

- **Realising preconditions :**

Satisfied in the first and third iteration.

- **Increment duration :**

About 2 weeks.

- **Outputs :**

- 4 web pages
- **Employee attendance** : each employee can view his attendance records in a specified time period.
- **Attendance Reporting progress** : view progress charts and tables reporting the attendance percentage over time for a specified employee , position or department.
- **Attendance reporting comparison** : compare attendance percentage among different employees , departments or positions in descending order on carts.
- **Insert permissions and vacations** : HR admin use this page to add permissions and holidays for a certain employee or add an official vacation for the entire company.

- **Tests :**

Test 1 :

- **Functionality tested** : employees view attendance records within time period.
- **Scenario** : choose a specific employee and log in from his account then view attendance records in a certain time period and check if it's compatible with the attendance table in the database.
- **Input** :

 - From 10/02/1984 to 29/02/1984

- **Expected output** :as Actual
- **Actual output** :

The screenshot shows the 'Employee Attendance' application interface. On the left is a vertical navigation bar with options: My Attendance (selected), Task Schedule, Feedback, My Attendance Progress, and My Performance Progress. The main content area has a title 'My Attendance'. Below it are two input fields: 'Start Date:' with placeholder 'dd-mm-yyyy' and 'End Date:' with placeholder 'dd-mm-yyyy'. A blue 'Set' button is positioned between them. Below these is a table titled 'Attendance table' with columns: Date, Arrival Time, Departure Time, and Notes. The table contains seven rows of data:

Date	Arrival Time	Departure Time	Notes
10/02/1984 00:00:00	08:45:41	16:45:41	Attendance
11/02/1984 00:00:00	08:49:09	16:49:09	Attendance
12/02/1984 00:00:00	08:40:48	16:40:48	Attendance
13/02/1984 00:00:00	08:19:31	16:19:31	Attendance
14/02/1984 00:00:00	08:03:19	16:03:19	Attendance
15/02/1984 00:00:00	00:00:00	00:00:00	Absent
16/02/1984 00:00:00	00:00:00	00:00:00	Absent

Figure 6.29: Employee Attendance (View Attendance Time For Employee Operation).

Test 2 :

- **Functionality tested :** test reporting progress for chosen employee within time period.
- **Scenario :** choose specific employee then view attendance progress report in certain time period and check if it's compatible with the attendance table in database
- **Input :**

The screenshot shows the 'Attendance Progress' section of the application. On the left is a vertical navigation bar with options: Training, My Attendance (selected), Task Schedule, Feedback, My Attendance Progress, and My Performance Progress. The main content area has a title 'Progress'. Below it is a dropdown menu labeled 'Employee' with 'Valerie' selected. To its right are two input fields for dates: '03/04/1970' and '04/04/2020'. A blue 'Set' button is located between these fields. Below the input fields, the name 'Valerie' is displayed. The output area also shows the name 'Valerie' again.

Figure 6.30: Employee Attendance (View Attendance Progress For Specific Period Employee Operation).

- **Expected output :** as Actual
- **Actual output :**

Valerie	
Month-Year	Attendance Percentage
5-1981	3.33 %
9-1982	3.33 %
11-1989	3.33 %
5-1991	3.23 %
6-1993	4.17 %
7-1994	3.85 %
12-1998	3.23 %
9-2001	3.33 %
10-2001	5.26 %
3-2003	3.70 %
10-2004	3.23 %
6-2006	4.35 %
9-2006	3.57 %
3-2010	3.33 %

Figure 6.31: Employee Attendance (View Attendance Percentage For Employee Visualization).

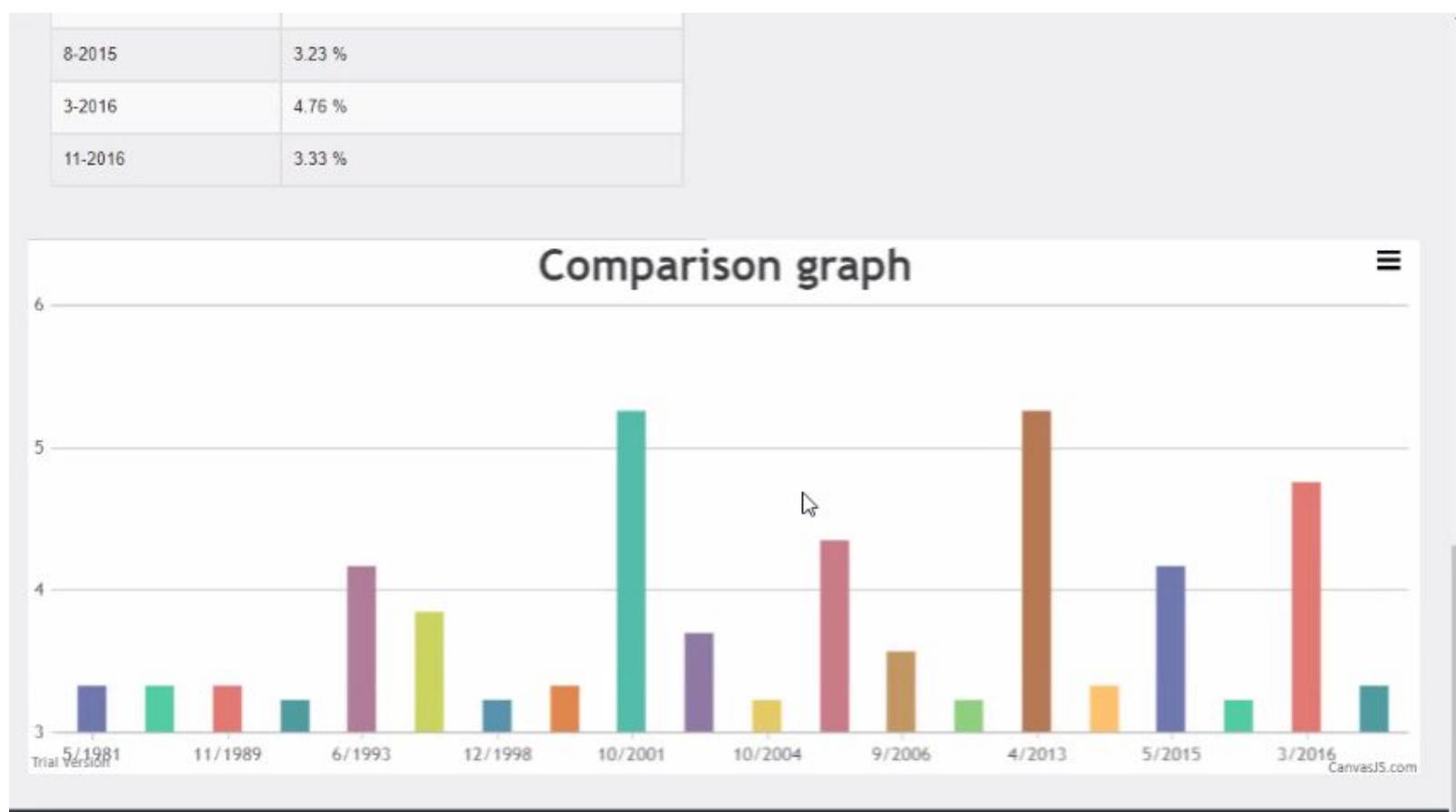


Figure 6.32: Employee Attendance (View Comparison Graph For Employee Attendance Visualization).

Test 3 :

- **Functionality tested :** test reporting progress for chosen department within time period.
- **Scenario :** choose specific department then view attendance progress report in certain time period and check if it's compatible with the attendance table in database
- **Input :**

Home > Attendance Progress

Progress

Department

Sales

Figure 6.33: Employee Attendance (Select Attendance Progress For Specific Period Operation).

- **Expected output :** as Actual
- **Actual output :**

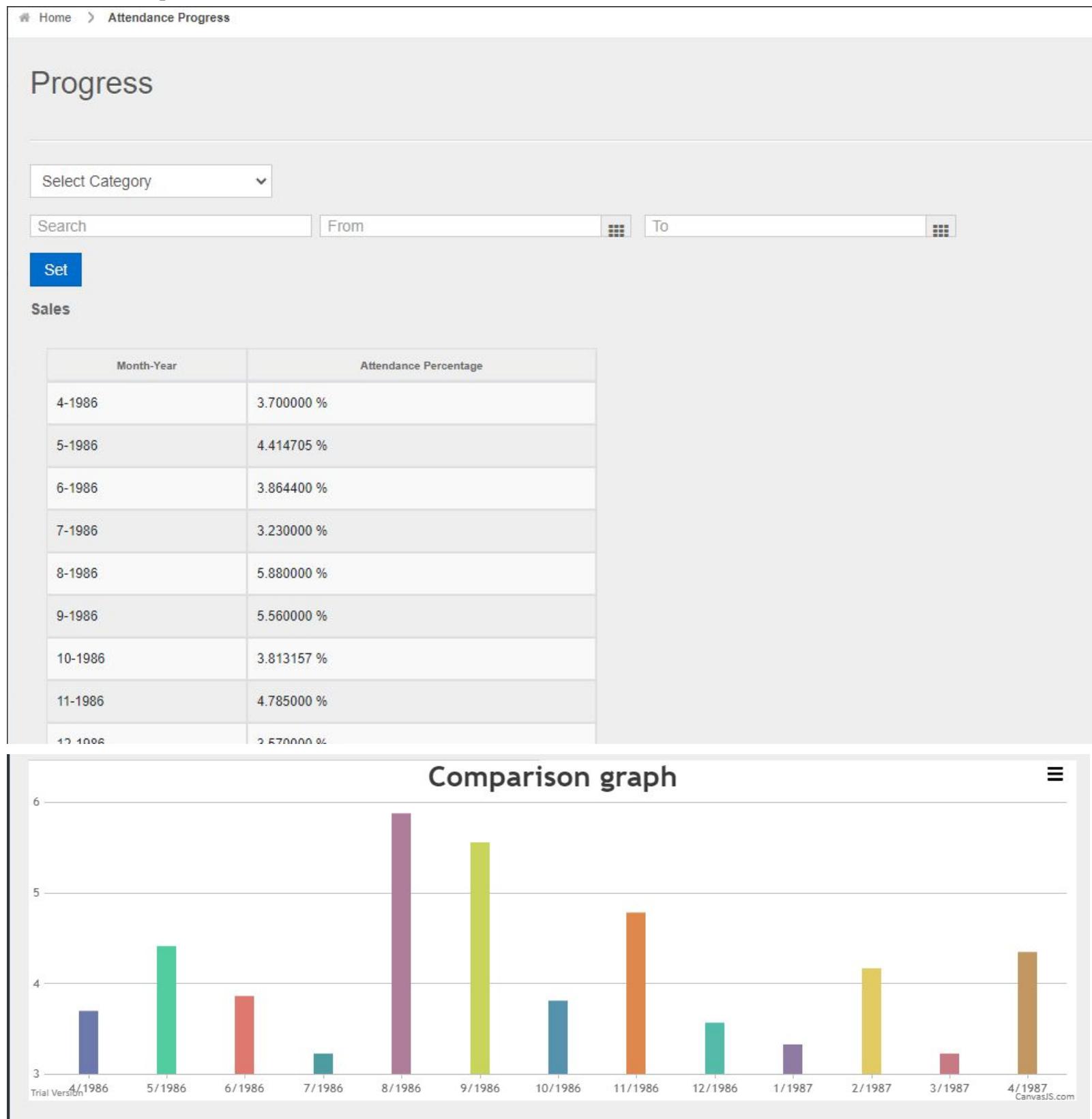


Figure 6.34: Employee Attendance (View Comparison Graph For Attendance Progress Operation).

Test 4 :

- **Functionality tested :** test reporting progress for chosen position within time period.
- **Scenario :** choose specific position then view attendance progress report in certain time period and check if it's compatible with the fact employee behavior table in data warehouse
- **Input :**
Position category
Date from 03/04/1986 to 03/04/1990
- **Expected output :** as Actual
- **Actual output :**

Home > Attendance Progress

Progress

Select Category ▼

Search
From
To

Set

Tester

Month-Year	Attendance Percentage
4-1986	3.672195 %
5-1986	4.354888 %
6-1986	3.330000 %
7-1986	3.230000 %
8-1986	5.880000 %
9-1986	5.748135 %
10-1986	3.450000 %
11-1986	4.350000 %

Figure 6.35: Employee Attendance (View Attendance Progress Operation).

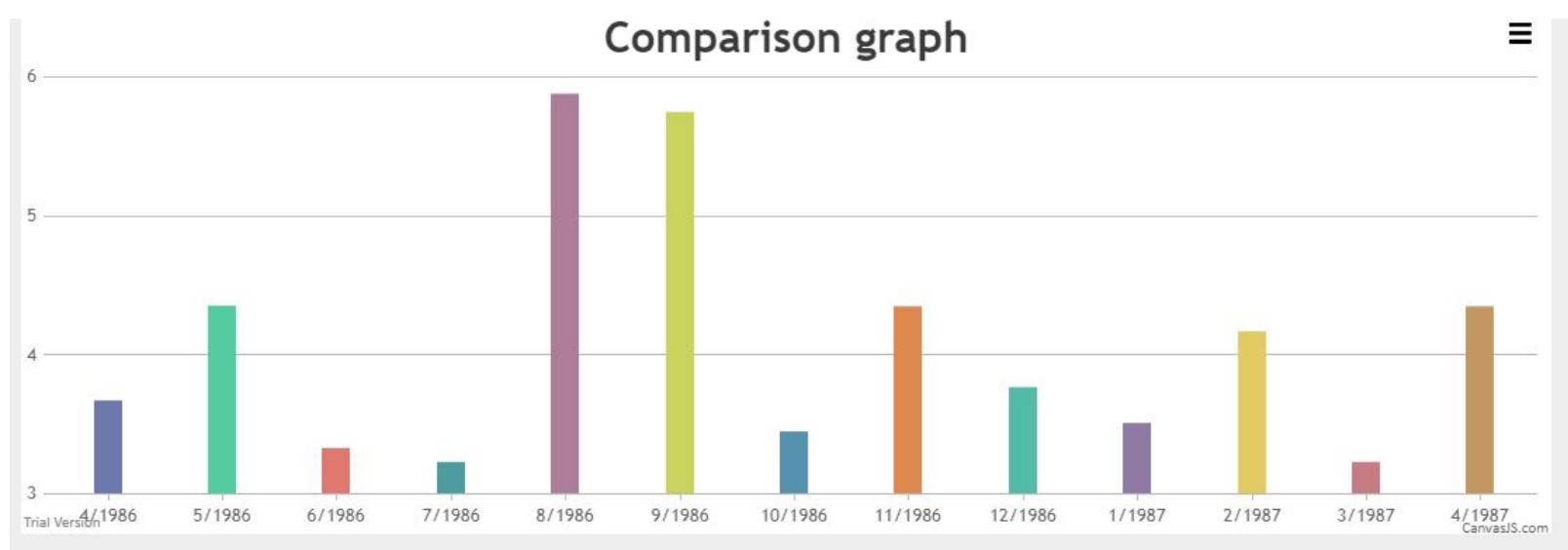


Figure 6.36: Employee Attendance (View Comparison Graph For Attendance Progress Operation).

Test 5 :

- **Functionality tested :** test reporting comparison of attendance percentage between employees within time period ordered in descending order.
- **Scenario :** view employee comparison and select a certain time period and check if it's compatible with the attendance table in the database.
- **Input :**

The screenshot shows a user interface titled "Comparison". At the top, there is a dropdown menu labeled "Employee" with a downward arrow icon. Below it is a text input field containing the date "6/4/1986". To the right of the date input is a small icon consisting of three vertical dots. Underneath the date input is a blue rectangular button with the word "Set" in white. At the bottom left, there is a label "Month-Year".

Figure 6.37: Employee Attendance (Comparison Of Attendance Percentage Between Employees Operation).

- **Expected output :** as Actual
- **Actual output :**

The screenshot displays a table of employee attendance data. The columns are labeled "Employee" and "%". The data is as follows:

Donnell Benton	7.41 %
Donnell Benton	7.41 %
Toby Erickson	3.70 %
Lauren Fields	3.70 %
Paige Farley	3.70 %
Josephine Watts	3.70 %
Paige Farley	3.70 %
Toby Erickson	3.70 %
Ismael Calhoun	3.70 %
Stephen Richards	3.70 %
Derek Yu	3.70 %
Derek Yu	3.70 %
Damion Irwin	3.70 %
Ismael Calhoun	3.70 %
Stephen Richards	3.70 %
Damion Irwin	3.70 %

Figure 6.38: Employee Attendance (View Attendance Percentage For Employees Operation).

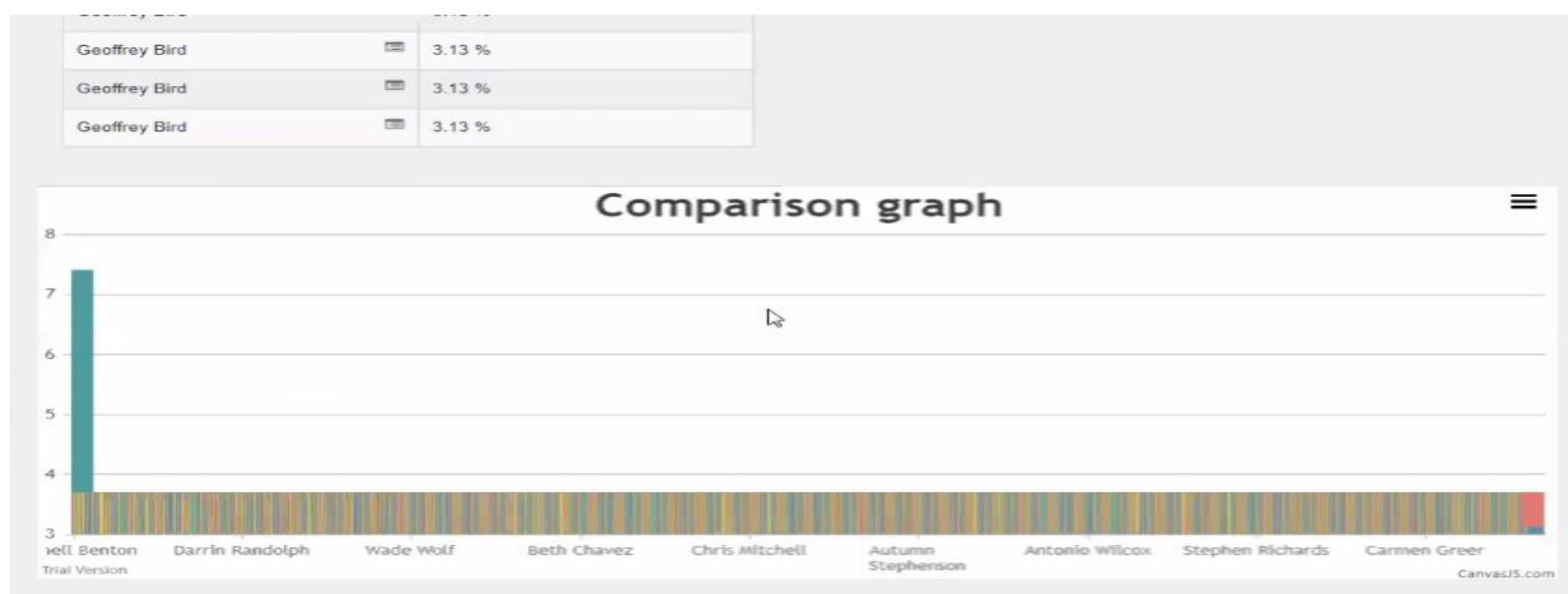


Figure 6.39: Employee Attendance (View Attendance Graph Percentage For Employees Operation).

Test 6 :

- **Functionality tested :** test reporting comparison of average attendance percentage between departments within time period ordered in descending order.
- **Scenario :** view departments comparison and select a certain time period and check if it's compatible with the attendance table in the database.
- **Input :**
Department category
Date 9/4/1986
- **Expected output :** as Actual
- **Actual output :**

The screenshot shows a web application interface for employee attendance management. On the left is a vertical navigation menu with items like Training, My Attendance, Task Scheduale, Feedback, My Attendance Progress, My Performance Progress, Attendance Reporting (which is selected), and Comparison (which is highlighted in green). The main content area has a title 'Comparison' and two input fields: 'Select Category' and 'Select Date'. Below these is a blue 'Set' button. A section titled 'Month-Year' contains a table with eight rows of data. The table has two columns: 'Category Name' and 'Attendance Percentage'. The data is as follows:

Category Name	Attendance Percentage
Web	3.757076 %
Service	3.751900 %
AccessorySales	3.700000 %
Accounting	3.700000 %
BusinessSales	3.700000 %
ConsumerSales	3.700000 %
Corporate Care	3.700000 %
CorporateSales	3.700000 %

Figure 6.40: Employee Attendance (View Attendance Comparison Operation).

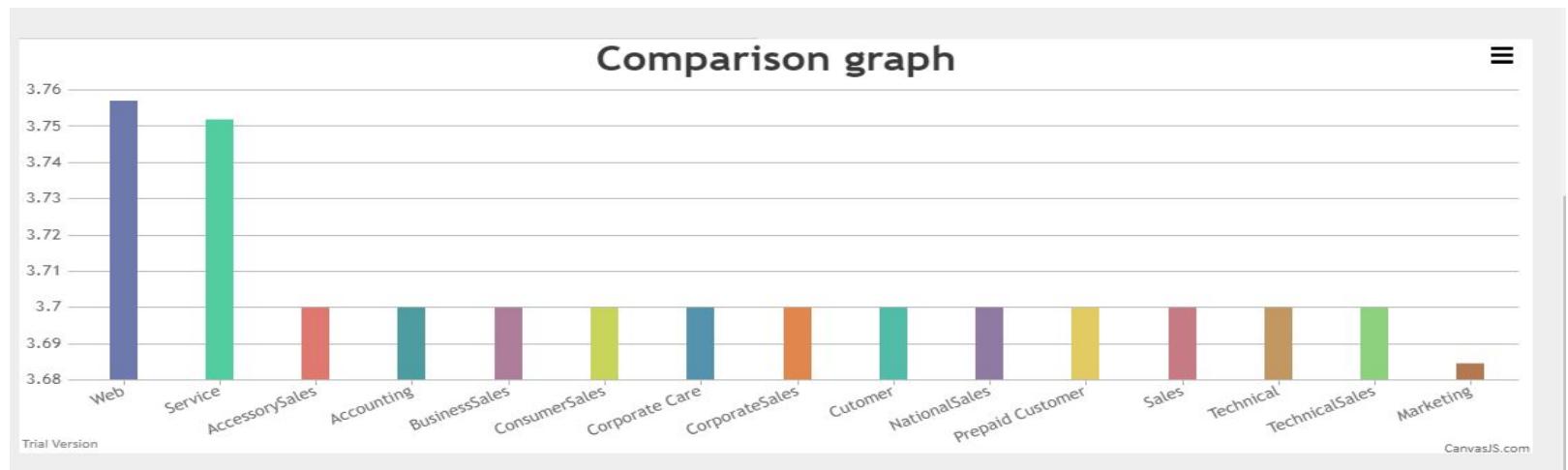
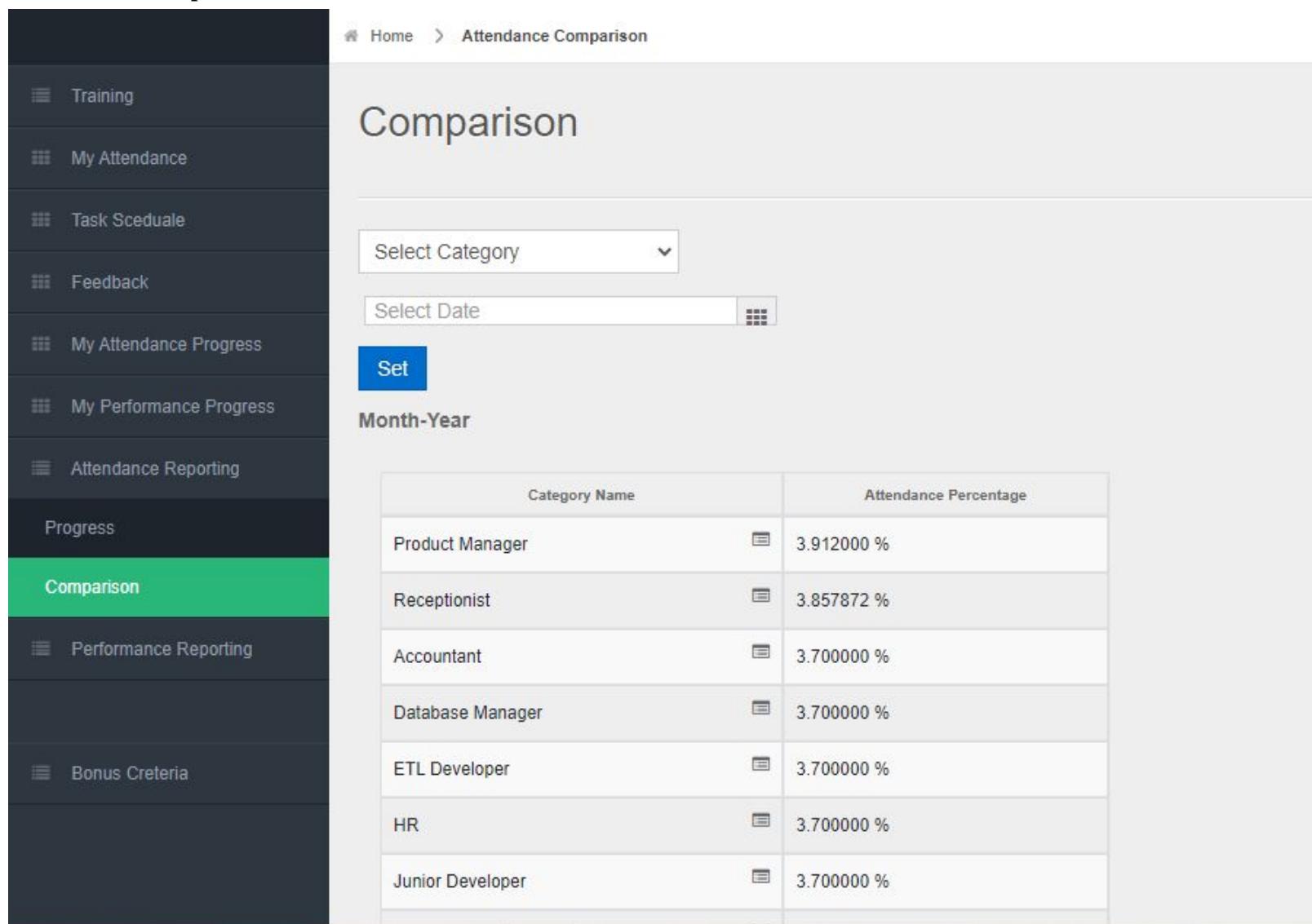


Figure 6.41: Employee Attendance (View Attendance Comparison Graph Operation).

