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THE DEVELOPMENT OF WORKFORCE MANAGEMENT SYSTEM FOR FALCON KINGDOM ACADEMY USING RULE-BASED EXPERT SYSTEM

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The Development of Workforce Management System for Falcon Kingdom Academy Using Rule-Based Expert System Logic

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The project was prepared under the supervision of the project supervisor, Miss Nurul Nadzirah binti Mohd Hasri. It was submitted to the Faculty of Computer and Mathematical Science and was accepted in partial fulfillment of the requirements for the degree of Bachelor of Information System Engineering.

Approved By

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STUDENT DECLARATION

I certify that this project to which it refers is the product of my own work and that any idea or quotation from the work of other people, published or otherwise, are fully acknowledged in accordance with the standard referring practices of the discipline.

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MUHAMMAD AMIR AFHAM BIN SHAHRIZUAN

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LIST OF ABBREVIATIONS

WFM	Workforce Management
AI	Artificial Intelligence
HR	Human Resource
HCM	Human Capital Management
SDLC	System Development Life Cycle
SRS	Software Requirement Specification
DDSM	Data-Driven Smart Manufacturing

CHAPTER 1

INTRODUCTION

This chapter presents the background of study, problem statement, project objectives, project scope. and project significance.

1.1 Background of Study

According to Vance & Paik (2015), workforce refers to an organization's global human talent, wherever the employees are temporarily or permanently located in the world. In short terms, workforce meaning the pool of labor available for work or not, whether it is full-time or part-time workers.

A well-trained and adaptable workforce is crucial for driving economic growth and meeting industry demands, a fact that has been recognized by policymakers worldwide. According to Ramasamy and Rowley (2013), Malaysia's labor policies started emphasizing technical, vocational education and training (TVET) to support rapid industrial growth and increase the employability of the local workforce. In the 1990s, a shift toward privatization, skills upgrading, and the early foundation of a knowledge-based economy.

Workforce management is about helping organizations run smoothly by making sure the right people are in the right place at the right time. It involves things like scheduling, tracking attendance, and managing performance. By keeping everything organized in one place, it is easier to stay compliant with labor laws, make informed decisions, and create a more efficient and supportive work environment (Khan, 2024). The goal is to boost productivity while minimizing potential risks. According to Ramasamy and Rowley in 2013, they said that the importance of aligning skill formation with economic transformation, especially as Malaysia

transitions to a service-driven and innovation-led economy. This necessitates systems that can effectively match labor supply with demand, enhance productivity, and support continuous skill development.

Falcon Kingdom Academy, a training and event consultancy under an organization named MH Kingdom Empire, serves in making team building and development programs. It was founded by Mohd Hafiz bin Mohd Nor who is the current executive director. The headquarters of this organization is located at Taman Melawati, Kuala Lumpur. The business that Falcon Kingdom Academy specializes in training and motivational events such as team building, workshops, camps, educational trips and family programs. This wide range of types of events is handled by using team-based and mostly hands-on experience. The current workforce is approximately around 190 workers including permanent workers, part-time and full-time facilitators. As there is a wide variety of programs that are being held, a group of facilitators are needed to facilitate the operations of operating the event. The assigning facilitator process is currently based on the experience, education, ability and behavior. However, the performance of their facilitators is hardly noticeable by the facilitator manager as there are too many facilitators to be managed. The experience felt by each facilitator may vary based on bias and perspective. This gives a different thoughts on recommending facilitators to events due to the perception of each facilitator is vary. Thus, with incorrect assignment of facilitators in event, problems such as inexperienced facilitators, bad behavior and lack of cooperation happens.

This organization serves as a relevant example of such operational challenges as it faces difficulties in assigning the correct facilitator for each type of event. With a workforce management system, the operation department can manage their facilitators better.

1.2 Problem Statement

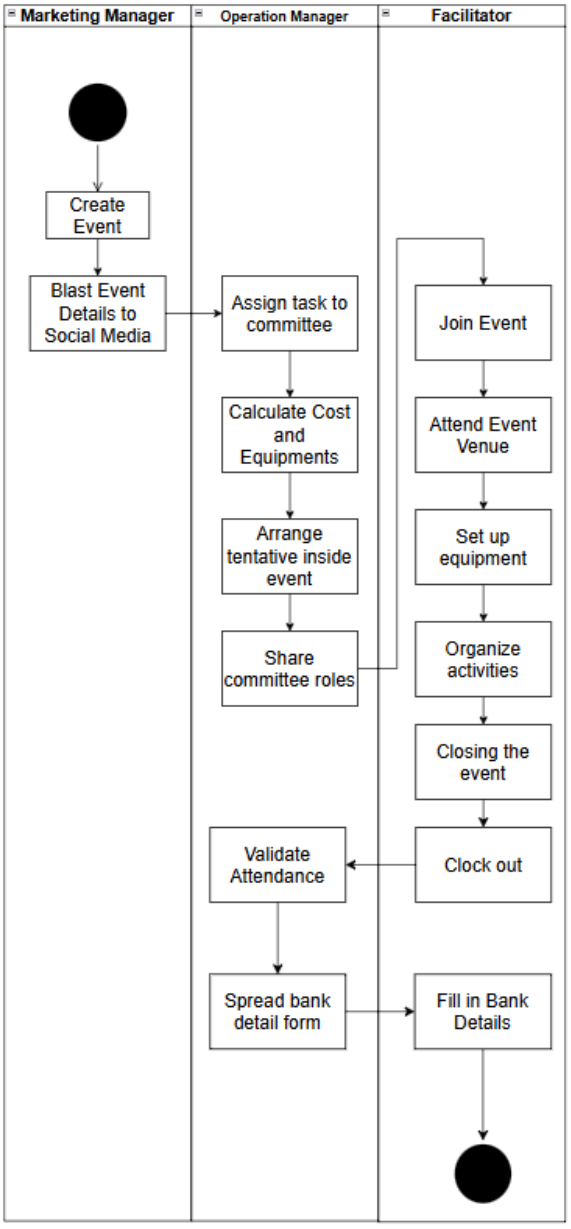


Figure 1.0 : Activity Diagram of Current Process of Managing Workforce in Falcon Kingdom Academy

Figure 1.0 shows the current process of managing the workforce inside the company.This activity diagram is the current event workflow process that occurs within Falcon Kingdom Academy, with three major roles involved, Marketing Manager, Operation Manager and

Facilitator. The process initiates with the Marketing Manager, who is responsible for creating the event and advertising the details on social media sites to attract customers. After the creation of the event, the Operation Manager takes over and assigns tasks to the committee members and calculates the costs and equipment needed for the event. The manager then arranges the event's tentative schedule and distributes specific roles among the facilitator committee before the execution of the event.

During the event, facilitators perform their role: join the event, attend the venue, set up equipment, organize activities and help the program run smoothly. Once the event is over, facilitators clock out and fill in their bank details via a form to get paid. Meanwhile, the Operation Manager confirms if the facilitators really attended the event and that payment details are collected and prepared for the processing of payment.

Overall, the diagram represents the end-to-end process flow in event management, from planning and execution to attendance validation to salary processing. However, it also puts in focus the weaknesses of the prevailing manual process for effective tracking of attendance and management of remunerations that could be greatly simplified with an integrated system for smooth coordination and automation.

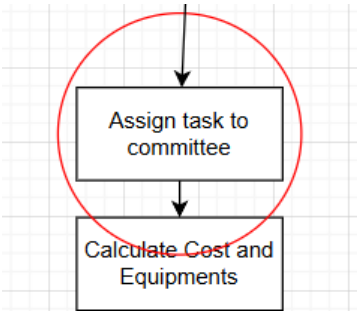


Figure 1.1: Assigning process issue from Figure 1.0 Activity Diagram

Based on an interview conducted on 27 May 2025 with Mr. Qawiem, operational manager for Falcon Kingdom Academy. Figure 1.1 shows that the main problem that is faced is the frequent wrongly assigned roles for facilitators. The operation department struggles to determine whether the facilitator is suitable for a particular event. Since Falcon Kingdom Academy offers multiple types of events, it is important to understand the performance and behavior of each facilitator before assigning tasks. Currently there is no system that suggests

facilitators. The assigning process relies heavily on assumptions and cooperation experience. This problem leads to inefficiency in managing the workforce during daily operations. Often resulting in human skills frequently being overlooked and unnoticed as there is no approach in evaluating human skills (Bibi et. al., 2021). To solve this problem, a workforce management system is issued to help suggest facilitators that are most suitable for specific event roles.

