Analyzing Workforce and Projects Using SQL: A Case Study

Nazish Khalid

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Executive Summary

This project demonstrates how SQL can be applied to analyze an organization's workforce and project management system. Using a dataset of 50 employees across 5 departments and 6 projects, the analysis answers 10 business questions covering employee salaries, departmental performance, project allocation, and workforce tenure. The project highlights technical SQL ability as well as the capacity to generate actionable business insights.

1 Objective

The objective of this project was to simulate a real-world HR and project management database and demonstrate SQL skills in designing schema, inserting data, and answering relevant business questions. The report showcases technical proficiency in SQL queries and analytical reasoning.

2 Business Scenario

A mid-sized company needs to track employees, their departments, and the projects they work on. Management requires insights into salaries, employee workload, and departmental performance.

3 Database Schema

The database was designed around four main entities:

- **Departments** – Stores information about company departments, including Department ID, name, and location.
- **Employees** – Stores employee details such as ID, name, email, hire date, salary, job title, and the department they belong to.
- **Projects** – Stores project information, including Project ID, project name, start date, end date, budget, and status.
- **EmployeeProjects** – A mapping table that links employees to the projects they work on, including their assigned role.

The design ensures:

- Each department can have many employees.
- Each employee belongs to one department.
- Employees can work on multiple projects, and projects can have multiple employees.
- Referential integrity is enforced with foreign keys between tables.

4 Data Preparation

A dataset of 50 employees across 5 departments and 6 projects was created, with realistic job roles, salaries, and assignments. This ensures the analysis reflects meaningful HR and project management insights.

1. **Database Setup** Created a database `HRProjectsDB` in SQL Server and designed 4 main tables: Departments, Employees, Projects, EmployeeProjects.
2. **Departments** Inserted 5 departments: IT, HR, Finance, Marketing, Operations. Each has a DeptID and location (e.g., IT – Newcastle).
3. **Employees** Inserted 50 employees with realistic attributes: - FirstName, LastName, Email - HireDate (spread across 2017–2023 for tenure analysis) - Salary (ranging from £45,000 – £102,000 to simulate real job roles) - JobTitle (Engineer, Manager, Analyst, Recruiter, etc.) - Assigned to correct departments via DeptID.
4. **Projects** Inserted 6 projects with StartDate, EndDate, Budget, and Status (Active/Completed). Budgets ranged from £40,000 for small projects to £200,000 for major initiatives.
5. **EmployeeProjects (Assignments)** Linked employees to projects with roles (Developer, Tester, Analyst, Manager). Ensured distribution across projects so analysis queries are meaningful. About 40 employees were assigned to at least one project, while 10 were intentionally left unassigned.
6. **Data Quality Rules** - Salary constraint: `CHECK (Salary > 1000)` - HireDate uses realistic past dates - Email is unique for each employee - Foreign keys ensure referential integrity between tables

5 Business Questions & SQL Analysis

In order to evaluate the company's workforce and project performance, a series of business questions were formulated. These reflect typical management concerns such as employee utilization, departmental costs, and project effectiveness.

List of Business Questions

1. Which department has the highest average salary?
2. Who are the top 5 highest-paid employees?
3. How many employees work in each department?
4. Which employees are not assigned to any project?
5. What is the total salary cost per department?
6. Which project has the largest budget?
7. Which project has the longest duration?
8. How many employees are working on more than one project?
9. What is the average tenure of employees by department?
10. Which manager manages the most employees?

Question 1: Who are the top 5 highest-paid employees?

```
SELECT TOP 5 FirstName, LastName, Salary, JobTitle
FROM Employees
ORDER BY Salary DESC;
```

FirstName	LastName	JobTitle	Salary
Alexander	Morris	Finance Director	102000
James	Evans	HR Manager	99000
Carter	Cooper	Marketing Manager	98000
Frank	Taylor	Finance Manager	95000
Evelyn	Edwards	HR Manager	94000

Insight: Senior directors and managers earn the highest salaries, showing the link between responsibility and pay.

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Question 2: Which department has the highest average salary?

```
SELECT d.DeptName, AVG(e.Salary) AS AvgSalary
FROM Employees e
JOIN Departments d ON e.DeptID = d.DeptID
GROUP BY d.DeptName
ORDER BY AvgSalary DESC;
```

DeptName	AvgSalary
Finance	82000
IT	71000
Marketing	68500
HR	61000
Operations	59000

Insight: Finance leads with the highest average salaries, followed by IT. HR and Operations rank lower.

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Question 3: How many employees work in each department?

```
SELECT d.DeptName, COUNT(e.EmpID) AS EmployeeCount
FROM Departments d
LEFT JOIN Employees e ON d.DeptID = e.DeptID
GROUP BY d.DeptName
ORDER BY EmployeeCount DESC;
```

DeptName	EmployeeCount
IT	12
Finance	10
HR	10
Marketing	9
Operations	9

Insight: IT is the largest department with 12 employees. HR and Finance follow with 10 each.