Test 7 :

- **Functionality tested :** test reporting comparison of average attendance percentage between positions within time period ordered in descending order.
- **Scenario :** view position comparison and select a certain time period and check if it's compatible with the attendance table in the database.
- **Input :**
position category
Date 9/4/1986
- **Expected output :** as Actual
- **Actual output :**



The screenshot shows a web-based application for employee attendance comparison. On the left, there is a vertical navigation menu with options like Training, My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, Attendance Reporting, and Comparison (which is highlighted in green). Below this is a Progress section and a Performance Reporting section. The main content area is titled "Comparison". It features two input fields: "Select Category" and "Select Date", followed by a "Set" button. Below these is a section labeled "Month-Year". A table is displayed with the following data:

Category Name	Attendance Percentage
Product Manager	3.912000 %
Receptionist	3.857872 %
Accountant	3.700000 %
Database Manager	3.700000 %
ETL Developer	3.700000 %
HR	3.700000 %
Junior Developer	3.700000 %

Figure 6.42: Employee Attendance (View Attendance Comparison Operation).

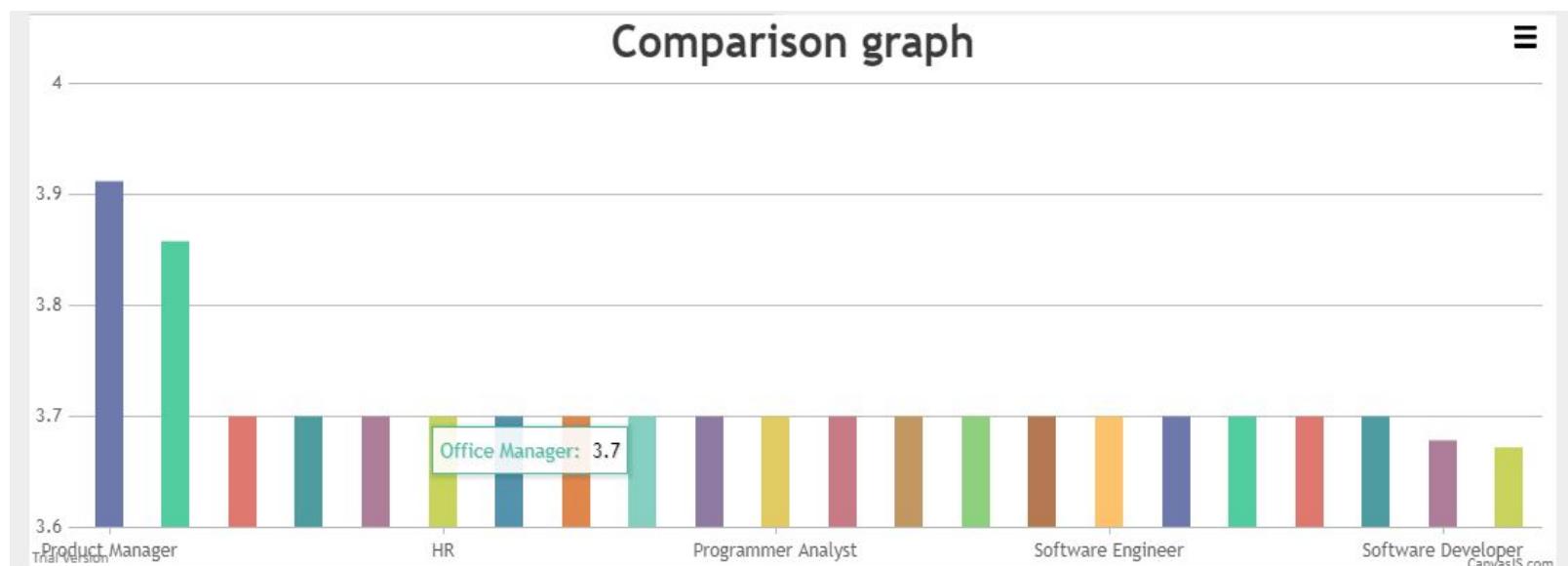


Figure 6.43: Employee Attendance (View Attendance Comparison Graph Operation).

Test 8 :

- **Functionality tested :** adding new permission , holiday and official vacation.
- **Scenario :** open the add holiday page and choose to add a permission for specific employee , a holiday and an official vacation for all employees then open the database to see if they were added.
- **Input :**

The screenshot shows a user interface for adding a permission. The title bar says "Permission". The form fields are as follows:

Employee Name :	Jeanine25
Start Time :	10
End Time :	2
Date :	6/4/1986
Causation :	personal issue

A green "Save" button is located at the bottom left of the form.

Figure 6.44: Employee Attendance (Add Permission `Causation` For Employee Operation).

The screenshot shows a user interface for adding an official vacation. The title bar says "Official Vaction". The form fields are as follows:

Name :	Eid
Start Date :	4/10/2020
End Date :	7/10/2020

A green "Save" button is located at the bottom left of the form.

Figure 6.45: Employee Attendance (Add Official Vacation Operation).

The screenshot shows a software window titled "Holiday". It contains four input fields: "Employee Name" with the value "Valerie", "Start Date" with the value "4/10/2020", "End Date" with the value "7/10/2020", and "Causation" with the value "personal issue". Below these fields is a green rectangular button labeled "Save". The window has a standard title bar and a close button in the top right corner.

Figure 6.46: Employee Attendance (Add Holiday Operation).

- **Expected output :** as Actual
- **Actual output :**
Added in the database tables

6.8 Sixth iteration - Implementing 2 features (Time tracking and task scheduling alongside with talent management)

- **Inputs :**
 - The functional requirements document along with use cases and sequence diagrams.
 - Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
 - The classes of the model part are generated and methods ready to be implemented.
- **Increment chosen Requirements :**
 - The team leader can view a list of all finished and unfinished projects and their information (ordered by due date).
 - The team leader can add a new project and specify (name, client, due date, price, ...).
 - The team leader can add new tasks and specify the project it serves ,the start and end date and the list of skills needed.
 - For each task the team leader gets a list of recommended employees with free time slots that matches the task and proper level of skill score for the skills specified as needed in the task.
 - The team leader can assign any of the recommended employees or assign an employee of his choice after checking that employee's time schedule won't contradict the task time limits.
 - For each assigned employee in a specific task , the team leader has to determine exactly which skills the employee would be using to be evaluated on later by the feedback feature.
 - Team leaders can mark the task as finished.
 - Each employee can view a list of tasks that he is currently working on and not yet finished.
 - Each employee can view a list of assigned tasks that he hasn't started yet and click on the task to start it.
- **Increment preconditions :**

- Classes Project,Task,Employee,TeamLeader and EmployeeSkill Implemented.
- Tables Project,Task_Skill,Employee_Task,Task,Employee_Skill and employee in database filled with data and ready.
- **Realising preconditions :**
Satisfied in the first and third iteration.
- **Increment duration :**
About 3 weeks.
- **Outputs :**
 - 5 web pages.
 - **View Projects** : team leaders can view a list of ordered projects by latest due date and create a new project.
 - **View Tasks by team leader** : team leader can view tasks of active projects and add new tasks.
 - **New Task** : team leader can insert task data and skills and view recommended employees according to time schedule and skills needed then assign some of the recommended employees or a chosen other employee then specify skills practiced by each chosen employee to be evaluated later on.
 - **View Tasks by team leader** : team leader view task details and can mark the task as finished.
 - **Task Scheduling for employees** : each employee can view a list of active unfinished tasks and a list of coming unstarted tasks and start any of them.
- **Tests :**
Test 1 :
 - **Functionality tested** : team leader views all projects and creates one.
 - **Scenario** : choose specific team leader and log in from his account then view projects and create new project then make sure that it appears in the projects list and in the project table in database
 - **Input** :

The screenshot shows a web-based application interface for creating a new project. The title bar says "New Project". The form has the following fields:

Project Name	Test Project1
Client Name	Eric2
Project Cost	2000
Project Department	Marketing
Due Date	6/4/1986

At the bottom left is a green "Save" button.

Figure 6.47: Time tracking and task scheduling (Create New Project).

- **Expected Output** : as Actual
- **Actual output** :

Project Name	Client	Price	Team Leader	Department	Started At	Due Date
Test Project1,,	Eric2	2000 \$	Jeanine25	Marketing	07/06/2020 00:00:00	06/04/2021 00:00:00
Test Project2,,	Lydia74	2000 \$	Jeanine25	Accounting	07/06/2020 00:00:00	06/04/2021 00:00:00
Hilary2	Tammi90	4917319 \$	Jeanine25	Accounting	20/10/2014 00:00:00	11/03/2015 00:00:00
Cassandra68	Lena9	3219934 \$	Jeanine25	Cutomer	10/03/2010 00:00:00	20/05/2021 00:00:00
Dale	Frank14	3146793 \$	Jeanine25	Accounting	22/12/2006 00:00:00	04/06/2007 00:00:00
Diane35	Gabriel676	5353048 \$	Jeanine25	Technical	15/03/2006 00:00:00	04/09/2006 00:00:00
Mary	Bobbie0	9602793 \$	Jeanine25	Service	26/03/2004 00:00:00	03/05/2004 00:00:00
Eric	Olga4	9417029 \$	Jeanine25	Corporate Care	27/10/2002 00:00:00	10/03/2003 00:00:00
Darin050	Bradford	529088 \$	Jeanine25	Prepaid Customer	30/11/2001 00:00:00	06/01/2002 00:00:00

Figure 6.48: Time tracking and task scheduling (View All Projects Operation).

Test 2 :

- **Functionality tested :** view list of tasks of active projects
- **Scenario :** choose specific team leader and log in from his account then view tasks list and make sure that it is compatible with the tasks table in database
- **Input :** open tasks in side menu
- **Expected Output :** as Actual
- **Actual output :**

Project Name - Task Name	Assign date	Deadline	Status	Notes
Test Project1,, - Task1	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task2	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task3	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task4	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task5	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task6	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task7	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task8	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task9	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task10	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task11	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	

Cassandra68 - Meredith	03/03/1988 10:40:03	16/03/1988 06:51:33	✓	
Cassandra68 - Elena86	08/07/2013 15:05:29	11/07/2013 10:28:10	✓	
Cassandra68 - Katina38	03/12/2008 12:25:03	11/12/2008 03:26:48	✓	
Cassandra68 - Penny	05/08/1997 21:16:23	19/08/1997 17:40:01	✓	DUE BY 8334 days
Cassandra68 - Marcie161	06/04/1999 01:32:50	14/04/1999 23:08:14	✓	
Cassandra68 - Marcus99	22/12/2015 15:12:24	29/12/2015 12:01:57	✓	
Cassandra68 - Chrystal5	29/10/1985 01:23:21	11/11/1985 08:03:06	✓	
Cassandra68 - Traci75	25/08/1989 12:56:37	27/08/1989 09:41:59	✓	
Cassandra68 - Lorie2	10/08/2009 16:49:43	19/08/2009 06:49:49	✓	DUE BY 1098 days
Cassandra68 - Jody27	21/12/1998 01:09:00	02/01/1999 03:32:00	✓	DUE BY 2222 days
Cassandra68 - Peggy	03/06/2017 05:03:25	08/06/2017 12:12:12	✓	

Figure 6.49: Time tracking and task scheduling (View All Tasks Operation).

Test 3 :

- **Functionality tested :** test create new task and view recommended employees.
- **Scenario :** create new task and enter its details and list of task needed then view recommended employees and make sure the employees in the list are the top that matches the criterion of the skills and time window of the task
- **Input :**

The screenshot shows a web-based application for managing tasks. The main area contains several input fields:

- Task Name :** Task1
- Assign Time :** 12-02-2012
- Deadline :** 12-02-2012
- Project Name :** Julie818
- Skills :** A dropdown menu with options: Please Select, Scientific computing, Creativity, PHP. The 'Scientific computing' option is currently selected.
- Description :** test
- Description field :** An empty text area labeled 'Description field'.

At the bottom left, there is a green button labeled 'Next'.

Figure 6.50: Time tracking and task scheduling (Add New Task Operation).

- **Expected Output :** as Actual
- **Actual output :**

Recommended Employees				
Employee Name				
Valerie	Scientific computing	5	Assign	
Lewis07	Scientific computing	5	Assign	
Eva997	Scientific computing	5	Assign	
Andrew17	Scientific computing	5	Assign	
Serena216	Scientific computing	5	Assign	
Glenda6	Scientific computing	5	Assign	
Christy	Scientific computing	5	Assign	
Glenda	Scientific computing	5	Assign	

Employee Name Add

Next

Figure 6.51: Time tracking and task scheduling (View The Recommended Employees For Task).

Assigned Employees				
Employee Name				
Valerie	Skills	Please Select Scientific computing	Assign	
Lewis07	Skills	Please Select Scientific computing	Assign	
Eva997	Skills		Assign	

Save

Figure 6.52: Time tracking and task scheduling (Assign Task To Employee).

Test 4 :

- **Functionality tested :** test assign task to employee and view task list for employee.

- **Scenario :** assign a task to a specific employee then log in from the employee's account and view the unstarted tasks list to make sure the assigned task appeared in the list.
- **Input :**

The screenshot shows a web-based application interface for managing tasks and employees. At the top, there is a navigation bar with links: Home > Tasks > View Task. The main title is "Viewing Task". Below this, there is a section titled "Task Info" containing the following data:

Task Name:	Elena86
Assign Time:	08/07/2013 15:05:29
Deadline:	11/07/2013 10:28:10
Project Name:	Cassandra68
Skills:	Critical Thinking

Below this is another section titled "List Of Employees" containing a table with the following data:

Employee Name	Phone Number	Email
Jeanine25	7839557581	araenhou0@yljgj.msusun.com
Terrence958	736-4231046	uurmdwj392@ruldmz.org
Gail564	883556-5642	whajkmim.nwcvbwmsx@gzdh.vjccls.org
Scot98	223-0554716	jjwgpsrp.ehonebkgi@rnrtur.wlzfppq.com
Demond	797-806-1814	uclrbe327@wtfbaimf.htjtp.net

At the bottom right of the application interface, there is a red button labeled "End Task".

Figure 6.53: Time tracking and task scheduling (View Task Description And List Of Employees Assigned To This Task).

- **Expected Output :** as Actual
- **Actual output :**

The screenshot shows a web-based application interface for managing tasks. At the top, there is a header with the Faculty of Engineering and Alexandria University logos. Below the header, there are two main sections:

- Task List:** A table showing a list of tasks with columns: Project Name - Task Name, Assign date, Start Time, Deadline, and Remaining Hours. The data includes:

Project Name - Task Name	Assign date	Start Time	Deadline	Remaining Hours
Cassandra68 - Penny	05/08/1997 21:16:23	13/06/2020 23:49:49	19/08/1997 17:40:01	-200022
Glenda03 - Lisa41	14/03/1999 21:55:42	20/05/2007 05:43:16	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	06/04/1999 01:32:50	16/10/1990 17:24:45	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	03/12/2008 12:25:03	03/04/1989 08:00:55	11/12/2008 03:26:48	172603
Debra517 - Calvin14	05/11/2010 07:02:55	20/01/2015 19:24:17	11/11/2010 12:36:34	-36751
- To-Do Section:** A table showing a list of tasks with columns: Project Name - Task Name, Assign date, Deadline, and a 'Start' button. The data includes:

Project Name - Task Name	Assign date	Deadline	
Cassandra68 - Fredrick70	15/06/1983 21:54:06	24/06/1983 05:51:20	<button>Start</button>
Cassandra68 - Meredith	03/03/1988 10:40:03	16/03/1988 06:51:33	<button>Start</button>
Cassandra68 - Elena86	08/07/2013 15:05:29	11/07/2013 10:28:10	<button>Start</button>

Figure 6.54: Time tracking and task scheduling (View And Start Specific Task Operation).

Test 5 :

- **Functionality tested :** test task finish and view active unfinished tasks for employees.
- **Scenario :** choose employee and log in from his account then view list of active unfinished tasks then choose a task and open the task's page from the team leader's account who is responsible for this task and mark the task as finished then reopen the active tasks list of the employee , make sure the task disappeared.
- **Input :**

The screenshot shows a web-based application interface for managing tasks. At the top, there is a header with the Faculty of Engineering and Alexandria University logos. Below the header, there is a main section titled "Viewing Task".

Task Info:

Task Name:	Penny
Assign Time:	05/08/1997 21:16:23
Deadline:	19/08/1997 17:40:01
Project Name:	Cassandra68
Skills:	

Figure 6.55: Time tracking and task scheduling (View Specific Task Information Operation).

List Of Employees		
Employee Name	Phone Number	Email
Jeanine25	7839557581	araenhou0@yljgj.msusun.com
Roberta503	337992-0232	hlmny64@dtifas.com
Joann197	257879-6646	osyaazer@qmhsfc.com
Penny859	148298-6211	vsuniky.laqfaqveeg@cwuxpvwlj.eojjpm.com
Pamela180	239508-9542	qrwencx17@ywmjxdjcz.qxnjwt.net
Eli80	318-5816792	trhh2@qfdfrm.net

End Task

Figure 6.56: Time tracking and task scheduling (View List Of Employees For Specific Task Operation).

Tasks Schedule				
Project Name - Task Name	Assign date	Start Time	Deadline	Remaining Hours
Cassandra68 - Penny	05/08/1997 21:16:23	13/06/2020 23:49:49	19/08/1997 17:40:01	-200022
Glenda03 - Lisa41	14/03/1999 21:55:42	20/05/2007 05:43:16	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	06/04/1999 01:32:50	16/10/1990 17:24:45	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	03/12/2008 12:25:03	03/04/1989 08:00:55	11/12/2008 03:26:48	172603
Debra517 - Calvin14	05/11/2010 07:02:55	20/01/2015 19:24:17	11/11/2010 12:36:34	-36751

Figure 6.57: Time tracking and task scheduling (View List Of Tasks Information Operation).

- **Expected Output :** as Actual
- **Actual output :**

Tasks Schedule				
Project Name - Task Name	Assign date	Start Time	Deadline	Remaining Hours
Glenda03 - Lisa41	14/03/1999 21:55:42	20/05/2007 05:43:16	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	06/04/1999 01:32:50	16/10/1990 17:24:45	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	03/12/2008 12:25:03	03/04/1989 08:00:55	11/12/2008 03:26:48	172603
Debra517 - Calvin14	05/11/2010 07:02:55	20/01/2015 19:24:17	11/11/2010 12:36:34	-36751

Figure 6.58: Time tracking and task scheduling (View List Of Tasks Information Operation).

Test 6 :

- **Functionality tested :** test start task.
- **Scenario :** choose employee and log in from his account then view list of active unfinished tasks then choose a task and click start then make sure it disappears from the unstarted list and appears in the active tasks list.
- **Input :**

The screenshot shows a web-based application interface. At the top, there is a modal dialog box with a dark background and white text. It displays the message "localhost:44346 says" followed by "Task Has Been Started and will Be Scedualed". In the bottom right corner of this dialog is a blue "OK" button. Below the dialog is a table titled "Project Name - Task". The table has columns for "Project Name - Task", "Deadline", and "Remaining Hours". There are four rows of data in the table.

Project Name - Task	Deadline	Remaining Hours
Glenda03 - Lisa41	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	11/12/2008 03:26:48	172603
Debra517 - Calvin14	11/11/2010 12:36:34	-36751

Below the table, there is a navigation bar with a "To-Do" tab selected. Under the "To-Do" tab, there is another table titled "Project Name - Task Name". This table has columns for "Assign date" and "Deadline". It contains two rows of data, each with a "Start" button in the last column.

Project Name - Task Name	Assign date	Deadline	
Cassandra68 - Meredith	03/03/1988 10:40:03	16/03/1988 06:51:33	Start
Cassandra68 - Elena86	08/07/2013 15:05:29	11/07/2013 10:28:10	Start

Figure 6.59: Time tracking and task scheduling (Start Task Pop-Up Notification Operation).

- **Expected Output :** as Actual
- **Actual output :**

The screenshot shows a web-based application interface. At the top, there is a table titled "Tasks Schedule". The table has columns for "Project Name - Task Name", "Assign date", "Start Time", "Deadline", and "Remaining Hours". There are five rows of data in the table.

Project Name - Task Name	Assign date	Start Time	Deadline	Remaining Hours
Cassandra68 - Meredith	03/03/1988 10:40:03	04/08/2020 20:41:23	16/03/1988 06:51:33	-283910
Glenda03 - Lisa41	14/03/1999 21:55:42	20/05/2007 05:43:16	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	06/04/1999 01:32:50	16/10/1990 17:24:45	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	03/12/2008 12:25:03	03/04/1989 08:00:55	11/12/2008 03:26:48	172603
Debra517 - Calvin14	05/11/2010 07:02:55	20/01/2015 19:24:17	11/11/2010 12:36:34	-36751

Below the "Tasks Schedule" table, there is a navigation bar with a "To-Do" tab selected. Under the "To-Do" tab, there is another table titled "Project Name - Task Name". This table has columns for "Assign date" and "Deadline". It contains one row of data, with a "Start" button in the last column.

Project Name - Task Name	Assign date	Deadline	
Cassandra68 - Elena86	08/07/2013 15:05:29	11/07/2013 10:28:10	Start

Figure 6.60: Time tracking and task scheduling (View All Tasks With TO-DO List Operation).

Test 7 :

- **Functionality tested :** test view list of active training..
- **Scenario :** choose employee and log in from his account then view list of active training then make sure it disappears from the unstarted list and appears in the active tasks list.
- **Input :**

Hr add employee jeanine25 in presentation skill training

Employee jeanine25 login

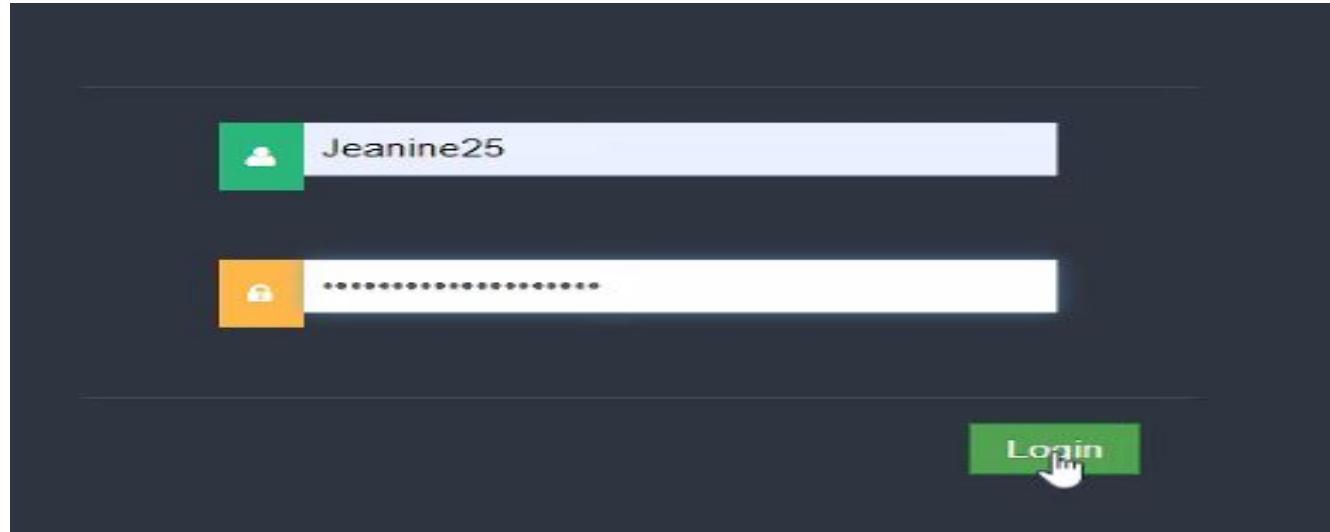


Figure 6.61: Time tracking and task scheduling (User Login Operation).

- **Expected Output :** as Actual
- **Actual output :**

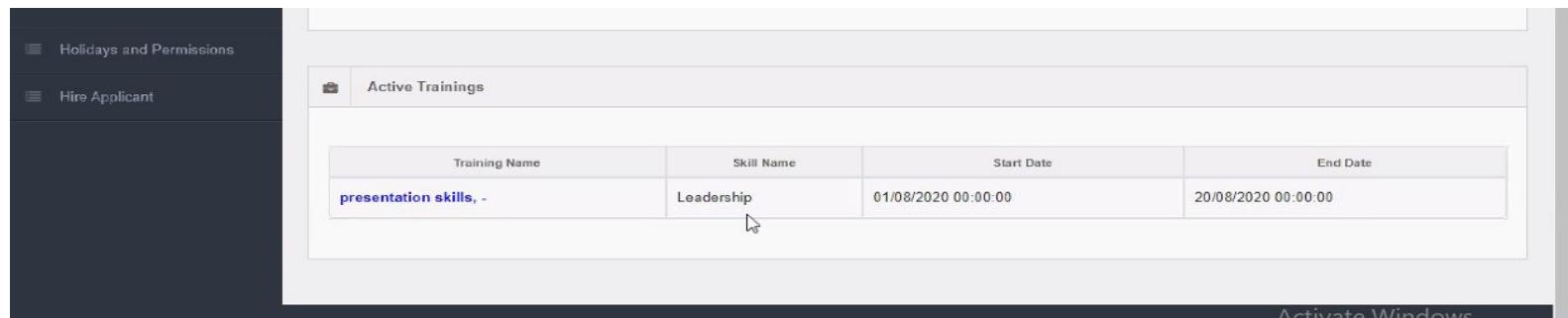


Figure 6.62: Time tracking and task scheduling (View Active Trainings Operation).