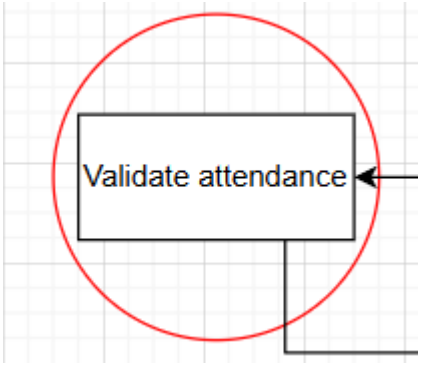


Figure 1.2 : Attendance validation issue from Figure 1.0 Activity Diagram

Based on Figure 1.2, the current process of the facilitator in attending and clocking out from their work is by sharing live location using Whatsapp. This method of validating attendance does not use any application programming interface that integrates with another system for storing attendance. This brought to problems such as difficulty in tracing attendance and performance of facilitators.

Furthermore, the operations manager also finds it difficult to track the performance of facilitators after each event. Without clear records, it's hard to evaluate how well each facilitator has performed or to make informed decisions when assigning them to future event slots based on their attendance, strengths and weaknesses. Having this data stored would make it much easier not only to manage assignments more fairly but also to recognize and reward facilitators during events like the AGM or on the day of the program itself.

Next, the current process of paying the facilitator their own salary for each event participation is becoming increasingly difficult due to increment of facilitator. Mr. Qawiem discussed that the process of filling in the form using Whatsapp tends to affect the salary payment causing salary payment delay issues for workers after an event. Workers tend to receive their salaries late due to oversight, as there are many programs and people involved at the same

time. Payment tracking relies on WhatsApp groups, and a WhatsApp form is used to collect bank details. The current process of collecting bank details results in redundant information and inconsistency due to repeated manual process entries.

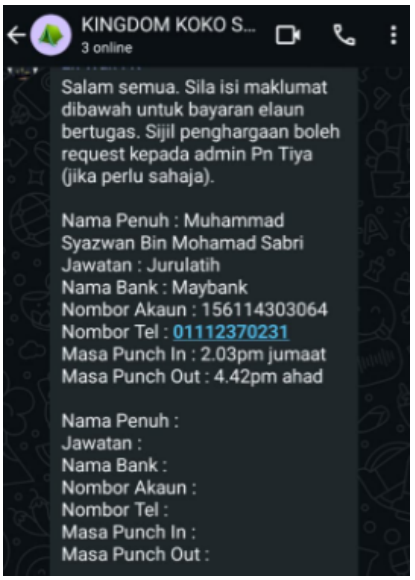


Figure 1.4 : Salary payment form

Figure 1.4 shows one of the forms that facilitators need to fill in after completing the event. The difficulty of tracking bank details increases when the collection of bank details increases. This inefficient work process is time consuming due to manually tracking bank details from forms filled in WhatsApp. According to Badroldin et al. (2018), late payments are a critical issue, often resulting from poor financial management and documentation errors. Such delays can disrupt cash flow and affect timely salary disbursements.

1.3 Project Objectives

The objectives of this project are:

1. To identify the requirements for the workforce management system for Falcon Kingdom Academy using rule-based expert system logic.
2. To design the workforce management system for Falcon Kingdom Academy using rule-based expert system logic.
3. To develop the workforce management system for Falcon Kingdom Academy using rule-based expert system logic.

1.4 Project Scope

The scope of this project aims to develop a Workforce Management System specifically for Falcon Kingdom Academy, focusing on improving the workforce management of full-time and part-time facilitators. The system will be tailored for the department involved specifically for the operation department that manages the workforce of facilitators. Besides, it will also be used by facilitators for collecting their performance and attendance. The development of this system will be deployed as a web based application.

The system will be featuring a rule-based expert system as a decision support system. A rule-based expert system operates by analyzing characteristics, features and feedback defined by keywords or tags, then generating recommendations based on the traits found and matching it with the current needs.(Phalle & Bhushan , 2024). The content-based filtering technique will be playing an important role in analyzing facilitator's past event participation and also their past performances. By the facilitator assignment process, the system will reduce reliance on subjective judgments and improve operational efficiency.

Other than that, facilitator performance tracking feature aims to store all of the facilitators performance and behavior. The collection data of performance and behavior will be mainly based on forms filled in by facilitators that operate the events and the attendance of each event. The performance and behavior will be rated based on their experiences working collaboratively. As the attendance will be strictly based on their time attending the event.

Additionally, the system will incorporate a facilitator payroll feature, addressing current issues such as delayed payments. Delayed payments due to manual processing in tracking the bank details in text forms inside WhatsApp, will be replaced by a more friendly feature that stores all of the bank information of each facilitator. The payroll feature will also track the facilitator involvement of events that are created.

The main users of this system will be the operations department, responsible for scheduling and workforce allocation, ensuring the system supports daily operational needs effectively including facilitators as a model to collect data for their behavior and performance to produce a recommendation.

1.5 Research Significance

The development of this Workforce Management System is highly significant to improve the daily operations and overall effectiveness of Falcon Kingdom Academy as the organization continues to handle a growing number of programs and facilitators. The current manual processes used for scheduling, attendance tracking, and payments have become increasingly inefficient and lead to error. This system offers a practical solution by helping the operations department manage the workforce more smoothly and with greater accuracy.

The proposed Workforce Management System is designed to make this process easier and better. By using past data and performance records, the system will suggest facilitators who are best suited for specific roles. The operation department will receive this benefit by ensuring that assignments are fair and well-matched, and that each program runs more smoothly with the right people in place.

Another key benefit is better performance tracking. At the moment, there are no records to keep track of how well facilitators perform in their roles. Without that information, it is hard for the operation department to make informed decisions for future assignments, or to recognize facilitators for their contributions. Plus, facilitators will also get assigned to more suited events suitable for their capabilities.

Finally, the system also helps address payment delays. Currently, salaries are processed manually through WhatsApp forms, which can be disorganized and lead to late payments. By tracking attendance and collecting bank details within the system, payments can be managed more efficiently and on time, building more trust and satisfaction among the facilitators.

1.6 Summary

Chapter 1 covers the outline and foundation of the Workforce Management System for Falcon Kingdom Academy to solve key operational problems such as assigning facilitators, tracking performance, and salary payments. The current processes for assigning facilitators, tracking performance, and managing salary payments are manual and fragmented. These manual processes lead to problems such as wrongly assigned facilitators, unknown facilitator performance, and unreliable salary payments. These problems lead to inefficiency in organizing

staff, and event flow. By combining all these functions into one management system will be an effective way in managing the workforce.

CHAPTER 2

LITERATURE REVIEW

This chapter will present a review of existing relevant literature on the development of the workforce management system.

2.1 Workforce

The workforce plays a crucial role in achieving business goals in any industry. According to Vance & Paik (2015), workforce refers to an organization's global human talent, wherever the employees are temporarily or permanently located in the world. Meanwhile, Hadrawi et al. (2022) emphasizes that workforce involves group of individuals engaged or available for work, either in a country or region or in a specific company or sector.The workforce encompasses all individuals engaged in productive activities within an organization or economy, regardless of employment type, and represents a critical human capital asset essential for operational efficiency and strategic growth. According to Khang et al.(2023), there are multiple types of workers inside an organization such as freelancers, part-time, full-time, consultants, independent contractors, freelancers, temporary workers and seasonal workers.

This project was focused on managing the workforce of full-time and part-time facilitators as there are approximately a number of 190 facilitators inside Falcon Kingdom Academy.

2.1.1 Workforce Trends In Malaysia

The rising gig economy inside Malaysia changed the workforce trend in Malaysia since the COVID-19 pandemic. The change of the workforce trends is driven by demographic and shifting economic policies. According to Nawawi et al. (2023) , the authors emphasize that economic activity related to people's short-term, project-based, and outcome-defined labor is referred to as the gig economy. As the gig economy, specifically in e-hailing companies like GrabFood, Foodpanda, and GrabCar, the workforce tends to rise in these companies as the flexibility of time management

(Nawawi et al. , 2023). According to Zelma (2024) policymakers now face the task of regulating this sector to protect worker welfare. Academically, researchers observe that gig work lacks the stability of traditional jobs, tasks are ad hoc and contract-based, with weak ties to a single employer (Zelma , 2024).

The changes impact the workflow of organizations shifting from working traditionally to remotely distributed workforces resulting in increase of online solution usage. Mkhize & Lourens (2025) emphasize that incorporating AI, robotics, and machine learning is foreseen to herald the automation of knowledge-based jobs and tasks. New technologies and automation tools reconstruct the workforce transforming AI and digital solutions leading to hybrid collaboration between machines and humans. Leading to new job roles and skills for technology adaptations.

These transformations show the changes of the workforce going on through major shifts from traditional workflows into digitalized and remote works. Flexible gig jobs and remote work inside corporations has become a new norm in this era.

