People's People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research

IBN KHALDOUN UNIVERSITY OF TIARET

Dissertation

Presented to:

FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
DEPARTEMENT OF COMPUTER SCIENCE

in order to obtain the degree of :

MASTER

Specialty:
software engineering

Conducted by:
Chiheb Fatma
Bouazza Mohammed El Amine

On the theme:

Design and Development of an HR Web Application

Defended publicly on 17 /06/2025 in Tiaret, before the jury composed of: :

Mr SIABDELHADI Ahmed	MCB	Tiaret University	Chairman
Mr CHADLI Abdelhafid	Pr.	Tiaret University	Supervisor
Mrs ZENATI Anissa	MAA	Tiaret University	Examiner

2024-2025

Acknowledgments

*We thank **ALLAH** the Almighty for granting us the strength, the will, and the patience to undertake and complete this modest work.*

*We would like to express our sincere gratitude to **Mr. CHADLI Abdelhafid**, whose exceptional supervision, patience, rigor, and availability greatly contributed to the successful completion of this thesis. His insightful guidance and unwavering support were instrumental throughout this journey.*

We would also like to extend our thanks to all those who, from near or far, have contributed to the realization of this work.

*Our heartfelt thanks go to the **members of the jury** for the honor they do us by accepting to evaluate our work:*

- ***Mr. SIABDELHADI Ahmed***
- ***Mrs. ZENATI Anissa***

*We are also deeply grateful to all the **teachers of the faculty**, whose efforts and dedication have shaped our academic journey over the past years.*

Finally, to all the individuals who have supported, advised, or encouraged us throughout this project, we offer our thanks, our respect, and our sincere gratitude.

Dedication

I dedicate this modest work to:

*The memory of my **dear father**, whose love, values, and strength continue to inspire me every day. Although he is no longer with us, he remains the reason I found the courage and determination to complete my master's degree.*

*To my **beloved mother**, whose constant support, prayers, and unconditional love have been my greatest source of strength.*

*To my **brothers and sisters**, for their encouragement, presence, and belief in me throughout this journey.*

This achievement is the result of all your sacrifices, support, and love. I am deeply grateful.

Chiheb Fatma

This project is lovingly dedicated to:

*My **parents**, who have always believed in me, even when I doubted myself. Your endless support, patience, and love gave me the strength to keep going.*

*To my **family**, for the warm words, late-night encouragement, and constant motivation.*

*To my **friends**, thank you for the laughs, the help, and the understanding.*

*And finally, to **myself** for not giving up.*

Bouazza Mohamed El amine

Table of contents

List of figures

List of tables

List of abbreviations

HR & Management

- **HR:** Human Resources
- **HRM:** Human Resource Management
- **HRMS:** Human Resource Management System
- **HCM:** Human Capital Management
- **KPIs:** Key Performance Indicators
- **MBO:** Management by Objectives
- **GPEC:** Gestion Prévisionnelle des Emplois et des Compétences (Forward Planning of Jobs and Skills)
- **CSR:** Corporate Social Responsibility
- **PTO:** Paid Time Off

Laws & Regulations

- **ADA:** Americans with Disabilities Act
- **Title VII:** Title VII of the Civil Rights Act of 1964
- **GDPR:** General Data Protection Regulation

Technology & Systems

- **HRIS:** Human Resource Information System
- **ERP:** Enterprise Resource Planning
- **SAP:** Systems, Applications & Products in Data Processing
- **LMS:** Learning Management System
- **ESS:** Employee Self-Service
- **RBAC** – Role-Based Access Control
- **UX:** User Experience
- **AI:** Artificial Intelligence
- **QR Code:** Quick Response Code
- **PDF:** Portable Document Format

Software & Development

- **HTML:** HyperText Markup Language
- **JS:** JavaScript
- **RxJS:** Reactive Extensions for JavaScript
- **SQL:** Structured Query Language
- **iOS:** iPhone Operating System
- **npm – Node Package Manager**
- **UML:** Unified Modeling Language
- **MVVM:** Model-View-ViewModel
- **CLI:** Command Line Interface

Miscellaneous

- **SMEs:** Small and Medium-sized Enterprises
- **IT:** Information Technology
- **e.g.:** exempli gratia (for example)
- **etc:** et cetera (and so on)
- **Gen:** Generation

GENERAL INTRODUCTION

Technological developments, especially in information technology, have drastically changed how businesses function in today's quickly changing workplace. As a technological, scientific, and industrial field, computer science is essential to updating management procedures since it makes information processing quicker, more dependable, and more secure than using conventional paper-based techniques. Organizations mainly relied on manual processes and paper records prior to the development of digital technologies, which made them vulnerable to delays, mistakes, and data degradation.

Human Resource Management (HRM) plays a key role within this transformation. It includes more than just staff management; it also includes training planning, performance reviews, skill development, and talent retention—all of which have a direct impact on an organization's competitiveness and success. Nowadays, most people agree that managing human capital effectively is a major challenge for contemporary businesses.

Globally, the rise of digital HR solutions has revolutionized the management of workforce operations by automating repetitive procedures, increasing data accuracy, and providing real-time insights that support strategic decision-making. However, due to variations in organizational culture, technological infrastructure, and economic development, the adoption of such technologies varies greatly**.[6]**

In Algeria, particularly within many public institutions, HRM procedures still mostly rely on manual and semi-digital tools such as spreadsheets and paper-based documentation. These traditional approaches contribute to slow administrative processes, a higher likelihood of errors, limited data analysis capabilities, and generally hinder the effectiveness of human resource functions. The implementation of fully digital HR systems is further constrained by financial limitations and a lack of technical expertise**.[2]**

Specifically, at the Faculty of Mathematics and Computer Science of IbnKhaldoun University, the HR department suffers significant difficulties as a result of outmoded practices. The majority of core operations—including attendance tracking, leave request management, promotions, and issuance of work certificates—are predominantly manual. This results in operational inefficiencies, administrative overload, and employee dissatisfaction due to slow, opaque workflows.

This project suggests designing and developing a web-based HR management application that is customized to meet the specific requirements of the faculty in order to address these issues. The technology aims to improve transparency, centralize employee data, and automate important HR processes. Employee self-service for leave requests, digital attendance tracking, streamlined management of training and promotions, and automated generation of official documents are some of the features.

The user experience will be given special attention, with a mobile-friendly interface to guarantee administrators' and employees' convenience. Additionally, the application will offer customization options and integration capabilities to seamlessly fit within current institutional systems.

The main objective is to improve operational efficiency, strengthen data security and integrity, and empower HR personnel with robust tools for decision support, thereby fostering a more responsive and transparent HR environment. This solution will also support the strategic development of the faculty’s human capital by facilitating timely and well-informed management actions.

This introduction sets the stage for the rest of the report, which will first explore HRM concepts and digital transformation concepts, evaluate the shortcomings of the current system, outline the specific design and implementation of the suggested application, and then assess the achieved benefits along with recommendations for future improvements.

CHAPTER 01: PRESENTATION OF THE FIELD OF STUDY

1.1 Introduction:

In this chapter, we introduce the field of human resources (HR) management, covering its history, objectives, benefits, etc. Then we identify the tools and web technologies used to create this application.

1.2 Definition and evolution of HR management:

1.2.1 What is HR Management? (Definition and objectives):

Human Resource Management (HRM) is a strategic and specialized function of management concerned with the effective acquisition, development, evaluation, and compensation of employees, while also ensuring the management of labor relations, workplace health and safety, and fairness within organizational practices. HRM plays a central role in designing and implementing policies that govern the relationship between an organization and its workforce.

Modern HRM integrates both operational and strategic dimensions, covering functions such as recruitment, training, performance management, employee relations, and compliance with labor laws. It also increasingly incorporates human capital management (HCM) technologies to optimize workforce planning and employee development. As a core component of management, HRM contributes to organizational success by aligning human resources practices with the broader strategic objectives through the execution of fundamental managerial functions: planning, organizing, staffing, leading, and controlling.

HRM plays a critical role in ensuring organizational success by both minimizing personnel-related risks and errors, and maximizing overall performance through the strategic management and development of human capital**.[3]**

1. Minimizing Personnel-Related Risks and Errors:

Minimizing personnel-related risks and errors is a fundamental objective of Human Resource Management (HRM) aimed to Prevent poor hiring decisions that result in employee underperformance or increased turnover that's make Maintain a safe work environment to minimize accidents and reduce company liability.

2. Maximize Organizational Performance Through People:

Maximizing company performance through its employees is the core goal of Human Resource Management (HRM). It is based on increasing productivity and profitability by leveraging and optimizing human capital. The focus is on maximizing the value of the workforce, aligning recruitment processes and talent management strategies with the company's overall strategic goals, and motivating and developing employees to ensure sustained high performance.

1.2.2 History and evolution: from personnel management to strategic HR management:

In ancient times, the military and organized organizations needed to recruit, select, train, and motivate workers, although these tasks were part of every manager's duties.

Until the end of the 19th century, personnel tasks were part of general management tasks in most countries.

After the Industrial Revolution, labor issues such as the recruitment and integration of large numbers of workers led to the establishment of welfare offices and safety offices in factories.

Around 1900, employers established recruitment agencies, training programs, and factory schools, marking the beginning of formal human resource management.

Early human resource managers performed tasks such as recruiting and firing, managing payroll, and administering employee benefit programs.

The advent of testing programs expanded the role of human resources departments in employee selection and training. In the 1930s, new trade union laws gave personnel management departments the responsibility to shape union relations. In the 1960s, equal employment opportunity legislation increased the importance of the HR department in preventing discrimination claims. In the 1970s, globalization emphasized the role of HRM in gaining competitive advantage through employee engagement. Today, HRM has become more complex.

The growth of high-tech jobs has highlighted the need to manage the knowledge, skills, and expertise of employees (human capital). Technological advances, including mobile and social media, have changed the way employers recruit, select, train, evaluate, and motivate employees**.[3]**

1.2.3 The differences between traditional and modern HRM:

HRM has evolved from being a pivotal administrative function to strategic pillar within an organization. In the old days, early HR managers or personnel officers dealt only with recruitment, payroll, and employee benefits. These were mostly passive roles, primarily concerned with maintaining a core workforce. Eventually, further developments in HRM legally required structured hiring practices and formal training programs for compliance-related tasks such as managing relations with unions. Contemporary HRM, on the other hand, deals with the strategic management of human capital and engaging employees in organizational goals. This includes improved systems for performance appraisal, motivation, and employee development. A key feature of this transformation is that technology now plays a critical role in changing the ways in which employees are recruited, trained, evaluated, and communicated with, enhancing overall effectiveness**.[3]**

Aspect	**Traditional HRM**	**Modern HRM**
Historical Role	Managerial responsibility within general duties	Specialized and strategic organizational function
Initial Developments	Welfare offices and safety bureaus post-Industrial Revolution	Formalized hiring offices, training programs, and factory schools
Key Responsibilities	Hiring/firing, payroll, benefits administration	Selection, training, performance management, engagement
Legal Influence	Union laws added union relation duties (1930s)	Equal employment laws enhanced legal compliance role (1960s)
Strategic Focus	Limited to administrative and compliance functions	Employee engagement for competitive advantage (1970s onward)
Technological Integration	Minimal technological involvement	Mobile/social media used in recruitment, training, appraisal, motivation

Aspect	Traditional HRM	Modern HRM
Human Capital Focus	Limited skills management	Emphasis on managing knowledge, skills, and expertise in high-tech contexts

Table 1.1: The differences between Traditional and Modern HRM

1.3 The importance of HRM in organizations:

1.3.1 The Key Role of HR in Organizational Performance:

HRM plays a crucial role in organizational performance by fostering as a lever for competitiveness and innovation, while directly influencing employee motivation, retention, and the social climate within the company. HRM contributes to performance through three main levers. The HR department lever ensures efficient delivery of HR services, including outsourcing tasks such as benefits management and leveraging technology to reduce operational costs. The employee costs lever positions HR to advise top management on appropriate staffing levels and to define and manage compensation, incentive, and benefits policies. The strategic results lever enables HR to implement policies that build employee skills and competencies aligned with the organization's strategic objectives. Together, these actions reinforce HRM's impact as a driver of both individual and collective performance within the organization.

1.3.2 HRM as a Lever for Competitiveness and Innovation:

HRM serves as a lever for competitiveness and innovation by mobilizing and enhancing an organization's human capital. Firstly, by recruiting qualified profiles and continuously developing employee skills through training, HRM enables the company to maintain an agile and high-performing workforce capable of adapting to market changes. Secondly, by implementing talent management, recognition, and motivation policies, HRM fosters employee engagement—an essential factor for boosting productivity and reducing turnover.

Furthermore, HRM encourages innovation by creating a collaborative work environment based on trust, autonomy, and participation. Through participative management, collective intelligence, and openness to diversity, it facilitates the emergence of new ideas and organizational creativity.

Finally, by aligning HR strategy with the company's strategic direction, HRM supports innovation initiatives and drives organizational transformation. It thus becomes a key player in competitive differentiation and long-term organizational sustainability

.

1.3.3 The impact of HRM on motivation, loyalty and social climate:

Human Resource (HR) management significantly influences employee motivation, loyalty, and the overall social climate within an organization. Based on a quantitative study conducted with 595 hospitality sector employees in Ho Chi Minh City, Vietnam, the research explored the impact of HR practices—team spirit, compensation, career development, relationship with managers, working environment and condition, and fringe benefits—on motivation and loyalty. The findings revealed that these HR factors directly affect employee motivation and, through it, indirectly impact employee loyalty. Additionally, career development, working environment, and motivation also showed direct effects on loyalty.

Fair and transparent HR policies, including equitable recruitment, performance evaluation, and career development, lead employees to feel valued and supported. Motivation is enhanced by recognizing contributions, offering incentives, and encouraging growth, resulting in greater commitment and job satisfaction. Loyalty is strengthened through clear communication, well-being support, and advancement opportunities. A positive social climate emerges from open dialogue, mutual respect, and inclusion, reducing conflict and improving morale. Effective HR management thus reinforces employee engagement, cohesion, and long-term organizational success**.[4]**

1.4 The main functions of HRM:

1.4.1 The recruitment and selection:

Recruitment and selection are strategic HRM processes aimed at identifying, attracting, and selecting candidates whose profiles best meet the needs of the organization. These processes ensure a continuous inflow of talent to support business development or replace departures. They involve defining a recruitment policy aligned with the company's strategy, conducting workforce planning such as forecasting, succession, and selecting appropriate sourcing channels, whether internal, external, through agencies, or specialized platforms. The selection phase uses validated

assessment methods such as interviews, tests, and situational exercises, ensuring compliance with legal standards (e.g., Title VII, ADA). Additionally, metrics such as cost per hire and selection ratios help evaluate effectiveness. Finally, integration efforts aim to enhance new employee engagement and performance. Recruitment thus acts as a strategic lever to ensure workforce effectiveness and long-term success.