6.9 Seventh iteration - Implementing feature (Give Feedback)

- **Inputs :**

- The functional requirements document along with use cases and sequence diagrams.
- Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
- The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- An employee would have a list of feedback to give for each finished task that he was assigned to.
- When clicking on the feedback icon the employee would see a form containing each employee in the task and a score to give on each skill.
- The skill score is updated for each employee and stored in the fact table in DW monthly based on the previous skill score and the feedback given by employees.

- **Increment preconditions :**

- Classes Feedback,Task,Employee_Skill and employee Implemented.
- Tables Feedback and Employee_Task,Task_Skill,Employee_Task employee in database filled with data and ready.
- Fact table Employee skill in the data warehouse.

- **Realising preconditions :**

Satisfied in the first and third iteration.

- **Increment duration :**

About 1 week.

- **Outputs :**

- 2 web pages.
- **Feedback** : each employee view list of feedback to give for each finished task that he was assigned to.
- **Give Feedback** : for each task finished when clicking on the give feedback icon on the feedback page , the employee would see a form containing each employee in the task and a score to give on each skill.

- **Tests :**

Test 1 :

- **Functionality tested** : test view list of task needs feedback.
- **Scenario** : log in from a team leader account and choose a task and mark it as finished then choose an employee that has worked on this task and log in from his account to view a list of tasks that needs feedback , check that the marked task appeared on the list.
- **Input** :
- Login from employee account and open Feedback side menu.
- **Expected Output** : as Actual
- **Actual output** :

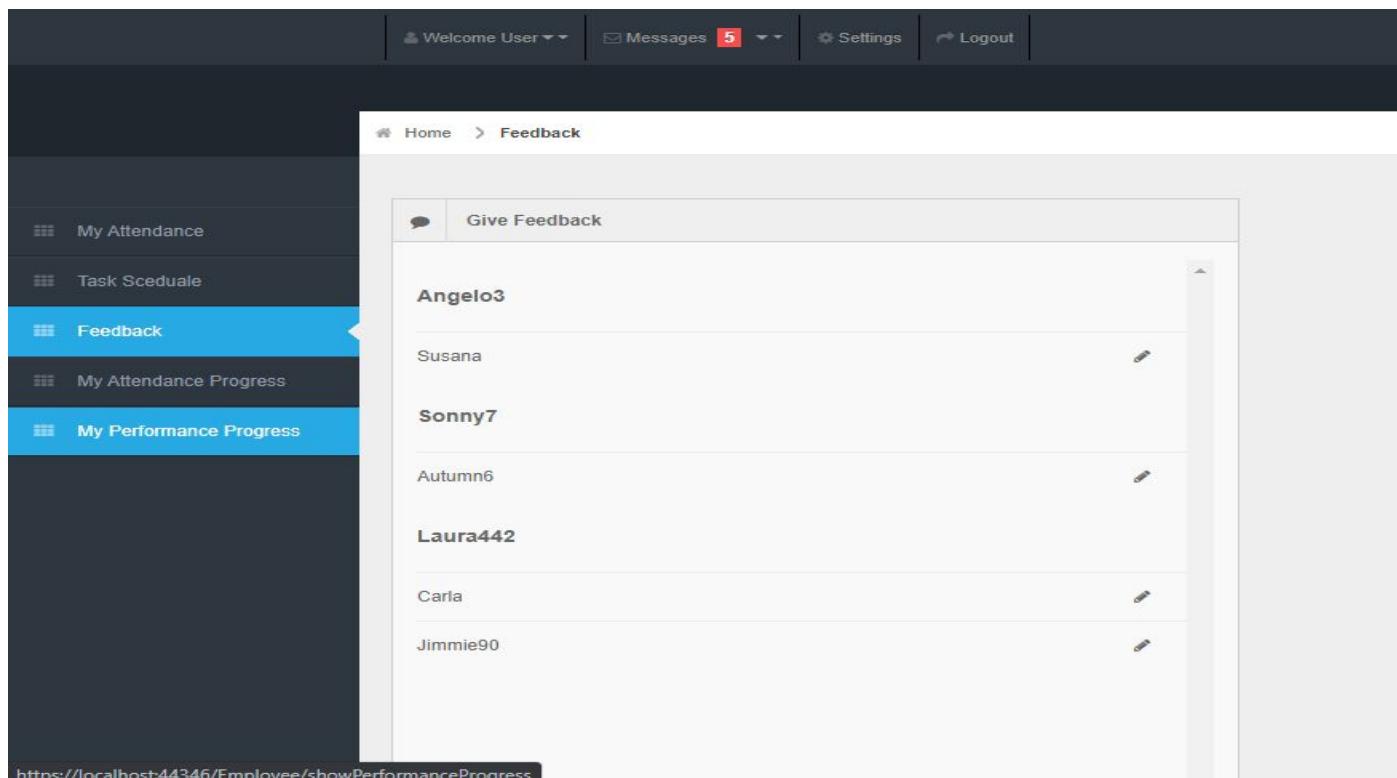


Figure 6.63: Give feedback (Give Feedback Operation).

Test 2 :

- **Functionality tested :** test feedback input.
- **Scenario :** choose a task and give feedback on it then check it in the feedback table in the database.
- **Input :**

Skill	Rank(1 to 5)	Message	Give
OOP	5	good at team work	Give
Scientific computing	3	not v	Give

Figure 6.64: Give feedback (Give Feedback For Specific Skill Operation).

- **Expected Output :** as Actual
- **Actual output :**
The feedback is added to the database table(Feedback table).

6.8 Eighth iteration - Implementing 2 features (Employee performance & bonus and promotion)

- **Inputs :**

- The functional requirements document along with use cases and sequence diagrams.
- Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
- The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- Calculate performance percentage for employees every month based on their attendance percentage ,latency in the task schedules and timing and the skill scores stored in the DW tables and update the monthly performance percentage accordingly in the data warehouse.
- Hr admin can view performance reports for employees , departments and positions ,... based on the percentage stored in DW.
- Hr can Insert new bonus and specify its criterion (department , position and min performance percentage to earn the bonus) then view list of employees deserving this bonus then approve the bonus.
- Hr can insert new promotion and specify its criterion (department , position and min performance percentage to earn the bonus) then view list of employees deserving this promotion then choose one of them to promote.
- When HR promotes the employee , the new position of employee is inserted to the database automatically.

- **Increment preconditions :**

- Classes Bonus, Department, EmployeeSkill, HrAdmin and Position Implemented
- Tables Employee_Department,Employee_Position,Bonus,Employee_Skill and employee in database filled with data and ready.
- Fact table Employee behavior in the data warehouse.
- Functions that calculate attendance percentage.
- Functions that keep track of time and task schedules.
- Functions that calculate the skill scores per employee based on feedback.

- **Realising preconditions :**

Satisfied in previous iterations.

- **Increment duration :**

About 2 weeks.

- **Outputs :**

- 4 web pages.
- **Performance Reporting progress** : view progress charts and tables reporting the performance percentage over time for a specified employee , or for employees in specific position or department.
- **Performance reporting comparison** : compare performance percentage among different employees ,in specific departments or positions in descending order on carts.
- **Insert bonus** : hr admin use this page to Insert new bonus and specify its criterion (department , position and min performance percentage to earn the bonus) then view list of employees deserving this bonus then approve the bonus.
- **Insert Promotion** : hr admin use this page to insert new promotion and specify its criterion (department , position and min performance percentage to earn the bonus) then view list of employees deserving this promotion then choose one of them to promote , the new position of employee is inserted to the database automatically.

- **Tests :**

Test 1 :

- **Functionality tested** : test reporting progress for chosen employee within time period.
- **Scenario** : choose a specific employee then view the performance progress report in a certain time period and check if it's compatible with the performance calculations equations in the database.
- **Input** :

The screenshot shows a user interface for tracking employee performance. At the top left, there's a navigation bar with 'Home' and 'Performance Progress'. Below it, a title 'Progress' is displayed. A dropdown menu labeled 'Employee' is open, showing 'Valerie' as the selected option. To the right of the dropdown are two date inputs: '03/04/1986' and '04/04/2020', each with a small calendar icon. A blue 'Set' button is positioned between the dates. The main area contains a table with two columns: 'Month-Year' and 'Performance Percentage'. The table lists 17 rows of data, starting from November 1989 and ending with May 2015. The performance percentages are: 21.00%, 20.97%, 39.25%, 21.16%, 20.97%, 21.00%, 21.58%, 21.11%, 20.97%, 21.31%, 21.07%, 20.97%, 21.58%, 21.00%, and 21.25%.

Figure 6.65: Employee performance, bonus and promotion (Test Reporting Progress For Chosen Employee Within Time Period Operation).

- **Expected Output :** as Actual
- **Actual output :**

Month-Year	Performance Percentage
11-1989	21.00 %
5-1991	20.97 %
6-1993	39.25 %
7-1994	21.16 %
12-1998	20.97 %
9-2001	21.00 %
10-2001	21.58 %
3-2003	21.11 %
10-2004	20.97 %
6-2006	21.31 %
9-2006	21.07 %
3-2010	20.97 %
4-2013	21.58 %
3-2014	21.00 %
5-2015	21.25 %

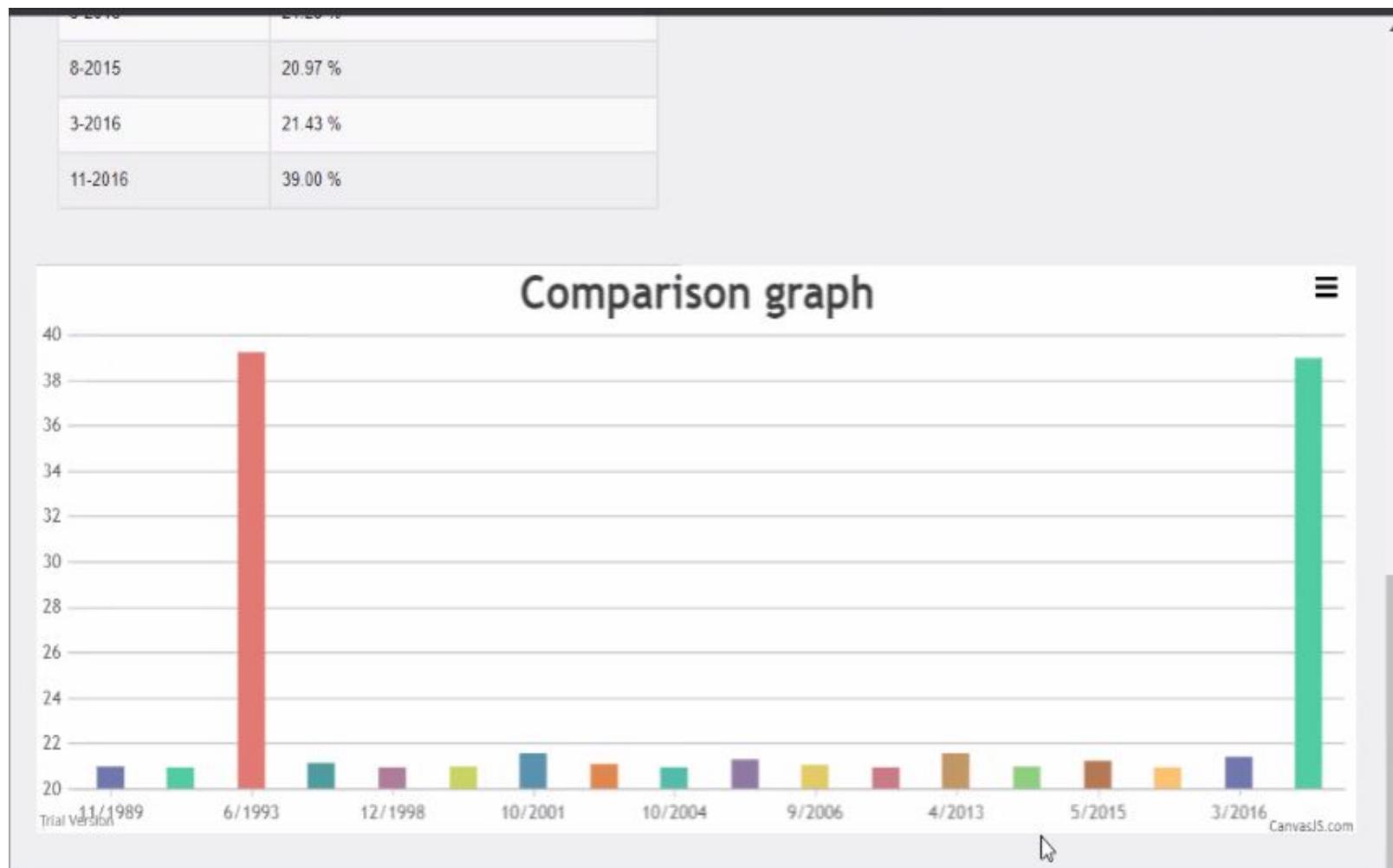


Figure 6.66: Employee performance, bonus and promotion (View Performance Reporting Progress For Chosen Employee Within Time Period Operation).

Test 2 :

- **Functionality tested :** test reporting progress for all employees in the chosen department within a time period.
- **Scenario :** choose specific department then view performance progress report in certain time period and check if it's compatible with the performance calculations equations in database
- **Input :**

The screenshot shows a form titled "Progress". It includes a dropdown menu labeled "Department" with a downward arrow icon. Below it are two input fields: "Sales" and "03/04/1986" followed by a date range selector, and "03/11/1990" followed by another date range selector. At the bottom left is a blue "Set" button.

Figure 6.67: Employee performance, bonus and promotion (Choose Department Performance Reporting Progress Within Time Period Operation).

- **Expected Output :** as Actual
- **Actual output :**



Figure 6.68: Employee performance, bonus and promotion (View Department Performance Reporting Progress Within Time Period Visualization).

Test 3 :

- **Functionality tested :** test reporting progress for all employees in specific positions within a time period.
- **Scenario :** choose a specific position then view the performance progress report in a certain time period and check if it's compatible with the performance calculations equations in the database.
- **Input :**

Progress

Position

Tester 03/11/1990

Figure 6.69: Employee performance, bonus and promotion (View Department Performance Reporting Progress Within Time Period Visualization).

- Expected output :
- Actual output :

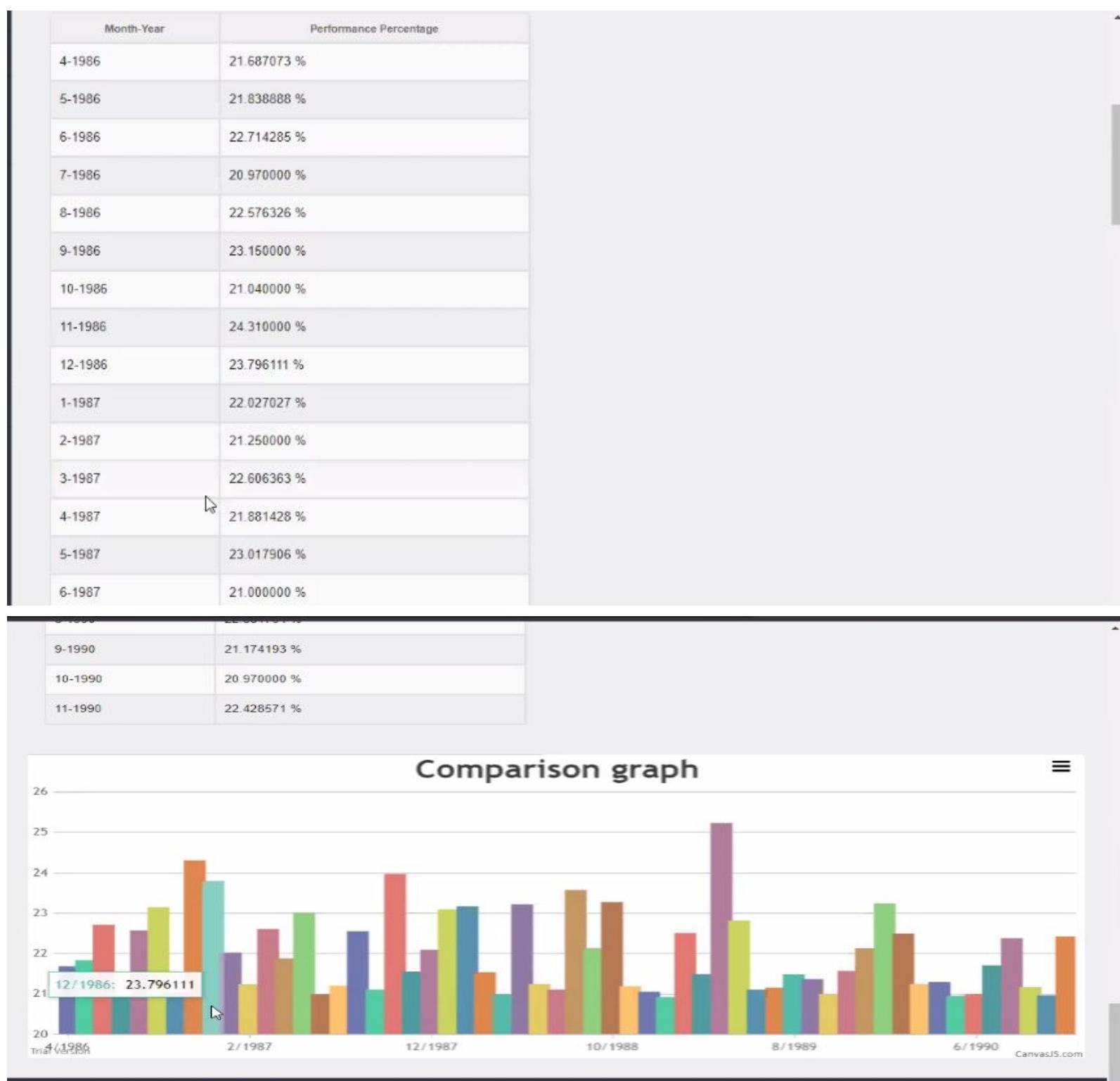


Figure 6.70: Employee performance, bonus and promotion (View Department Performance Reporting Progress Within Time Period Visualization).

Test 4 :

- **Functionality tested :** test reporting comparison of performance percentage between employees within time period ordered in descending order.
- **Scenario :** view employee comparison and select a certain time period and check if it's compatible with the fact employee behavior table in the data warehouse.
- **Input :**

The screenshot shows a user interface titled "Comparison". On the left, there is a sidebar with links: Training, My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, Attendance Reporting, and Performance Reporting. The main area has a dropdown menu "Employee" set to "6/4/1986", a "Set" button, and a "Month-Year" input field. Below these are two empty input fields labeled "Category Name" and "Performance Percentage".

Figure 6.71: Employee performance, bonus and promotion (Performance Comparison Operation).

- **Expected Output :** as Actual
- **Actual output :**

The screenshot shows a table titled "Month-Year" with columns "Category Name" and "Performance Percentage". The data is as follows:

Category Name	Performance Percentage
Gerard	51.11 %
Micah665	39.11 %
Micah665	39.11 %
Micah665	39.11 %
Lawanda627	39.11 %
Lawanda627	39.11 %
Lawanda627	39.11 %
Micah665	39.11 %
Lawanda627	39.11 %
Esther83	33.11 %

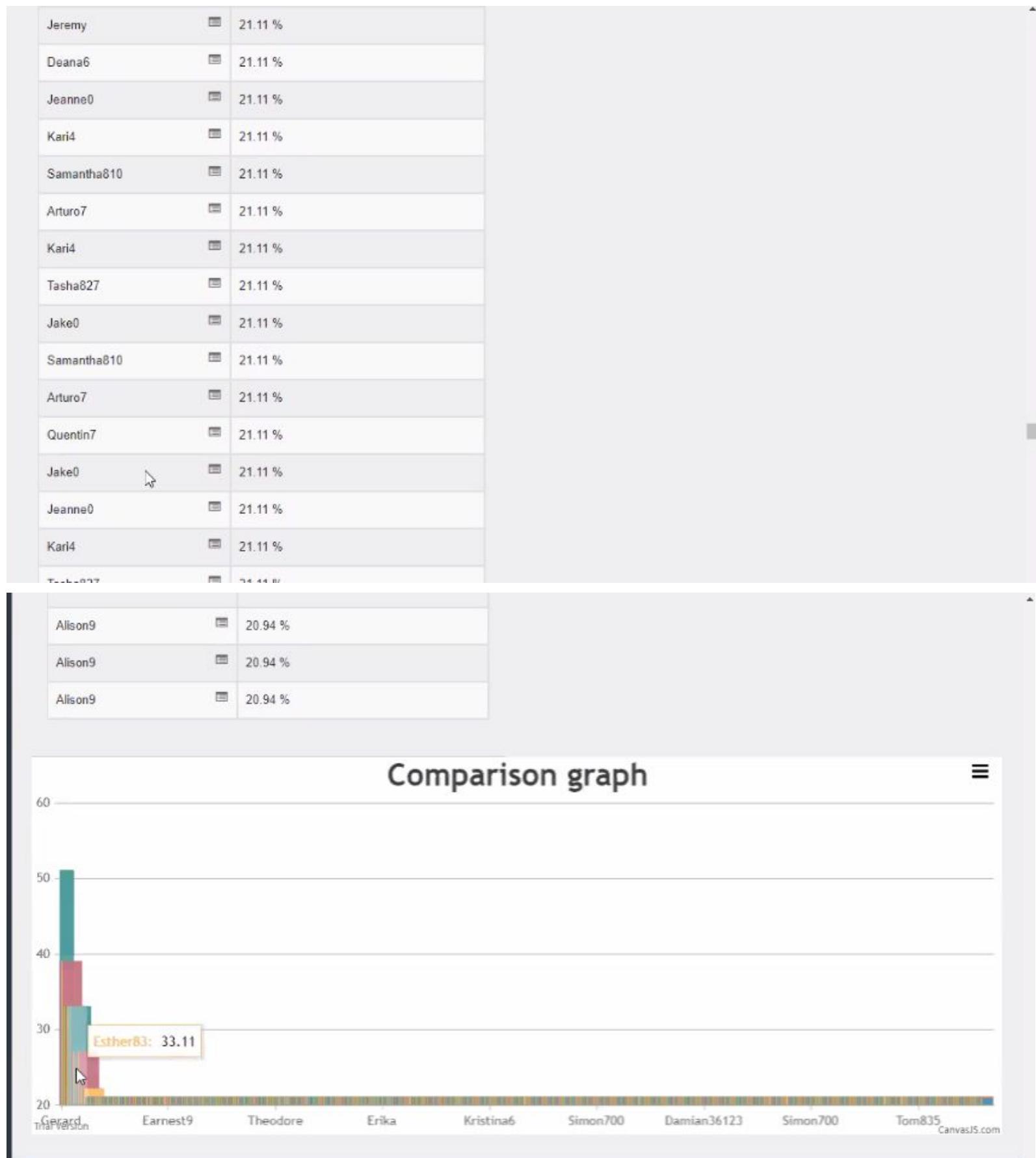


Figure 6.72: Employee performance, bonus and promotion (View Performance For Employees For Specific Month & Year Operation With Visualization).

Test 5 :

- **Functionality tested :** test reporting comparison of average performance percentage between departments within time period ordered in descending order.
- **Scenario :** view departments comparison and select a certain time period and check if it's compatible with the performance calculations equations in the database.
- **Input :**
Category department
Date 6/4/1986
- **Expected Output :** as Actual

- **Actual output :**

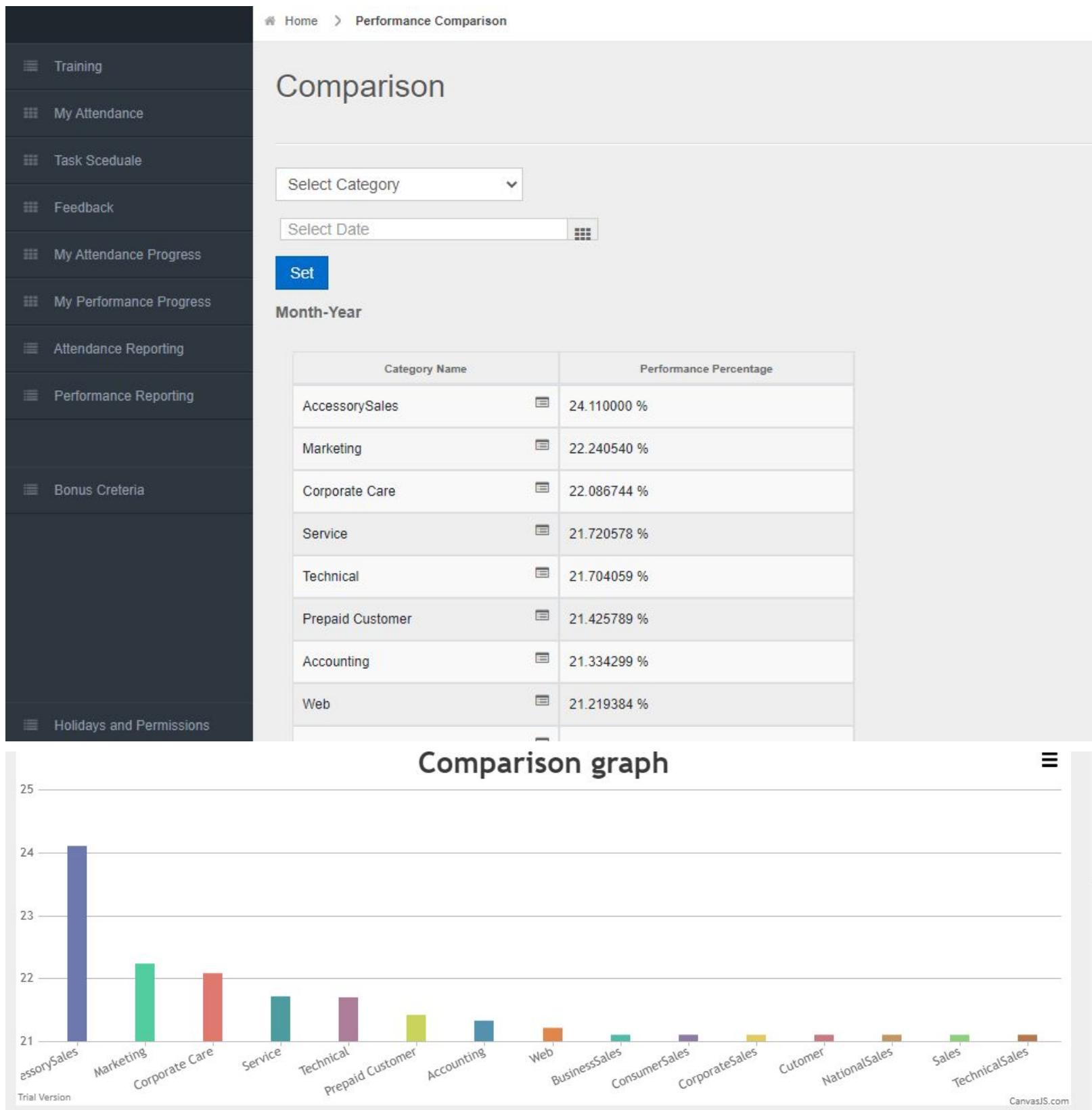


Figure 6.73: Employee performance, bonus and promotion (View Test Reporting Comparison Of Average Performance Percentage Between Departments Within A Specific Time Period).