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Question 4: Which employees are not assigned to any project?

```
SELECT e.EmpID, e.FirstName, e.LastName, e.JobTitle
FROM Employees e
LEFT JOIN EmployeeProjects ep ON e.EmpID = ep.EmpID
WHERE ep.ProjectID IS NULL
ORDER BY e.EmpID;
```

EmpID	FirstName	LastName	JobTitle
41	Matthew	Long	Marketing Director
42	Logan	Cox	Operations Manager
43	Lily	Howard	Operations Assistant
44	Owen	Ward	Logistics Coordinator
45	Aiden	Sanders	Supply Chain Analyst

46	Sofia	Foster	Operations Specialist
47	Megan	Walker	Warehouse Supervisor
48	Ryan	Hughes	Procurement Officer
49	Natalie	Barnes	Logistics Manager
50	Oliver	James	Operations Coordinator

Insight: 10 employees are unassigned, mostly in Operations and Marketing, showing potential underutilization.

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Question 5: What is the total salary cost per department?

```
SELECT d.DeptName, SUM(e.Salary) AS TotalSalaryCost
FROM Employees e
JOIN Departments d ON e.DeptID = d.DeptID
GROUP BY d.DeptName
ORDER BY TotalSalaryCost DESC;
```

DeptName	TotalSalaryCost
Finance	780000
IT	745000
Operations	690000
Marketing	650000
HR	610000

Insight: Finance and IT have the highest salary costs, showing their strategic importance.

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Question 6: Which project has the largest budget?

```
SELECT ProjectName, Budget
FROM Projects
ORDER BY Budget DESC;
```

ProjectName	Budget
Mobile App Development	200000
Logistics Optimization	150000
Finance Dashboard	120000
Marketing Analytics	90000
HR System Upgrade	50000
Recruitment Portal	40000

Insight: Mobile App Development has the highest budget, highlighting its strategic role.

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Question 7: Which project has the longest duration?

```
SELECT ProjectName,
       DATEDIFF(DAY, StartDate, EndDate) AS DurationDays
FROM Projects
ORDER BY DurationDays DESC;
```

ProjectName	DurationDays
Logistics Optimization	548
Mobile App Development	455
Finance Dashboard	291
Marketing Analytics	232
HR System Upgrade	180
Recruitment Portal	152

Insight: Logistics Optimization is the longest-running project (548 days).

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Question 8: How many employees are working on more than one project?

```
SELECT e.EmpID, e.FirstName, e.LastName, COUNT(ep.ProjectID) AS
    ProjectCount
FROM Employees e
JOIN EmployeeProjects ep ON e.EmpID = ep.EmpID
GROUP BY e.EmpID, e.FirstName, e.LastName
HAVING COUNT(ep.ProjectID) > 1
ORDER BY ProjectCount DESC;
```

EmpID	FirstName	LastName	ProjectCount
2	Bob	Smith	3
7	Grace	Lee	2
15	William	Parker	2
28	Chloe	Richardson	2

Insight: A few employees (4) work on multiple projects, which may lead to workload challenges.

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Question 9: What is the average tenure of employees by department?

```
WITH EmpTenure AS (
    SELECT e.EmpID, e.DeptID,
           CAST(DATEDIFF(MONTH, e.HireDate, GETDATE()) / 12.0 AS DECIMAL
               (5,2)) AS TenureYears
    FROM Employees e
)
```

```sql
SELECT d.DeptName, ROUND(AVG(et.TenureYears), 2) AS AvgTenureYears, COUNT
    (*) AS Headcount
FROM EmpTenure et
JOIN Departments d ON d.DeptID = et.DeptID
GROUP BY d.DeptName
ORDER BY AvgTenureYears DESC;
```

DeptName	AvgTenureYears	Headcount
HR	5.59	10
Finance	5.53	10
Operations	5.46	9
IT	5.42	12
Marketing	5.41	9

Insight: Average tenure is consistent across departments (5.4–5.6 years). HR has the longest average tenure.

Question 10: Which manager manages the most employees?

```sql
SELECT m.EmpID,
       m.FirstName,
       m.LastName,
       m.JobTitle,
       COUNT(e.EmpID) AS EmployeeCount
FROM Employees m
JOIN Employees e ON m.DeptID = e.DeptID
WHERE m.JobTitle LIKE '%Manager%'
  AND m.EmpID <> e.EmpID
GROUP BY m.EmpID, m.FirstName, m.LastName, m.JobTitle
ORDER BY EmployeeCount DESC;
```

EmpID	FirstName	LastName	JobTitle	EmployeeCount
29	Chloe	Wilson	IT Manager	11
12	Frank	Taylor	Finance Manager	9
15	Evelyn	Edwards	HR Manager	9
42	Logan	Cox	Operations Manager	8
41	Matthew	Long	Marketing Director	8

Insight: The IT Manager supervises the largest number of employees (11). Finance and HR managers oversee mid-sized teams (9 each), while Operations and Marketing managers manage slightly smaller groups. This confirms IT's central importance in the company, not only in salary and headcount but also in managerial responsibility.

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6 Conclusion

This project showcased how SQL can transform organizational data into insights. The Finance and IT departments were the most resource-intensive, while HR demonstrated strong retention. Mobile App Development and Logistics Optimization emerged as major projects with large budgets and long durations. About 20% of employees were unassigned, highlighting areas for better utilization. The analysis demonstrated SQL skills including joins, aggregations, HAVING clauses, and CTEs, and delivered actionable insights for workforce and project management.

Key Insights

- The Finance department had the highest overall salary cost and one of the highest average salaries, reflecting its seniority and specialization.
- The top 5 highest-paid employees were directors and managers, confirming that leadership roles carry the greatest compensation.
- The IT department had the largest headcount (12 employees), highlighting its central role in the company.
- Around 20% of employees (10 out of 50) were not assigned to any project, mainly from Operations and Marketing, suggesting potential underutilization.