2.2 Workforce management

A workforce management is a solution that helps organizations in automating and optimizing processes related to employee time tracking, labor deployment, self-service for both employees and managers, and ensuring workplace safety. It is all about strategically planning and coordinating the people behind the operation. It involves making sure the right employees with the right skills are in the right place at the right time (Onifade et al. , 2025). According to Adesanyan et al. (2025), the workforce management focuses on aligning staffing levels with workloads by making sure the right people are assigned to the right jobs at the right time. This involves planning which staff are really suited for the work and creating a work schedule to match with their own capabilities. The services industry is one of the industries especially in event planning that highly depends on human coordination.

2.2.1 Elements of workforce management

To extinguish a better understanding of the impact of a workforce management, it is important to explore the elements of a workforce management. In developing workforce management, these processes create bonds together to create a comprehensive system that manages daily operations and also supports the organization in improving the current state of their performance.

A. Workforce planning

According to Wang (2024), workforce planning is a process that helps businesses prepare for future staffing needs based on their goals, growth plans, and changes in the market. Rather than reacting to staffing issues as they arise, workforce planning allows organizations to stay one step ahead. The crucial part of this process is forecasting. This means using current employment trends, company plans, and industry conditions to predict how many staff will be needed in the future. Tools like statistical models and scenario planning help HR teams explore different possibilities, such as what to do if the business expands rapidly or if there's an unexpected downturn (Wang, 2024). This kind of preparation helps organizations stay prepared and ready to adapt.

However, in recruiting people in the process of workforce planning, the traits , performance, and capabilities need to be considered before assigning them to roles. Hiring the right people is not just about filling job positions, it is about finding individuals with the right skills and mindset who can contribute to organizational growth. When recruitment focuses on both talent and shared values, it helps build a team that not only meets today's needs but also supports where the organization wants to go in the future (Wang,2024). In the context of service-based companies like Falcon Kingdom Academy, allocating the right facilitators in each of their events is crucial for the comfort of the participants and the workflow efficiency during the execution of the event. This impacts in giving a more contribution to their own growth and also the cooperation between facilitators that work together in organizing the events.

B. Scheduling

Scheduling plays a crucial role in workforce management, as it directly impacts both operational efficiency and employee health. Effective scheduling ensures that the right number of staff with the appropriate skills are available at the right time to meet service demands. Rinaldi et al. (2022) highlight the importance of incorporating ergonomic risk factors and human performance into scheduling decisions, noting that worker capabilities

vary across different tasks and even across task sequences.

C. Time and attendance management

Time management is all about planning your time wisely and staying in control of how it's spent on different tasks, so you can be more effective, efficient, and productive. Especially in the event industry, managing time well is absolutely essential for determining whether an event runs smoothly or falls apart (Ahmad et al. , 2012). Time management plays a critical role in determining job performance, especially in environments like event planning that involves a variety of types of facilitators for handling the events. This time and attendance management helps in supporting the decision for choosing the experienced facilitators and acknowledge facilitators that are new.

D. Analytics and reporting

Analytics and reporting help make workforce planning smarter. By using data, organizations can make better decisions about their people. Organizations can improve hiring, spot potential issues early, and make sure the workforce is growing in the right direction to support long-term goals. Elugbaju et al. (2024) said that Human Resource Analytics (HRA) provides evidence-based insights that support effective workforce planning and succession management, utilizing both quantitative and qualitative data to ensure a holistic understanding of workforce dynamics. This way, with a proper analysis, it will improve the hiring process and retention.

This project was intended to implement the workforce elements into the system that involve workforce planning for assigning facilitators with suitable events, time and attendance management for tracking facilitator participation and also reporting for Falcon Kingdom Academy. This not only facilitated the workflow of managing their workforce, but also making beneficial impacts to the audience that attended the events.

2.3 Artificial Intelligence in Decision Support and Management

Artificial Intelligence (AI) has evolved from a theoretical discipline into a critical driver of operational efficiency across industries. In the context of Human Resource Management (HRM) and operations, AI is no longer limited to simple data processing but is increasingly tasked with complex decision-making, such as predicting workforce performance and optimizing resource allocation. Recent literature from *ScienceDirect* and *IEEE Xplore* indicates a paradigm shift where AI systems are designed not just to automate tasks but to augment human decision-making by handling high-dimensional constraints that exceed human cognitive capacity (Yang & Zhu, 2024).

In the specific domain of event management and staffing, the challenge lies in the "combinatorial explosion" of matching a finite pool of staff to dynamic event requirements while adhering to legal, physical, and preferential constraints. While modern machine learning (ML) models excel at pattern recognition, they often lack the transparency required for administrative decisions where justification is legally or operationally necessary. This necessity has sustained the relevance of symbolic AI, particularly Expert Systems, which offer interpretable and logical reasoning capabilities (Sarkar, 2021).

Table 2.1 : Rule-Based Expert System vs Alternative

Characteristic	**Rule-Based Expert System (RBES)**	**Neural Networks (NN) / Machine Learning (ML)**	**Mathematical Optimization (CP / MILP)**	**Academic Evidence**
Knowledge Representation	**Explicit & Symbolic:** Knowledge is encoded as human-readable "IF-THEN" rules and facts. It relies on a predefined knowledge base derived from domain experts.	**Implicit & Sub-symbolic:** Knowledge is distributed across weights and biases within a network. It is "learned" from large datasets rather than explicitly	**Mathematical Formulation:** Knowledge is represented as objective functions (e.g., minimize cost) and linear/non-linear constraints.	(Sarkar, 2021); (Yang & Zhu, 2024)

		programmed.		
Reasoning Mechanism	**Logical Inference:** Uses inference engines (Forward/Backward Chaining) to logically deduce conclusions from facts. It mimics the step-by-step reasoning of a human expert.	**Pattern Recognition:** Uses algorithms (e.g., backpropagation) to identify statistical patterns and correlations in data to predict outcomes.	**Search & Propagation:** Uses solvers to explore the solution space (e.g., Branch and Bound) to find the mathematically optimal or feasible solution.	(Yang & Zhu, 2024); (Soto et al., 2013)
Explainability (Transparency)	**High (White Box):** The system can generate an execution trace explaining exactly *why* a decision was made (e.g., "Candidate rejected due to Rule #402"). Essential for unions and legal compliance.	**Low (Black Box):** The decision-making process is often opaque and difficult to interpret without additional "Explainable AI" (XAI) layers.	**Medium:** Can prove optimality, but explaining *why* a specific schedule is the best among millions of options is abstract to non-technical users.	(Wang & Chen, 2024); (Sarkar, 2021)

Handling Constraints	**Rigid (Hard Constraints):** Excellent for enforcing binary regulations (e.g., "Must have License A"). Struggles with soft constraints (preferences) without complex fuzzy logic.	**Probabilistic:** Might "hallucinate" or violate hard constraints unless specifically constrained or penalized heavily during training.	**Strict & Flexible:** The gold standard for satisfying complex combinations of hard and soft constraints simultaneously.	(Soto et al., 2013); (Kaur et al., 2022)
Maintenance & Scalability	**Difficult at Scale:** Adding new rules can contradict existing ones, leading to a maintenance bottleneck. It does not "learn" from new data automatically.	**Adaptive:** Can retrain on new data to improve performance over time without manual code changes.	**Scalable:** Highly effective for large combinatorial problems (e.g., 500+ staff), but model formulation is complex.	(Yang & Zhu, 2024); (Li et al., 2025)
Primary Application in Staffing	**Compliance & Validity:** Ensuring assignments are legal, qualified, and safe (e.g., checking credentials).	**Prediction & Profiling:** Forecasting absenteeism, predicting demand, or profiling staff skills from unstructured resumes.	**Optimization:** Finding the single best roster that minimizes cost and maximizes fairness.	(Kaur et al., 2022); (Li et al., 2025)

The selection of a Rule-Based Expert System (RBES) over alternative artificial intelligence models (such as deep learning or pure mathematical optimization) is driven by the strict requirement for

decision transparency and **regulatory compliance** in human resource allocation. Unlike neural networks, which operate as "black boxes," an RBES allows the system to generate an explicit execution trace, explaining precisely *why* a specific facilitator was assigned or rejected based on verifiable criteria like certification expiry or union constraints (Sarkar, 2021; Wang & Chen, 2024). This transparency is critical in event management to prevent perceptions of bias and to ensure adherence to safety ratios, such as the requirement for specific crowd management certifications, which must be treated as "hard constraints" that cannot be probabilistically violated (Yang & Zhu, 2024).

Furthermore, the assignment of a facilitator is rarely a binary decision but rather a qualitative assessment of "suitability." Recent research indicates that RBES architectures are uniquely capable of encoding these heuristics through **Fuzzy Logic** (e.g., "If experience is high and venue proximity is close, then suitability is excellent"), allowing the system to mimic the nuanced judgment of a human recruiter while maintaining the consistency of an automated system (Duodu & Hamidu, 2021). This capability not only improves the "fit" of the assignment but also supports long-term retention by systematically respecting facilitator preferences and skill-utilization goals, a factor identified as essential for workforce stability (Kaur et al., 2022).