Test 6 :

- **Functionality tested :** test reporting comparison of average performance percentage between positions within time period ordered in descending order.
- **Scenario :** view position comparison and select a certain time period and check if it's compatible with the performance calculations equations in the database.
- **Input :**
Position Category
Date 6/4/1986
- **Expected Output :** as Actual
- **Actual output :**

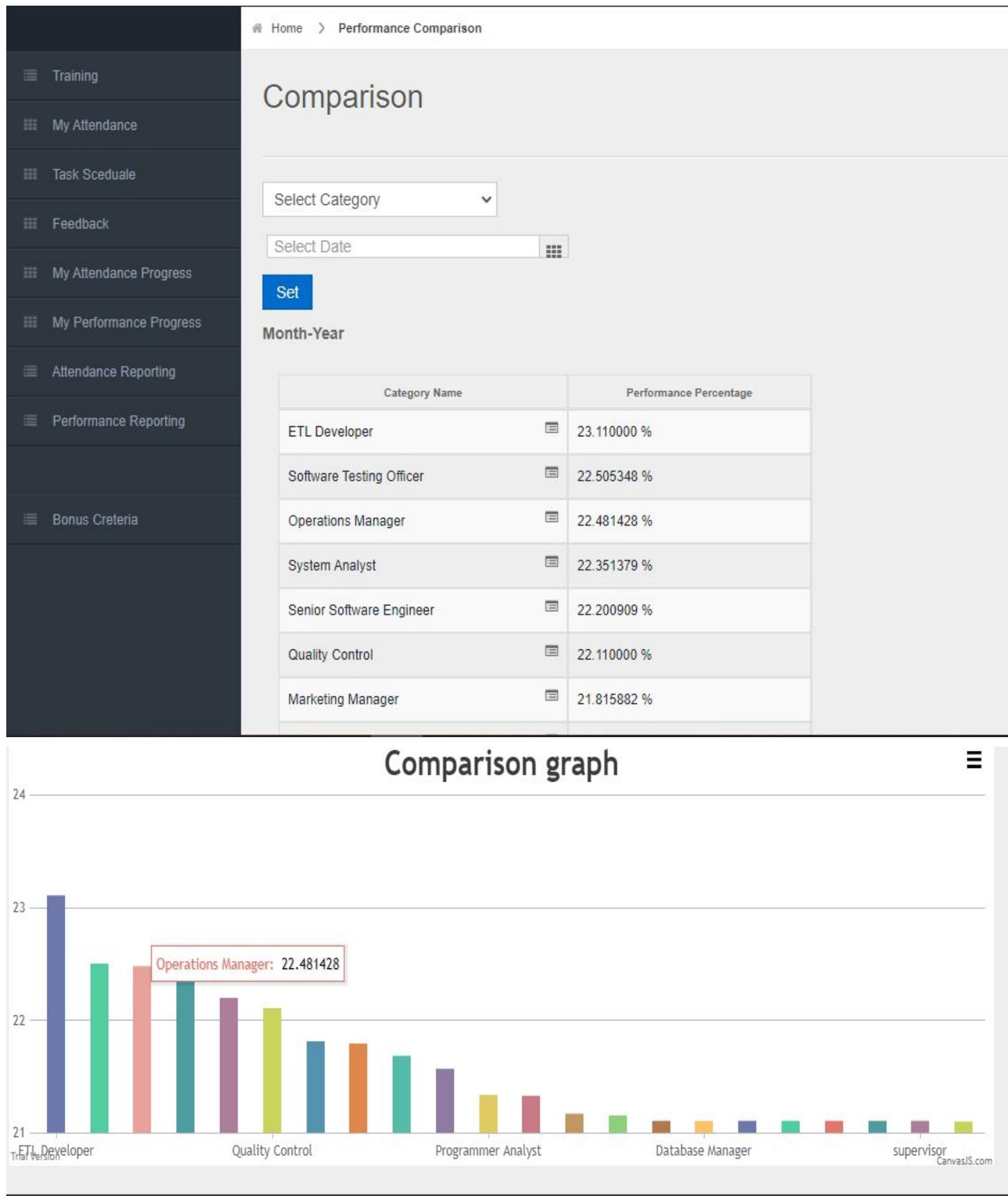


Figure 6.74: Employee performance, bonus and promotion (View Test Reporting Comparison Of Average Performance Percentage Between Positions Within A Specific Time Period).

Test 7 :

- **Functionality tested :** adding new bonus and view employee list who earn the bonus.
- **Scenario :** add the bonus criterion then view the employee list and check that the employees match the entered criterion from the database.
- **Input :**

Criteria

Department Name : Service

Position Name : TeamLeader

Maximum Skill Rank : 3

Minimum Performance Percentage : 30
99%

Minimum Attendance Percentage : 20
99%

Bonus Value : 1000 \$

Description : give bonus to team leaders

Set

Figure 6.75: Employee performance, bonus and promotion (Adding New Bonus Operation).

- **Expected output :** as Actual
- **Actual output :**

User Name	Average Skill Rank	Performance Percentage	Attendance Percentage
Yvonne328	5	58.00%	21.00%
Colby2	4	66.00%	36.00%
Mia05	5	74.00%	23.00%
Jocelyn8	3	87.00%	23.00%

Figure 6.76: Employee performance, bonus and promotion (View Employee List Who Earn The Bonus).

Test 8 :

- **Functionality tested :** adding new promotion and view employee list to earn the promotion.
- **Scenario :** add the promotion criterion then view the employee list and check that the employees match the entered criterion from the database.
- **Input :**

Promotion

Criteria

Department Name : ConsumerSales

Position Name : HR

Maximum Skill Rank : 3

Minimum Performance Percentage : 40
99%

Minimum Attendance Percentage : 30

New Position : Manager

Print

Figure 6.77: Employee performance, bonus and promotion (Adding New Promotion Criteria Operation).

- **Expected output :** as Actual
- **Actual output :**

The screenshot shows a web-based application for managing employee performance. On the left, a sidebar menu includes 'Promotion', 'Strength And Weakness Fields', 'Company Performance', and 'Project Performance'. The main area has four input fields: 'Maximum Skill Rank' (empty), 'Minimum Performance Percentage' (99%), 'Minimum Attendance Percentage' (empty), and 'New Position' (a dropdown menu showing 'Please select'). Below these is a green 'Print' button. Underneath is a 'Table' section with a 'Print' icon. A table lists two employees: Jeremy and Theresa375. Each row contains columns for User Name, Average Skill Rank, Performance Percentage, Attendance Percentage, and a blue 'Promote' button.

User Name	Average Skill Rank	Performance Percentage	Attendance Percentage	
Jeremy	3	51.00%	30.00%	Promote
Theresa375	5	70.00%	31.00%	Promote

Figure 6.78: Employee performance, bonus and promotion (View Employee List Who Earn The Promotion).

Test 9 :

- **Functionality tested :** choose an employee to promote.
- **Scenario :** choose an employee from recommended employees to the promotion and click promote then log in to this employee's account and check that it has been promoted to the new position.
- **Input :**
Choose jeremy employee to promote

This screenshot is identical to Figure 6.78, showing the same interface and data. It highlights the 'Promote' button for employee Jeremy, indicating the action being performed.

Figure 6.79: Employee performance, bonus and promotion (Choose An Employee To Promote Operation).

- **Expected output :** as Actual
- **Actual output :**
He became manager

User Name:	Jeremy
Department Name:	Web
Position Name:	Manager
Full Name:	Judy Flynn
Email:	lillo.nkzqcnvyjg@hsztjw.com
Salary:	11985
Phone Number:	979-576-0037
SSD:	877-19-0101
Address:	19 West New St.
Start Work Date:	12/06/2026 00:00:00
Birth Date:	26/06/1974 00:00:00
Educational Degree:	BS

Figure 6.80: Employee performance, bonus and promotion (Choose An Employee To Promote Example Operation).

6.11 Ninth iteration - Implementing 2 features (Project and overall company performance & weakness and strength fields)

- **Inputs :**

- The functional requirements document along with use cases and sequence diagrams.
- Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
- The classes of the model part are generated and methods ready to be implemented.

- **Increment chosen Requirements :**

- Managers can view comparison of projects performance reports for all projects or in specific department specific departments in a selected time interval as a table or a chart ordered by the performance percentage descendant ,... based on the percentage calculated from the project latency (divergence from the due date of every task and the feedback) if the project was finished.
- Managers can view comparison of company performance progress in a selected time interval as a table or a chart over time ,... based on the monthly overall performance calculated from the average employee performance (30%) and the average finished projects performance (70%).
- Managers can view all departments , their performance percentage and most powerful skills in their top projects within a selected time interval ordered from strongest down.
- Managers can view all departments , their performance percentage and most weak skills in their lowest projects within a selected time interval ordered from weakest up.

- **Increment preconditions :**

- Classes Manager and Project Implemented.
- Tables Project,Skill,Department and Task_Skill in the database filled with data and ready.
- Fact table Employee behavior in the data warehouse.
- Functions that keep track of time and task schedules.
- Functions that calculate the project performance.
- Functions that calculate the employee average performance.

- **Realising preconditions :**

Satisfied in previous iterations.

- **Increment duration :**

About 2 weeks.

- **Outputs :**

- 3 web pages.
- **Performance reporting comparison** : compare performance percentage among different projects ,in specific departments or for all departments within a selected time interval.
- **Overall Company Performance** : compare performance percentage of the company over time in a selected time interval.
- **Weakness and strength fields** : view weak and strength skills in each department and view strongest and weakest departments.

- **Tests :**

Test 1 :

- **Functionality tested** : test reporting comparison of performance percentage between projects within time period ordered in descending order.
- **Scenario** : view project comparison and select a certain time period and check if it's compatible with the project performance calculation equations in the database.
- **Input :**

The screenshot shows a web interface for 'Project Performance'. At the top, there is a navigation bar with 'Home' and 'Project Performance'. Below the navigation, the title 'Project Performance' is displayed. Underneath the title, there are two date input fields: '03/04/1986' and '04/04/2020', separated by a grid icon. Below these fields is a label 'Department Name' followed by a dropdown menu containing the option 'Accounting'.

Figure 6.81: Project and overall company performance & weakness and strength fields (Test Reporting Comparison Of Performance Percentage Between Projects Within Time Period Operation).

- **Expected output** : as Actual
- **Actual output** :

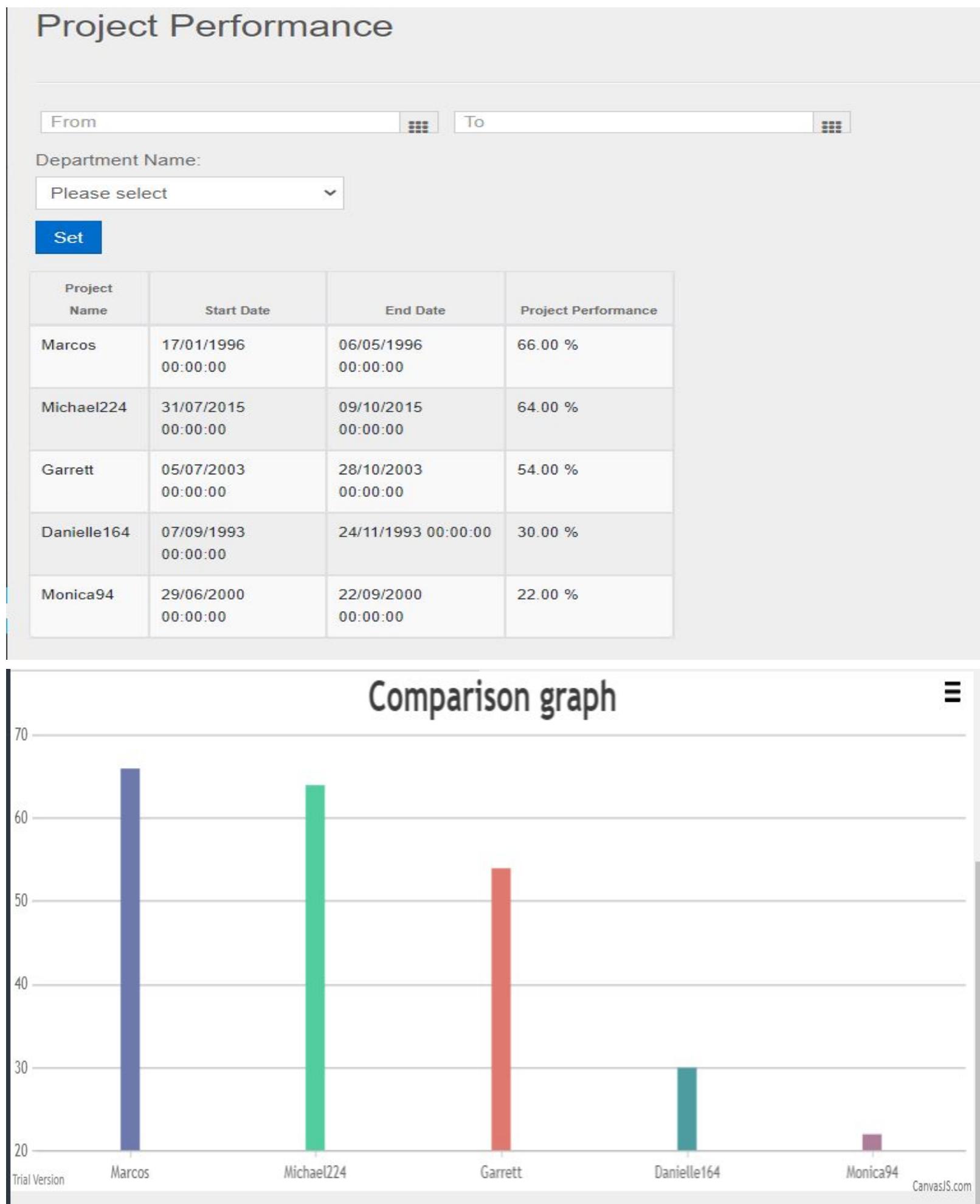


Figure 6.82: Project and overall company performance & weakness and strength fields (Vire Comparison Of Performance Percentage Between Projects Within Time Period Operation With Visualization).

Test 2 :

- **Functionality tested :** test reporting progress of average performance percentage over time within time period.
- **Scenario :** select a certain time period then view company performance during it and check if it's compatible with the performance calculations equations in the database.

- **Input :**

The screenshot shows a user interface for 'Company Performance'. On the left, a sidebar menu includes 'My Attendance', 'Task Schedule', 'Feedback', 'My Attendance Progress', and 'My Performance Progress'. The main area is titled 'Company Performance' and features a date range selector with '03/04/1986' and '03/11/1990' fields, a 'Set' button, and a search bar with 'Date' and 'Company Performance' fields. A cursor is visible near the search bar.

Figure 6.83: Project and overall company performance & weakness and strength fields (Choose Specific Period For Viewing Performance Operation).

- **Expected output :** as Actual
- **Actual output :**

The screenshot shows a table titled 'Company Performance' with two columns: 'Date' and 'Company Performance'. The data rows show percentages for specific dates from March 4, 1986, to March 6, 1987. The table is part of a larger interface with a sidebar containing 'My Attendance Progress', 'My Performance Progress', 'Promotion', 'Strength And Weakness Fields', 'Company Performance' (which is highlighted in blue), and 'Project Performance'.

Date	Company Performance
03/04/1986 00:00:00	8 %
03/05/1986 00:00:00	13.6 %
03/06/1986 00:00:00	57 %
03/07/1986 00:00:00	6.6 %
03/08/1986 00:00:00	19.5 %
03/09/1986 00:00:00	6.6 %
03/10/1986 00:00:00	62.6 %
03/11/1986 00:00:00	30 %
03/12/1986 00:00:00	34.6 %
03/01/1987 00:00:00	6.6 %
03/02/1987 00:00:00	6.9 %
03/03/1987 00:00:00	61.2 %
03/04/1987 00:00:00	11.5 %
03/05/1987 00:00:00	70.6 %
03/06/1987 00:00:00	6.6 %



Figure 6.84: Project and overall company performance & weakness and strength fields (View Company Performance Graph Visualization).

Test 3 :

- **Functionality tested :** test reporting strength fields in departments within time period ordered in descending order.
- **Scenario :** select a certain time period then view strength fields and skills in company departments and check if it's compatible with the performance calculations equations in the database.
- **Input :**

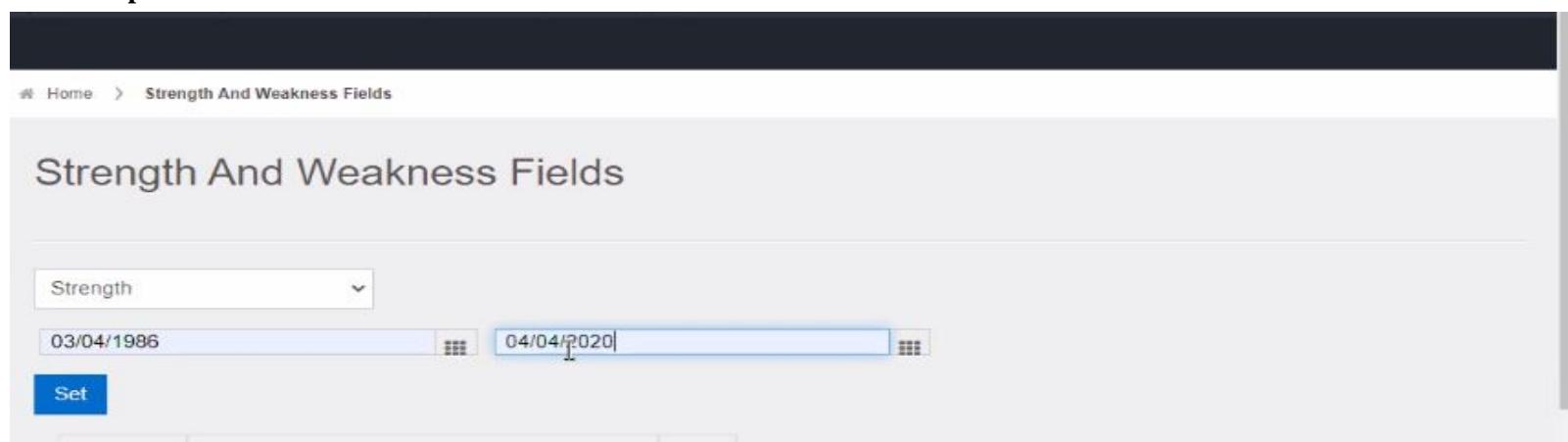


Figure 6.85: Project and overall company performance & weakness and strength fields (Choose Period For Viewing Strength And Weakness Fields Operation).

- **Expected output :** as Actual
- **Actual output :**

Department Name	Skills	Score
Corporate Care	PHP,React.js,	85
Service	Management,PHP,Video production,	82
Customer	Business analysis,Decision Making,Express.js,JavaScript,Management,SQL,UX design,	80

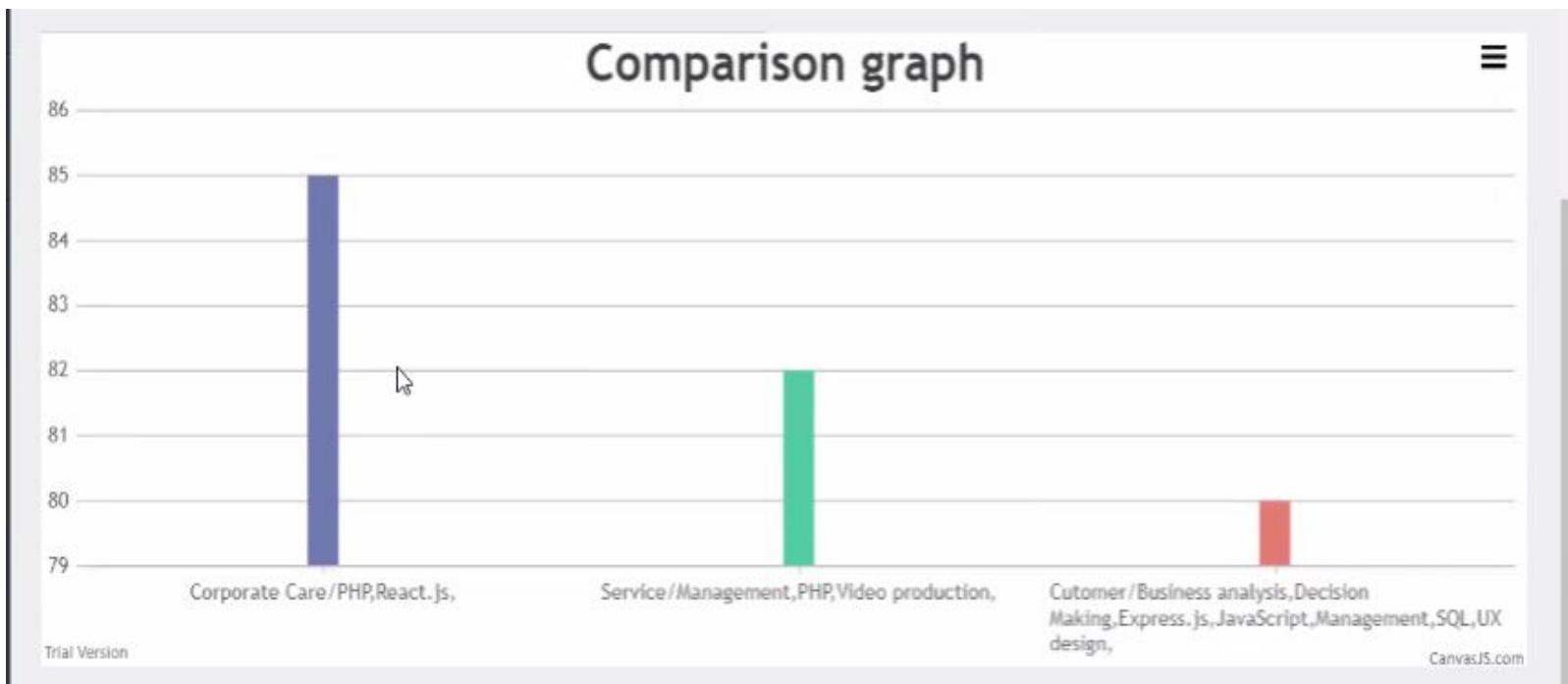


Figure 6.86: Project and overall company performance & weakness and strength fields (View Weakness And Strength Fields Graph And Visualization).

Test 4 :

- **Functionality tested :** test reporting weakness fields in departments within time period ordered in descending order.
- **Scenario :** select a certain time period then view weakness fields and skills in company departments and check if it's compatible with the performance calculations equations in the database.
- **Input :**

The screenshot shows a web application interface titled "Strength And Weakness Fields". On the left is a sidebar with links: "My Attendance", "Task Scheduale", "Feedback", "My Attendance Progress", and "My Performance Progress". The main area has a dropdown menu set to "Weakness", two date inputs (03/04/1986 and 04/04/2020), and a "Set" button. Below these are three input fields: "Department Name", "Skills", and "Score".