1.4.2 The training and development (Amended the competencies):

Training and Development (Amended the Competencies) refers to structured Human Resource Management functions aimed at improving the skills, knowledge, and abilities of employees to enhance their performance and support organizational goals.

Training refers to structured short-term programs designed to help employees acquire specific skills or knowledge needed for their current roles aimed at increasing efficiency and reducing performance gaps, while development focuses on leadership and growth of the individual within the organization in long-term.

Together, training and development contribute to amending and updating competencies to keep pace with technological changes, increasing employee engagement and satisfaction, improving productivity and innovation, reducing turnover and promoting internal mobility.

In short, training and development are strategic levers that ensure the workforce remains competent, competitive, and aligned with the organization's long-term objectives.

1.4.3 Performance Management (Evaluation and Feedback):

Performance management is a core component of human resource management that focuses on developing individual and team performance in alignment with organizational objectives. It includes defining clear performance expectations, conducting regular evaluations, and providing feedback to improve employee efficiency. A central element of this process is the performance appraisal, which evaluates employees against established standards to identify strengths, correct deficiencies, and determine training needs.

Appraisals influence key decisions related to pay, promotion, and retention, and are typically conducted by the immediate supervisor, with HR providing tools and oversight to minimize bias.

Tools used in this process include 360-degree feedback, KPIs (key performance indicators), and competency assessments.

Additionally, goal-setting approaches such as Management by Objectives (MBO), and tools like software systems, cloud-based platforms, electronic monitoring, or structured feedback sessions, further enhance the effectiveness of the process. Performance management plays a vital role in motivating employees, fostering a culture of continuous improvement, and ensuring that individual efforts align with the organization's strategic objectives and long-term success.

1.4.4 Compensation and Benefits (Motivation and Equity):

In professional and academic contexts, compensation and benefits are integral to employee motivation and perceptions of equity. According to Pearson's Strategic Compensation: A Human Resource Management Approach, compensation encompasses both direct financial rewards, such as salaries and bonuses, and indirect benefits, including health insurance and retirement plans. These elements are designed to attract, retain, and motivate employees by aligning their interests with organizational goals. Equity theory, as discussed in Pearson's materials, posits that employees assess the fairness of their compensation by comparing their input-output ratios to those of others. Perceived inequities can lead to a decrease in motivation and productivity. In growing organizations, HR departments support line managers by specializing in areas such as compensation and benefits. Compensation managers are responsible for developing rewards and benefit management structures, which are crucial for employee motivation and equality.

Motivation is influenced by both financial and non-financial rewards, including recognition, job quality, career development, and a supportive work environment. Equity in compensation is related to fairness and transparency, helping prevent dissatisfaction and turnover.

Total rewards programs combine pay, social benefits, growth opportunities, and a positive culture. Rewards the purpose of motivating, ensure equity, attract talent and optimize performance.

1.4.5 Social Relations and Conflict Management (Social Dialogue):

Social relations in organizations refer to the interactions and relationships between employers, employees, and their representatives. These relationships, especially between superiors and subordinates, are based on mutual trust, responsibility, and accountability. They are essential for maintaining institutional cohesion and performance.

Social dialogue includes all forms of negotiation, consultation, and communication between management and employee representatives. It plays a vital role in fostering cooperation, preventing conflicts, and improving working conditions. It promotes mutual understanding and supports workplace democracy.

Conflict is a natural part of organizational life, often resulting from differing interests, values, or expectations. If not managed effectively, conflict can harm morale, reduce productivity, and weaken organizational trust.

Conflict management involves identifying the causes of disputes and applying appropriate resolution strategies, such as mediation, negotiation, or disciplinary measures. It aims to protect the rights of all parties and preserve organizational harmony.

Effective social dialogue and conflict management enhance decision-making, strengthen employee engagement, and ensure respect for roles and responsibilities. Together, they contribute to a positive and stable work environment, supporting the organization’s long-term goals and performance.

1.4.6 Forward Planning of Jobs and Skills (GPEC) (Anticipating Future Needs):

Forward Planning of Jobs and Skills (GPEC) is a human resources engineering approach that involves designing, implementing, and monitoring policies and practices aimed at proactively reducing gaps between the company's needs and resources, both quantitatively (staff) and qualitatively (skills). GPEC has two dimensions: the integration of human resources as a strategic variable aimed at the anticipated reduction of gaps between the company's needs and resources in terms of staff and skills, and employee involvement in the development and implementation of a career development plan. In simpler terms, GPEC consists of anticipating medium- and long-term changes in order to manage their consequences on human resources (volume, skills, costs) and to implement collective and individual action plans (training, mobility, recruitment, etc.) that take these anticipations into account**.[5]**

1.5 Contemporary challenges of HRM:

1.5.1 Digitalization and the Impact of New Technologies (AI, HRIS, Remote Work):

Digitalization is transforming HRM and reshaping the way work is organized. Transitioning from paper-based systems to computerized databases, HR functions have become significantly more efficient and effective. Cloud technology enables access to data at any time and from any location.

The integration of technology into HR is essential to raise processes and enhancing productivity through the use of software and digital tools. Artificial intelligence (AI) strengthens decision-making, while remote working technologies such as collaborative platforms and virtual communication tools support flexible work arrangements, improve work-life balance, and broaden talent acquisition beyond geographical boundaries.

Technologies related to remote work promote flexibility, enhance work-life balance, and facilitate global recruitment. Human Resource Information Systems (HRIS) centralize employee data, increase accuracy, and support regulatory compliance.

A notable example of the impact of technology in HR is a multinational organization that implemented an automated performance management system. By digitizing its processes through a cloud-based platform, the company eliminated manual paperwork and reduced administrative costs. This allowed managers to provide timely feedback based on real-time data, resulting in improved motivation, engagement, and fairness in performance evaluations.

1.5.2 Diversity and inclusion in the workplace:

Diversity refers to all the ways that humans are different from one to another. It encompasses both visible characteristics (e.g., age, gender, physical ability) and invisible ones (e.g., beliefs, values, sexual orientation). Diversity is selective, context-dependent, and relative. It is defined not in isolation, but in relation to others, making it a dynamic and complex construct in organizational settings.

The ability of organizations and their members to completely connect with, engage, and employ people across all forms of diversity is known as inclusion. It aims to help all employees feel a sense of belonging and value within the organization, integrating diversity into organizational culture and ensuring all individuals are respected and their contributions valued.

Inclusion occurs at both the individual and organizational levels and is perceived differently across contexts and individuals. It is a contextual, momentary, and transient concept that requires ongoing monitoring and adaptation by organizations.

The document highlights the benefits of diversity and inclusion, including cost savings, talent attraction and retention, increased innovation and creativity, flexibility, effective leadership, business growth, commitment, and enhanced morale and job satisfaction.

It also covers issues including rising expenses, a lack of backing from upper management, intricacy, conflict, group agendas, fears of reverse discrimination, and tokenism.

Diversity management is a proactive and strategic process aimed at managing differences to meet organizational goals. It involves a cyclical process of analysis, planning, implementation, and evaluation, supported by diversity training (awareness-based and skills-based).

The text concludes that organizations should move from diversity management towards inclusion, where differences and similarities are holistically integrated into organizational functioning, allowing employees to be their full selves at work**.[1]**

1.5.3 Managing generations (X, Y, Z) and new ways of working:

Managing a diverse workforce can be a challenging task, especially when it comes to managing employees from different generations. The workplace is currently experiencing a unique dynamic, with three distinct generations - Gen X, Gen Y (also known as Millennials), and Gen Z, (and soon Alpha)- working side by side.

Each generation brings distinct characteristics, values, and expectations, influencing how they approach work, communication, and collaboration. However, understanding these generational differences and implementing strategies to effectively manage them can drive organizational success and create a harmonious and productive work environment.

Generation X (born 1965–1980):

Generation X is often known for their independence, adaptability, and desire for work-life balance. When managing Gen X employees, it is important to offer opportunities for career

growth, provide clear expectations, allow flexibility in work arrangements, and recognize their accomplishments to ensure motivation and satisfaction.

Generation Y (Millennials, born 1981–1996):

Millennials, or Gen Y employees are often characterized as tech-savvy, ambitious, and value purpose-driven work. Millennials thrive in collaborative environments, and they expect regular feedback and opportunities for personal and professional development. Regular communication, clear goals, and a supportive work environment can help to manage Millennials effectively.

Generation Z (born 1997–2012):

Generation Z is the first truly digital-native generation, and the newest entrants to the workforce, having grown up with smartphones, social media, and instant access to information. Gen Z values work-life balance, mental health support, and career growth opportunities. Organizations should provide them with diverse experiences, encouraging their input, and prioritize well-being initiatives can help tap into their potential.

1.5.4 Corporate Social Responsibility (CSR) and Sustainable HRM:

Corporate Social Responsibility (CSR) is the voluntary integration by companies of social, environmental, and economic concerns into their activities and their relationships with stakeholders. It manifests itself in different forms according to three models: the shareholder model, which limits CSR to compliance with the law; the stakeholder model, which includes the expectations of all internal and external stakeholders; and the societal model, which expands CSR to include moral responsibilities towards society as a whole. CSR represents a strategic lever that goes beyond economic objectives to include social justice, equity, respect for human rights, and the environment.

Sustainable human resources management (HRM) is part of this logic by promoting practices that support overall performance while respecting the principles of sustainable development. Sustainable HRM is characterized by a strategic and shared approach, cantered on the value of the individual, inclusion, participation, ethics, and the sustainability of skills. It supports social, economic, and environmental objectives through assessment tools that integrate dimensions such as commitment, legitimacy, productivity, and value creation for society**.[7]**

1.6 Conclusion:

In this first chapter, we provide a comprehensive study of HRM and its evolution from a traditional administrative function to a strategic role within organizations. We also review its core functions and the contemporary challenges it faces in the modern workplace.

The future of HRM is expected to increasingly rely on data, inclusiveness, and strategic vision. It will play a pivotal role in supporting resilient and sustainable organizations capable of adapting to technological, social, and environmental transformations.

In short, HRM is undergoing a transformation from a support function to a strategic partner in shaping the future of work.

CHAPTER 02: STUDY OF THE EXISTING

2.1 Introduction:

Given the increasing complexity of human resources management within organizations and the significant limitations of existing systems especially those that rely on manual processes, legacy software, or inflexible platforms it becomes imperative to adopt more advanced solutions. In this context, developing a dedicated human resources management application represents a strategic step aimed at modernizing workflows, improving accessibility, and enhancing transparency. This section presents the proposed improvements and innovative features of the solution, demonstrating how our project effectively addresses identified shortcomings in traditional systems.

2.2 General Context:

2.2.1 Analysis of Needs for an HRM Application:

Educational institutions, especially those with large staff and teachers, are facing increasing challenges in managing human resources effectively. With evolving business requirements and increasing administrative complexity, it has become imperative to analyze the basic requirements for an integrated and effective human resources management application. This analysis involves understanding the needs of the various groups benefiting from the system, as well as the challenges resulting from the lack of appropriate digital solutions.

2.2.1.1 Needs of teachers and employees in HR management:

The needs of teachers and employees include a set of essential functions that any effective human resources management (HRM) application should provide, including:

- **Recruitment and Hiring:** Easily apply for jobs, track applications, schedule interviews, archive resumes, and manage contracts.
- **Payroll and Compensation Management:** Generate payrolls, manage bonuses, overtime, and absences, and automatically calculate salaries.
- **Appraisal Management:** Monitor and evaluate performance, record annual reviews, and set goals.
- **Training and Development**: Organize and supervise training, record attendance, and evaluate results and their impact on skills.

- **Vacation, Attendance, and Absence Management**: Submit applications electronically, and receive approval or rejection notifications.
- **Internal Communication:** An effective platform for official notifications and communication with the HR department.

These needs are essential to increasing productivity, reducing human error, and enhancing transparency in human resources operations.

2.2.1.2 Challenges faced without an integrated software solution:

In the absence of integrated software solutions and reliance on traditional procedures or disparate systems, organizations face several difficulties that impact operational efficiency, including:

- The use of Excel files, paper documents, or disconnected software, which leads to errors, duplication, or loss of information.
- Poor coordination between departments (e.g., payroll, education management, and human resources).
- Incomplete and duplicate data from multiple departments can cause errors and delay decision-making.
- Difficulty tracking employee performance and career progression over the long term.
- High operating expenses due to the need for repetitive manual processes.
- Limited transparency in evaluation and promotion processes.
- Low employee satisfaction due to slow responses to administrative needs.
- Excessive time spent on administrative tasks reduces the added value of work.

2.2.1.3 User expectations (HR managers, employees, leadership):

Understanding user expectations is essential in designing or adopting any HR management system, as each group's needs vary according to the nature of their role within the organization. The following is a presentation of the most prominent expectations by target group:

1. **HR Managers:**

Understanding user expectations is essential in designing or adopting any HR management system, as each group's needs vary according to the nature of their role within the organization. The following is a presentation of the most prominent expectations by target group:

- They desire a comprehensive, easy-to-use, and automated tool,
- Real-time employee data (attendance, performance, salary, training, etc.) is shown on interactive dashboards,
- Analysis and statistical tools that contribute to making decisions based on accurate data,
- The ability to adapt processes (such leave approval or evaluation procedures) to conform to the organization's policies.

2. **Employees:**

This group represents the end user of the system and expects the application to be an effective tool for improving their administrative experience. Their most prominent expectations include:

- Ease of access to personal data such as salary, attendance, leave, and evaluation history,
- Submit requests electronically (training, vacation, data revision, etc.) instead of contacting management directly,
- Transparency in promotions and evaluations, which enhances a sense of fairness and confidence,
- Instant notifications about approvals or new requests,
- A user interface that is responsive and easy to use with various devices (phone, computer, tablet).

3. **Leadership:**

Management uses the system for strategic monitoring and enterprise-wide decision-making. Their key expectations include:

- Periodic and comprehensive reports on employee and department performance,
- A high level of security and control over privileges to guarantee the privacy of sensitive data,
- A decision support system that enables human resources budget planning.

These forecasts highlight the need to build a smart, comprehensive system that takes into account the diversity of tasks and roles within an organization, helps improve the user experience, and increases the overall efficiency of human resources.

2.2.2 Study of Existing Solutions :

There are several software options on the market to satisfy the needs of human resources management. These solutions can be divided into two primary categories: open-source solutions and market software solutions. Each category has its own characteristics, advantages, and limitations, depending on the organizational context.