2.4 The Expert System (ES): Architecture and Modern Relevance

Narrowing down from general AI, Expert Systems (ES) represent a knowledge-based approach designed to emulate the decision-making ability of a human expert. Unlike neural networks, which learn from data correlations, expert systems rely on explicit knowledge representation.

A 2024 review published in IEEE Access highlights that expert systems remain vital in industrial applications, including fault diagnosis and decision analysis, because they decouple the domain knowledge from the reasoning mechanism (Yang & Zhu, 2024). This separation allows system architects to update staffing policies (knowledge) without rewriting the core processing code (reasoning), a critical feature for event management where labor laws and venue safety codes frequently change.

The literature consistently identifies four core components that must be present in any robust ES:

1. **Knowledge Base:** The repository of facts and rules.
2. **Inference Engine:** The processor that applies rules to facts to derive conclusions.
3. **Working Memory:** A storage area for the current state of the specific problem (e.g., the current list of available staff).
4. **Explanation Facility:** A module that justifies *why* a specific decision was made (Yang & Zhu, 2024).

2.5 Rule-Based Expert Systems (RBES)

Within the family of expert systems, Rule-Based Expert Systems are the most applicable architecture for assignment problems where logic can be expressed as "IF-THEN" statements.

2.5.1 The Knowledge Base

To build a system that decides which person is suitable for an event, the Knowledge Base must formally represent the "suitability" logic. Duodu and Hamidu (2021) demonstrate that in personnel selection, this knowledge is often fuzzy rather than binary. A rule might not simply state IF Experience > 5 Years, but rather use linguistic variables to approximate human reasoning, such as IF Experience is High AND Distance is Short THEN Suitability is Very High. This allows the system to rank candidates for an event rather than just filtering them, providing a nuanced "suitability score" that mimics a human recruiter's intuition (Duodu & Hamidu, 2021).

2.5.2 The Inference Engine

The engine acts as the "brain" of the assignment system. In the context of staffing, it must process two types of constraints defined in the literature:

Hard Constraints: Mandatory rules that cannot be violated, such as "Staff must possess a valid security license".

Soft Constraints: Preferences that should be optimized, such as "Prefer staff who live within 10km of the venue".

Research by Kaur et al. (2022) in Socio-Economic Planning Sciences emphasizes that effective assignment systems must prioritize these constraints to maximize retention and performance. Their work on volunteer task assignment illustrates that an inference engine must not only check for availability ("Is the person free?") but also optimize for "task-volunteer compatibility" to ensure long-term engagement (Kaur et al., 2022).

2.6 Design and Architecture of Rule-Based Expert Systems for Personnel Assignment

Unlike statistical recommendation systems (e.g., content-based filtering) that rely on historical similarity patterns, a Rule-Based Expert System (RBES) relies on explicit logical deductions derived from human expertise. The literature defines the design of such systems through a modular architecture and specific decision flowcharts.

2.6.1 System Architecture Model

To design the structural framework of the system, recent studies consistently validate a Three-Tier Architecture. You can refer to or adapt the block diagrams presented in Yang and Zhu (2024) or Sarkar (2021).

The Model Description: The system is divided into three distinct modules that operate independently but interact sequentially:

The Knowledge Base (Storage Layer): This module stores the domain-specific "IF-THEN" rules (e.g., IF Event_Type is Workshop AND Staff_Skill is Certified THEN Assign). It also holds the "Fact Base" (static data about facilitators and dynamic data about events).

The Inference Engine (Processing Layer): This is the core processor that matches facts against rules. For assignment tasks, Duodu and Hamidu (2021) propose an engine that utilizes Fuzzy Logic to handle non-binary attributes (e.g., "High Experience" vs. "Low Experience") rather than just strict Boolean matching.

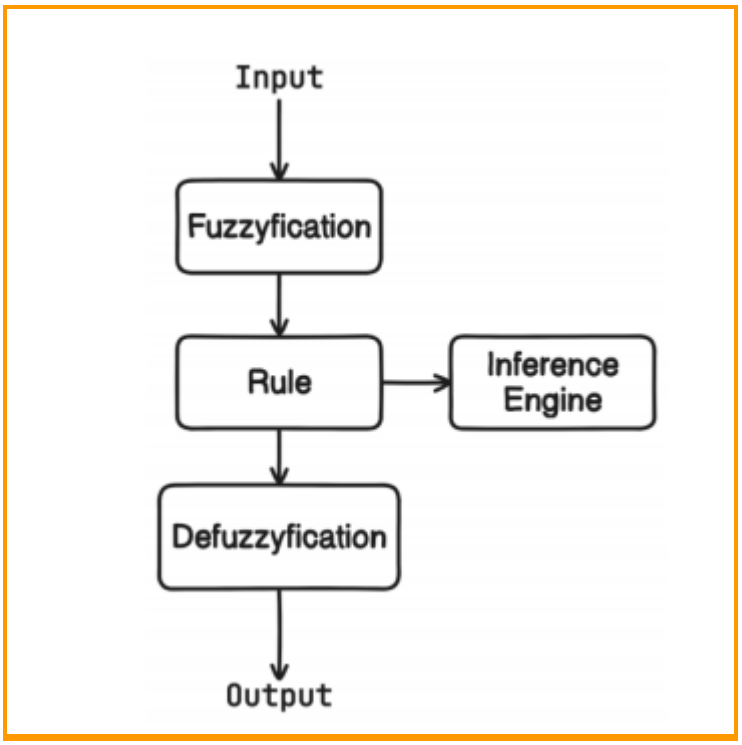
The User Interface (Interaction Layer): This layer allows the Event Manager to input constraints (Time, Venue, Required Skills) and allows the system to output the "Explanation" for why a specific facilitator was chosen (e.g., "Selected based on Rule #4: Proximity Priority").

Diagram Reference: You can construct a "Block Diagram" based on Figure 1 in Yang and Zhu (2024), which depicts the data flow from the User Interface $\rightarrow$ Inference Engine $\rightarrow$ Knowledge Base.

2.6.2 Operational Flowchart (Decision Logic)

Replacing the "recommendation algorithm" flow, the RBES uses a Forward Chaining decision flow. Henderi et al. (2020) and Duodu and Hamidu (2021) provide excellent flowchart models for this

decision-making process.The Flowchart Description:Start/Input Node: The system accepts "Event Requirements" (Input A) and "Facilitator Profiles" (Input B).Fuzzification/Matching Process: Data is passed through a "Rule Matcher." If you are using fuzzy logic (as suggested for "suitability"), numerical values (e.g., 5 years experience) are converted into linguistic variables (e.g., "Experienced").Constraint Checking (Decision Diamonds):Is Facilitator Available? (Hard Constraint) $\rightarrow$ If No, Reject.Does Facilitator meet Qualification? (Hard Constraint) $\rightarrow$ If No, Reject.Scoring/Ranking: Eligible candidates are assigned a "Suitability Score" based on soft constraints (preferences).Defuzzification/Output: The system outputs the "Best Fit" candidate and generates a notification.Diagram Reference: You can model your system's flow after the "Algorithm Flowchart" presented in Duodu and Hamidu (2021), which details the step-by-step logic for personnel recruitment and selection.2.X.3 Mechanism of Assignment: Forward Chaining vs. RecommendationIn the context of event staffing, the literature argues against "Content-Based Recommendation" (which suggests items based on user history) in favor of Forward Chaining Inference.Justification: Henderi et al. (2020) demonstrate that Forward Chaining is superior for assessment and assignment tasks because it is data-driven. The process starts with the available data (Event Date, Location, Skills) and moves forward through the rules to reach a specific conclusion (The Assignment). This ensures that no assignment is made unless it strictly satisfies the "Hard Constraints" defined in the rule base, ensuring 100% regulatory compliance, which probabilistic recommendation systems cannot guarantee.