- **Expected output :** as Actual
- **Actual output :**

Department Name	Skills	Score
Prepaid Customer		0
Sales	,C#,Management,Problem Solving,Public Speaking,Python,Video production,	4
Web	MongoDB,PHP,	10

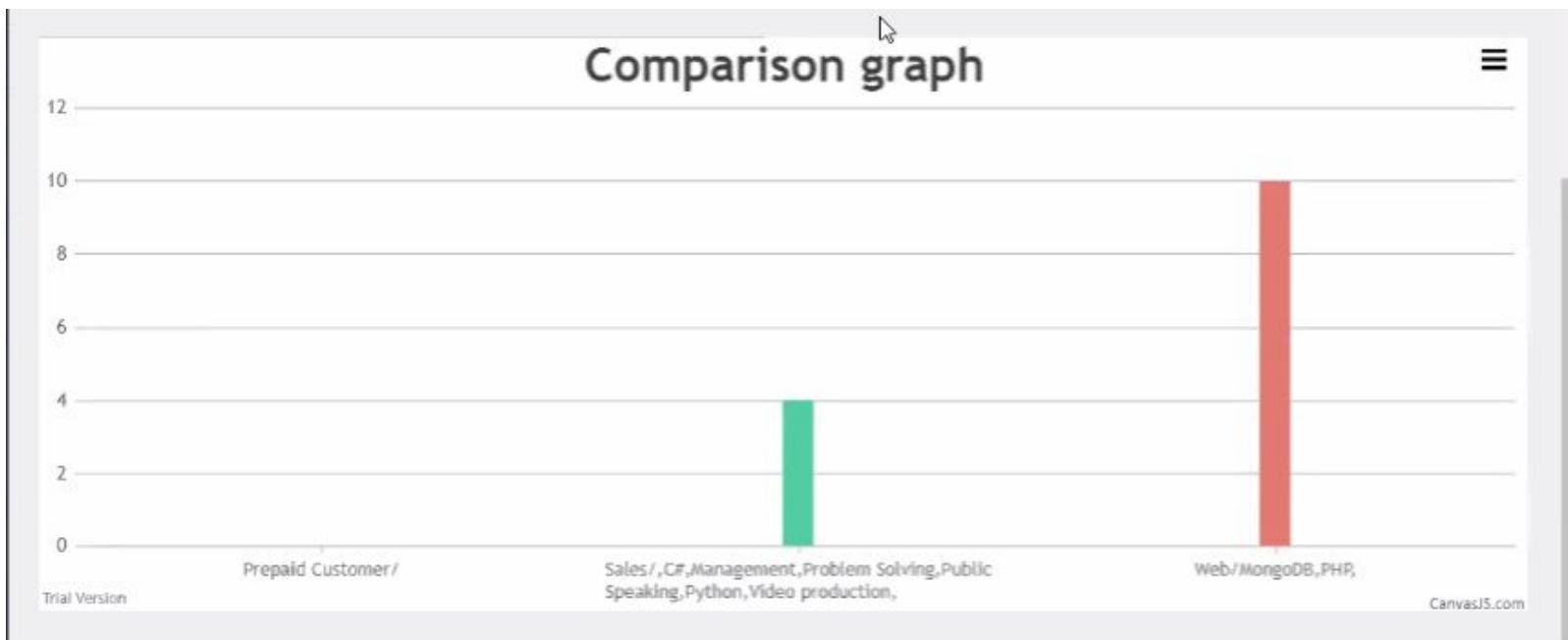


Figure 6.87: Project and overall company performance & weakness and strength fields (View Weakness And Strength Fields Graph And Visualization).

6.12 Tenth iteration - Implementing feature (Recruitment)

- **Inputs :**
 - The functional requirements document along with use cases and sequence diagrams.
 - Database tables and data warehouse tables and relations built and filled with dummy pregenerated data for experimenting.
 - The classes of the model part are generated and methods ready to be implemented.
- **Increment chosen Requirements :**
 - An applicant can fill a form with his information and list of skills that he ranks himself on as he sees (initial ranking would be tested later through the recruitment process by HR managers and interviewers).
 - The form must be accessible without the need to log in the system.
 - The hr management can enter criterion of the new job he wants to see candidates for then the system would give him a list of candidate applicants that filled the application form earlier and matches the entered criterion (range of graduation year , min experience years desired , desired skills and min skill score with max of 5 skills).
- **Increment preconditions :**
 - Classes Applicant , controller and HR implemented.
 - Tables Applicant and applicantSkill in the database filled with data and ready.
- **Realising preconditions :**
 - Satisfied in previous iterations.
- **Increment duration :**
 - About 1 weeks.
- **Outputs :**
 - 2 web pages
 - **Applicant form** : applicant enters his personal and professional information and skills list needed for job filtration by HR.
 - **HR recruitment** : HR can enter the desired skills and conditions for the job and get a list of applicants that fulfill these conditions and their contact information to carry on with the recruitment process.
- **Tests :**
 - Test 1 :
 - **Functionality tested** : test adding a new applicant.
 - **Scenario** : open the application page and fill in the applicant information then make sure that the applicant record was added to applicant and applicant-Skills table in database.
 - **Input** :

Applicant Name :	Ahmed gamal
Email :	ahmedGamal@gmail.com
Phone Number:	01023476890
SSN :	21356365980
Education :	faculty of engineering
Address :	7 Ekata CHS
Graduation Date :	12-02-2020
Experience:	5
Gender :	male
Skills	Please Select Scientific computing Creativity PHP

Figure 6.88: Recruitment (Adding A New Applicant Operation).

Set Skills Rank		
Skill Name	Skill rank	
Scientific computing	3	Assign
Creativity	4	Assign
PHP	5	Assign

Figure 6.89: Recruitment (Set Skills Rank Operation).

- **Expected output :** as Actual
- **Actual output :**
The applicant record was added to applicant and applicant-Skills table in database.

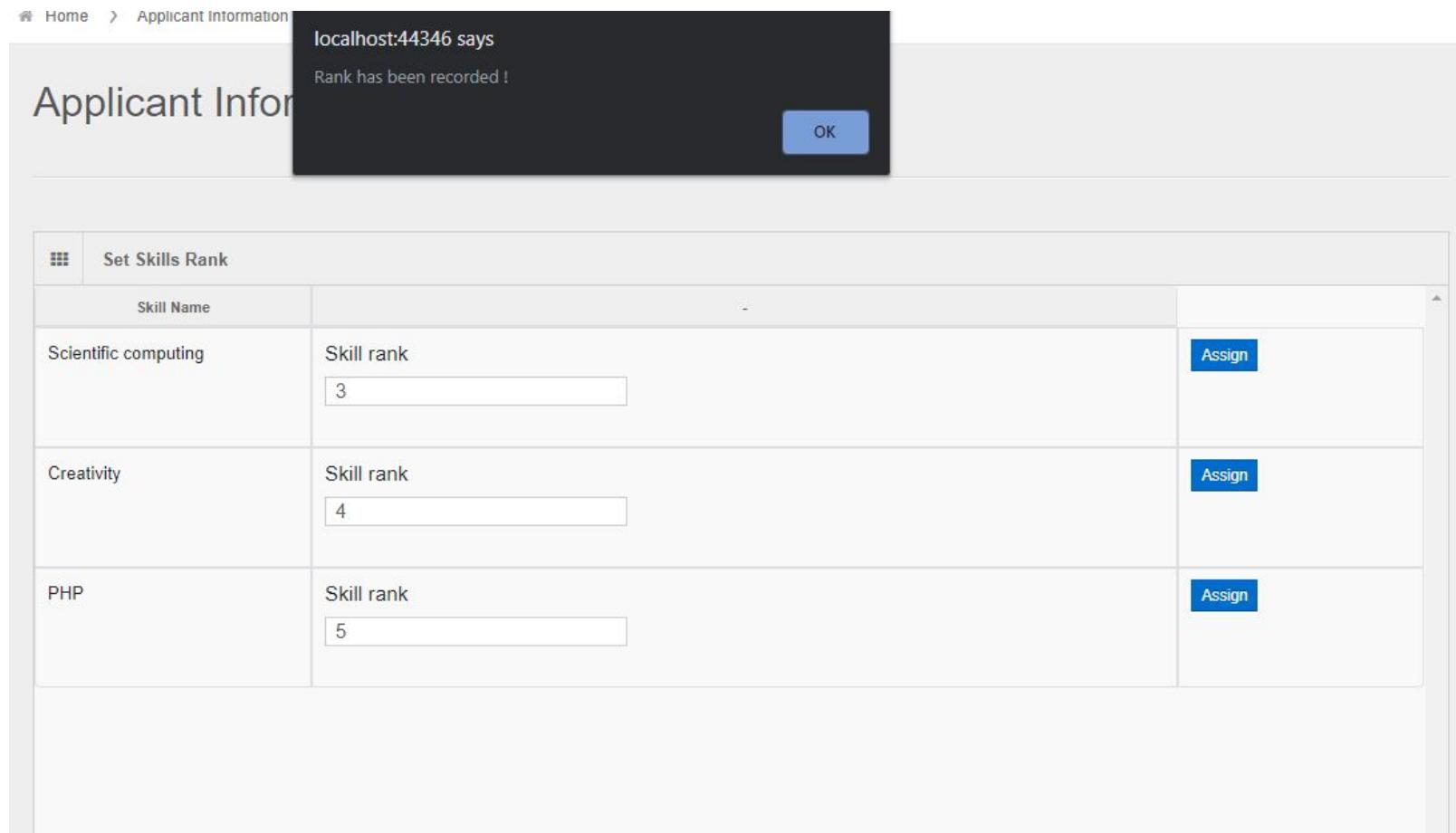
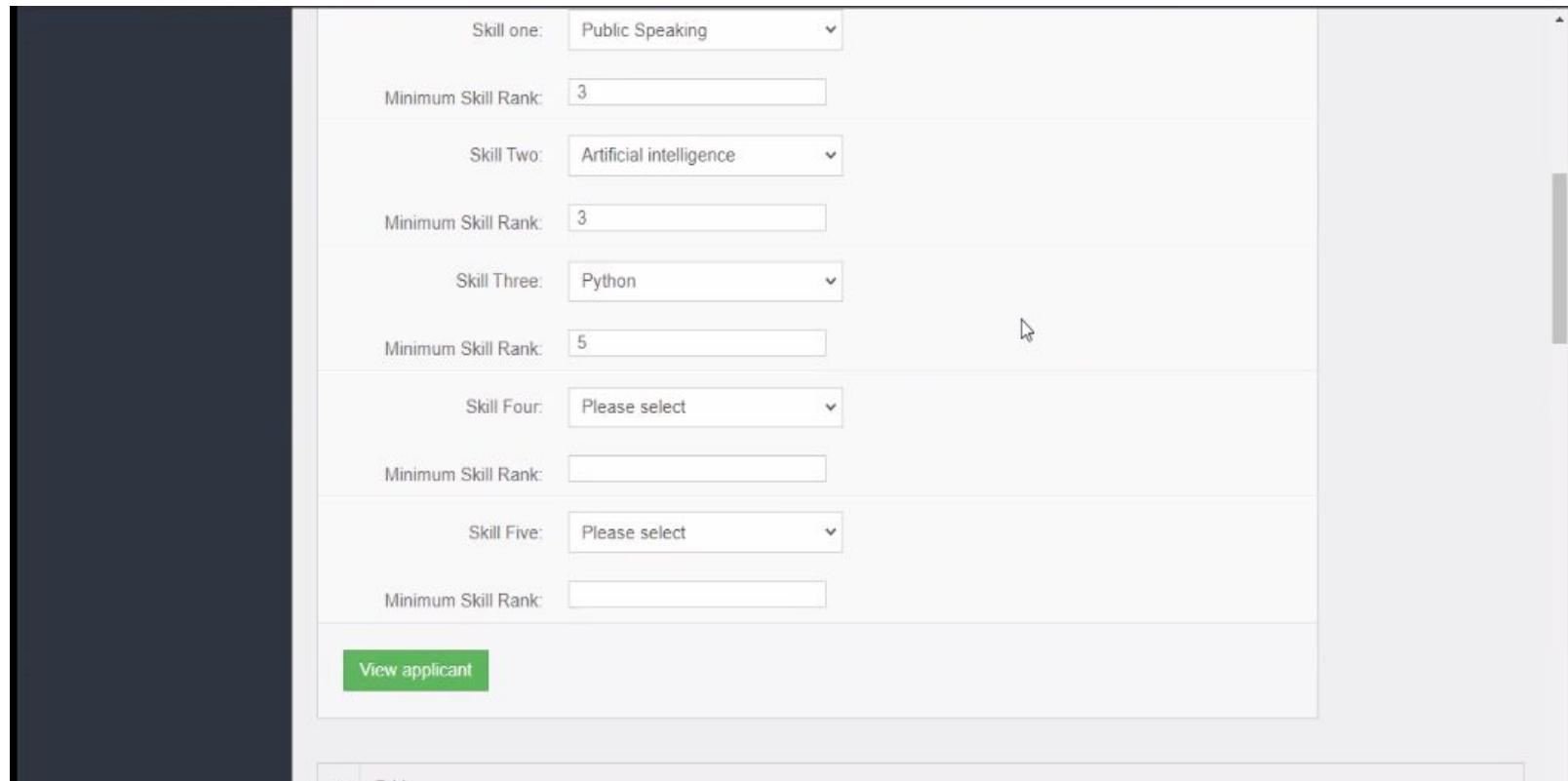


Figure 6.90: Recruitment (Rank Recorded Pop-Up Notification).

Test 2 :

- **Functionality tested :** test getting recommended applicants for some job conditions.
- **Scenario :** open the recruitment page from an HR account then fill in the job requirements and skills needed then get recommended employees , make sure that the recommendations match the entered conditions by inspecting the applicant and applicantSkills tables in the database.
- **Input :**

The screenshot shows the 'Recruitment' page. On the left, there is a vertical sidebar menu with the following items: Training, Employee Attendance, Attendance Reporting, Projects, Tasks, Feedback, Bonus, and Recruitment. The 'Recruitment' item is highlighted with a blue background. The main content area is titled 'Recruitment' and contains a form for defining search criteria. The form includes fields for 'Experience In Years:' (set to 3), 'Graduation Date:' (with 'From:' set to 12-02-1986 and 'To:' set to 12-02-2020), 'Skill one:' (set to 'Public Speaking'), 'Minimum Skill Rank:' (set to 3), 'Skill Two:' (set to 'Artificial intelligence'), and 'Minimum Skill Rank:' (set to 3). The background of the main content area is light gray, while the sidebar and form fields have a white background.



The screenshot shows a recruitment application form with the following fields:

- Skill one:** Public Speaking (dropdown menu)
- Minimum Skill Rank:** 3 (text input field)
- Skill Two:** Artificial intelligence (dropdown menu)
- Minimum Skill Rank:** 3 (text input field)
- Skill Three:** Python (dropdown menu)
- Minimum Skill Rank:** 5 (text input field)
- Skill Four:** Please select (dropdown menu)
- Minimum Skill Rank:** (empty text input field)
- Skill Five:** Please select (dropdown menu)
- Minimum Skill Rank:** (empty text input field)

View applicant button (green button at the bottom left).

Figure 6.91: Recruitment (Setting Criteria For Getting Recommended Applicants For Some Job Conditions Operation).

- **Expected output :**
- **Actual output :**



The screenshot shows a table titled "Table" listing recommended applicants:

Name	Email	Phone Number	Address	Graduation Year	Experience	Skills	Gender
Wendy	anwh.hilh@kszqfa.com	79101	55 Fabien Boulevard	1998	22	Python -	F
Julia0	lcbx.xlumfneua@ebvw.kkxlad.com	45953	79 Oak Street	2005	15	Python -	M
Lawanda	xopjzf.mkhjryv@sorhmwly.zzqdqk.net	82097	25 White Second Freeway	1987	29	Python -	M
Dennis35	rhtou.vqlouuqlgs@fjmwr.org	70317	876 New Blvd.	2001	7	Public Speaking -	M
Sean97	avmmymdmi.zoopwz@rpxyee.com	63397	177 South Rocky Hague Boulevard	1999	20	Artificial intelligence -	M
Ramon719	slzj85@idvzry.com	32642	323 East New Way	2002	12	Artificial intelligence -	M
Olivia	bohvdmz.smburidmop@gcghjfnyjhgaj.net	73889	424 Clarendon St.	1999	22	Artificial intelligence -	M

							intelligence -	
Kristine2	vyzq.ksgfprta@ujrpbbjlo-q-qusw.com	36166	239 Green Second Drive	2004	27		Artificial Intelligence -	M
Norma	zcoxczj612@iuhkysdqr.vzebvq.org	09237	57 Old Street	1989	17		Public Speaking -	F
Abigail	mjpucey19@vxsexbn.l-ygmz.net	84480	88 East Rocky Cowley Blvd.	2001	28		Public Speaking -	M
Leanne	ueynse60@efxish.org	36637	38 Clarendon St.	1994	28		Artificial intelligence -	M
Gabriel361	zzeoy4@axaamu.org	53952	896 North White Old Blvd. ↳	1994	12		Artificial intelligence -	M
Mitchell928	mhfznfqj29@buoryl.com	19714	113 Cowley Blvd.	2002	25		Artificial intelligence -	M
Shaun	kpbimpu.jtuzgcrg@krjyg.pqiver.com	18548	75 South Nobel Road	2011	8		Public Speaking -	M

Figure 6.92: Recruitment (Getting Recommended Applicants For Some Job Conditions Operation).

7- CHAPTER SEVEN: SYSTEM TESTING

7.1 Introduction

The main objective of system testing is to verify both functional and nonfunctional requirements in the system as a whole. In this case, defects are detected, such as improper use of system resources, unexpected combinations of user level data, incompatibility with the environment, unexpected usage scenarios, missing or incorrect functionality, inconvenience of use, etc.

The testing process will be divided into two main stages:

- **Requirements-Based Testing**
 - **Functional requirements validation**
 - **Non Functional requirements validation**

7.2 Functional requirements validation

In this section , we will list how we satisfied each requirement agreed on in the requirements elicitation section :

7.2.1 Employee self service

- Each employee is provided with a control panel to execute all eligible operations according to his position.
- Employee's panel gives him all access to his personal data , attendance, logging records , progress and performance charts.

User Name:	Jeanine25
Department Name:	Web
Position Name:	Quality Testing Officer
Full Name:	Owen Bates
Email:	araezhou0@yljgj.msusun.com
Salary:	11639
Phone Number:	7839557581
SSD:	876-16-1474
Address:	254 East White Hague Parkway
Start Work Date:	30/01/2013 00:00:00
Birth Date:	15/08/1971 00:00:00

Figure 7.1: Employee Self service (Viewing Profile Operation).

HR's panel gives him access to employees and departments performance evaluations , attendance reports and skill reports , permission and holiday's control panel , recruitment tools and training control panel.

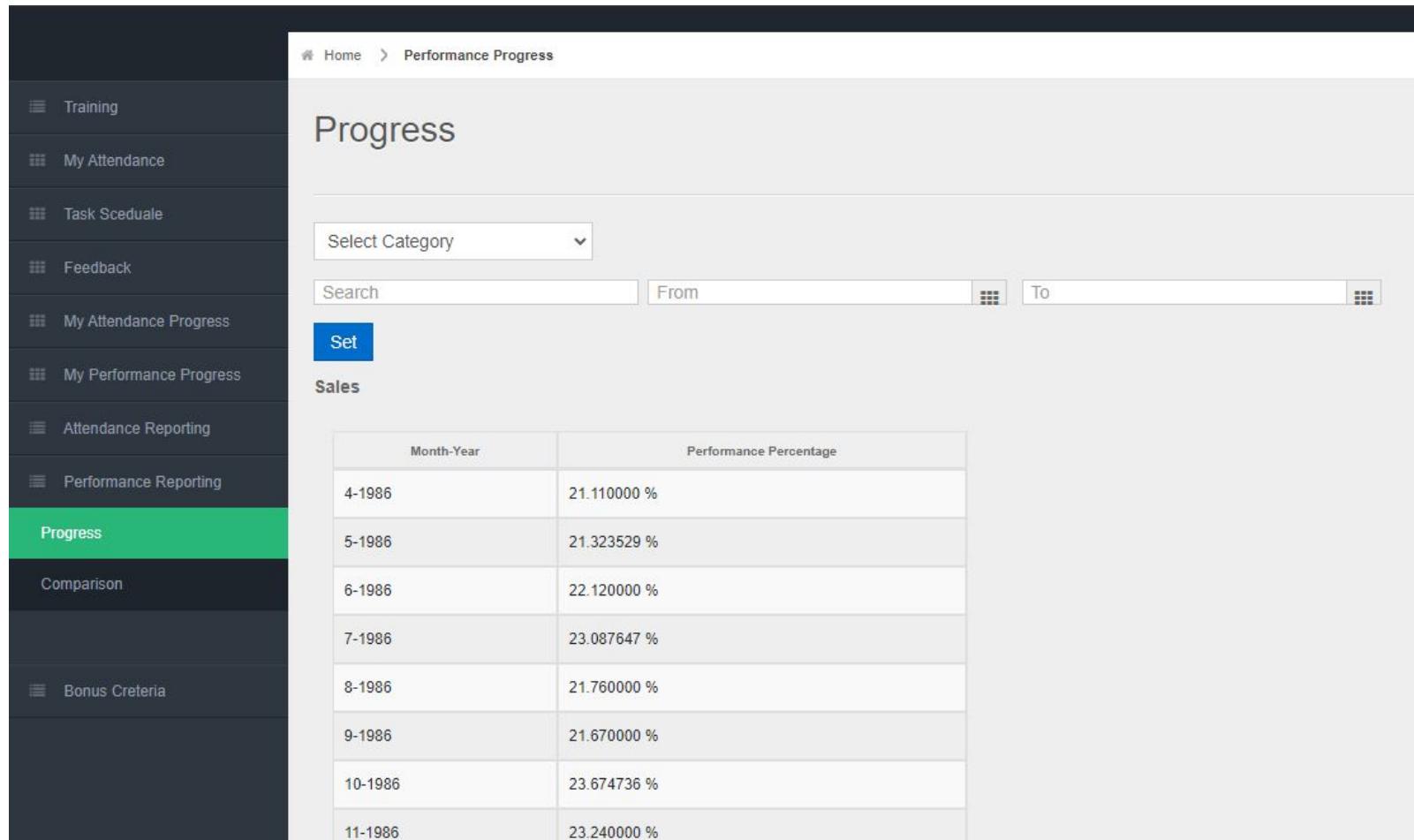


Figure 7.2: Performance Progress (Viewing Performance For Specific Team Operation).

The screenshot shows a form for adding bonus criteria. On the left, a vertical navigation menu lists Task Scheduale, Feedback, My Attendance Progress, My Performance Progress, Attendance Reporting, Performance Reporting, Bonus Criteria (which is highlighted), Holidays and Permissions, and Hire Applicant. The main form is titled 'Criteria' and contains fields for Department Name (Service), Position Name (TeamLeader), Maximum Skill Rank (3), Minimum Performance Percentage (30, 99%), Minimum Attendance Percentage (20, 99%), Bonus Value (1000 \$), and a Description field (give bonus to team leaders). A 'Set' button is at the bottom.

Figure 7.3: Adding Bonus Criteria Operation.

- Team leader's panel would also show his personal data , attendance and performance reports as an ordinary employee in addition to the task scheduling and projects' creation control panel.

The screenshot shows a user profile interface. On the left, a sidebar lists navigation options: My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, Projects and Tasks, Projects, and Tasks. The 'Tasks' option is currently selected. The main content area is titled 'My Profile' and contains a sub-section titled 'Information'. This section displays the following data in a table:

User Name:	Jeanine25
Department Name:	Web
Position Name:	TeamLeader
Full Name:	Owen Bates
Email:	araenhou0@yjgj.msusun.com
Salary:	11639
Phone Number:	7839557581
SSD:	876-16-1474
Address:	254 East White Hague Parkway
Start Work Date:	30/01/2013 00:00:00

Figure 7.4: Viewing Profile Operation.

- Manager's panel gives him access to overall company reports , weakness and strength diagnosis , reports of all employee's attendance and performance in addition to his ability to run the monthly system updating with just a button click.

The screenshot shows a 'Promotion' configuration page. The left sidebar includes options: My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, Promotion (which is highlighted in blue), Strength And Weakness Fields, Company Performance, and Project Performance. The main content area is titled 'Promotion' and contains a 'Criteria' section with the following fields:

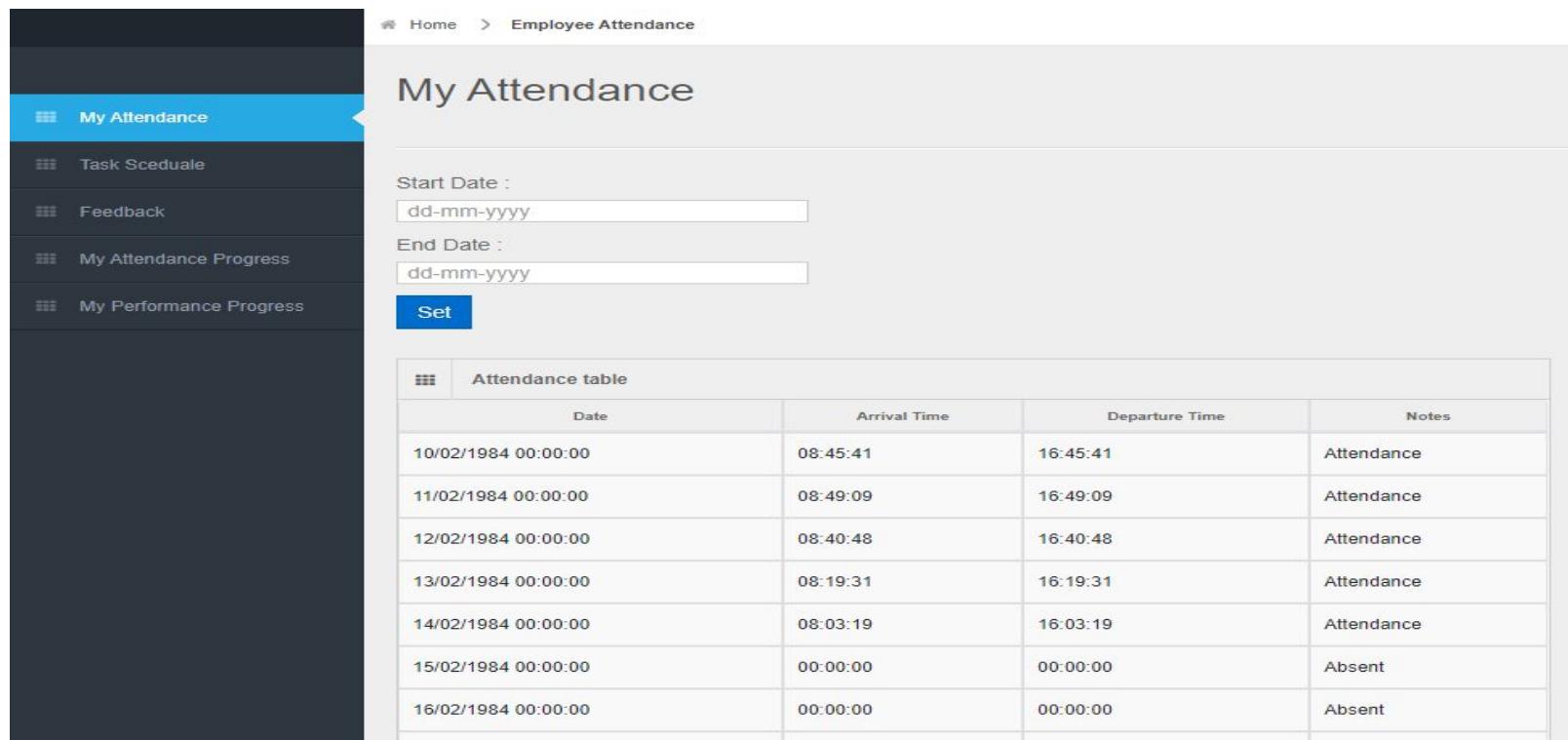
Department Name :	ConsumerSales
Position Name :	HR
Maximum Skill Rank :	3
Minimum Performance Percentage :	40
Minimum Attendance Percentage :	99%
New Position :	Manager

At the bottom of the form is a green 'Print' button.