2.2.2.1 Market Software Solutions (SAP SuccessFactors, Workday, Oracle HCM, BambooHR):

2.2.2.1.1 Features offered :

1- SAP SuccessFactors :

- Recruitment: An applicant tracking system integrated with data flows to track hiring results.
- Performance and Goal Management: Tools designed to support ongoing feedback, productivity analytics, and continuous improvement initiatives.
- Learning Management System (LMS): An AI-powered platform for personalized employee training and development.
- Payroll: A cloud-based payroll automation system with advanced analytics designed to minimizes errors and guarantees on-time payments.
- Employee Center: Manage essential HR data, including self-service, organizational management, time tracking, attendance, and comprehensive benefits management**.[8]**

2- Workday :

- Employee Self-Service: includes the ability to Update personal information, manage benefits, view payroll, tax documents.
- Time Management: includes managing absences, scheduling work, and requesting vacation.
- Performance Reviews: Access and manage evaluations and set goals.
- Manager Self-Service: Request staffing, monitor leave, and manage teams.
- Interactive organizational charts to visualize company's structure.
- Available on desktop, smartphones, and tablets devices, with notifications for required actions**.[9]**

3- Oracle HCM :

- An integrated cloud-based system for data organization and ease of access.
- Core HR: Centralized employee data management, organizational structure visualization, and automated HR processes (employee onboarding/offboarding, leave tracking).
- Employee Data Management: Compile thorough employee profiles that include employment details, personal information, and performance evaluations.
- Workforce Management : Attendance and absence management.
- Effective Recruitment: Streamline the recruitment process to identify and attract qualified candidates.
- Performance Management: Implement performance management strategies that link individual goals with organizational objectives**.[10]**

4- BambooHR :

- Cloud-based integrated system with mobile-friendly access.
- Core HR: Automated, centralized HR data for payroll, benefits, and personnel management.
- Workforce Management: Time tracking, time off, PTO (paid time off) management, benefits administration.
- Talent Management: includes employee surveys, performance management, onboarding, and applicant tracking**.[11]**

2.2.2.1.2 Advantages and limitations :

The table below presents an overview of some market software solutions. It summarizes their respective advantages and limitations in order to provide a clear understanding of how each system performs in real-world organizational contexts.**[12]**

Solutions	Advantages	limitations
SAP SuccessFactors	- Scalability: Suitable for large enterprises with evolving HR requirements, - Comprehensive Functionality: Provides a full suite of HR modules	- Costs: Smaller businesses may find it more difficult to get licensing and maintenance expenses due to their high cost. - Complex Implementation: It may

	catering to complex organizational needs, - Regulatory Compliance: Automatic updates for labor laws.	take a long time and a lot of IT resources to deploy. - User Experience: According to some users, the UI is less intuitive, requiring more training.
Oracle HCM	- System Comprehensiveness and Integration: Includes integrated modules for HR management, payroll, talent management, succession planning, performance management, and employee learning. - Global Compliance: It is appropriate for multinational firms since it supports a variety of languages, currencies, and regional legal requirements. - AI & Machine Learning: Contains AI-powered workforce planning, performance management, and talent acquisition solutions. - Strong Security: State-of-the-art security features guarantee data protection and adherence to industry norms.	- High Cost: It is considered one of the most expensive systems when it comes to customization, training, and license. - Limited Customization: While customization is possible, some core features are restricted to the templates provided by Oracle, reducing the flexibility to adapt to the nature of the on-premises business. - Complex User Experience: The interface can be confusing and unintuitive, leading to prolonged user onboarding.
BambooHR	- User-Friendly Interface: Intuitive for HR teams and employees, - Quick Implementation: Rapid deployment suitable for small to medium-sized businesses, - Cost-Effective: Offers a competitive pricing structure for organizations with limited HR budgets.	-Not suitable for large and complex companies, - Cost: freeremium need to subscription plan for advanced features, - Limited Global Payroll: Only supports U.S. and Canada natively.

Table 2.1: The advantages and limitations of Market Software Solutions

2.2.2.2 Open-Source Solutions (Odoo HR, Dolibarr, OrangeHRM) :

2.2.2.2.1 Comparison with proprietary solutions:

This section aims to highlight the key differences in terms of cost, flexibility, ease of use and technological innovation between open-source solutions and proprietary solutions, thus justifying the relevance and competitiveness of the proposed application in the current HR software environment, in the table-bellow**:[13]**

Criteria	Open-source solutions	Proprietary solutions
Cost & Licensing	-Free to use under open-source licenses with low to no cost (often free, with optional support costs).	-Paid subscription or license fees with very high costs (annual subscriptions, support fees, licenses).
Customization	-Highly flexible, customizable and scalable.	- Less flexibility, customization options may be limited.
Scalability & Flexibility	- Highly flexible and scalable; suitable for small and medium businesses, but may require more technical expertise.	-Designed for large organizations with complex needs, scalable and may require a higher level of expertise.
Security	- Depends on the technical team's configuration capabilities, and there are potential risks if proper maintenance is not carried out.	-Strong enterprise-grade security, with international compliance certifications
Integration	- It can be integrated with various systems, but custom development may be required in many cases.	- Strong integration capabilities with other systems, especially especially from the same company
Features	- Some open-source solutions	- Comprehensive, more

	have a more limited feature set.	advanced features, including AI-powered analytics and global compliance tools.
Publication	- Often limited to small or medium-sized businesses.	- Widespread in large and multinational organizations.

Table 2.2: Comparison between Market software & Open-source solutions

2.2.2.2.2 Adaptability and costs:

Open-source HR solutions, including Odoo HR, Dolibarr, and OrangeHRM, are appealing substitutes for proprietary systems because they provide a special blend of high scalability and affordability, especially for SMEs and businesses with particular operating needs. These platforms do not require the costly licensing costs that come with commercial solutions like SAP or Oracle because they are freely available under open-source licenses. Organizations must take into account possible operating costs associated with installation, customization, training, technical support, and optional cloud hosting, even though they drastically lower the original expenditure. If internal IT capabilities are limited, expert intervention may be necessary for installation, and development resources are frequently needed to modify features to meet the organization's workflow.

Despite these costs, scalable design is made possible by the modular architecture and source code accessibility, which let businesses create unique solutions that perfectly match their HR procedures. Custom modules for recording internships or teacher evaluations, for instance, can be developed for the education sector, while industries like manufacturing or healthcare can modify their functionality to accommodate shifts and adhere to legal standards. These systems may also be hosted on-premises or in the cloud, which makes it easier to comply with local data protection requirements. Additionally, they allow multilingual environments Odoo HR and OrangeHRM both have built-in support for Arabic, while Dolibarr employs customisable language profiles. Scalability and cost control are improved by the flexibility to add functions like payroll, performance appraisal, and recruitment modules progressively.

All things considered, open-source HR platforms give businesses a scalable, adaptable, and affordable base; they are especially well-suited for companies that can handle or contract out the technical facets of setup and upkeep.

2.2.3 Identifying Strengths and Weaknesses of Current Solutions:

To design an effective human resource management system, it is necessary to analyse the strengths and weaknesses of current solutions. This analysis enables us to identify areas that can be improved or developed in the proposed solution.

2.2.3.1 Strengths of Current Solutions:

Comprehensive Features:

- Most leading HR software solutions offer integrated modules covering recruitment, time and attendance management, payroll processing, and performance evaluations. This integration streamlines HR processes, reduces manual data entry errors, and improves coordination across HR functions.
- Certain platforms, like BambooHR and Workday, provide intuitive user interfaces that make navigating easier and require less work from the user. However, the ease of use of these interfaces may vary depending on the complexity of the organization and its ability to customize.

Integration and Scalability:

- Efficient HR management solutions facilitate data sharing and expedite workflows across a range of corporate tasks by supporting integration with other enterprise technologies, including collaboration software and enterprise resource planning (ERP) systems.
- These solutions are scalable, meeting the needs of a wide range of organizations (from small and medium-sized startups to large multinational corporations) by providing customizable modules that can adapt to workforce growth and complexity.

Security and Compliance:

- Leading HR systems include mechanisms to ensure compliance with data protection regulations, such as the General Data Protection Regulation (GDPR) and local labor laws. HR software integrates automated compliance management and alerts to reduce legal risks, helping organizations manage employee data securely and in accordance with approved legislative requirements.

- Strong security measures, including data encryption protocols, role-based access control (RBAC), and multi-factor authentication, protect sensitive employee data, while it's in transit and storage, lowering the possibility of unauthorized access and breaches.

Support and Community :

- Solutions like SAP and Odoo benefit from extensive user communities and comprehensive documentation, facilitating knowledge exchange and providing valuable resources for troubleshooting, implementing best practices, and user training. Vendor support often includes regular software updates, security patches, and professional assistance, ensuring system reliability and compliance.

2.2.3.2 Weaknesses and Observed Limitations :

High Cost:

- For small and medium-sized enterprises, proprietary premium systems like SAP SuccessFactors and Oracle HCM are sometimes unaffordable due to their hefty licensing, implementation, and maintenance costs.
- Additional fees associated with software maintenance, upgrades, and add-on modules are common factors that contribute to a higher total cost of ownership, often exceeding initial estimates. These costs may also include hidden fees, complicating budgeting for many organizations.

Complexity and Learning Curve:

- Complex HR management platforms, such as SAP SuccessFactors, require extensive training and onboarding for users and administrators due to their complex interfaces and feature-rich environments, which can overwhelm small HR teams and negatively impact their productivity during the initial deployment phase.
- HRMS systems may offer feature-rich but crowded interfaces, making them difficult to use and slowing down routine tasks, especially for less tech-savvy users.

Limitations of Open-Source Solutions:

- Open-source HR management tools often provide only basic features, and may not satisfy the needs of organizations requiring advanced functionality, which requires technical expertise to deploy advanced features or integrations.

- Customization, upkeep, and guaranteeing security compliance in open-source deployments can be difficult for organizations with limited IT resources.

Poor User Experience (UX) :

- Mobile apps in many HR management platforms often have limited functionality or unintuitive designs, leading to low adoption rates and frustrating users who rely on mobile access.

2.3 Context Linked to Our Study:

2.3.1 Current State of the Studied System:

During our training in the Human Resources Department at Ibn Khaldoun University's Faculty of Mathematics and Computer Science, we conducted a field survey to learn about the workplace and analyse HRM procedures. This included gathering comprehensive information on the management of vacations, attendance tracking, employee profiles, training, promotions, and work certificates. We also monitored the tools used and the daily challenges faced by the team.

The analysis revealed that the department currently manages essential operations like payroll and vacation requests using traditional methods such as Excel spreadsheets and paper records. These methods lead to slow processing, raise the possibility of errors, and a lack of integration and transparency. The lack of a centralized system and ineffective automation also reduces operational efficiency and puts more strain on the small human resources team, which has a detrimental influence on management and decision-making quality.

A summary of the main HR functions and their present constraints can be seen below:

1.Vacations:

There are three types of leave: maternity leave, sick leave, and annual vacation. Each type must be formally requested by the employee and is subject to approval or rejection by the employer. During certain periods particularly the summer vacation season the employer faces significant workload pressure due to the high volume of leave requests.

- **Critique:** The current leave management process relies on manual requests and approvals, which becomes particularly burdensome during peak periods such as summer. This leads

to delayed processing and administrative overload, ultimately contributing to employee dissatisfaction.

2. Attendance tracking:

Monitoring attendance is a critical aspect of human resource management, as it records precise arrival and departure times and provides valuable insights into employee performance and absences. This data is essential for various departments within the institution, particularly the accounting department, where it supports accurate payroll and bonus calculations.

- **Critique:** Attendance is monitored manually, without digital tools or real-time dashboards. This compromises data accuracy and makes it difficult to analyze employee performance or ensure reliable inputs for payroll and bonus calculations.

3. Employee profiles:

Employee data is currently stored either in Excel files or on paper documents, which

often include excessive and irrelevant information for the internal faculty system,

such as personal details about spouses and parents. This approach presents a

significant risk of permanent data loss in the event of file corruption or physical document damage.

- **Critique:** Storing employee data in Excel files or paper documents poses a significant risk of data loss and inconsistency. The lack of a secure, structured database hinders accessibility, especially for long-term or former staff, and affects the integrity of personnel records.

4. Training, promotions:

Training sessions are either requested by employees subject to approval or rejection

by administrators or they are planned and scheduled directly by the administration for the employees.

- **Critique:** Training requests are managed manually without a centralized system, leading to poor traceability and limited strategic planning. This absence of traceability makes it difficult to evaluate training outcomes or align them with career development plans.

5. Work certificates:

Work certificates are requested by employees; however, their preparation requires considerable time and effort from the administrative staff. This is due to the need to manually search through documents and Excel files to retrieve the relevant information for each specific employee.

- **Critique:** The preparation of work certificates is time-consuming due to the need for manual searches across scattered files. This inefficiency slows down administrative processes and increases the likelihood of errors or delays in document issuance.

6. Recruitment:

When a job vacancy arises, the personnel department submits a request to the Rectorate to initiate a formal recruitment procedure. This process typically involves either a written examination or candidate selection based on the most suitable qualifications. As a result, the internal system does not have the privilege of conducting direct hiring.

- **Critique**: The recruitment process is rigid and formalized through external authorities, with no internal digital tracking or workflow. This slows down staffing procedures and prevents the HR team from responding quickly to urgent hiring needs.

7. Promotions:

Promotions refer to the advancement in echelon and grade levels. These adjustments are carried out manually and are based on the employee's overall performance, including criteria such as professional conduct, compliance with institutional regulations, and attendance records. In some

cases, promotions do not follow a sequential order; instead, an accelerated advancement referred to as “le glissement” is

applied. For example, an employee may be promoted by two or three echelons or grades at once, depending on their qualifications and performance.

- **Critique**: Promotions are administered manually and rely on loosely tracked criteria such as conduct and attendance, often without structured performance data. This reduces objectivity, increases the risk of perceived unfairness, and limits transparency in career advancement.

2.3.2 Proposed Solutions :

Solution 1:

ESS-Based Leave Management: Incorporate Employee Self-Service (ESS) principles in leave management by allowing employees to submit leave requests, which can then be reviewed and scheduled by administrators.

Solution 2:

Attendance Monitoring: Integrate attendance tracking for each user to support objective performance evaluations and administrative decision-making.

Solution 3:

Reliable and Efficient Data Storage: Store all HR data in digital formats on secure and space-efficient media, with automatic backups in the cloud to prevent data loss and ensure high availability.

Solution 4:

Apply the ESS approach to training activities, enabling employees to request participation in training sessions, which are then evaluated and scheduled by the HR administration.

Solution 5:

ESS-Based Certificate Requests: Extend ESS functionality to administrative requests such as work certificates, allowing employees to request these documents directly through the platform.

Solution 6:

Decision Support through Real-Time Statistics: Provide real-time statistical insights and multi-criteria management functionalities to support accurate and timely decision-making.

Solution 7:

User Profile Management: Facilitate the seamless updating and management of user profiles and administrative records.

2.2.2. Justification for the Improvement Brought by Our Project:

Our HR management application was designed to address key shortcomings in the current system, identified through a thorough analysis of core functions. These include inefficient manual processes and a lack of centralized data, which negatively impacts productivity, data integrity, and employee satisfaction.

Our project offers clear improvements that not only solve existing problems but also add significant value for future growth and operational efficiency.