Rule	Inference Engine
If outdoor temperature is cool and temperature sensor is cool	Send stable mode
If outdoor temperature is cool and temperature sensor is medium	Send hot mode
If outdoor temperature is cool and temperature sensor is hot	Send hot mode
If outdoor temperature is medium and temperature sensor is cool	Send hot mode
If outdoor temperature is medium and temperature sensor is medium	Send stable mode
If outdoor temperature is medium and temperature sensor is hot	Send cool mode
If outdoor temperature is hot and temperature sensor is cool	Send cool mode
If outdoor temperature is hot and temperature sensor is medium	Send cool mode
If outdoor temperature and temperature sensor are hot	Send stable mode

$$cool = \begin{Bmatrix} 0 \approx x > 20 \\ \frac{20-x}{20-15} \approx \leq x \leq 20 \\ 1 \approx x < 15 \end{Bmatrix} \quad \ldots\ldots\ldots \quad (1)$$

$$medium = \begin{Bmatrix} 0 \approx x < 15 \; or \; x > 25 \\ \frac{20-x}{20-15} \approx 15 \leq x \leq 20 \\ \frac{25-x}{25-20} \approx 20 \leq x \leq 25 \end{Bmatrix} \quad \ldots\ldots\ldots \quad (2)$$

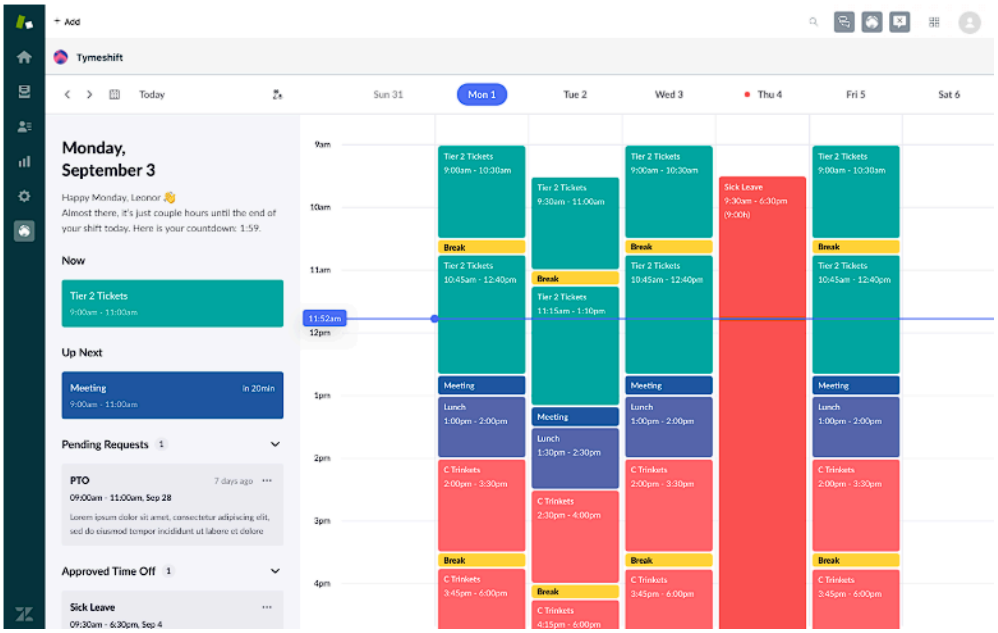
$$hot = \begin{Bmatrix} 1 \approx x \leq 25 \\ \frac{20-x}{25-20} \approx 20 \leq x \leq 25 \\ 0 \approx < 20 \end{Bmatrix} \quad \ldots\ldots\ldots \quad (3)$$

2.4 Similar existing system

In this technological era, the usage of workforce management in multiple industries has become a streamlined process that manages the operations. Another similar system that exists inside the market is Zendesk, iTrent and a data-driven smart manufacturing workforce management system.

2.4.1 Zendesk

Zendesk operates by managing daily customer support for a better engagement. It is a cloud-based system that helps in managing customer support, sales and communication. Moreover, Zendesk has tools such as Zendesk WFM AI that streamline the traditional workforce processes. Bouchrika (2025) made a review upon using this tool and stated that Zendesk Workforce Management is a tool designed to optimize workforce planning and enhance operational efficiency.



It supports user, role and access management to ensure secure data handling. Meanwhile, real-time performance monitoring and customizable dashboards give access in tailoring the dashboards following the user preferences. The system offers shift scheduling capabilities as well as time and attendance tracking that has payroll system wage calculation. Forecasting tools help in planning staff allocation, while absence and leave management automate availability of staff. The cross-platform access empowers organizations to make informed, data-driven decisions and maintain agile, efficient, and satisfied support teams.

2.4.2 iTrent

Landa-Silva et al. (2010) present an integrated workforce management solution developed with Midland HR, targeting customer-service sectors with many part-time employees. Payroll, attendance, absence monitoring, and staffing forecasting are all integrated into iTrent's personnel scheduling system. Landa-Silva et al. (2010) also emphasize that the assignment of employees that matches customer demand, task assignment, and shift-pattern design are important components. Every employee has a skill profile, and each task or work unit assigns workers to positions that allow for flexible replacements and has the necessary skill positions into user-defined workforce pools. Throughout the assignment, restrictions are enforced. The authors highlight that iTrent is flexible for managing part-time work and is well integrated with Human Resource (HR) processes, especially for scheduling. However, a limitation is that specific industry rules were not fully included and the early

version of the system only supported a limited number of scheduling conditions

2.4.2 Data-driven smart manufacturing (DDSM)

Other than that, Pietroni & Marconi (2023) have developed a data-driven smart manufacturing workforce management system for a leather goods company. Pietroni & Marconi (2023) also emphasized a digitally integrated workforce management platform designed to improve efficiency, planning, and decision-making in a manufacturing environment. The system includes attendance management, one of the components of the workforce management system. The system traces the attendance and time of the workers inside the company. According to Pietroni & Marconi (2023), the application allows employees to make requests for permits and absence. The application also includes talent management that stores skills of the employees and matching the skills required for each task with the employee with the same capability. According to Pietroni & Marconi (2023), the application combines the best combination of employees' skills and skills required by the task to ensure the highest quality product possible. Lastly, the application also provides employees scheduling for the right task as it provides benefits in terms of work scheduling and staff planning optimisation (Pietroni & Marconi, 2023).

2.4.3 Similar system comparison

There are several similar systems to compare for seeing the advantages, similarities and differences could be adapted inside the project.

Table 2.1: Table of similar system comparison

Similar System	Scheduling	Attendance Management	Performance Report	Advantages	Disadvantages
Zendesk	✓	✓	✓	AI Driven and automated scheduling process.	Complex to learn
iTrent	✓	✓	✓	Fully integrated HR and payroll system,self-se	Complex setup, requires training

				rvice portal	
Data-Driven Smart Manufacturing (DDSM)	✓	✓	✓	Real-Time Dashboards and Analytics, Talent Management	Sensitive data, require secure infrastructure and user access control

Table 2.1 emphasizes Zendesk, BambooHR, and DDSM by evaluating their features, advantages, and disadvantages. DDSM, Zendesk and BambooHR provide comprehensive functionality, covering scheduling, attendance management, and performance reporting.

Zendesk distinguishes itself with its AI-driven and automated scheduling process, offering advanced capabilities for organizations looking to streamline workforce planning. However, its complexity can be a drawback, especially for teams unfamiliar with such sophisticated tools. On the other hand, iTrent is a comprehensive Human Capital Management (HCM) solution. It offers robust modules for HR, payroll, time & attendance, talent management, learning and development. The platform is known for its strong reporting tools, workflow automation, and employee self-service features, making it suitable for medium to large organizations. However, it is hard to learn to fully utilize the features that iTrent offers and the learning process can be time consuming. DDSM excels in staff scheduling as it uses AI and machine learning to match employees to tasks based on skills, availability, and safety requirements. It also has strict attendance management where employees need to make an absent application permit. Data-Driven Smart Manufacturing uses talent management to fully utilize the performance report of each of the employees.

Overall, the choice between these systems depends on organizational priorities. Zendesk suits companies seeking automation and AI integration, iTrent appeals to those needing a fully customizable workflow and comprehensive payroll system. Meanwhile DDSM is ideal for large cooperation that focuses on assigning the right workers at the right time. Each system offers unique strengths, and organizations must weigh these against their specific needs and constraints.

These comparisons contribute to identifying proven features and validating the industry standards of developing the workforce management system. The proposed system will adapt some key features to make the deliverable of events more smoothly, these key elements are such as scheduling, attendance management and performance report by referring to the similar systems.

2.6 System Development Life Cycle (SDLC)

Methodology is an important step in project development. Choosing the right system development is a crucial part in ensuring the system development project runs smoothly and successfully. These methodologies act as guides that help planning and designing the system. By using the right approach and method in developing the project, developers can make better decisions and complex tasks. However, there are many methodologies and approaches that can be used to suit many types of project development. In this context, system development requires system development life cycle methodologies.

2.6.1 System Development Life Cycle Models Comparison

The System Development Life Cycle (SDLC) provides the fundamental stages required for building and maintaining an information system. Choosing the right development methodologies is crucial before starting system development. However, various development methodologies have been created to guide how these stages are carried out, such as the Waterfall model, Rapid application development (RAD), and the V-Model. The Waterfall model, RAD, and the V-Model were chosen for this project because each methodology provides unique advantages suitable for different phases of system development. The Waterfall model offers a structured approach for clearly defined requirements, ensuring proper documentation and straightforward progress tracking. RAD enables rapid prototyping, allowing the development team to incorporate feedback from operational managers and facilitators quickly, improving the system's usability. Meanwhile, the V-Model emphasizes verification and validation, ensuring that the recommendation engine and scheduling modules meet the system requirements and perform reliably. The selection of a methodology depends on project requirements, time constraints, and the level of flexibility needed during development.