Figure 7.5: Adding Promotion Criteria Operation.

7.2.2 Attendance

- Each employee can view his attendance records with notes of (holidays , absence , presence and permissions).

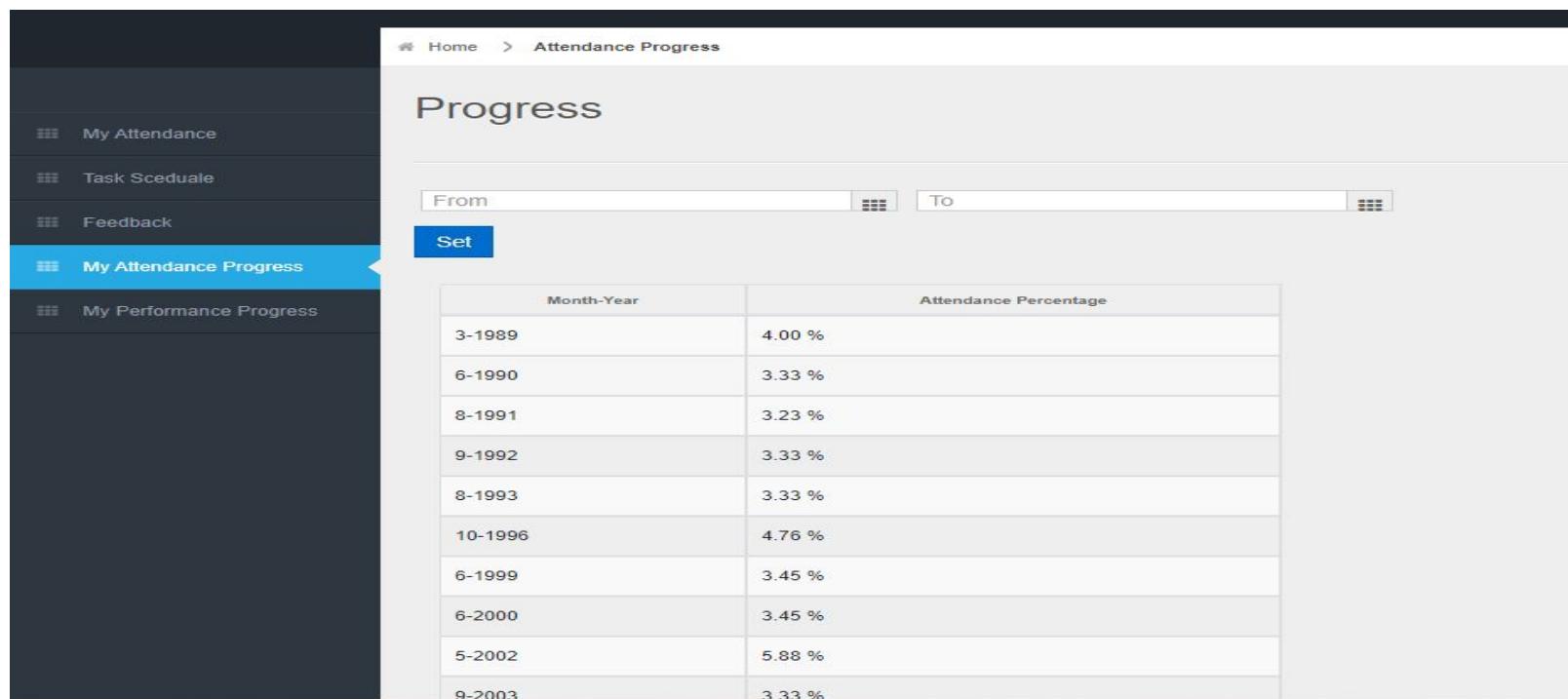


The screenshot shows a web-based application interface for viewing employee attendance. On the left, there is a vertical navigation menu with options: My Attendance (selected), Task Schedule, Feedback, My Attendance Progress, and My Performance Progress. The main content area has a title "My Attendance". It includes input fields for "Start Date" and "End Date" (both set to "dd-mm-yyyy") and a "Set" button. Below these is a table titled "Attendance table" with columns: Date, Arrival Time, Departure Time, and Notes. The table contains 8 rows of data representing attendance records from February 10, 1984, to February 16, 1984.

Date	Arrival Time	Departure Time	Notes
10/02/1984 00:00:00	08:45:41	16:45:41	Attendance
11/02/1984 00:00:00	08:49:09	16:49:09	Attendance
12/02/1984 00:00:00	08:40:48	16:40:48	Attendance
13/02/1984 00:00:00	08:19:31	16:19:31	Attendance
14/02/1984 00:00:00	08:03:19	16:03:19	Attendance
15/02/1984 00:00:00	00:00:00	00:00:00	Absent
16/02/1984 00:00:00	00:00:00	00:00:00	Absent

Figure 7.6: View Employee Attendance Operation.

- Each employee can get his attendance percentage records to monitor his progress over time.



The screenshot shows a web-based application interface for viewing employee attendance progress. The left navigation menu is identical to Figure 7.6. The main content area has a title "Progress". It includes input fields for "From" and "To" dates and a "Set" button. Below these is a table titled "Attendance Percentage" with columns: Month-Year and Attendance Percentage. The table contains 10 rows of data representing attendance percentages from 1989 to 2003. At the bottom, there is a bar chart titled "Comparison graph" showing attendance percentages for specific months and years.

Month-Year	Attendance Percentage
3-1989	4.00 %
6-1990	3.33 %
8-1991	3.23 %
9-1992	3.33 %
8-1993	3.33 %
10-1996	4.76 %
6-1999	3.45 %
6-2000	3.45 %
5-2002	5.88 %
9-2003	3.33 %

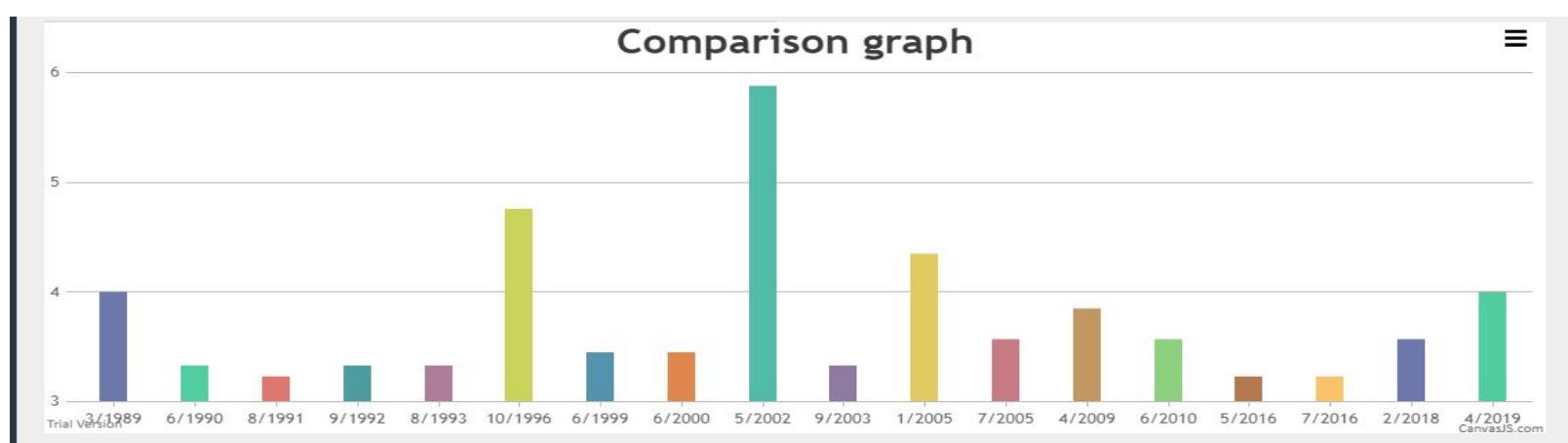


Figure 7.7: View Employee Attendance Progress Visualization Operation.

- Hr employee can enter a permission , holiday or official vacation to be taken into account during calculating the employees' attendance percentage calculation.

Permission

Employee Name :	Jeanine25
Start Time :	10
End Time :	2
Date :	6/4/1986
Causation :	personal issue

Save

Official Vaction

Name :	Eid
Start Date :	4/10/2020
End Date :	7/10/2020

Save

Figure 7.8: Adding Permission And Official Vacation Operation.

The screenshot shows a web-based application for adding a holiday entry. At the top right, there is a close button (X) and the word "Holiday". Below this, there are four input fields: "Employee Name" with the value "Valerie", "Start Date" with the value "4/10/2020", "End Date" with the value "7/10/2020", and "Causation" with the value "personal issue". At the bottom left, there is a green "Save" button.

Figure 7.9: Adding Holiday Operation.

- Hr and managers can view the attendance reporting over time for specific employees , departments or positions to monitor any drop in attendance or any out of regular observation.

[Home](#) > [Attendance Progress](#)

Progress

Select Category ▼

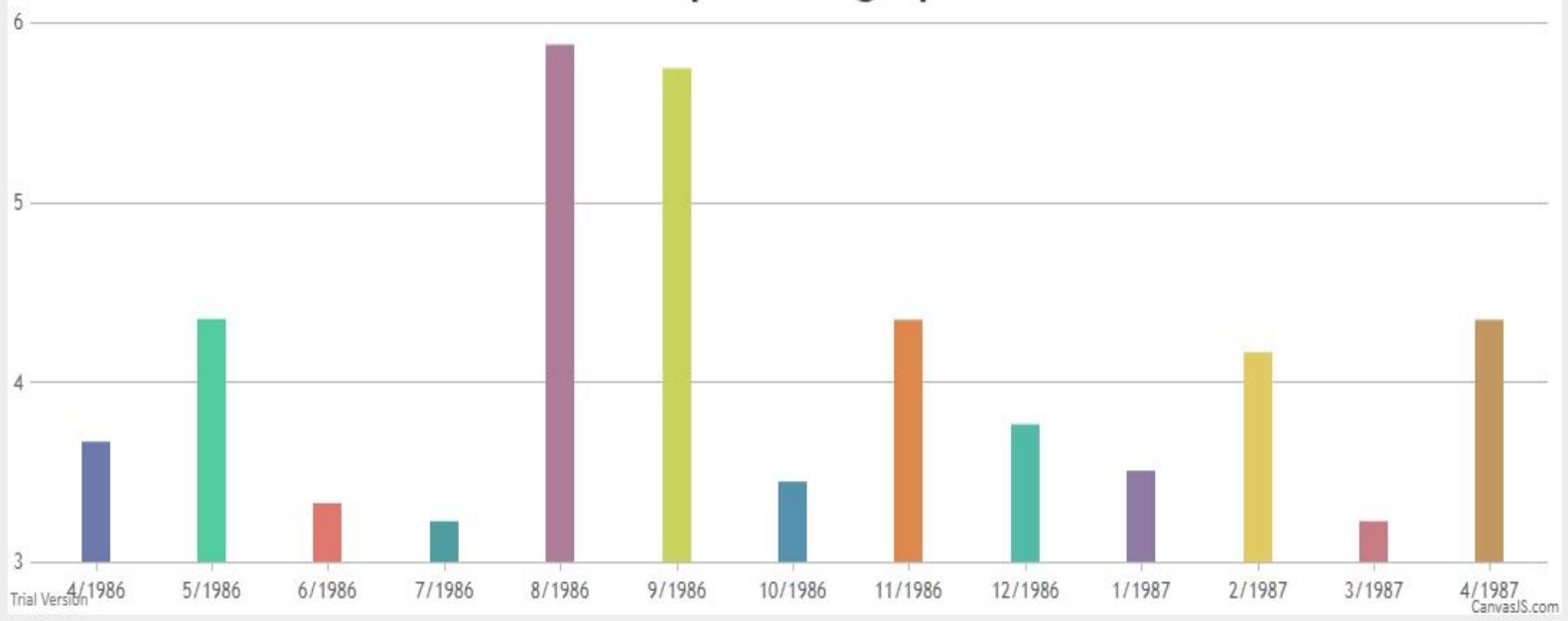
Search

From

To

Set**Tester**

Month-Year	Attendance Percentage
4-1986	3.672195 %
5-1986	4.354888 %
6-1986	3.330000 %
7-1986	3.230000 %
8-1986	5.880000 %
9-1986	5.748135 %
10-1986	3.450000 %
11-1986	4.350000 %

Comparison graph**Figure 7.10: View Attendance Progress And Percentage Operation.**

7.2.3 Feedback

- At the end of every task , all members that worked on the task and the team leader must give feedback on the members skills.
- This feedback is taken into account on calculating both project and employee's performance.

The screenshot shows a web-based application interface for giving feedback. At the top, there is a navigation bar with links for 'Welcome User', 'Messages' (with a count of 5), 'Settings', and 'Logout'. Below the navigation bar, the page title is 'Home > Feedback'. On the left, a vertical sidebar menu includes 'My Attendance', 'Task Sceduale', 'Feedback' (which is highlighted in blue), 'My Attendance Progress', and 'My Performance Progress'. The main content area is titled 'Give Feedback' and lists several users with their names and edit icons:

- Angelo3
- Susana
- Sonny7
- Autumn6
- Laura442
- Carla
- Jimmie90

The URL in the browser address bar is <https://localhost:44346/Employee/showPerformanceProgress>.

Figure 7.11: Give Feedback Operation.

This screenshot shows the 'Give Feedback' interface with two entries displayed:

- Cassandra68 - Fredrick70**: For skill 'OOP', a rank of 5 is given with the message 'good at team work'.
- Mickey4**: For skill 'Scientific computing', a rank of 3 is given with the message 'not v'.

The sidebar menu on the left includes 'Training', 'My Attendance', 'Task Sceduale', 'Feedback' (highlighted in blue), 'My Attendance Progress', 'My Performance Progress', 'Attendance Reporting', 'Performance Reporting', and 'Bonus Creteria'. A 'Next' button is visible at the bottom of the main content area.

Figure 7.12: Give Feedback Operation.

7.2.4 Time tracking and task scheduling

- Each employee can see his active tasks and the required task not started yet.

The screenshot shows a software interface with two main sections:

- Active Tasks Table:**

Project Name - Task Name	Assign date	Start Time	Deadline	Remaining Hours
Cassandra68 - Penny	05/08/1997 21:16:23	13/06/2020 23:49:49	19/08/1997 17:40:01	-200022
Glenda03 - Lisa41	14/03/1999 21:55:42	20/05/2007 05:43:16	25/03/1999 13:50:29	-71464
Cassandra68 - Marcie161	06/04/1999 01:32:50	16/10/1990 17:24:45	14/04/1999 23:08:14	74454
Cassandra68 - Katina38	03/12/2008 12:25:03	03/04/1989 08:00:55	11/12/2008 03:26:48	172603
Debra517 - Calvin14	05/11/2010 07:02:55	20/01/2015 19:24:17	11/11/2010 12:36:34	-36751
- To-Do Table:**

Project Name - Task Name	Assign date	Deadline	Action
Cassandra68 - Fredrick70	15/06/1983 21:54:06	24/06/1983 05:51:20	Start
Cassandra68 - Meredith	03/03/1988 10:40:03	16/03/1988 06:51:33	Start
Cassandra68 - Elena86	08/07/2013 15:05:29	11/07/2013 10:28:10	Start

Figure 7.13: View Active Tasks And Required Tasks Not Started Yet Operation.

- Each employee can choose to start a task but only the team leader can end a task when he thinks it's over.
- If the deadline of the task is passed and it's not finished yet , the system would alert the employee.

The screenshot shows a software interface with a main title and a detailed view section:

- Title:** Viewing Task
- Task Info Table:**

Task Info	
Task Name:	Penny
Assign Time:	05/08/1997 21:16:23
Deadline:	19/08/1997 17:40:01
Project Name:	Cassandra68
Skills:	

The screenshot shows a software interface with a header 'List Of Employees'. Below the header is a table with columns: Employee Name, Phone Number, and Email. The table contains six rows of employee data. At the bottom right of the interface is a red button labeled 'End Task'.

Employee Name	Phone Number	Email
Jeanine25	7839557581	araenhou0@yljgj.msusun.com
Roberta503	337992-0232	hlmny64@dtifas.com
Joann197	257879-6646	osyaazer@qmhsfc.com
Penny859	148298-6211	vsuniky.laqfaqveeg@cwuxpvwkj.eojpm.com
Pamela180	239508-9542	qrwencx17@ywmjxdjcz.qxnjwt.net
Eli80	318-5816792	trhh2@qfdfrm.net

Figure 7.14: View Task And List Of Employees Assigned To This Task Operation.

- Each team leader can create a new project then create project tasks and assign employees to tasks which fit in slots of their time schedule in order to the time schedule to be consistent between tasks and training so that no 2 tasks or task and training can overlap.
- Each team leader would end the project when it's over.

Home > Projects

The screenshot shows a software interface with a header 'Projects'. On the right side of the header is a blue button labeled '+ New Project'. Below the header is a table with columns: Project Name, Client, Price, Team Leader, Department, Started At, and Due Date. The table contains ten rows of project data.

Project Name	Client	Price	Team Leader	Department	Started At	Due Date
Test Project1,,	Eric2	2000 \$	Jeanine25	Marketing	07/06/2020 00:00:00	06/04/2021 00:00:00
Test Project2,,	Lydia74	2000 \$	Jeanine25	Accounting	07/06/2020 00:00:00	06/04/2021 00:00:00
Hilary2	Tammi90	4917319 \$	Jeanine25	Accounting	20/10/2014 00:00:00	11/03/2015 00:00:00
Cassandra68	Lena9	3219934 \$	Jeanine25	Cutomer	10/03/2010 00:00:00	20/05/2021 00:00:00
Dale	Frank14	3146793 \$	Jeanine25	Accounting	22/12/2006 00:00:00	04/06/2007 00:00:00
Diane35	Gabriel676	5353048 \$	Jeanine25	Technical	15/03/2006 00:00:00	04/09/2006 00:00:00
Mary	Bobbie0	9602793 \$	Jeanine25	Service	26/03/2004 00:00:00	03/05/2004 00:00:00
Eric	Olga4	9417029 \$	Jeanine25	Corporate Care	27/10/2002 00:00:00	10/03/2003 00:00:00
Darin050	Bradford	529088 \$	Jeanine25	Prepaid Customer	30/11/2001 00:00:00	06/01/2002 00:00:00

Project Name - Task Name	Assign date	Deadline	Status	Notes
Test Project1,, - Task1	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task2	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task3	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task4	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task5	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task6	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task7	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task8	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task9	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task10	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	
Test Project1,, - Task11	12/05/2020 00:00:00	12/06/2020 00:00:00	✓	

Figure 7.15: View All Tasks With The Project For Each Task Operation.

Task Name :	Task1
Assign Time	12-02-2012
Deadline	12-02-2012
Project Name :	Julie818
Skills	Please Select Scientific computing Creativity PHP
Description :	test
Description field	
Next	

The screenshot shows a software interface for managing assigned employees. At the top, there is a search bar labeled "Employee Name" and a blue "Add" button. Below this is a green "Next" button. The main area displays a table titled "Assigned Employees". The table has three columns: "Employee Name", "Skills", and "Assign". The first row shows Valerie assigned the skill "Scientific computing". The second row shows Lewis07 assigned the skill "Scientific computing". The third row shows Eva997 assigned the skill "Scientific computing". At the bottom left of the table is a green "Save" button.

Assigned Employees		
Employee Name	Skills	Assign
Valerie	Please Select Scientific computing	Assign
Lewis07	Please Select Scientific computing	Assign
Eva997	Skills	Assign

Figure 7.16: Add New Task And Assign Employee To Task Operation.

7.2.5 Talent management

- Each team leader would have a list of suitable employees for the task he's creating ready for him based on the skill level the task needs and both time management and skill rank of other employees in a specific department or position to choose from.

Recommended Employees			
Employee Name			
Valerie	Scientific computing	5	Assign
Lewis07	Scientific computing	5	Assign
Eva997	Scientific computing	5	Assign
Andrew17	Scientific computing	5	Assign
Serena216	Scientific computing	5	Assign
Glenda6	Scientific computing	5	Assign
Christy	Scientific computing	5	Assign
Glenda	Scientific computing	5	Assign

Employee Name Add

Next

Figure 7.17: Assign Recommended Employees To Tasks Operation.

7.2.6 Bonus and promotion

- HR can enter criteria of the bonus then view a list of employees that earn the bonus then grant the bonus.

Department Name : Service

Position Name : TeamLeader

Maximum Skill Rank : 3

Minimum Performance Percentage : 30
99%

Minimum Attendance Percentage : 20
99%

Bonus Value : 1000 \$

Description : give bonus to team leaders

Set

Figure 7.18: Add Bonus Criteria Operation.

User Name	Average Skill Rank	Performance Percentage	Attendance Percentage
Yvonne328	5	58.00%	21.00%
Colby2	4	66.00%	36.00%
Mia05	5	74.00%	23.00%
Jocelyn8	3	87.00%	23.00%

Figure 7.19: View Average Skill Rank, Performance Percentage And Attendance Percentage For All Employees Operation.

- The manager can enter criteria of the promotion and view list of employees who would fit the promotion then he can choose one of them and promote him to the new position.

The screenshot displays a user interface for managing employee promotions. On the left, a vertical sidebar lists various performance-related modules: My Attendance, Task Schedule, Feedback, My Attendance Progress, My Performance Progress, Promotion (which is selected and highlighted in blue), Strength And Weakness Fields, Company Performance, and Project Performance.

The main content area is titled "Promotion". It contains a form titled "Criteria" with the following fields:

- Department Name: ConsumerSales (dropdown menu)
- Position Name: HR (dropdown menu)
- Maximum Skill Rank: 3 (text input)
- Minimum Performance Percentage: 40 (text input)
99% (text input)
- Minimum Attendance Percentage: 30 (text input)
- New Position: Manager (dropdown menu)

A green "Print" button is located below the criteria form.

Below the criteria form, there is another set of input fields for promotion parameters:

- Maximum Skill Rank: (text input)
- Minimum Performance Percentage: (text input)
99% (text input)
- Minimum Attendance Percentage: (text input)
- New Position: Please select (dropdown menu)

A green "Print" button is located below these fields.

At the bottom of the page, there is a section titled "Table" which displays a list of employees who qualify for promotion:

User Name	Average Skill Rank	Performance Percentage	Attendance Percentage	Action
Jeremy	3	51.00%	30.00%	Promote
Theresa375	5	70.00%	31.00%	Promote

Figure 7.20: View Promotion Criteria And List Of Employees Who Would Fit The Promotion Operation.

7.2.7 Need For Training

- Each employee would view the list of training that he is currently enrolled in as a part of his time schedule.

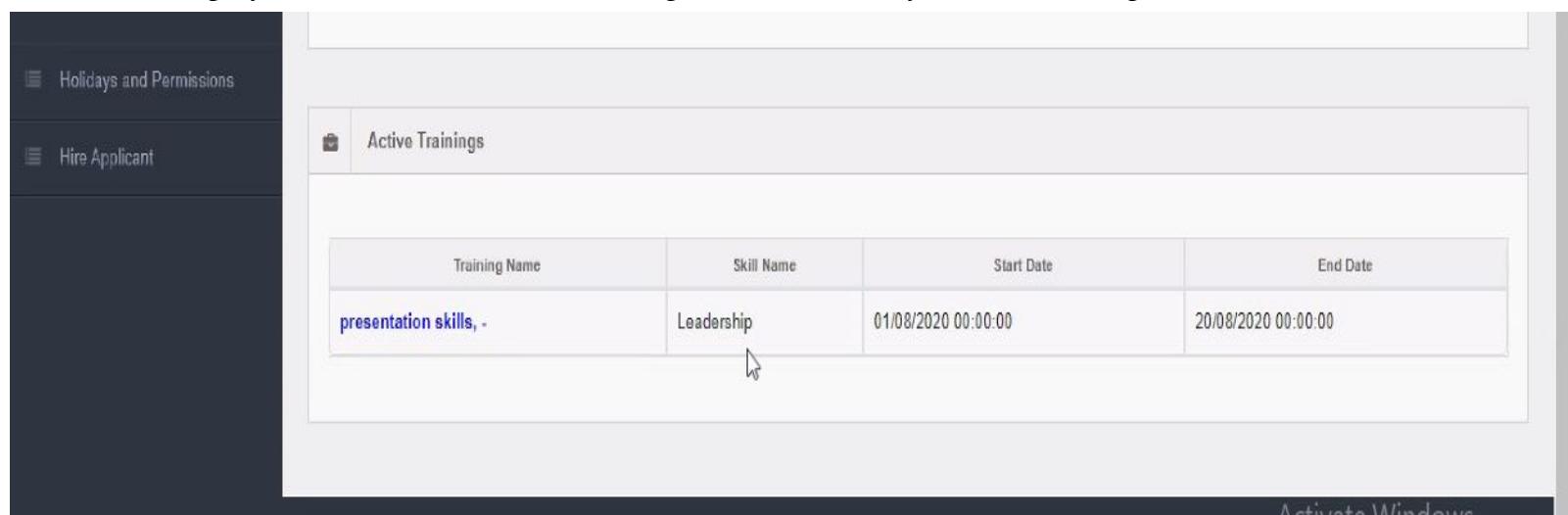


Figure 7.21: View List Of Trainings For Each Employee Operation.