2.3.2.1 Proposed Improvements:

- **Financial Accessibility**:

Many departments refrain from adopting advanced HR solutions due to their high costs and prohibitive maintenance fees, placing them beyond the reach of small and medium-sized enterprises (SMEs). Therefore, we propose a low-cost or partially free solution that meets the needs of these organizations and enables them to perform basic HR tasks efficiently and professionally, without sacrificing quality or scalability.

- **Simplicity and Optimized UX**:

An intuitive and user-friendly interface facilitates the execution of a wide range of procedures, such as submitting leave requests and requesting work certificates, which helps speed up HR tasks and reduce time and effort.

A mobile-first approach ensures that employees and administrators can access the system from any device at any time, enabling critical HR tasks to be performed on the go, enhancing responsiveness and improving user satisfaction.

- **Advanced Customization**:

No-code configuration tools enable HR staff to customize workflows, forms, and approval chains without the need for programming skills. This flexibility ensures that the system remains compliant with organizational policies, whether related to leave validation, training approvals, or promotion criteria.

Open APIs enable seamless integration with enterprise resource planning (ERP) systems, academic systems, and document management platforms. This technological compatibility enables automatic updates and precise process alignment, reducing duplicate data entry, enhancing consistency across departments, and improving operational efficiency through immediate and accurate synchronization of HR information with other corporate systems.

- **Innovative Features**:

Modern HR systems increasingly rely on automation to ease administrative burdens and enhance strategic decision-making. By automating repetitive tasks, such as attendance tracking, updating leave balances, and issuing certifications, HR departments can focus on value-added activities, such as improving the employee experience and developing talent.

2.3.2.2 Differentiation vs. Existing Solutions :

Criterion	Current solutions	Our solution
Cost	Often expensive, especially for full-featured systems like (SAP); freemium options (Odoo) have limited capabilities and hidden upgrade costs.	Affordable pricing with transparent cost structure; basic functionality are offered without requiring upgrades.
	Rigid, often requires	No-code/low-code tools

Customization	technical expertise or costly developer support; limited flexibility for non-technical users.	allow easy tailoring of processes without technical skills.
User Experience	Interfaces are often complex and not optimized for mobile use.	User-friendly, mobile-first; ergonomic and accessible interface.
Scalability	Complex to scale; expensive upgrades	Scalable by design, suitable for institutions of various sizes

Table2.3: Current solution vs Our solution

2.4 Conclusion:

In this chapter, we have demonstrated how the proposed HR management application responds to operational gaps in the current system. Each of the improvements presented represents a response to a pressing need, adding qualitative advantages that surpass many available market solutions. This clearly highlights the importance of our project and its added value in supporting operational efficiency and facilitating HR management. In the next chapter, we will move on to “analysis and design” the proposed system through precise process modeling, using tools such as use case diagrams, class diagrams, and sequence diagrams to build system logic that precisely aligns with business needs.

CHAPTER 03: ANALYSIS AND DESIGN

3.1 Introduction:

The objective of this chapter is to describe the functional and behavioral analysis of the Human Resource Management System (HRMS). This analysis is essential to understand the interactions between users and the system, and to design a robust, scalable, and maintainable architecture. This chapter includes the identification of system actors, the elaboration of use case diagrams, sequence diagrams, class diagrams. It aims to clearly define how different actors interact with the system and how data flows are managed across its various components.

3.2 Specifications:

Our specifications consist of a set of functional and non-functional requirements identified based on an analysis of current HR procedures at the Faculty of Mathematics and Computer Science, Ibn Khaldoun University. These requirements are presented as follows:

3.2.1 Functional Requirements :

Functional requirements define the basic features and behaviors that a system must provide. These are actions that the system must be able to perform, which including the following:

- The system should allow administrators, HR managers, and employees to securely log in using their credentials to access their dashboards.
- The application gives administrators the ability to create, update, delete, and search for user accounts in addition to managing employee profiles.
- A self-service interface should be used by staff members to submit, monitor, and cancel leave requests.
- HR managers should examine and accept or deny leave requests through their dashboard.
- The system should be able to track staff attendance by scanning QR codes and generate attendance summaries.
- Official documentation, including work certificates in PDF format, ought to be automatically generated by the system.
- Promotions and grades (job grades) can be managed by HR managers.
- The interface should be user-friendly and responsive, ensuring users can access it from both computers and mobile phones.

- Administrators should be able to receive reports from users about requirements or mistakes.

3.2.2 Non-Functional Requirements :

Non-functional requirements ensure the system is efficient, reliable, maintainable, and user-friendly across different environments and use cases. They describe how the system should behave (e.g., in terms of speed, security, usability, scalability) rather than what it should do. Among these non-functional needs we can cite:

- A scalable architecture allowing the addition of new modules without requiring a complete redesign.
- The system must ensure data security and confidentiality with secure storage so that sensitive information is not publicly accessible.
- The system must provide fast response times, with pages and processes loading in under two seconds during normal usage.
- The system must be easy to maintain and update.
- The platform must be easy to use, with an intuitive and accessible interface, even for non-technical users.
- The application must support multilingual interfaces.
- The application must be responsive and compatible with various devices and screen sizes.

3.3 System Actors :

3.3.1 Identification of actors :

1. Administrator (HR Manager):

The administrators has full access to all management features. They can create, modify, and delete employee profiles, manage leave requests, generate administrative documents (such as work certificates), monitor attendance, update promotions, pay grades, and consult analytical dashboards.

2. Employee:

The employee can access their personal space to view their information, submit and track leave requests, check attendance records,

3. Security Agent (Guard):

The security agent has the same access rights as an employee, plus uses the application to scan employee QR codes in order to verify their presence upon entering or leaving the premises.

3.3.2. Message Identification Table:

The following table lists the key messages exchanged within the Human Resource Management System. For each message, the table specifies the sender (source), the receiver (destination), and the purpose of the message in the context of system interactions.

Message	Source	Destination	Purpose
Enter login Credentials	User	System	Authenticate user.
Send new employee request	Admin	System	Add a new employee to the database.
View list of employees	Admin	System	Display all employee profiles.
Update profile	Admin	System	Edit employee information.
Delete profile	Admin	System	Remove an employee profile.
Submit requests	Employee	system	Ask for
Check request status	Employee	System	Track the progress of a submitted request.
Approve/Reject a request	Admin	System	Validate holiday/formation/promotion/report requests.
Scan employee QR code	Guard	System	Control access.
Add a new formation/promotion	Admin	System	Schedule a new formation or promotion.
Generate work	Admin	System	Produce a downloadable PDF

certificate			certificate.
Search employee	Admin	System	Filter employee list based on search input.
Create a log	Admin	System	Register entry/exit/absence of employees

Table3.1: Message identification table

3.4 Use Case Identification:

A use case represents a coherent and complete unit of functionality offered by the system, as perceived from an external point of view. Each use case models what the system should do to fulfill a specific user need, without specifying how this functionality is internally implemented.

3.4.1 Use Case Identification Table :

This table identifies the key use cases of the Human Resource Management System, listing each use case along with its main actor.

Use Case Name	Main Actor
Authenticate	All users
Manage Employees	Admin
Manage Requests	Admin
Manage Logs	Admin
Manage Work Certificate	Admin
View Status of Requests	Employee
Scan Employee QR Codes	Guard
Make Requests	Employee
Search Employees	Admin

Table3.2: Use case identification table

3.4.2 Use case diagram :

Use case diagrams describe the expected behaviors of a system, in other words, what the system is supposed to do from the user's perspective. The main elements of these diagrams are the actors, use cases, and the system boundary. The system represents the scope within which interactions take place between the actors and the functionalities provided.

3.4.2.1 Use case diagram for “Admin Space”:

The “Admin Space” use case diagram illustrates the functionalities available to the administrator within the Human Resource Management System. It highlights how the admin manages employee profiles, responds to various requests (such as leave, promotion, formation, and work certificate), and manages formations, reports, and user roles. This diagram outlines the interactions between the admin actor and the system, showcasing the main services under their responsibility.

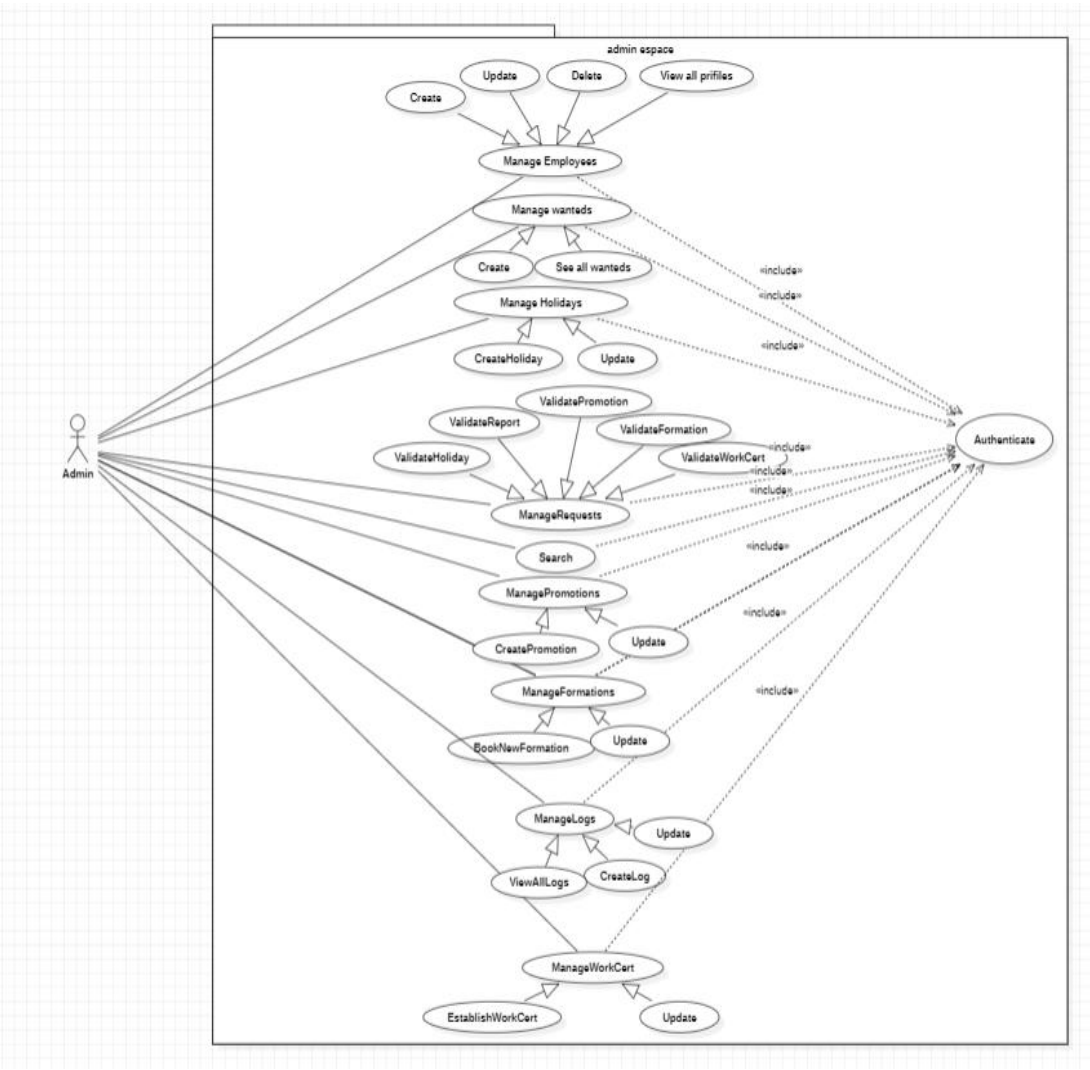

Figure 3.1: Use case diagram "Admin Space"

Use Case N=2	**Admin Space**
Brief Description	This use case allows the admin to perform all administrative tasks in the system. It includes employee management, request validation, logs, Certifications, and more.
Actor	Admin

Main Scenario	-Admin logs in. -Admin access the dashboard. - Admin chooses a task: manage employees, view requests, add logs, etc. -Executes selected task.
Alternative Flows	-If the admin session is expired, they must re-authenticate. -If a task fails, an error message is shown.

Table3.3: "Admin space**"** use case table

3.4.2.2 Use case diagram: "User Space":

The "User Space" use case diagram presents the set of actions available to a regular user (Employee or Guard) within the Human Resource Management System. It includes functionalities such as submitting various requests (leave, promotion, formation, work certificate, report), viewing request statuses, and accessing personal profile information. For Guards, it also includes the ability to perform QR code scanning for access control. This diagram outlines the direct interactions between the user and the system, focusing on individual HR-related needs and daily operations.

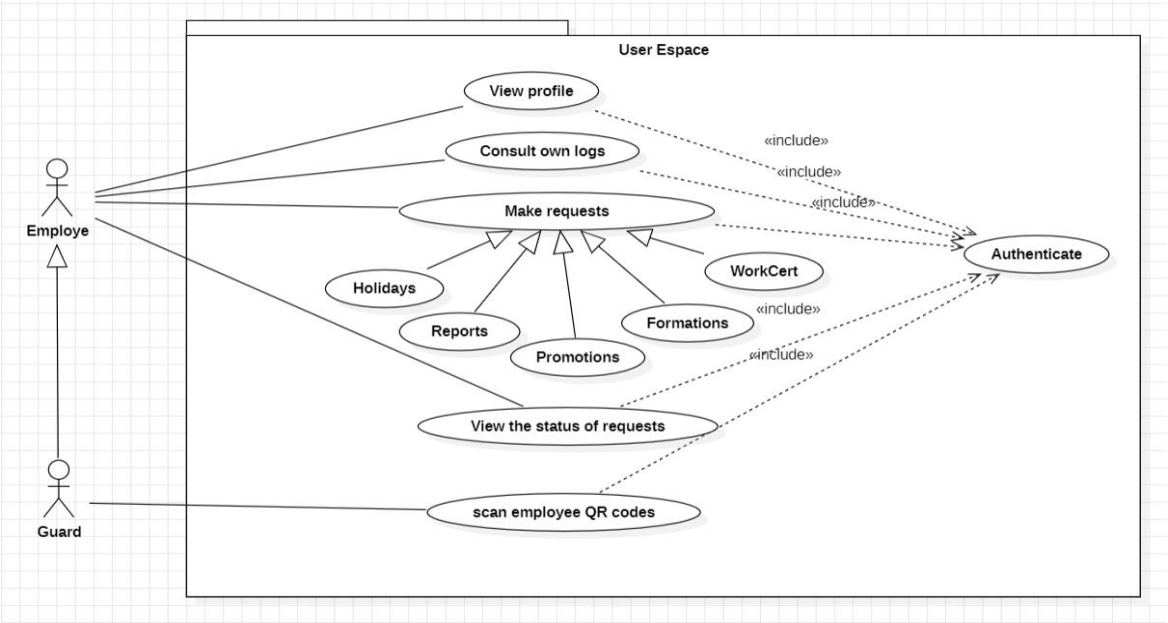

Figure 3.2: Use case diagram “User Space”

Use Case N=3	**User Space**
Brief Description	Allows an authenticated employee to view their profile, make various requests, check their request status, and (for guard) scan QR codes
Actor	Employee (includes Guard)
Main Scenario	-User logs in. -User accesses the main dashboard. -User chooses an action: view profile, make request, check status, etc. -System performs the requested action.
Alternative Flows	-If login fails, the user cannot access this space.