Table 2.2 : Table of methodology comparison

Model	**Approach**	**Stakeholder involvement**	**Flexibility**
Waterfall Model	Linear and sequential distinct phases: requirements, design, implementation,	Low (customers mainly in requirements and acceptance phases)	Very low (highly inflexible once phased

	testing, deployment. (Saravanos & Curinga , 2023)		
V-Model	Sequential like Waterfall, but each development phase is paired with a corresponding testing phase (forming a “V” shape) (Leong et al. , 2023)	Low (similar to Waterfall)	Low (rigid, derived from Waterfall)
Rapid application development	Iterative, prototype-driven development (small increments with rapid prototyping) (Leong et al. , 2023)	High (continuous user feedback during prototyping)	High (quick iterations allow changes)

Based on Table 2.2, it explains the comparison of system development life cycle models between Waterfall Model, V-Model and Rapid Application Development Model. These models each have unique benefits based on their methodology, stakeholder involvement, and flexibility. The Waterfall and V-Models both use a step-by-step development process with minimal stakeholder participation, mostly in the requirement and acceptance stages. While RAD emphasizes on flexibility and quick iterations through ongoing stakeholder feedback, the V-Model improves verification by matching each development phase with a matching testing phase. Nonetheless, the Waterfall model was selected for this project because the project requirements are clearly defined and stable. Based on the preliminary interviews with the operation manager, the specific solutions required have been identified before development begins. Its sequential development guarantees meticulous documentation and methodical progress, which fits in nicely with the project's academic scope and time constraints.

2.6.2 Waterfall Model Approach

Figure 2.1 : Waterfall Model Approach (Sinha & Das, 2021)

Based on Figure 2.1, the Waterfall Model approach consists of six phases. The phases are requirement, design, implementation, verification, deployment and maintenance. This model emphasizes a linear and sequential approach. According to Saravanos & Curinga (2023), The Waterfall model is a classical, linear-sequential SDLC approach in which each phase must be completed before the next begins. Despite the popularity of agile methods, many projects still adopt Waterfall when requirements are well understood. Each phase inside this model needs to be completed before moving on to the next phase. This step is crucial to keep the system development on track. However, this model has drawbacks as the phases can only move in one direction, going back is not an option. The requirement phase includes requirement elicitation to gather requirements from the stakeholder or an organization. This phase is the foundation of the system development life cycle and the initial startup to create the project.

This model gained prominence for its simplicity and structured design, making it suitable for projects with clearly defined goals and stable requirements (Khan, 2023). According to Adenowo & Adenowo (2013), the Waterfall Model divides development into requirement analysis, design, implementation, testing, deployment, and maintenance. Each phase with its own specific goals and deliverables. Once a phase is finalized, the development process does not return back to the previous phase, it needs to move on to the next phase. This raises problems in development teams as there can be adjustments to the requirements gathered. In fact, Saravanos & Curinga (2023) emphasizes that

despite the rise of iterative methods, many organizations still use Waterfall or hybrid methods with a sequential base. The authors also stated that Waterfall Model strengths include ease of management, clear stage deliverables, and traceability through documentation, but its weakness is its poor handling of evolving requirements and late feedback. This clearly shows that it is easy to implement due to clear stages or phases that are to be thorough.

The Requirement phase is the foundation of the entire model. At this stage, developers collaborate with stakeholders to gather all relevant information about the system's desired functionalities. These requirements are formally documented in a Software Requirement Specification (SRS), which serves as the reference for all subsequent phases. The System Design phase then interprets the SRS into a technical blueprint, involving the development of data structures, architecture design, interface mockups, and database schemas.- tak cukup terperinci (processes in requirement)

Following design, the Implementation phase involves translating the designs into a working system through coding. Each software component is built based on the previous design documents, typically by development teams working within a defined stack or framework. Upon completion, the Integration and Testing phase ensures that all modules work together as intended. This includes unit testing, integration testing, and system-level verification to identify and resolve functional or logical errors.

Once the system is confirmed to be stable and meets the original specifications, the Deployment phase involves installing the application in a live environment, where real users begin interacting with the system. Finally, the Maintenance phase ensures that the software remains functional and relevant through bug fixes, updates, or enhancements based on user feedback and emerging needs.

Despite its historical popularity, the Waterfall Model has several limitations. It is rigid and not suited for projects that may require frequent changes or have evolving requirements. First, the requirements for the Falcon Kingdom Academy system were well understood from the outset through the Preliminary Study phase. Since the specific issues regarding facilitator assignment and payroll were clearly identified via stakeholder interviews , the project prioritizes stability over flexibility. As noted by Khan (2023), once a phase is completed, returning to make changes is difficult and often costly. Additionally, testing occurs late in the process, which increases the risk of discovering major issues only at the end. These characteristics make the model less ideal for large-scale, dynamic, or

object-oriented software development (Adenowo & Adenowo, 2013).

Furthermore, the strict linear structure of the Waterfall Model ensures discipline and on-time delivery , which aligns with the fixed academic timeline of this Final Year Project. The Waterfall Model remains valuable in contexts where requirements are well understood from the outset and stability is prioritized over flexibility.When project requirements are clear and unlikely to change, Waterfall's discipline can help ensure on-time delivery. It is often applied in government, manufacturing, or embedded systems projects, where change is minimized, and documentation is essential. As such, it continues to be an important reference point in software engineering literature and practice.

2.7 Summary

Managing the workforce effectively is essential for any organization, as employees play a vital role in driving success. In the context of Falcon Kingdom Academy, the academy manages a large and diverse pool of facilitators, making it difficult for the operation department to assign roles accurately, track attendance, evaluate performance, and process payments efficiently.

Workforce management systems usually help with scheduling, task assignment, and performance tracking. This project goes a step further by incorporating a recommendation system that suggests the right facilitators for the right roles based on their skills, experience, and past performance. Among various techniques, content-based filtering was chosen because it works well in environments where individual profiles are detailed, and where privacy or limited data makes collaborative methods less effective.

Finally, the system will be developed using the Waterfall model. This approach was selected for its clear, step-by-step structure, which fits well within the academic project timeline and the clearly defined requirements. While it's not as flexible as some modern methods, Waterfall allows for detailed planning and documentation making it a strong choice for this type of system development.

CHAPTER 3

METHODOLOGY

This chapter provides the information of chosen methodology for development phases of this project. It also gives the details of the activities held in each of the system development phases.

3.0 Executive Summary

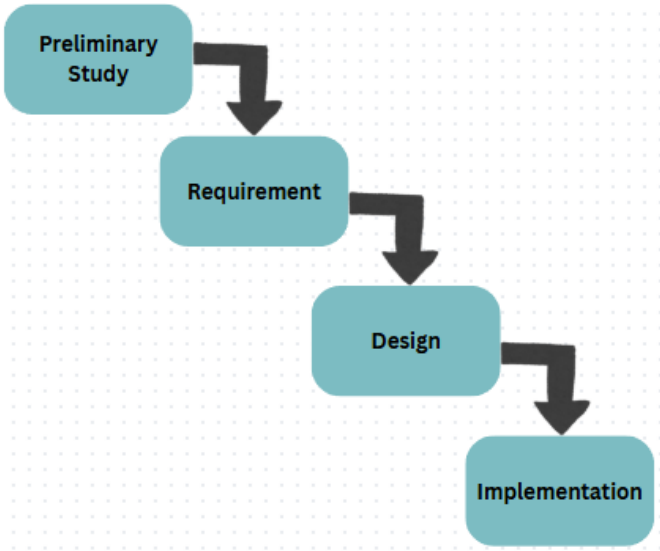


Figure 3.0 Modified Waterfall Model

Figure 3.0 shows that the modified Waterfall Model starts with preliminary study to make a feasibility study by identifying whether the project is doable. This initial phase usually conducts basic requirement research to identify the problem statement from the stakeholder, project scope and project objective. Next, the requirement phase takes place to analyze requirements documented that are gathered during requirement elicitation. A structured interview can be conducted to retrieve requirements needed for design and development. Then, it continues to the design phase where designing visuals or diagrams are needed to make it as the blueprint for the implementation phase. It

includes designing the system architecture, database schemas and sequence diagrams. The visuals and diagrams are created based on the requirements that are documented during the requirement phase. Moving on to the implementation phase where the actual system development takes place. The system will be built based on the design documents that are created. Lastly, system development completion, system validation with the stakeholder will be held at the end of this phase.