- Hr can create new training , choose employees from a recommended employees list by the system of employees who need the training based on the skill rank and enroll them in training after system inspecting if their time schedule is suitable for the training time.

The screenshot shows a form for adding a new training program. The left sidebar has options like 'Feedback', 'My Attendance Progress', 'My Performance Progress', 'Attendance Reporting', 'Performance Reporting', 'Bonus Criteria', 'Holidays and Permissions', and 'Hire Applicant'. The main form is titled 'Add Training' and includes the following fields:

- Training Name: presentation skills
- Start Date: 12-11-2020
- End Date: 12-12-2020
- Location: Alexandria
- Hours Per Day: 3
- Skill: Leadership
- Maximum Rank: 3
- Position: Receptionist
- Department: Marketing
- Maximum Number Of Participants: 20

 A hand cursor icon is positioned over the 'Position' dropdown field.

Figure 7.22: Add Training Program Operation.

Recommended Employees				
Employee Name	Email	Phone Number	Address	
Angela9	bjpagst94@zrnnhpcvd.mkvovt.org	2119783420	53 Nobel Blvd.	<button>Assign</button>
Evelyn74	qtrtz44@wxyx-d.org	8841964090	32 Rocky Cowley Freeway	<button>Assign</button>
Michele46	gvsu.qcjxrkb@yhgaq.upoycg.org	5496311077	101 Green Second Boulevard	<button>Assign</button>
Vernon	bzcdk4@vsepuydu.yoxtis.net	926887-3306	913 Rocky Cowley Boulevard	<button>Assign</button>
Jana557	pmrwysrv.yattvuyou@zqzpnfk.ljyicp.org	670-5709732	149 Green Nobel Way	<button>Assign</button>
Dale354	lhujsk01@bexqqn.org	000-357-9454	163 Cowley Road	<button>Assign</button>
Edith2	pqgwphol.dixonxt@vtzelah.jvbfgt.com	4693657800	706 Clarendon Freeway	<button>Assign</button>
Greg062	dlwjzdkn.hywwgpxmf@bknzia.org	304-7205809	24 White Second Street	<button>Assign</button>
Marisol	xaeanui.jsim@tijnpniv.riazhj.com	036-059-6738	94 White Second Blvd.	<button>Assign</button>
Timmy417	jfvedyic.acmn@fuqaol.oephdt.org	416-169-2620	73 Old Avenue	<button>Assign</button>
Tabitha	mtqzgpb.alrqlhsbe@untpoym.znpehp.com	566-4198024	35 Rocky Hague Avenue	<button>Assign</button>
Rogelio7	nfzc.duner@leaszncjm.yxofoq.net	0353403175	14 South New Avenue	<button>Assign</button>

Figure 7.23: Assign Recommended Employees To Training Operation.

7.2.8 Performance evaluation

- Each employee can keep track of his skill rank and his performance progress through time.

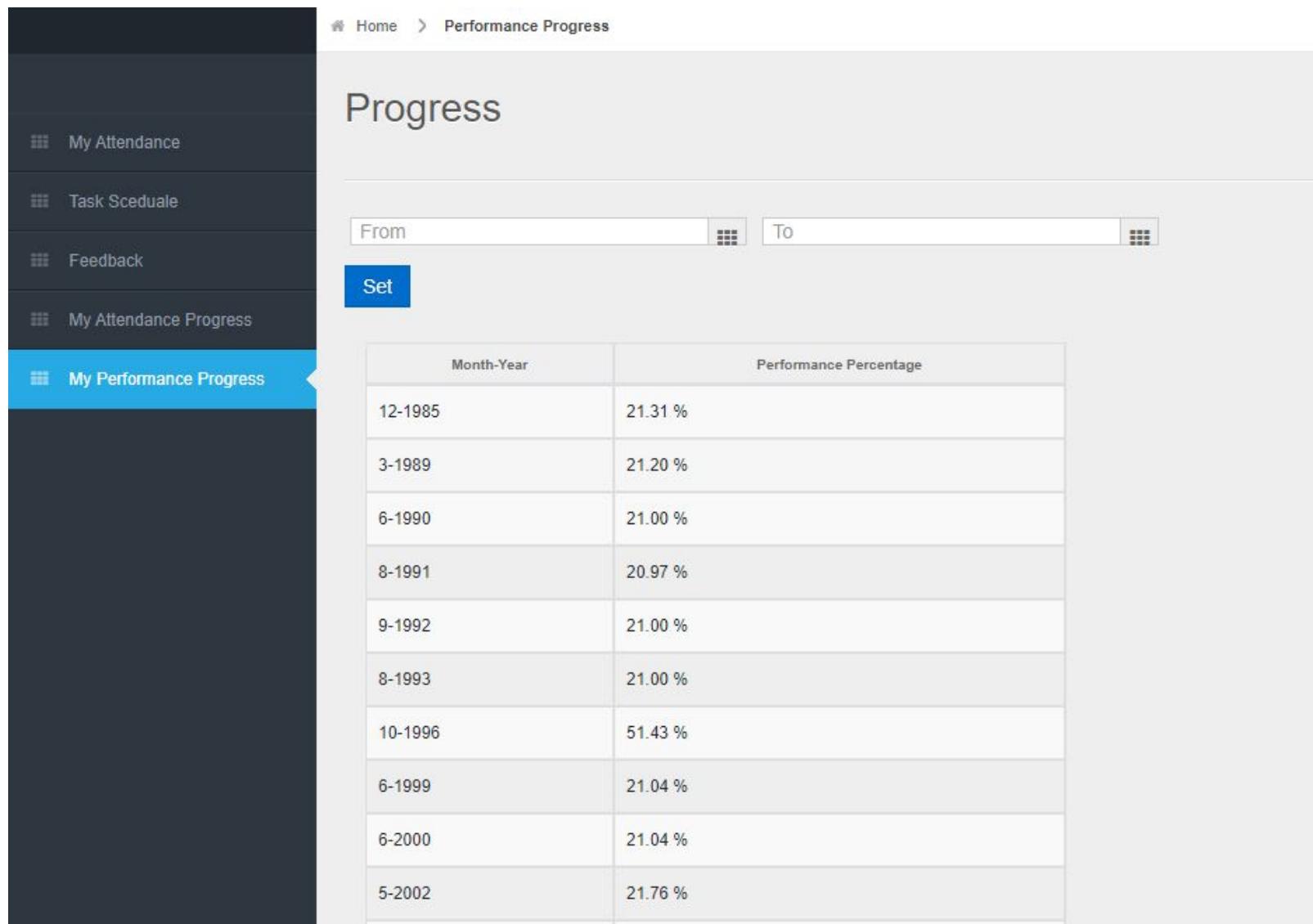


Figure 7.24: View Performance Progress Percentage For Each Month-Year Operation.

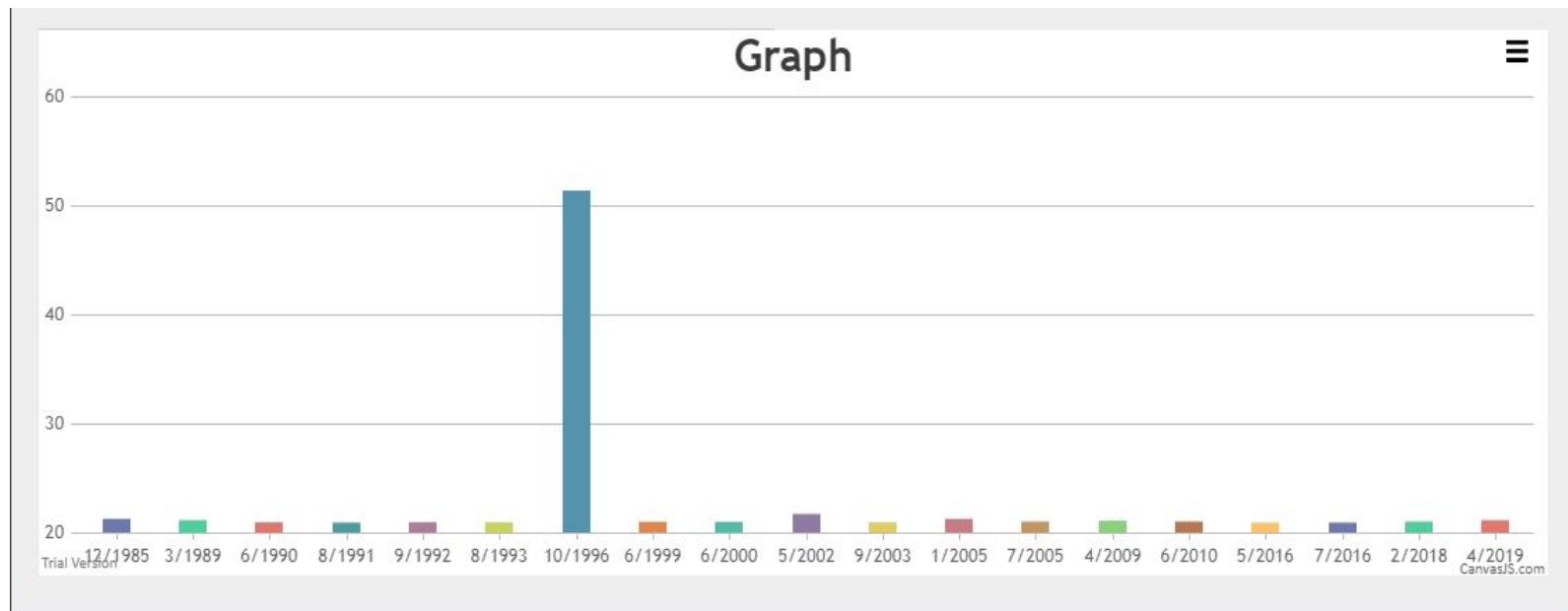


Figure 7.25: View Performance Progress Percentage For Each Month-Year Visualization.

- Hr employees can view employee's performance progress by employee , position or department.

Progress

Department

Sales	03/04/1986	<input type="button" value="grid"/>	03/11/1990	<input type="button" value="grid"/>
Set				

Month-Year	Performance Percentage
4-1986	21.110000 %
5-1986	21.323529 %
6-1986	22.120000 %
7-1986	23.087647 %
8-1986	21.760000 %
9-1986	21.670000 %
10-1986	23.674736 %
11-1986	23.240000 %
12-1986	21.993076 %
1-1987	21.000000 %
2-1987	24.850000 %
3-1987	20.970000 %
4-1987	21.310000 %
5-1987	21.670000 %
6-1987	21.000000 %
9-1990	22.887500 %
10-1990	20.970000 %
11-1990	21.000000 %

Comparison graph

4/1986 2/1987 12/1987 10/1988 8/1989 6/1990

4/1988: 28.285714

CanvasJS.com

Home > Performance Progress																																	
Progress																																	
Employee	<input type="button" value="▼"/>																																
Valerie	<input type="text" value="03/04/1986"/> <input type="button" value="grid"/> <input type="text" value="04/04/2020"/> <input type="button" value="grid"/>																																
<input type="button" value="Set"/>																																	
<table border="1"><thead><tr><th>Month-Year</th><th>Performance Percentage</th></tr></thead><tbody><tr><td>11-1989</td><td>21.00 %</td></tr><tr><td>5-1991</td><td>20.97 %</td></tr><tr><td>6-1993</td><td>39.25 %</td></tr><tr><td>7-1994</td><td>21.16 %</td></tr><tr><td>12-1998</td><td>20.97 %</td></tr><tr><td>9-2001</td><td>21.00 %</td></tr><tr><td>10-2001</td><td>21.58 %</td></tr><tr><td>3-2003</td><td>21.11 %</td></tr><tr><td>10-2004</td><td>20.97 %</td></tr><tr><td>6-2006</td><td>21.31 %</td></tr><tr><td>9-2006</td><td>21.07 %</td></tr><tr><td>3-2010</td><td>20.97 %</td></tr><tr><td>4-2013</td><td>21.58 %</td></tr><tr><td>3-2014</td><td>21.00 %</td></tr><tr><td>5-2015</td><td>21.25 %</td></tr></tbody></table>		Month-Year	Performance Percentage	11-1989	21.00 %	5-1991	20.97 %	6-1993	39.25 %	7-1994	21.16 %	12-1998	20.97 %	9-2001	21.00 %	10-2001	21.58 %	3-2003	21.11 %	10-2004	20.97 %	6-2006	21.31 %	9-2006	21.07 %	3-2010	20.97 %	4-2013	21.58 %	3-2014	21.00 %	5-2015	21.25 %
Month-Year	Performance Percentage																																
11-1989	21.00 %																																
5-1991	20.97 %																																
6-1993	39.25 %																																
7-1994	21.16 %																																
12-1998	20.97 %																																
9-2001	21.00 %																																
10-2001	21.58 %																																
3-2003	21.11 %																																
10-2004	20.97 %																																
6-2006	21.31 %																																
9-2006	21.07 %																																
3-2010	20.97 %																																
4-2013	21.58 %																																
3-2014	21.00 %																																
5-2015	21.25 %																																

Figure 7.26: View Performance Progress Percentage For Each Month-Year Visualization.

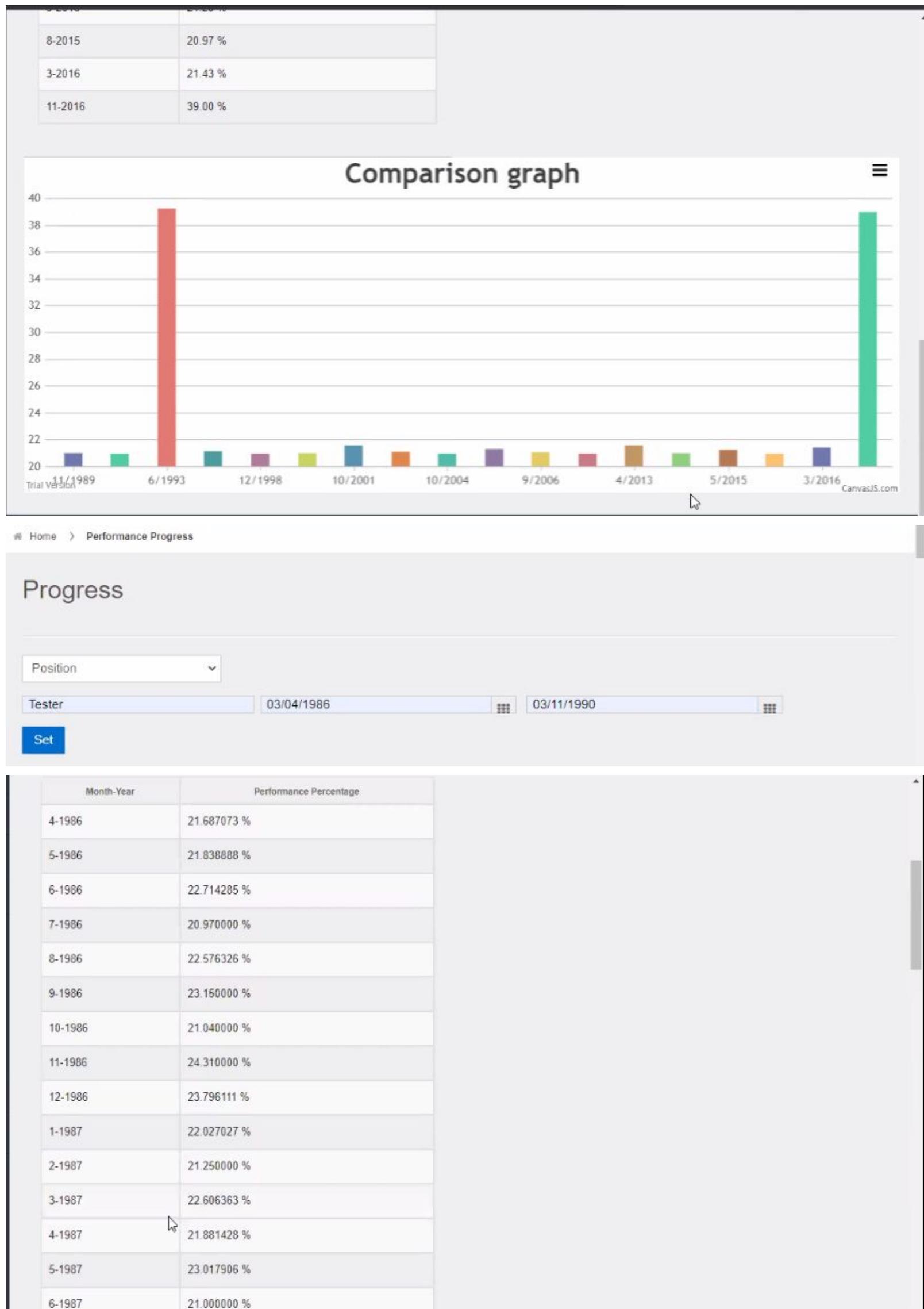


Figure 7.27: View Performance Progress Percentage For Each Month-Year Visualization.

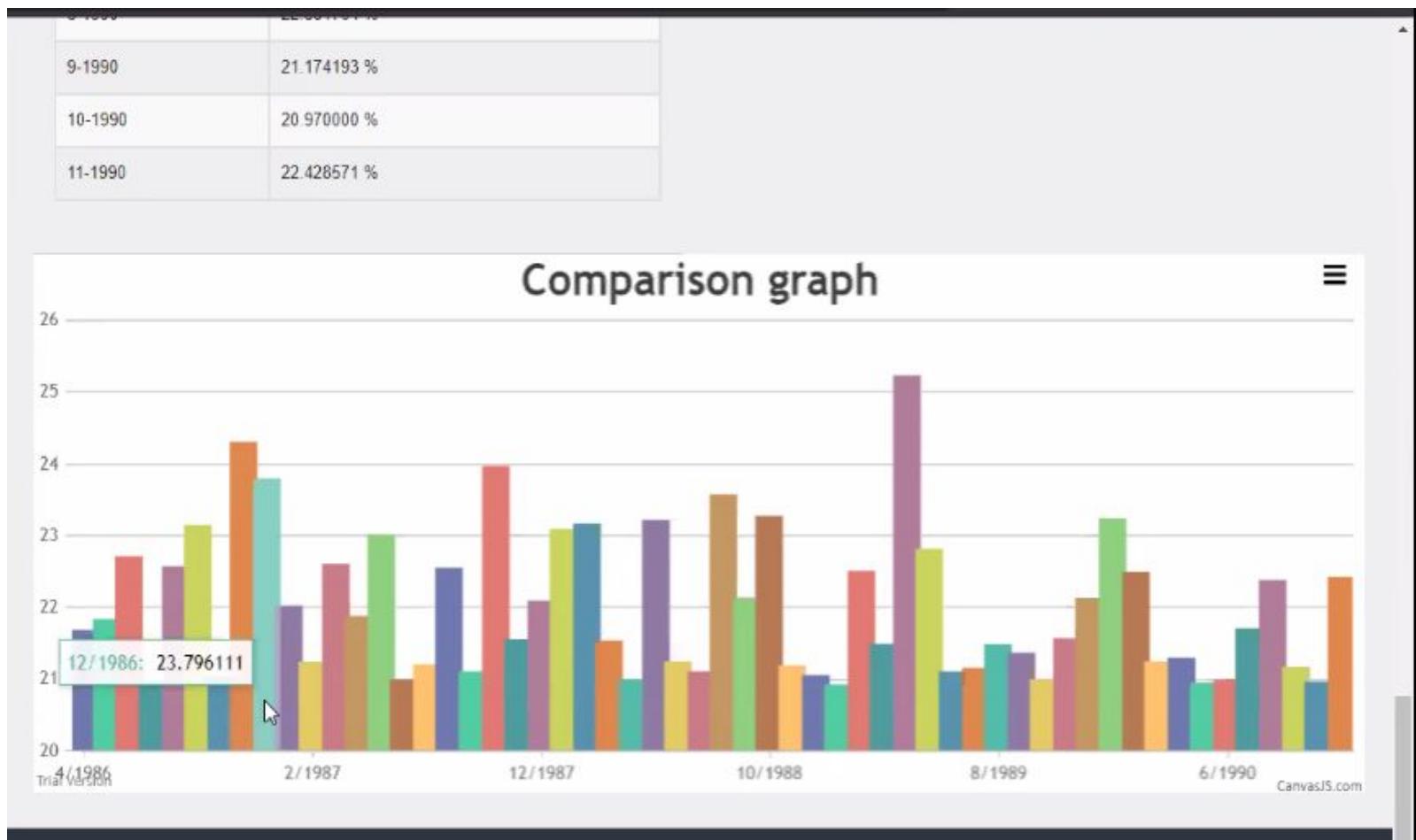
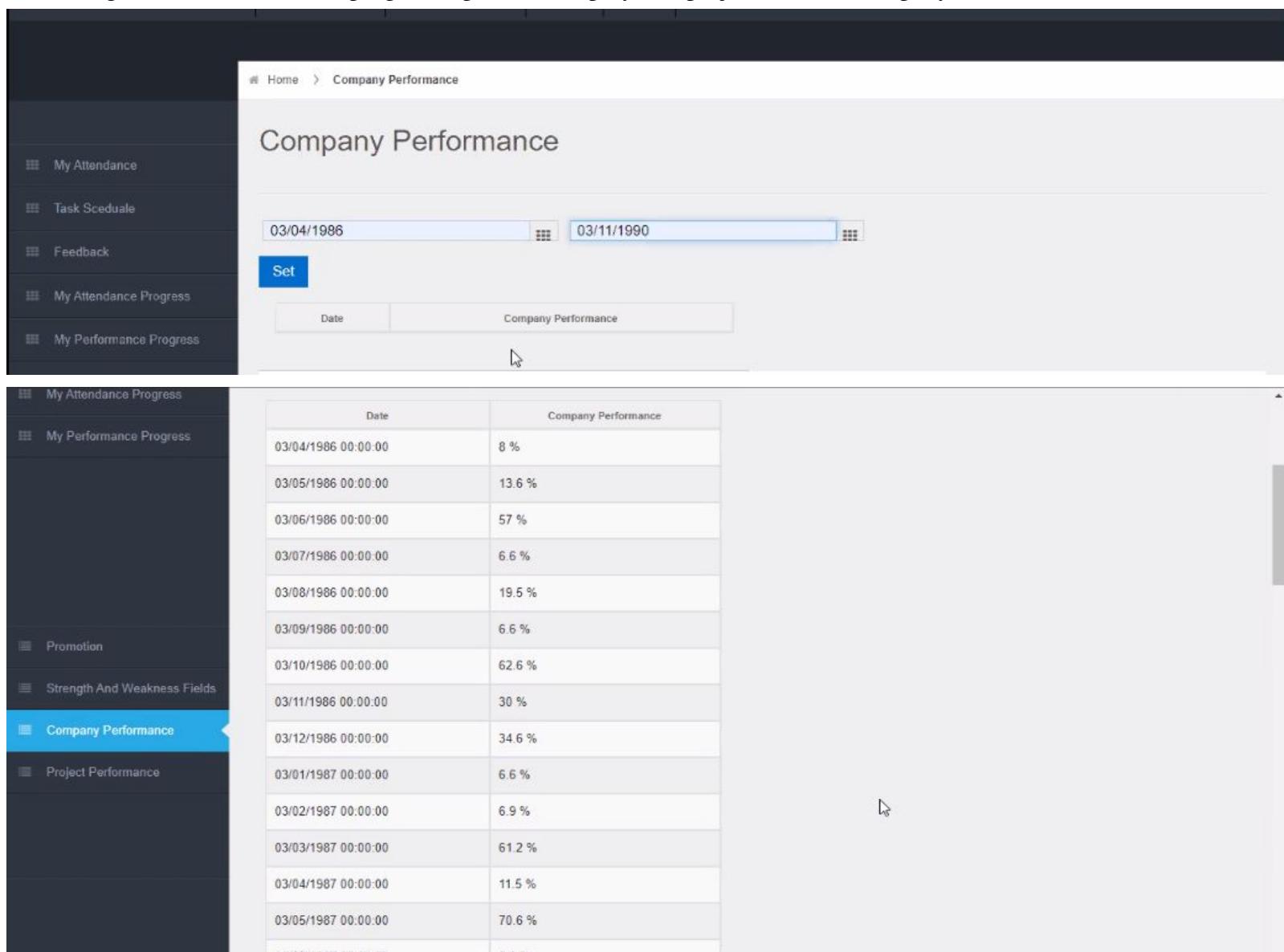
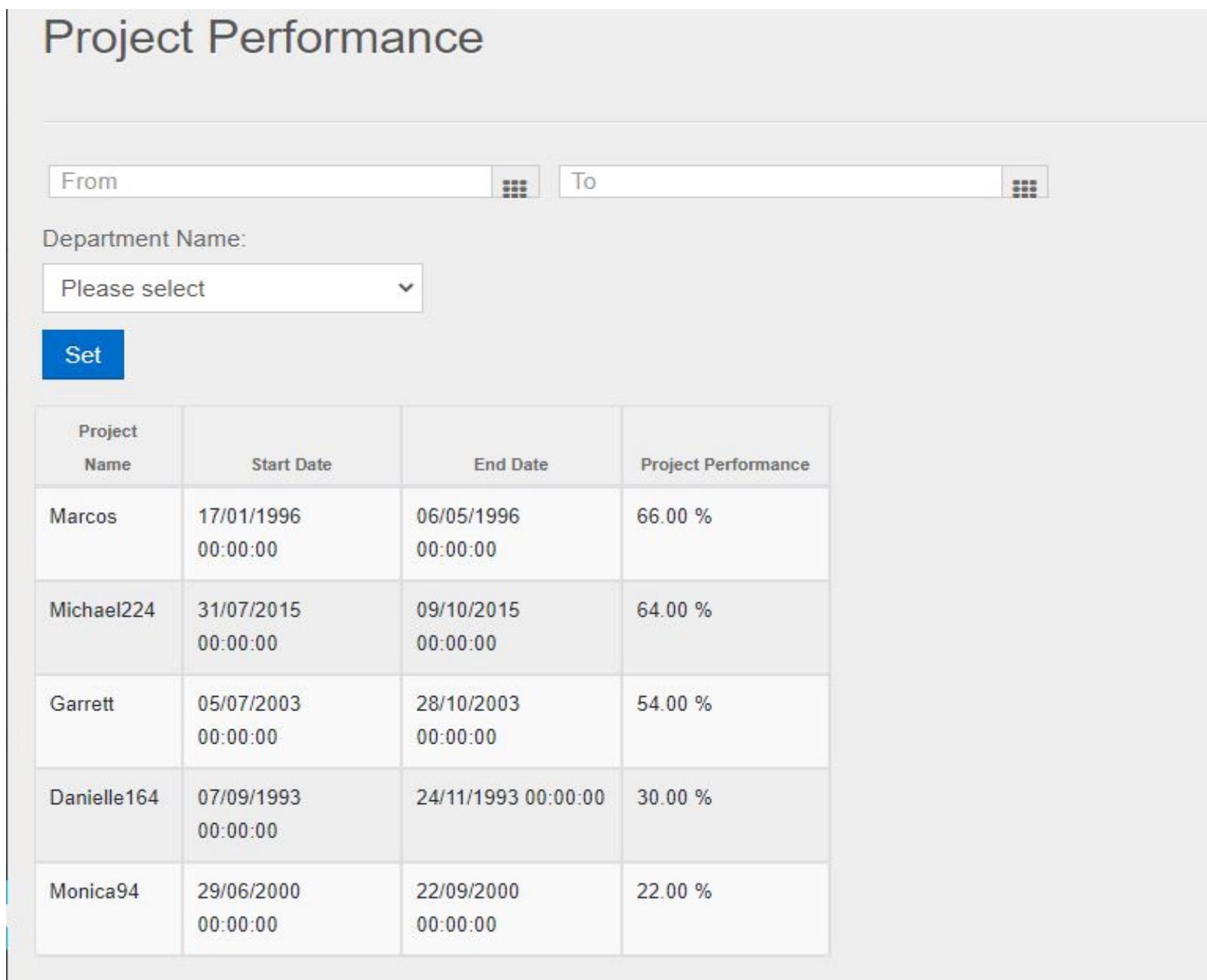


Figure 7.28: View Performance Progress Percentage For Each Month-Year Visualization.