Table3.4: “User space**”** use case table

3.5 Sequence Diagram:

3.5.1 Sequence diagram of the “Manage Requests” use case:

The “Manage Requests” use case illustrates how the administrator interacts with the system to view, accept, and refuse various employee requests such as holidys, promotions, formations, reports and work certificates. This diagram details the sequence of messages exchanged between the admin, the system interface, and the database to ensure accurate tracking and decision-making.

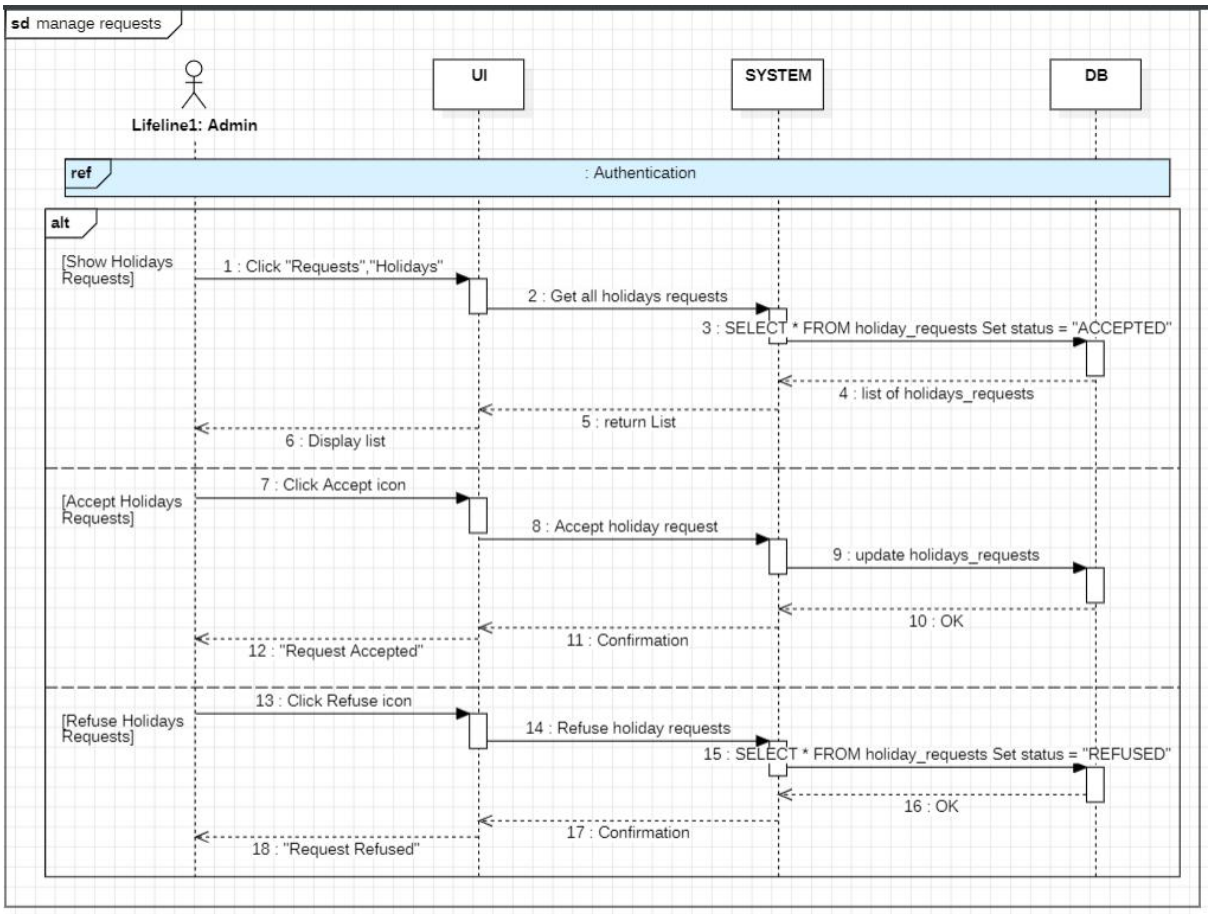

Figure 3.3: Sequence diagram of the "Manage requests" use case

3.5.2 Sequence diagram of the "Manage Formations" use case:

The "Manage Formations" use case outlines how the administrator handles training-related requests submitted by employees. This includes reviewing, approving, or rejecting training requests and updating formation records accordingly. The sequence diagram demonstrates the interactions between the administrator, the system interface, and the underlying database, ensuring proper processing and traceability of training activities.

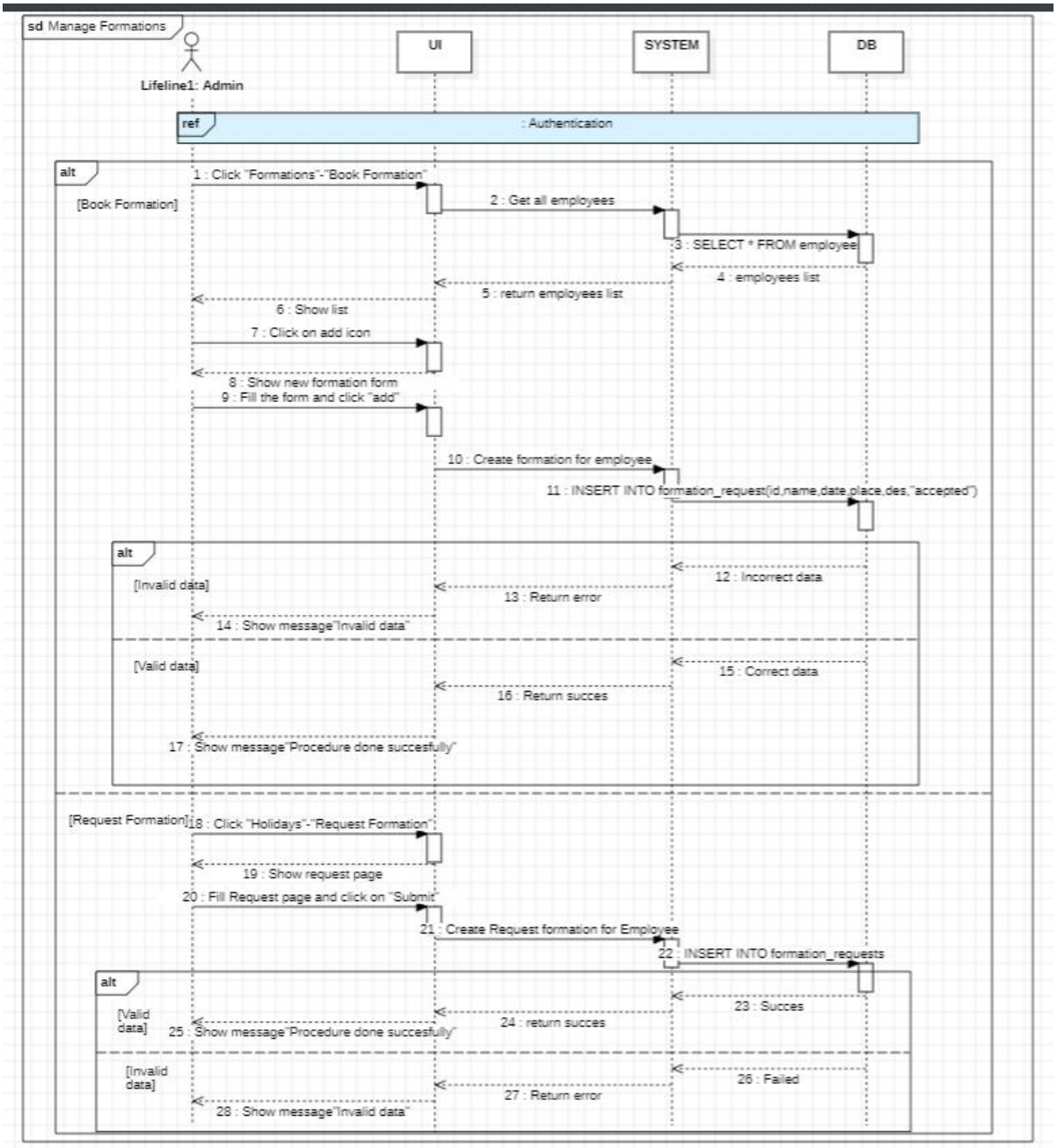

Figure 3.4: Sequence diagram of the "Manage formations" use case

3.5.3 Sequence diagram of the “Manage Work Certificate” use case:

The “Manage Work Certificate” use case illustrates how the administrator processes employee requests for work certificates. This involves viewing the request details, verifying the employee’s information, and generating or rejecting the certificate. The sequence diagram captures the flow of interactions between the admin and system to ensuring reliable handling and issuance of official documents.

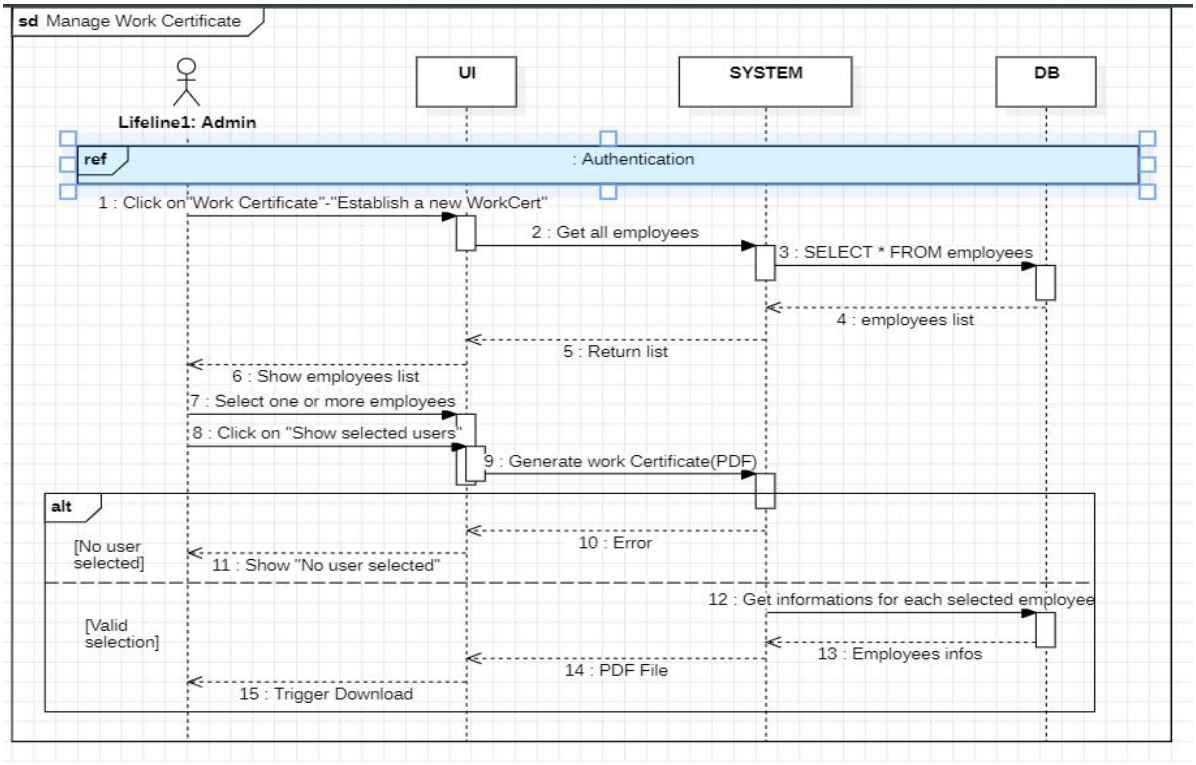

Figure 3.5: Sequence diagram of the “Manage work certificate” use case

3.5.4 Sequence diagram of the “Employee Space” use case:

The **“Employee Space”** use case represents the set of actions an employee can perform within their personal workspace. This includes viewing their profile, submitting various requests (e.g., leave, formation, promotion), and tracking the status of those requests. The sequence diagram details the dynamic interaction between the employee, the user interface, and the system database, ensuring a smooth and personalized user experience.

3.6 Class diagram:

Class diagrams represent the static structure of a system by showing its classes, attributes, methods, and the relationships between them. Each class defines a specific concept in the system, along with its properties and behaviors. The main goal of the class diagram is to illustrate how different parts of the system are connected and how they interact structurally. The diagram below represents the class diagram of our Human Resource Management System.

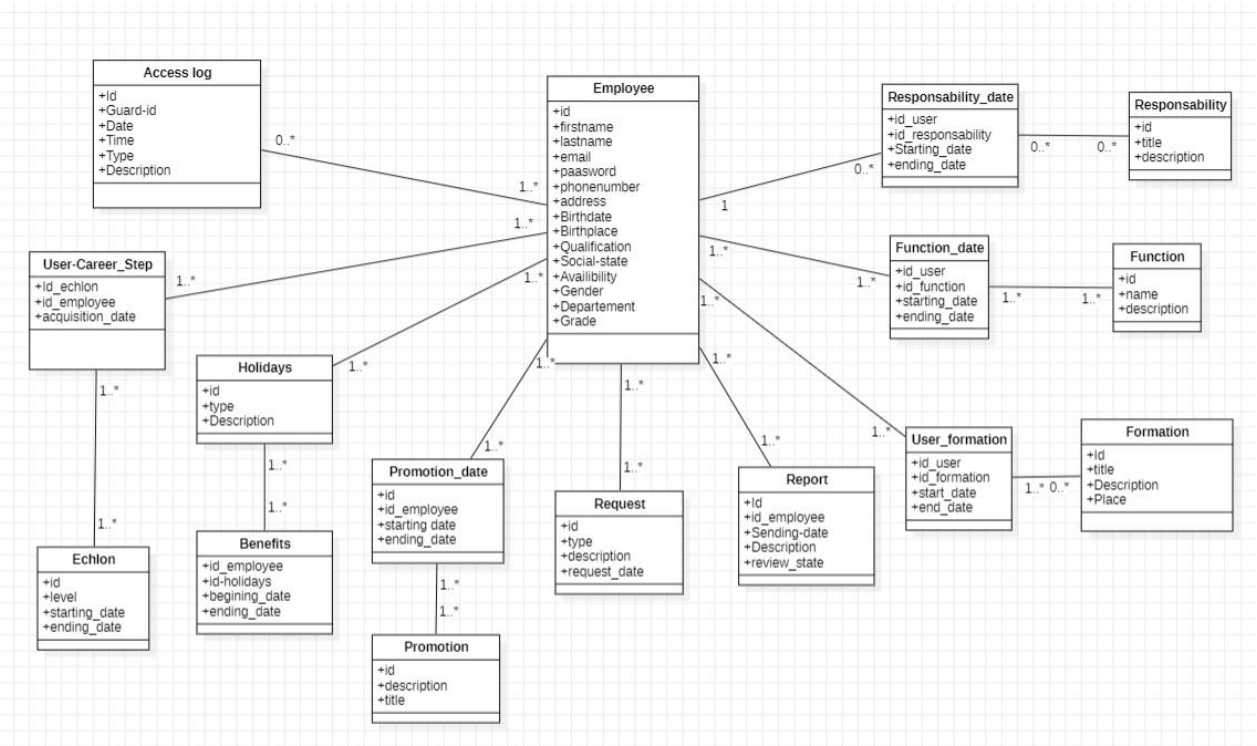

Figure 3.6: Class diagram of the system

3.7 Conclusion:

This chapter provided a comprehensive analysis and design of the Human Resource Management System. By identifying the system actors and their responsibilities, we were able to model all interactions through use case and sequence diagrams. The class diagram offered a structured view of the system's core components and their relationships. These models play a crucial role in clarifying requirements, improving communication between stakeholders, and guiding the

implementation phase. They ensure that the developed system will be both functionally complete and technically robust.