Table 3.0 : Modified Waterfall Model System Development Lifecycle

Phase	Activity	Techniques/Tools	Deliverable	Objective
Preliminary Study	1.Identify Project problem identification. 2. Conduct Preliminary interview with Operation Manager and Facilitator from Falcon Kingdom Academy. 3.Make literature review on project title. 4.Choose system development life cycle models to suit with the project	Preliminary Interview	Project Proposal	To identify the requirements for workforce management system for Falcon Kingdom Academy
Requirement	1. Interview with Operation Manager and Facilitator from Falcon Kingdom Academy 2.Analyze interview session using content analysis 3.Create use case	1.Semi-structured interview 2.Document Analysis 3. Google Docs 4. Content Analysis	1. Functional requirements 2. Use Case Diagram 3. Use Case Description 4. Domain Class Diagram 5. System Requirement Specification	

	diagram 4.Create use case description 5.Design Domain Class Diagram 6.Document requirements in SRS			
Design	1. Design Design Class Diagram 2. Design User Interface 3. Design Database 4.Design rule-based expert system logic to decide facilitators 5.Created System Design Document	1.Draw.io 2. Figma 3. Google Docs	1.Design Class Diagram 2. Data Dictionary 3.System Design Document	To design the workforce management system for Falcon Kingdom Academy
Implementation	1.Develop the workforce management system. 2.Develop rule-based expert system logic to decide facilitators	1.Visual Studio Code 2. GitHub	1. Workforce Management System 2. Database 3. Functioning rule-based expert system logic	To develop the workforce management system for Falcon Kingdom Academy

3.1 Preliminary Study

The preliminary study is critical before proceeding in analysing requirements. It works as a foundation for starting to develop the project. Before gathering the requirements, a preliminary interview is done with the stakeholder to identify the core problems and current activity process. After that, construct the project objectives to plan the results of this project.

As for this project, the preliminary interview was conducted with the Falcon Kingdom Academy operation manager to understand the current process of handling the workforce of facilitators and matching facilitators with events created. The current activity processes conducted raises a few problems that can be solved by creating the workforce management system. This foundation acts as a startup to build up requirement gathering after understanding the scope, problem statement and objectives of the workforce management system.

3.1.1 Preliminary Interview with Stakeholder

In a preliminary interview with the logistic manager, Mr Qawiem, which is one of the operation departments inside Falcon Kingdom Academy, it is done to grasp the current situation and problem that is currently facing during managing the workforce to distribute tasks for event or program execution. With a grasp of the situation, more questions can be constructed to create more precise scope for creating the solution. By understanding the current situation, understanding the source of the issue which is the problem that causes difficulties in handling the workforce. Hence, the problem statement for this project can be defined and the project scope can be identified.

Additionally, the preliminary interview also contributes in defining the scope of this project. This system was developed specifically for the operation department to help manage the workforce of facilitators.

3.1.2 Project Problem Identification

Identifying the project problem is the first step before analyzing the problem further. Based on the preliminary interview conducted with the logistic manager, the problem statements have been

identified. The problem statement is the difficulty in role assignment for event facilitators. The organization primarily uses WhatsApp as their main communication and management tool to manage their own current facilitators. The next problem statement is difficulty in performance tracking. Currently, the organization has no records of facilitator performance to keep track on. Furthermore, the next problem is regarding the salary payment delay as there are many facilitators among the workforce that are yet to receive their salary accurately.

3.1.3 Literature Review on Project Title

Literature review is essential for any academic project, so does this final year project. Understanding the background of the project title is crucial as it helps in developing the knowledge in the area. Literature is needed to gain knowledge regarding the theories, techniques and technologies that are related to the workforce management system. Analyzing articles and research papers helps in identifying the elements of the workforce management system and grasp a better understanding in the existing systems.

3.1.4 Choosing System Development Life Cycle Model

This project uses the Waterfall Model as the SDLC approach. The Waterfall Model is a linear and sequential model that only increments when each phase is completed. This model is suitable for projects that have defined requirements, problem statement, scope and objectives from the beginning. The traditional Waterfall Model phases involve Requirement, Design, Implementation, Verification and Deployment. However, adjusting to this project, changes are made to suit the project. The Modified Waterfall Model includes one phase before Requirement, which is Preliminary Study for understanding the problem statement before gathering requirement and removes one phase after Implementation which is Verification,

3.1.5 Project Proposal Preparation

Project proposal preparation is outlining all the important aspects of the project, starting from project background, project objectives, problem statements, project scope and project significance. Then, making a literature review on the project topic to understand the background of the topic, supporting the choice made and learning from existing solutions. Then, explaining the Waterfall Model approach

as the methodology chosen for developing the project.

3.2 Requirement

The requirements that have been elicited from the stakeholders need to be analysed and documented. This process leads to making progress and making sure the project development keeps on track and aligns with the requirements. The functional and non-functional requirements are elicited, analysed, and documented to provide a clear understanding of what the system should do. This ensures the stakeholders have a mutual understanding and helps avoid scope creep. A system requirement specification is made as a result of requirement documentation.

3.2.1 Requirements Gathering

Relevant data is collected using the requirements elicitation techniques such as document analysis and interview. The requirements are gathered from Falcon Kingdom Academy by conducting a semi-structured interview, which is provided by interviewing the operation manager himself, Mr. Qawiem. Meanwhile, the requirements about the facilitator are collected by interviewing Mr. Shafiq, who is a facilitator in Falcon Kingdom Academy.

The semi-structured interview method was applied by preparing a set of guiding questions related to events , facilitator assignment, attendance tracking, and payment workflow. These questions served as the main structure of the interview, ensuring that all important topics were covered. However, during the interview, additional follow-up questions were asked based on the interviewee's responses to gather deeper insights or clarify unclear information.

3.2.2 Analyze Requirements

After relevant information that has been gathered, it needs to be analyzed to ensure the requirements are clear and complete. Analyzing the requirements helps in defining the features and identifying the requirements that are out of project scope.

3.2.3 Requirements Documentation

Requirements that have been elicited, gathered and analyzed need to be documented in one documentation. Separate requirements into categories such as functional requirements and non-functional requirements. The use case diagram will be created to describe the functional

requirements inside the workforce management system. Additionally, define the interactions between the actors and the system. Include use case descriptions to define the use case diagram and the flow of activity between the actor and the workforce management system.

3.3 Design

The design phase transforms the requirements documented into a blueprint for building the system. In this phase, it involves designing the module of the workforce management system. Designing the domain class diagram to represent the concept of relationship and designing the content based filtering gives a blueprint to the development process for understanding the flow of the filtering process. The entity relationship diagram models the structure of the database by showing the tables, attributes, functions and relationships. Plus, a data dictionary will also be included to understand the data type, field size, data description and example. Additionally, this phase also involves the selection of system development framework to be used.

Tools that were used in this phase are StarUML, for designing the domain class diagram, entity relationship diagram and system architecture diagram. Following with the usage of Microsoft Word, to construct the System Design Document to document all the designs and diagrams. The deliverables of this phase will be the Domain Class Diagram, Design Class Diagram, Entity Relationship Diagram, Data Dictionary and the System Design Document. At the end of this phase, the objective of this design phase is to design the structure of a workforce management system for Falcon Kingdom Academy.

3.4 Design rule-based expert system logic

The core of the intelligent workforce management system is the Inference Engine. Unlike statistical models, this engine utilizes a Forward Chaining strategy, where known facts (Event Criteria) are passed through a sequence of logical production rules to infer a valid list of candidates.

3.4.1 Process Flowchart

The following flowchart illustrates the decision-making process the system performs for every recommendation request. It functions as a "Multi-Stage Filter," narrowing down the pool of 190+

facilitators to the most qualified candidates.

3.4.2 Production Rules (The "If-Else" Structure)

The Knowledge Base is encoded using standard Production Rules in the form of IF <Condition> THEN <Action>. These rules are grouped by the 5 Event Categories defined in the System Design.

3.4 Implementation

During the implementation phase, the actual coding of the system takes place. Design documents during the design phase are used to write the source code using appropriate programming languages, tools, and frameworks. The outcome of this phase is a working workforce management system that aligns with the specified requirements. The development of the workforce management system for Falcon Kingdom Academy will be starting off with developing the content-based filtering method to recommend the right facilitator for each event.

The intent of working on a content-based filtering method is to ensure that it is functioning and solves the problem statement. The programming language that will be used in this project will be Python for the content-based filtering, PHP for the backend and the frontend. Moreover, the database will be developed using MySQL and managed by using phpMyAdmin to store all the data such as facilitator attendance, information, and events. The deliverables that will be expected from this phase are the database of the workforce management system, a fully functioning workforce management system for Falcon Kingdom Academy, and the content-based filtering facilitator recommender.

3.4.1 Development of Rule-Based Inference Engine to Recommend Facilitators

The development of the rule-based recommendation method focuses on matching facilitators to events by applying a forward-chaining inference strategy against a structured Knowledge Base. In this project, the recommendation model is designed to deterministically identify valid and qualified facilitators for a newly created event based on specific hard constraints (Availability) and soft constraints (Competency and Quality) stored in the database.