The manager can view collective progress reports for employees , projects and the company as whole.



**Figure 7.29: View Company Performance Progress Visualization.****Figure 7.30: View Project Performance Progress Visualization.**

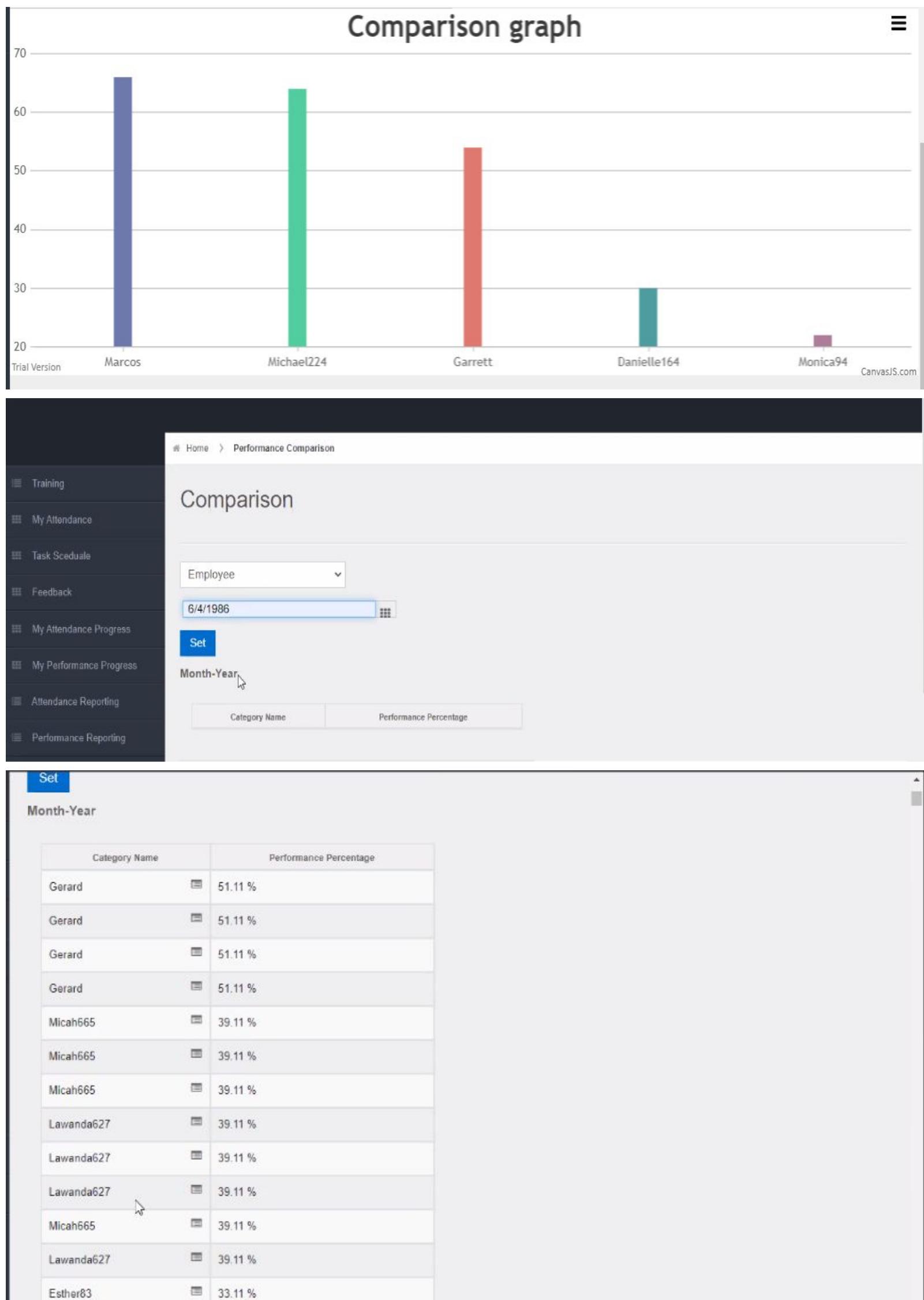


Figure 7.31: View Performance Comparison Operation.

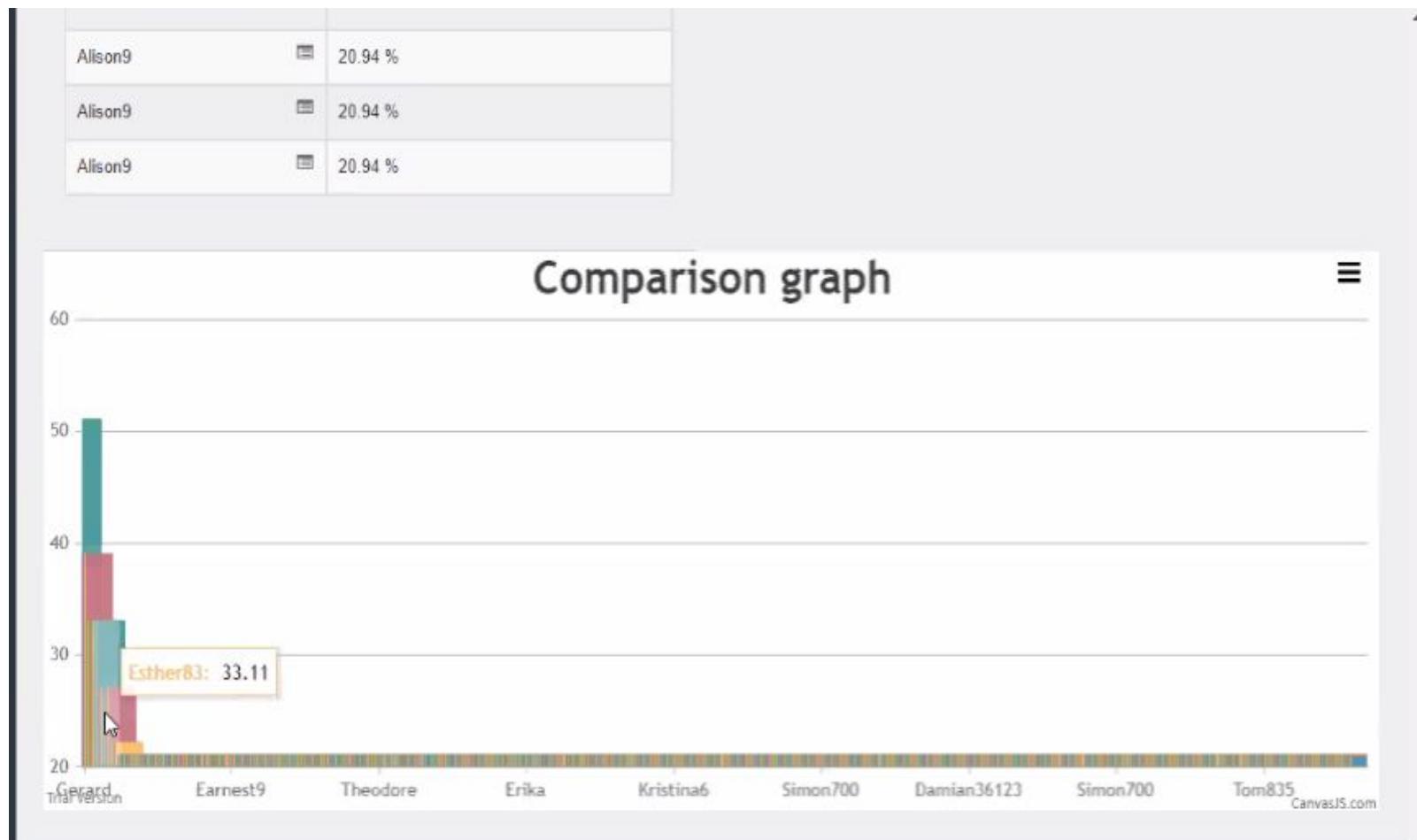


Figure 7.32: View Performance Comparison Visualization.

7.2.9 Strength and weakness

- Manager can view the departments of his company in order from strongest down and the most powerful skills in each department based on projects and employees performance of this department and relative skills.

Department Name	Skills	Score
Corporate Care	PHP, React.js,	85
Service	Management, PHP, Video production,	82
Customer	Business analysis, Decision Making, Express.js, JavaScript, Management, SQL, UX design,	80

Figure 7.33: View Strength And Weakness Fields And Scores.

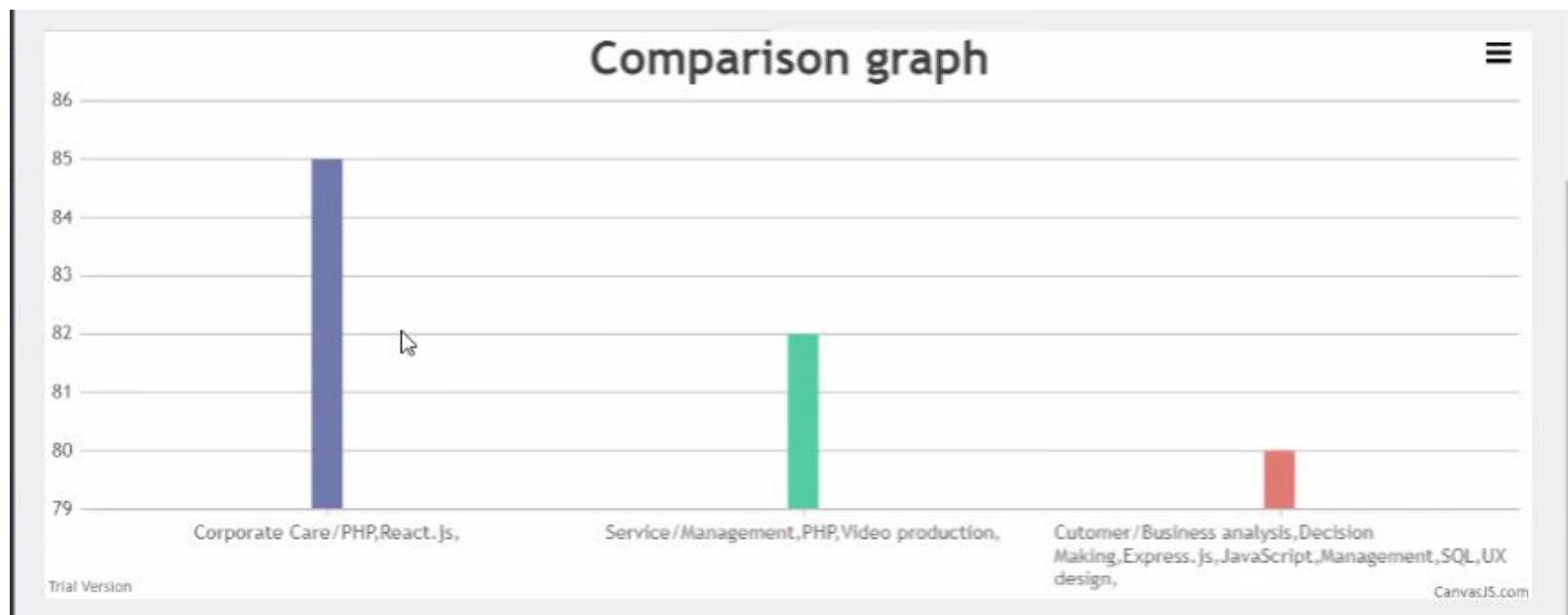


Figure 7.34: View Strength And Weakness Fields Visualization.

- Manager can view the departments of his company in order from weakest up and the weakest skills in each department based on projects and employees performance of this department and relative skills.

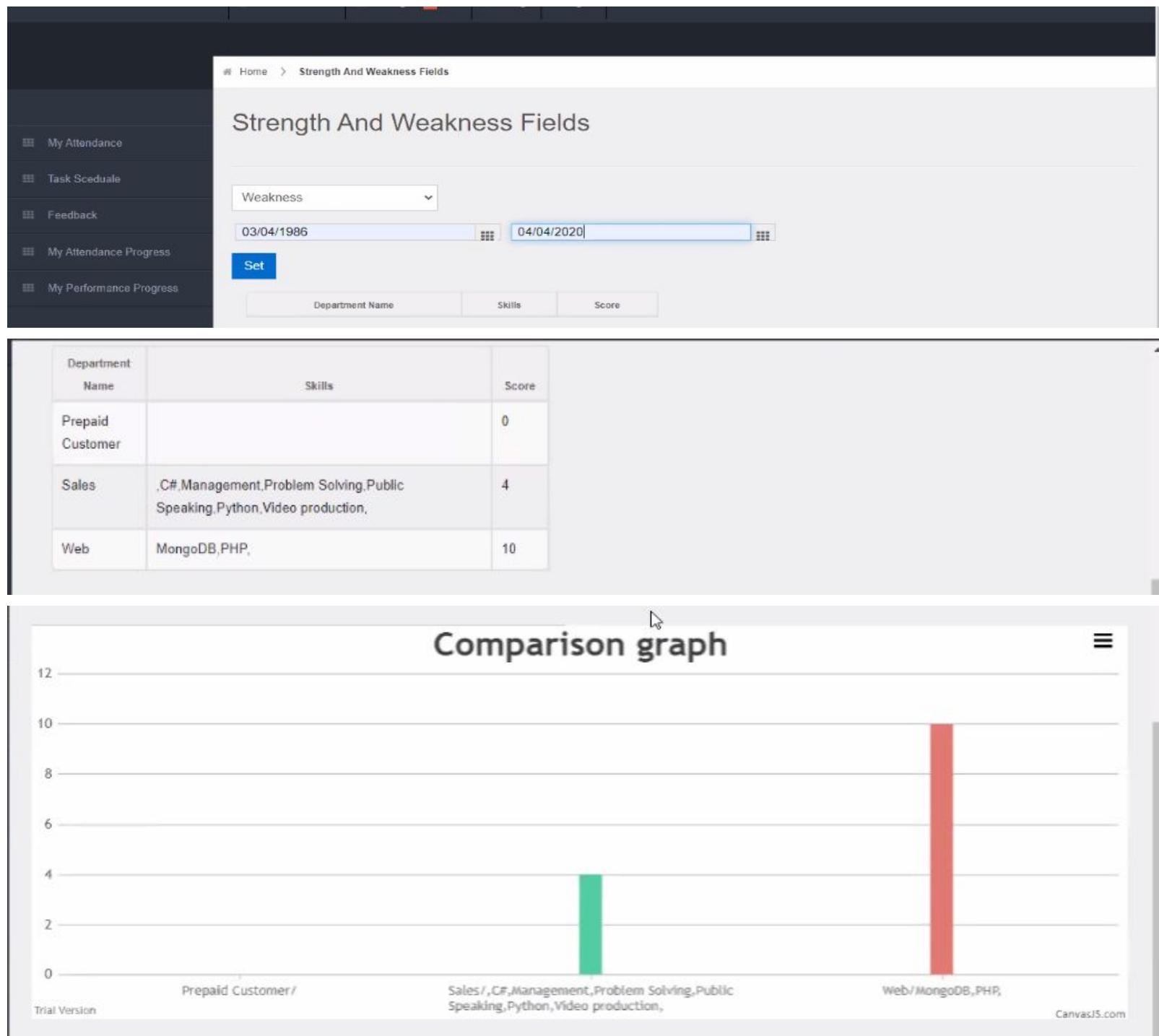


Figure 7.35: View Strength And Weakness Fields Scores And Visualization.

7.2.10 Recruitment

- Applicants can fill in the form with required data needed for the initial filtration process.

Applicant Name :	Ahmed gamal
Email :	ahmedGamal@gmail.com
Phone Number:	01023476890
SSN :	21356365980
Education :	faculty of engineering
Address :	7 Ekata CHS
Graduation Date :	12-02-2020
Experience:	5
Gender :	male
Skills	Please Select Scientific computing Creativity PHP

Set Skills Rank		
Skill Name	Skill rank	
Scientific computing	3	Assign
Creativity	4	Assign
PHP	5	Assign

Figure 7.36: Set Skills Rank And Apply For Applicants.

- Hr can view lists of recommended applicants based on job requirements they specified and the stored applications.

The screenshot shows a user interface for setting recruitment criteria. On the left is a vertical navigation bar with icons for Training, Employee Attendance, Attendance Reporting, Projects, Tasks, Feedback, Bonus, and Recruitment. The Recruitment icon is highlighted with a blue background. The main area has a header "Recruitment". Below it, there are two stacked sections, each titled "Criteria".

Top Criteria Section:

- Experience In Years: 3
- Graduation Date:
From: 12-02-1986
To: 12-02-2020
- Skill one: Public Speaking
- Minimum Skill Rank: 3
- Skill Two: Artificial intelligence
- Minimum Skill Rank: 3

Bottom Criteria Section:

- Skill one: Public Speaking
- Minimum Skill Rank: 3
- Skill Two: Artificial intelligence
- Minimum Skill Rank: 3
- Skill Three: Python
- Minimum Skill Rank: 5
- Skill Four: Please select
- Minimum Skill Rank: (empty)
- Skill Five: Please select
- Minimum Skill Rank: (empty)

A green "View applicant" button is located at the bottom of the bottom section.

Figure 7.37: Set Recruitment Criteria For Applicant.

Name	Email	Phone Number	Address	Graduation Year	Experience	Skills	Gender
Wendy	anwh.hilh@kszqfa.com	79101	55 Fabien Boulevard	1998	22	Python -	F
Julia0	lcbx.xlumfneua@ebvw.kkxdad.com	45953	79 Oak Street	2005	15	Python -	M
Lawanda	xopjztf.mkhjryv@sorhmwly.zqdqk.net	82097	25 White Second Freeway	1987	29	Python -	M
Dennis35	rhtou.vqlouuqlgs@fjmwr.org	70317	876 New Blvd.	2001	7	Public Speaking -	M
Sean97	avmmymdmi.zoopwz@rpwyee.com	63397	177 South Rocky Hague Boulevard	1999	20	Artificial intelligence -	M
Ramon719	slzj85@idvzry.com	32642	323 East New Way	2002	12	Artificial intelligence -	M
Olivia	bohvdmz.smburidmop@gcghjfnt.yjhgaj.net	73889	424 Clarendon St.	1999	22	Artificial intelligence -	M

Kristine2	vyzq.ksgfprta@ujrpbbjlo.q-qusw.com	36166	239 Green Second Drive	2004	27	Artificial intelligence -	M
Norma	zcoxcz612@luhkysdqr.vzebvq.org	09237	57 Old Street	1989	17	Public Speaking -	F
Abigail	mjpucey19@vxssbn.l-ygmz.net	84480	88 East Rocky Cowley Blvd.	2001	28	Public Speaking -	M
Leanne	ueynse60@efxish.org	36637	38 Clarendon St.	1994	28	Artificial intelligence -	M
Gabriel361	zzeoy4@axaamu.org	53952	896 North White Old Blvd.	1994	12	Artificial intelligence -	M
Mitchell928	mhfznfq129@buoryl.com	19714	113 Cowley Blvd.	2002	25	Artificial intelligence -	M
Shaun	kpbimpu.jtuzcrg@krjyg.pqiver.com	18548	75 South Nobel Road	2011	8	Public Speaking -	M

Figure 7.38: View List Of All Applicants.

- HR can hire new employees, register their data and give them their username and initial password.

My Attendance Progress	Applicant Name :	Lesley7
My Performance Progress	Department :	Corporate Care
Attendance Reporting	Position :	supervisor
Performance Reporting	Salary :	10000 \$
Bonus Criteria	Date Of Birth :	12-02-1990 ####
Holidays and Permissions	Educational Degree :	bachelor
Hire Applicant	Graduation Date :	12-02-2015 ####
	Notes :	new applicant
	Temporary User Name :	fatma2020
	Temporary Password :	*****

Figure 7.39: New Applicant Application.

7.3 Non Functional requirements validation

Usability	The system's interfaces are easy to use by any average employee with training periods that won't exceed 2 weeks due to descriptive messages , warnings and interfaces.
Performance	The system has fast response to analysis and reporting and listing commands due to the efficient implementation of the DW and database transactions (we only tested the system on localhost so the performance might differ when deployed on a host server due to network and other technical complications).
Maintainability	The system is very highly maintainable as we lied the bases in the architecture , design , database procedures and backend implementation for very wide range of additions and modifications that can easily be added even when new functionalities are going to be introduced , the system would show great flexibility , readability and simplicity through requirement changes as we made sure to site a detailed system modeling and implementation documentation.
Security	Security is partially achieved through password log in mechanism but there would be threats as authorization and token authentication mechanisms weren't applied as they were out of our interest scope that included DW design and implementation in real life application.
Reliability	The system wouldn't fail in the normal conditions and operations but in case of unpredicted input , the system behavior would be unpredictable and there's risk of system failure as input validation and testing wasn't thoroughly examined.

8- CHAPTER EIGHT: PROJECT CONCLUSION AND FUTURE WORK

8.1 Overall Strengths

- 1- Compared to regular systems without using DW queries the system is very fast and performance is way better due to the high volume data ; the loading operations with a normal database would be very time and resources costing.
- 2- The architectural design of the system makes it very flexible and accepting to new functionalities and features to be added easily and with barely no design modification.
- 3- There are way more analysis and prediction possibilities that can be added and implemented based on the current architecture with hardly any change to schema or design.
- 4- The documentation is very accurate , precise and highly understandable which makes it maintainable by any foreign programmers who would just read the documentation and plan their own requirements.
- 5- We made use of the agile environment practice in managing the work which made it easier to work in parallel (front end , back end and database) as all phases (requirements identification , design and implementation) were done in iterations and incrementally which made the system embrace the constantly changing requirements and design decisions and also made it maintainable and ready for new additions as additional increments with the minimum modifications.
- 6- We used some of the XP (extreme programming) practices such as :
Pair programming : we programmed in pairs so that code reviews are done constantly and it also supports collective ownership to all parts of the system and deep understanding of all aspects and issues.
Repeated refactoring : for the code to be simple and understandable to support the agility of the implementation process.

8.2 Overall Weaknesses

We cared more about the data warehouse and system design and implementation to realize the most functionalities that would show the system capabilities as a practical ready to use application so some of the non functional requirements weren't taken care of such as :

- 1- **Security** : security is partially achieved through password log in mechanism but there would be threats as authorization and token authentication mechanisms weren't applied as they were out of our interest scope that included DW design and implementation in real life application.
- 2- **Reliability** : the system wouldn't fail in the normal conditions and operations but in case of unpredicted input , the system behavior would be unpredictable and there's risk of system failure as input validation and testing wasn't thoroughly examined.
- 3- Excessive unit and component testing for all edge cases and input validation are not to the point needed.

8.3 Future Work

- 1- Some extra functional requirements can be added (training follow up , further data analysis and predictions ,...etc).
- 2- Security can be increased through token authentication.
- 3- More excessive testing can take place to make the system.
- 4- More reliable and increases availability and failure mutiny.
- 5- Input validation for non predictable inputs and behavior can be done.
- 6-Using SSAS tools for data warehousing analytics(perform analysis and generate automated reports)

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Available:<https://www.freshworks.com/hrms/>
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- [12] Software Engineering - a Practitioner’s Approach, Roger Pressman, 8th Edition, McGraw-Hill, 2014. Chapter Three “System Requirements Engineering & Analysis”, Chapter Four “System Design & Modeling”, Chapter Five “System Architecture”, Chapter Six “System Implementation & Testing”, Chapter Seven “System Testing” [Chapters].