CHAPTER 04: Implementation

4.1 Introduction :

This chapter details the overall structure of the application, the justification behind the technological choices made and the key components developed to fulfill the needs of the main user roles. Also includes screenshots, and demonstrations of the core features implemented, highlighting how the theoretical model was translated into a functional web-based HR platform.

4.2 Used Architecture :

MVVM (Model, View, ViewModel) :

Model–View–ViewModel (MVVM) is a software architectural pattern originally invented by Microsoft architects Ken Cooper and Ted Peters, breaks down an application into three distinct components—Model, View, and ViewModel. MVVM promotes the separation of the graphical user interface (View) from the business logic or back-end logic (Model) by introducing an intermediate layer known as the ViewModel. This separation of concerns enables the creation of applications that are more maintainable, testable, and more extensible, particularly for environments that leverage data binding and rich user interactions.

- **Model :**

The Model layer is responsible for managing application data and business logic. In the context of Angular + Firebase, it includes: Angular Components, Firestore or Realtime Database, Firebase Authentication and Firebase Storage.

- **View :**

The View is implemented using Angular HTML templates. It displays the data provided by the ViewModel and handles user interface elements.

- **ViewModel (Angular Component Classes) :**

The ViewModel is represented by Angular component classes. It contains presentation logic, interacts with the Model (services and Firebase), and exposes observable data streams to the View.

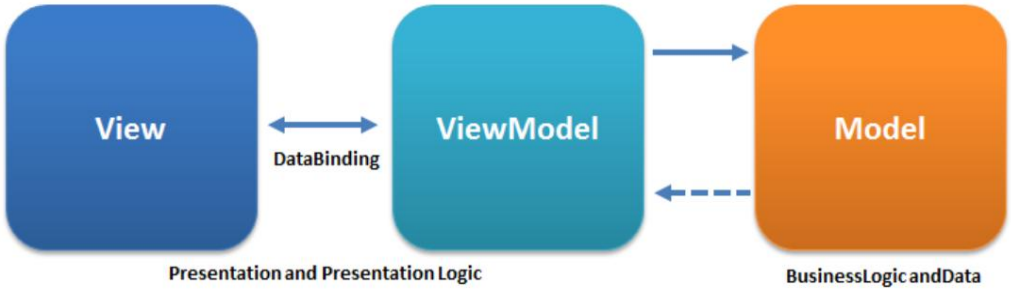

Figure 4.1: Illustration of the MVVM pattern.

The following table describe a simple Example of MVVM Mapping in the Application:

Layer	**implimentation**
Model	Firestore collection : users
ViewModel	Angular Component : AllUsersListComponent.ts
View	Angular Template: all_userslist.component.html

Table 4.1: Example of MVVM Mapping

4.3 Application development environment:

4.3.1 Visual studio code :

is a lightweight, open-source code editor developed by Microsoft. It offers a wide range of features that enhance productivity in web and software development.[18]

4.3.2 StarUML :

StarUML is an advanced software modeling tool that supports UML diagrams and other standards such as SysML and ERD. According to its official website, it is an open-source project offering a flexible and extensible environment for rapid, adaptable, and scalable modeling. It targets developers, analysts, and system architects, featuring a modern user interface, cross-

platform compatibility, and support for multiple programming languages through code generation and reverse engineering**. [21]**

4.4 Used Software technologies :

4.4.1 Angular:

Angular CLI is a command-line interface tool that simplifies Angular development. It provides commands for:

-Creating Angular projects and components (ng new, ng generate)
-Serving and building the application (ng serve, ng build)
-Running tests and linting code (ng test, ng lint)
-Optimizing the application for production builds**.[17]**

- **Key Features:**

- Component-Based Architecture
- TypeScript Integration
- Two-Way Data Binding (between HTML and TypeScript)
- Dependency Injection
- Routing and Navigation
- Reactive Programming with RxJS

4.4.2 Firebase :

Firebase CLI is the command-line interface used to interact with Firebase services. It was used in this project for:

- Initializing Firebase features (firebase init)
- Deploying the application to Firebase Hosting (firebase deploy)

- **Key Features of Firebase Used in Application Development:**

Firebase Authentication: Firebase Authentication supports the email/password authentication method using robust security mechanisms such as password hashing**.[14]**

Cloud Firestore: Cloud Firestore is a NoSQL cloud database that provides real-time data listeners, enabling seamless synchronization between the client and the database**.[14]**

Firebase Hosting: Firebase Hosting offers fast and secure hosting for both static and dynamic web content via the Firebase CLI (Command Line Interface).[**15]**

Why Firebase is Recommended:

- Real-Time Synchronization for instant UI updates.
- Serverless Architecture that allows developers to focus on frontend logic.
- High Security and Scalability, supported by built-in authentication and security rules.
- Cross-Platform Compatibility for web, Android, and iOS applications.[16]

4.4.3 Node.js:

Node.js is a JavaScript runtime environment built on Chrome's V8 JavaScript engine. It allows developers to execute JavaScript on the server side and is essential in the Angular development ecosystem. [19]

4.4.3.1 npm (Node Package Manager):

npm is the package manager for Node.js and is used to manage project dependencies**.[20]**

4.5 Representation of application interfaces:

In this part we will present some interfaces, which will put in the real conditions of use of the application:

4.5.1 “Authentication” interface:

To access the system, the user must enter their **work number**, **username**, and **password**. If the credentials are valid, the system grants access and redirects the user to the homepage. Otherwise, an error message such as **"Failed to login"** is displayed.

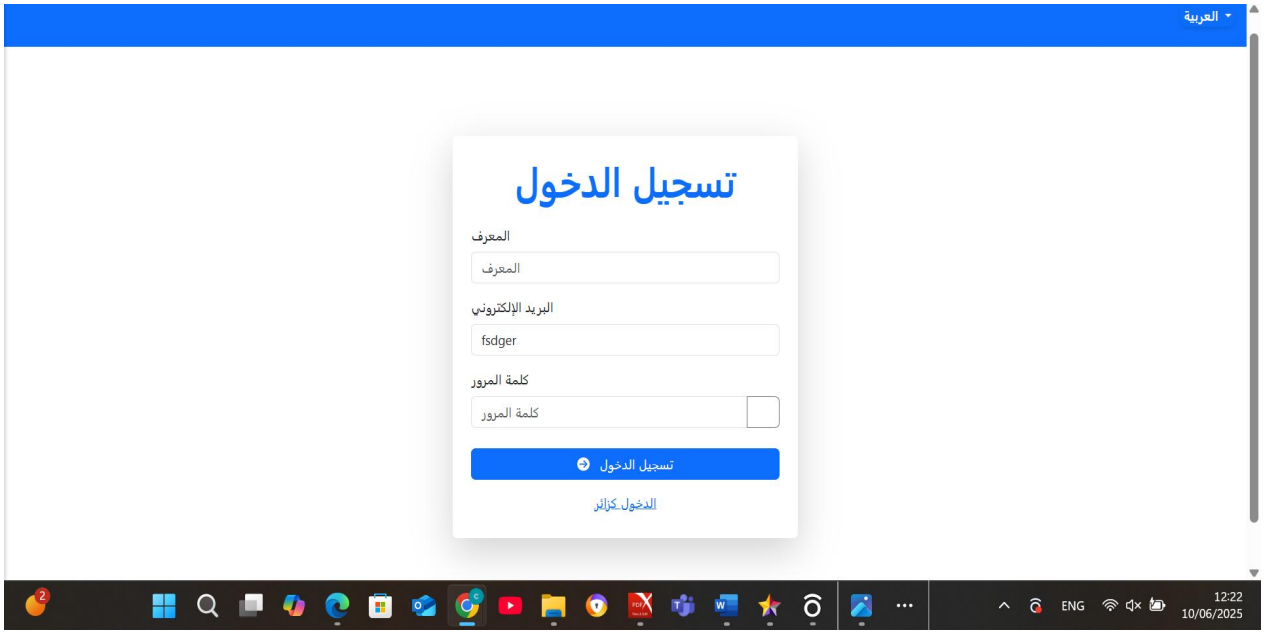

Figure 4.2: “Authentication” interface.

4.5.2 “Admin dashboar” interface:

After successful authentication, administrators are redirected to the **Admin Dashboard**, which serves as the central hub for managing the system. This interface provides quick access to essential functionalities.

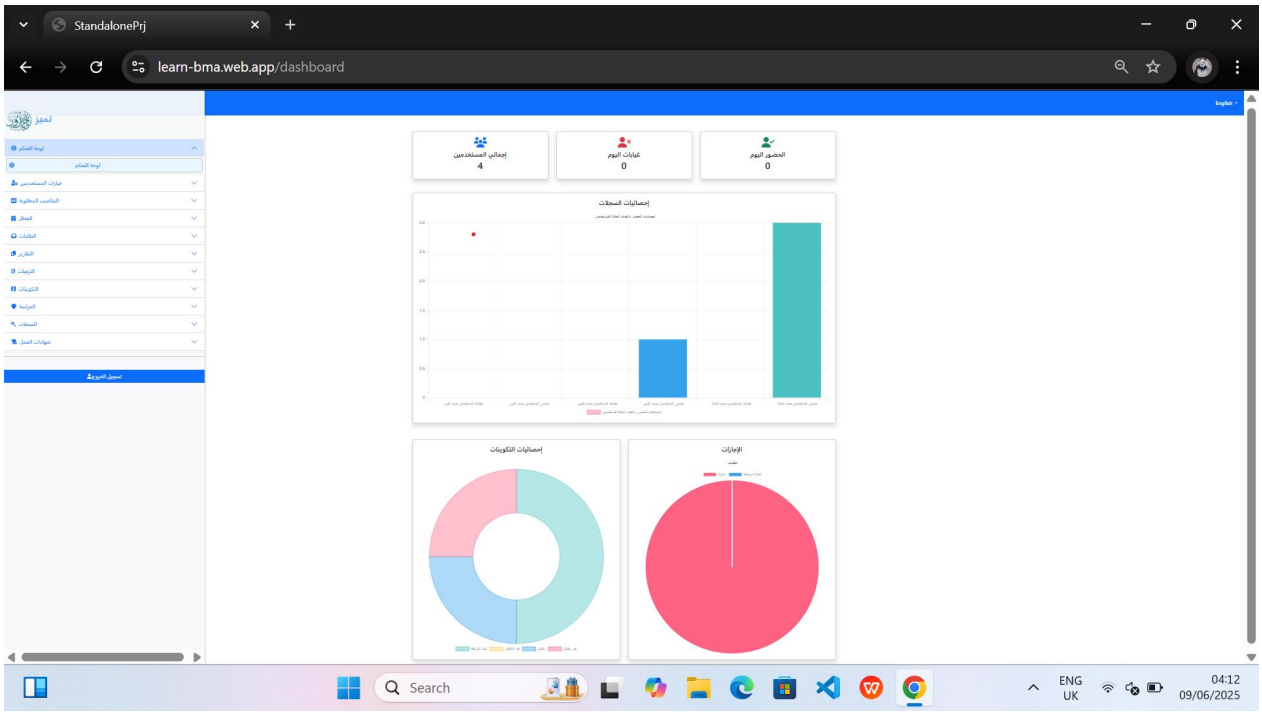

Figure 4.3: "Dashboard" interface.

4.5.3 "List of users" interface:

This interface shows the list of employees for admin.

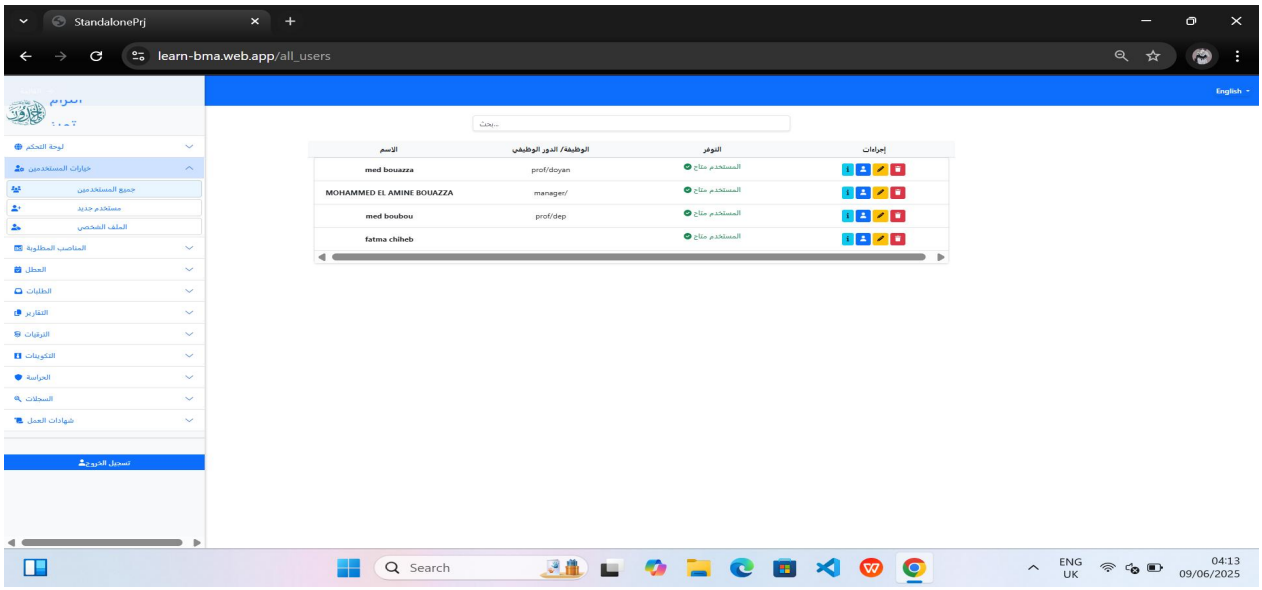

Figure 4.4: "List of users" interface.

4.5.4 “Add user” interface:

The **Add User** interface allows the administrator to register a new employee, guard, or admin into the system.

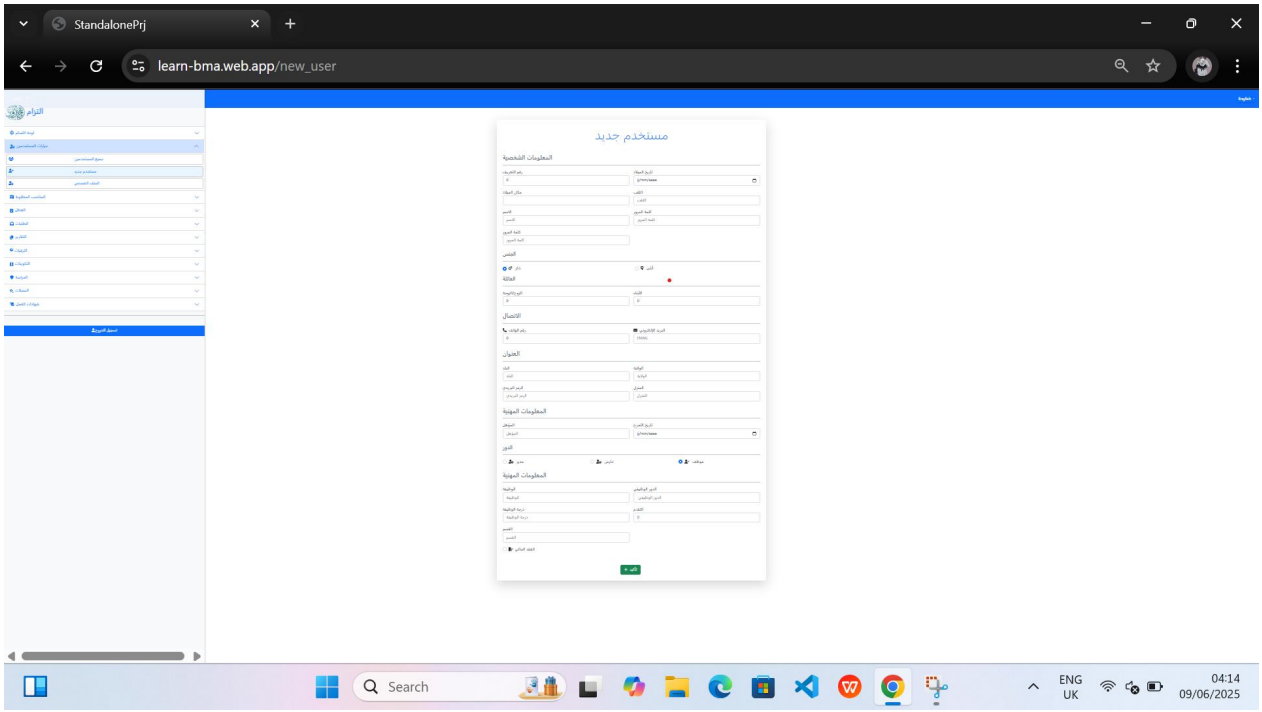

Figure 4.5: “Add user” interface.

4.5.5 “View profile” interface:

This interface allows the user to **consult their personal information** stored in the system, such as their name, contact details, grade, echelon, responsibilities, and functions. The layout presents the data in a clear and organized manner.

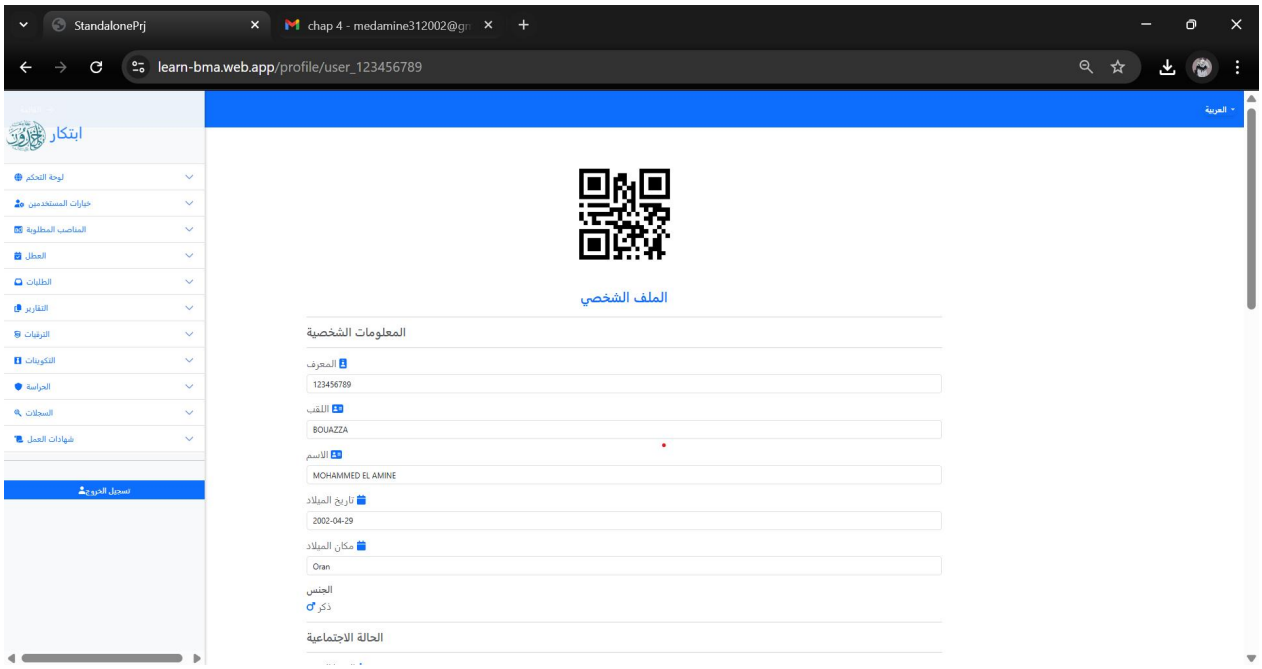

Figure 4.6: "User profile" interface.

While consulting profile user can make a report.

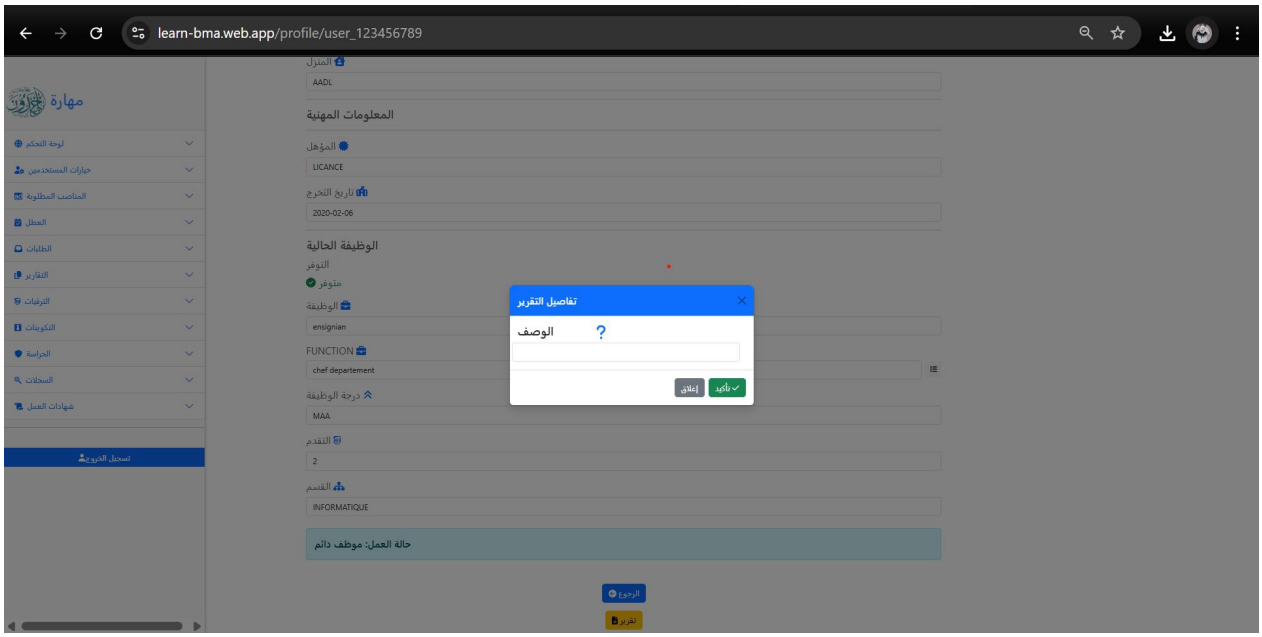

Figure 4.7: "Making report" interface.

4.5.6 “Promotion request” interface:

The **Requests** interface allows users (employees, guards) to submit various types of requests, such as:

- **Promotion**
- **Formation**
- **Holiday**
- **Work Certificate**
- **Report**

When selecting a **Promotion**, the user is given the option to choose between:

- **Promotion by Echelon**.
- **Promotion by Grade**.

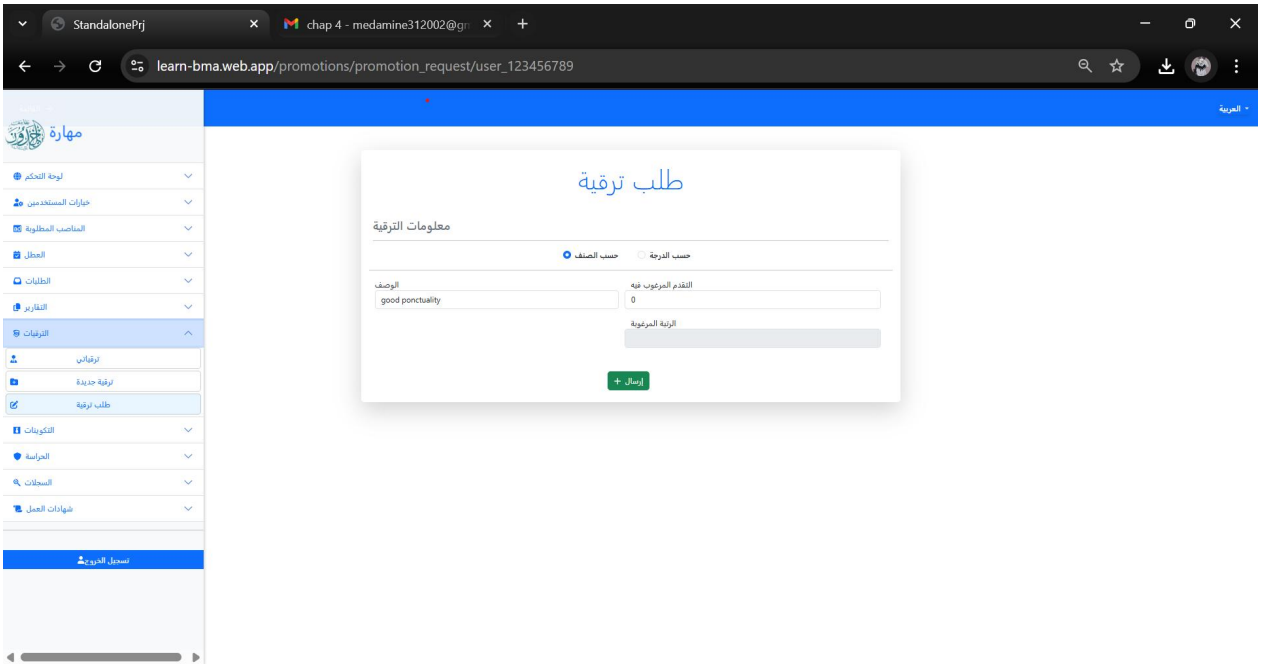

Figure 4.8: "Promotions request" interface

4.5.7 "work_certificate request" interface:

In the **Work Certificate** section, the admin has the ability to:

- **Select multiple users** for whom work certificates should be generated.
- **Choose the language version** of the certificate: either **Arabic** or **French**.

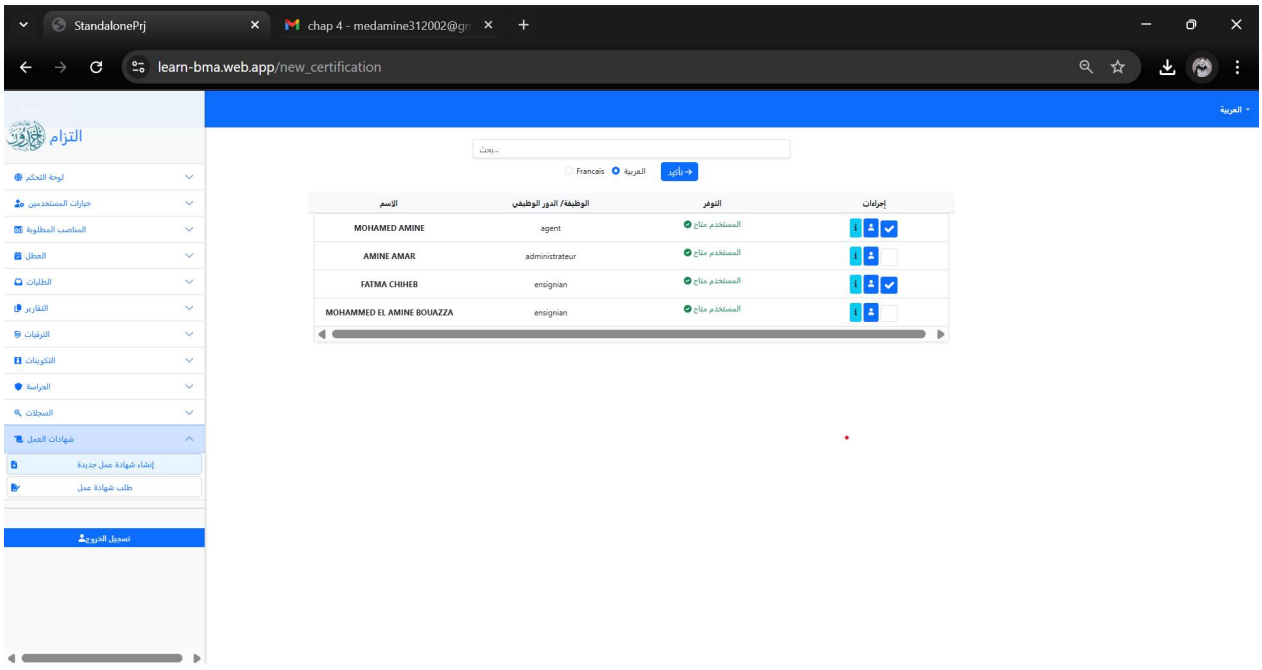

Figure 4.9: "Work certificate request" interface.

- After selection, the system **generates a PDF file** containing all the requested certificates formatted and ready for download.

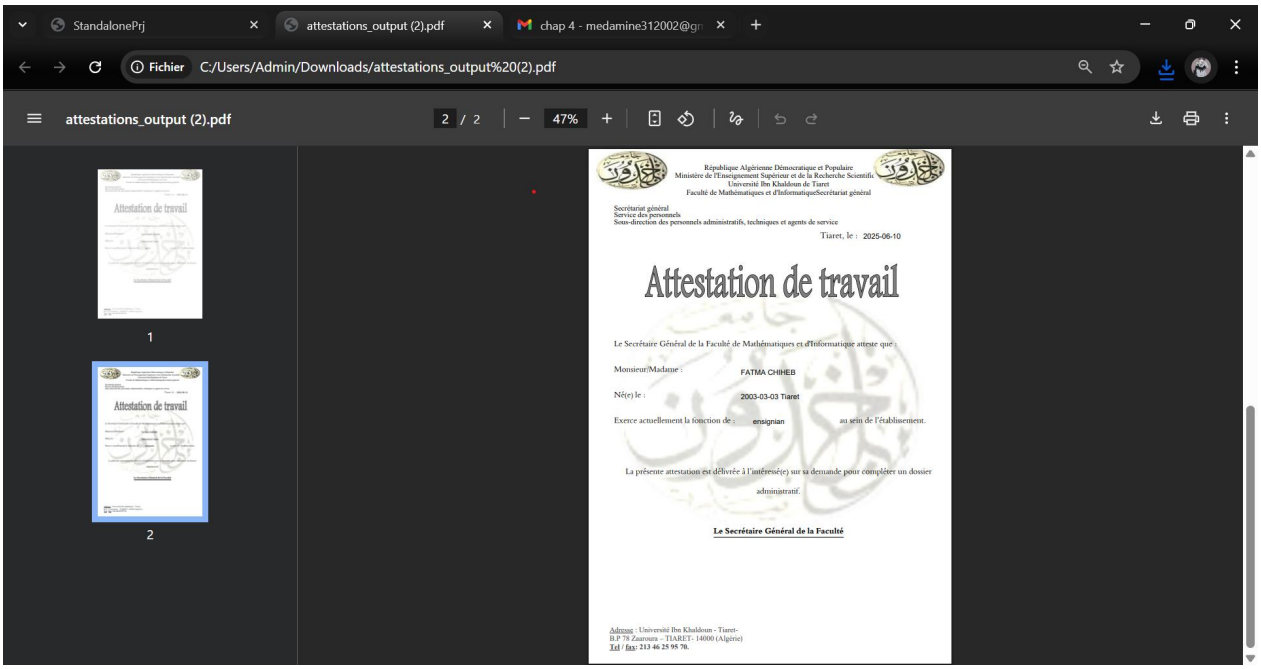

Figure 4.10: "Work certificate" prototype.

4.5.8 "Logs and QR Code Scanning" interface:

Guards use a mobile interface or scanner to:

- **Scan QR codes** presented by employees.

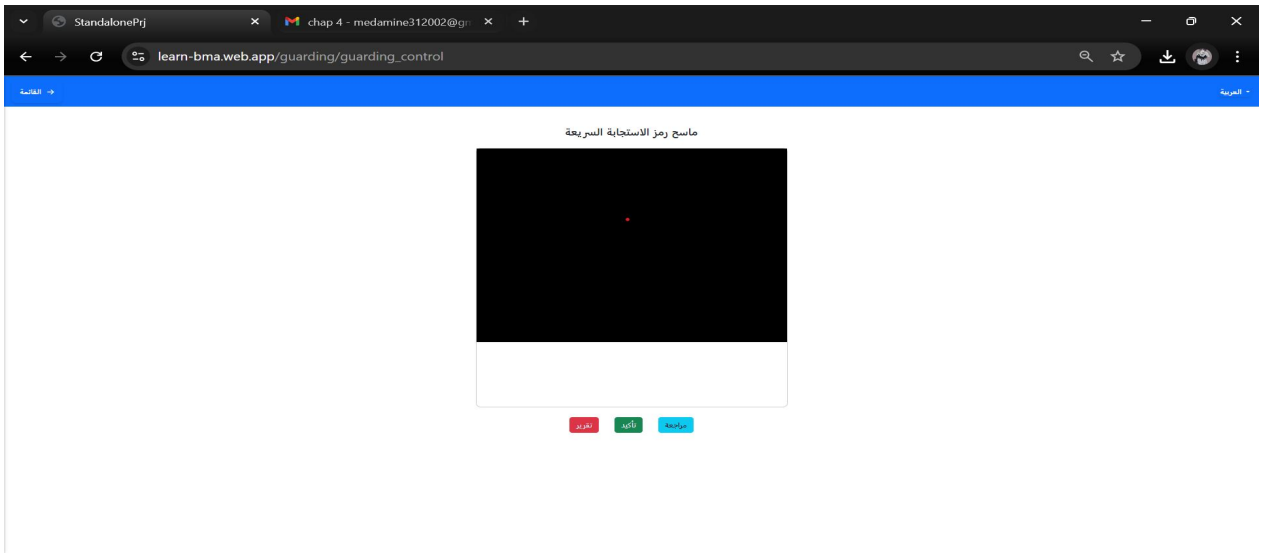

Figure 4.11: “QR Code Scanning” interface.

- The system logs the **entry or exit time**, creating an **attendance record** for the user.
- This log contributes to the system's security and attendance tracking mechanism.

This scanning mechanism ensures that physical presence is recorded accurately and in real-time.

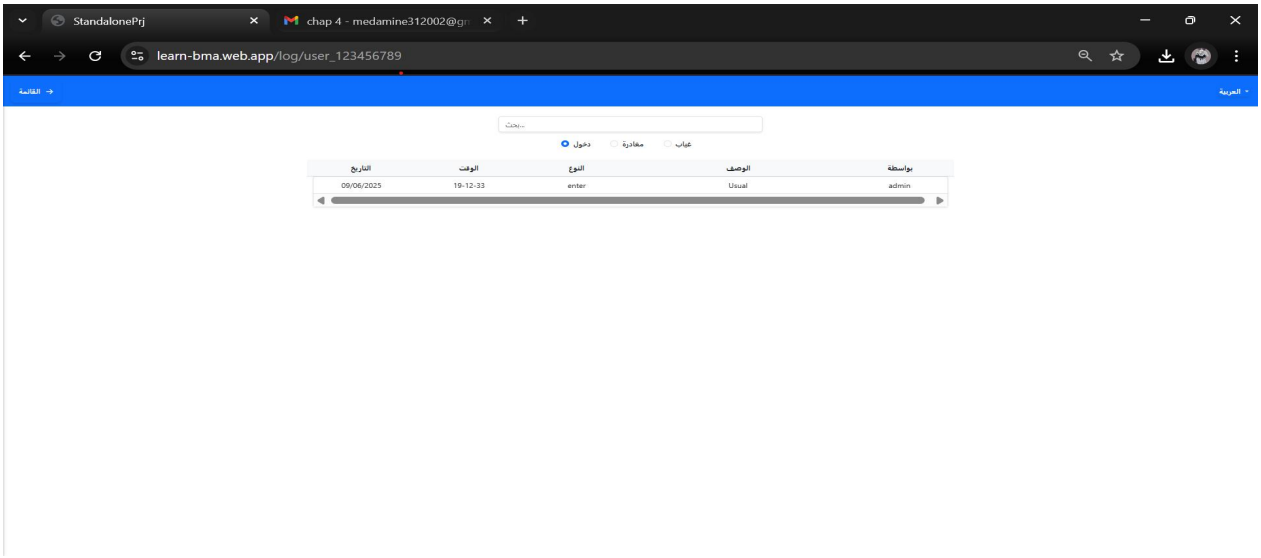

Figure 4.12: “Logs history” interface.

4.6 Conclusion:

In this chapter, we presented the implementation of our Human Resource Management System. We described the main functionalities developed, the user interfaces, and the technologies used, such as Angular and Firebase. The system was built to meet the needs of different users by offering features. This implementation demonstrates the practical realization of our design and serves as a strong base for future improvements.

GENERAL CONCLUSION

This project was carried out as part of our final year project for the completion of a master degree in computer science. It focused on the design and development of a web-based Human Resource Management System (HRMS) for The Mathematics and Computer science Faculty, aiming to meet specific HR needs such as managing employee requests (holidays, training, promotion, reports, work certificates), tracking career progression, and managing roles, responsibilities, echelons, and grades over time.

To achieve this, we followed a structured methodology, beginning with a clear **definition of Human Resource Management (HRM) and its core functions**, followed by a thorough **analysis of the current system** within the institution. We also conducted a **comparative study of existing HRM solutions** (such as Odoo, OrangeHRM, and other open-source platforms), which helped guide the design of our own system. We then used **UML modeling** (use case diagrams, sequence diagrams, and class diagrams) to formalize functional requirements and system interactions.

From a technical perspective, the application was built using **Angular** for the front-end and **Firebase** for authentication, data storage, and backend services. This technology stack enabled us to build a modern, scalable, and responsive solution.

While the current system addresses the identified needs, it remains **open to future improvements**, especially through the integration of **artificial intelligence techniques**. For example, AI could help automate request handling, detect anomalies in HR processes, or recommend personalized training and promotion paths.

Overall, this project was a valuable opportunity to apply the knowledge acquired during our studies, strengthen our problem-solving and technical skills, and gain practical experience with modern web development tools. It also lays a solid foundation for future enhancements aligned with the evolving needs of the faculty and HRM best practices.

Abstract

This project focuses on the design and modelling of a Human Resource Management System (HRMS) aimed at improving the administrative management of personnel within an organization. It is structured around three types of users: employees, HR administrators, and security agents. The system enables the management of various requests, including leave, training, promotion, work certificates, and reports. It also ensures the tracking of employee responsibilities, functions, grades, and echelons over time. Through a rigorous functional analysis and the use of UML diagrams (use case, sequence, and class diagrams), a clear, scalable, and domain-accurate architecture has been proposed to effectively meet HR management needs.

Résumé

Ce projet porte sur la conception et la modélisation d'un système de gestion des ressources humaines (HRMS) destiné à améliorer la gestion administrative du personnel au sein d'une organisation. Il s'articule autour de trois types d'utilisateurs : les employés, les administrateurs RH et les agents de sécurité. Le système permet notamment la gestion des demandes de congé, de formation, de promotion, de certificats de travail et de rapports, ainsi que le suivi des responsabilités, fonctions, grades et échelons des employés dans le temps. À travers une analyse fonctionnelle rigoureuse et l'utilisation de diagrammes UML (cas d'utilisation, séquence, classe), une architecture claire, évolutive et fidèle à la réalité du domaine RH a été proposée.

ملخص

يركز هذا المشروع على تصميم و نمذجة نظام ادارة الموارد البشرية بهدف تحسين الادارة الادارية للموظفين داخل المؤسسة. بقوم النظام على ثلاث فئات من المستخدمين: الموظفون ، مسؤولو الموارد البشرية ، ووكلاء الامن. يتيح هذا النظام ادارة مجموعة متنوعة من الطلبات مثل طلبات الاجازة ، التكوين ، الترقية ، شهادات العمل ، و التقارير. كما يضمن تتبع تطور المسؤوليات ، المهام ، الدرجات و السلالم الوظيفية للموظفين عبر الزمن. و من خلال تحليل وظيفي دقيق و اعتماد مخططات حالات الاستخدام ، المخططات التسلسلية ، و مخطط الفئات. تم اقتراح بنية واضحة و قابلة للتوسع. تتوافق مع خصوصيات مجال ادارة الموارد البشرية و تلبي احتياجاته بفعالية.

BIBLIOGRAPHY

[1] Arioua, N., & Benyamina, S. (n.d.). *Employing human resources at the Algerian University: Policy, procedures, and impact of the organizational culture*. University of M'sila, Algeria.

[2] Sułkowski, Ł., Przytuła, S., & Kulikowski, K. (2025). *Human resource management in higher education institutions*. Publisher. https://doi.org/

[3] Dessler, G. (2020). *Human resource management* (16th ed.). Pearson.

[4] Khuong, M. N., Mai, T. P., & Phuong, N. T. M. (n.d.). *The impacts of human resource management practices on employees' motivation and loyalty*. International University - Vietnam National University, Ho Chi Minh City, Vietnam.

[5] *Cours Complet GPEC*. (n.d.). Scribd. Retrieved [05,14, 2025], from https://www.scribd.com/document/675097316/Cours-Complet-GPEC

[6] Achievers. (2023, May 3). *Diversity and inclusion in the workplace*. Achievers Blog. https://www.achievers.com/blog/diversity-and-inclusion/

[7] Maazouz, M. (n.d.). *La Responsabilité Sociétale et la Performance de GRH dans les Entreprises*. ISEM, Université de Nice Sophia-Antipolis, France / CECCI, Université de M'Sila, Algérie.

[8] IBM Think. (n.d.). *What is SAP SuccessFactors?* IBM. Retrieved June 10, 2025, from IBM website

[9] Workday @ RISD. (n.d.). *Features of Workday*. Rhode Island School of Design. Retrieved June 10, 2025, from https://workday.risd.edu/features-of-workday/

[10] Redress Compliance. (n.d.). *Oracle HCM Cloud benefits: A comprehensive guide*. Retrieved June 10, 2025, from https://redresscompliance.com/oracle-hcm-cloud-benefits-a-comprehensive-guide/

[11] Software Advice. (n.d.). *BambooHR – Software Profile*. Software Advice. Retrieved June 10, 2025, from https://www.softwareadvice.com/hr/bamboohr-profile/

[12] JoinSecret. (n.d.). *BambooHR reviews*. Retrieved June 10, 2025, from https://www.joinsecret.com/bamboohr/reviews

[13] Synconics. (n.d.). *Compare Odoo vs BambooHR vs SAP vs Oracle HCM vs Workday vs Personio*. Synconics. https://www.synconics.com/compare-odoo-vs-bamboohr-vs-sap-vs-oraclehcm-vs-workday-vs-personio

[14] Google LLC. (n.d.). *Firebase Documentation*. Firebase. Retrieved from https://firebase.google.com/docs

[15] Google LLC. (n.d.). *Firebase Hosting*. Firebase. Retrieved from https://firebase.google.com/products/hosting

[16] Google LLC. (n.d.). *Firebase on Google Cloud*. Google Cloud. Retrieved from https://cloud.google.com/firebase

[17] Google LLC. (n.d.). *Angular Documentation*. Angular. Retrieved from https://angular.io

[18] Microsoft. (n.d.). *Visual Studio Code Documentation*. Visual Studio Code. Retrieved from https://code.visualstudio.com/docs

[19] OpenJS Foundation. (n.d.). *Node.js Documentation*. Node.js. Retrieved from https://nodejs.org/en/docs

[20] npm, Inc. (n.d.). *npm Documentation*. npm. Retrieved from https://docs.npmjs.com

[21] StarUML. (n.d.). *StarUML – The best software modeling tool*. Retrieved June 10, 2025, from https://staruml.io