The process begins with extracting structured features from facilitator profiles, specifically: current assignment status, skill tags, years of experience (derived from join date), and average performance ratings. Unlike statistical models that rely on probability, this system uses Production Rules (IF-THEN logic) to strictly validate whether a facilitator meets the safety and operational criteria of the event.

The inference engine processes these attributes through a Multi-Stage Filtration Mechanism:

1. Availability Filtering (Hard Constraint): The system first queries the Assignment and `Leave` tables. Any facilitator who is already assigned to another event or is on approved leave during the event dates is immediately excluded to prevent scheduling conflicts.
2. Competency Mapping (Skill Constraint): The system maps the Event Category (e.g., "Water Safety") to a mandatory Skill Requirement (e.g., "Swimming" or "Medic"). Only facilitators possessing the specific required skill tag are retained in the candidate pool.
3. Safety & Heuristic Verification (Experience Rule): To ensure operational safety, the system applies heuristic rules based on the event's intensity. For high-risk events (such as High Elements or Water Confidence), the system enforces a "Minimum Tenure Rule" (e.g., rejecting staff with less than 2 years of experience), ensuring that only seasoned staff handle critical safety roles.
4. Quality Ranking (Performance Rule): Finally, the system sorts the remaining qualified candidates based on their Average Rating. This ensures that among the eligible staff, the highest-performing individuals are recommended first.

Through this method, the system guarantees that every recommendation is 100% compliant with safety regulations and availability requirements. This approach effectively removes human error in scheduling, ensures specific skill matching for specialized tasks, and enhances the overall safety standard of workforce planning within Falcon Kingdom Academy.

3.5 Project Timeline

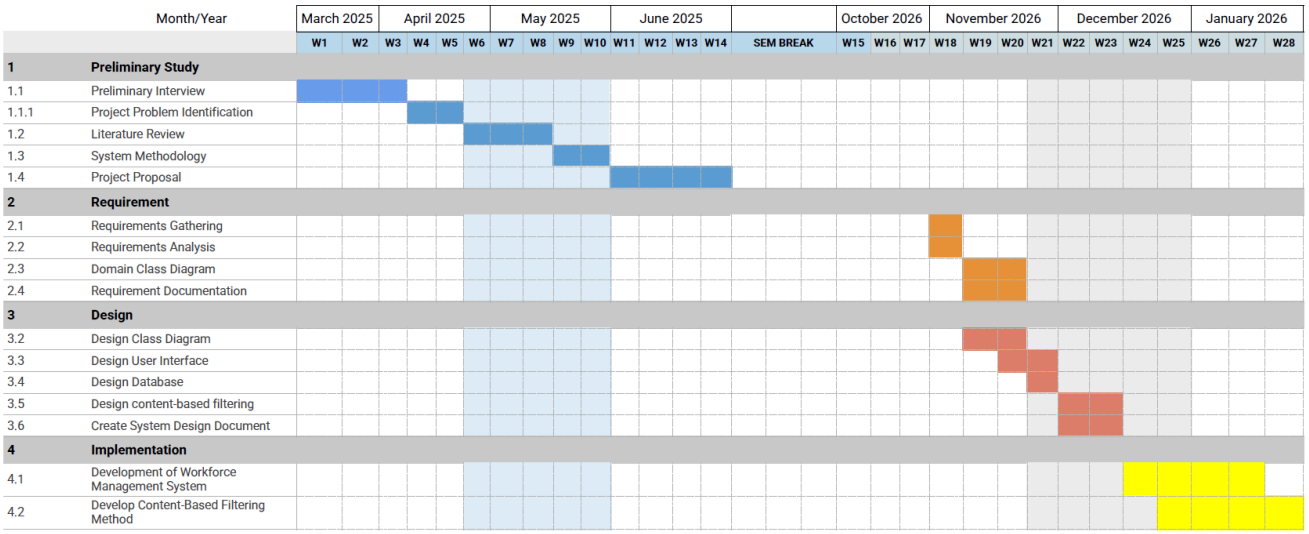


Figure 3.1 : Gantt Chart of Project Timeline

3.6 Summary

This project follows the Modified Waterfall Model to develop a Workforce Management System for Falcon Kingdom Academy. The development process began with a Preliminary Study, including stakeholder interviews to identify key issues in current workforce handling such as role assignment difficulties, lack of performance tracking, and salary payment delays.

Following that, the Requirements Phase involved gathering, analyzing, and documenting both functional and non-functional requirements through interviews and brainstorming sessions. This ensured that the system design aligns precisely with stakeholder expectations.

The Design Phase translated the requirements into technical blueprints such as domain class diagrams, ER diagrams, and system architecture, using tools like StarUML and documented in a System Design Document.

In the Implementation Phase, the system is built using Python for the content-based filtering recommendation function, PHP for the web application, and MySQL for the database. This phase aims to deliver a fully functional system that efficiently manages facilitators, matches them to events, and stores relevant workforce data.

By adhering to the structured Waterfall model, this project ensures clarity, traceability, and alignment with the defined objectives to solve existing operational challenges.

CHAPTER 4

ANALYSIS AND FINDINGS

This chapter provides information on the results of requirements gathering from the stakeholder.

4.1 Requirement Gathering & Analysis

The requirements gathered are for the development of Workforce Management System using Content-Based Filtering. The requirements are gathered by using an interview session with the stakeholder, which was Operation Manager and Facilitator. The interviews are analysed using content analysis to find the user, requirement, business rules, and domain. The domain is also identified to construct the domain class diagram later after the use case has been completed.

4.1.1 Results of Demographic Interview Session

This section reveals the answers that are received from the interview. A preliminary interview was conducted on 25th November 2025, with the operation manager, Mr. Muhammad Qawiem Mustaqim bin Kamrizal and facilitator, Mr. Muhammad Shafiq Shauqi bin Mohd Kamar. The interview was held to gain information regarding the facilitator management processes and the flow of facilitator assignment. The full transcript of the interview can be accessed under Appendix F and Appendix G.

OM = Muhammad Qawiem Mustaqim bin Kamrizal

FC = Muhammad Shafiq Shauqi bin Mohd Kamar

Table 4.1 : Business Process & Operational Workflow Analysis and Requirements

Question ID	Question	Answer	Analysis	Requirement
Q01-OM	Can you briefly explain the business that Falcon Kingdom Academy is doing?	Falcon Kingdom Academy is a training consultancy under MH Kingdom Empire specializing in motivational events, such as team building and workshops. We currently manage a workforce of approximately 190 permanent and freelance facilitators to execute these programs.	-N/A-	-N/A-
Q02-OM	How frequent an event is created in a month?	While the exact number varies by season, the frequency is high enough that our current manual processes for scheduling and tracking have become inefficient. We have daily operational needs involving scheduling and workforce allocation.	-N/A-	-N/A-
Q03-FC	Can you describe your role and responsibilities as a facilitator in Falcon Kingdom Academy events?	My job is to execute the programs on the ground. This includes attending the venue, setting up the necessary equipment, organizing the activities for participants, and ensuring the event runs smoothly until the closing ceremony.	List of User: - Operation Manager - Facilitator Domain : - User	Actor : - Facilitator - Operation Manager

4.1.2 Requirement Extraction from Interview Session

This section explains the questions and answers that explains the problem that arise in the company

Table 4.2 :

Question ID	Question	Answer	Analysis	Requirement
Q04-OM	Can you describe your main responsibilities in managing facilitators for events?	As the operation manager, my main responsibilities include assigning facilitators to events, managing their schedules, tracking attendance, and ensuring each event has the right number of facilitators based on the event requirements. I also have to confirm if the facilitators really attended the event and ensure payment details are collected for processing.	List of User: Operation Manager Domain : User	Actor : Operation Manager List of requirement: - Assign Facilitator to Event - Manage Facilitator Schedule - Track Facilitator Attendance - Ensure right amount of facilitator assigned - Validate facilitator attendance - Collect facilitator payment details
Q05-OM	Who is responsible for creating the events?	The Marketing Manager is responsible for creating the events. They are the ones who plan the events, design the programs, and promote the details on social media to attract clients.	List of User: Marketing Manager Domain : User	Actor : Marketing Manager - Create Event
Q06-OM	Can you explain the flow of the activity from creating events until the completion of the events?	The process starts with the Marketing Manager creating the event and blasting the details to social media. Once that is done, Operation Manager takes over. I assign tasks to the committee, calculate costs and equipment, and arrange the tentative schedule. During the event, the facilitators join, attend the venue, set up	List of User: - Marketing Manager - Operation Manager - Facilitator Domain: - User	Actor : Marketing Manager - Create Event Actor : Operation Manager - Assign Task to Committee - Arrange Tentative Schedule - Validate attendance - Prepare payment

		equipment, and organize the activities. After the event closes, facilitators clock out and fill in a bank detail form via WhatsApp to get paid. Finally, I have to validate their attendance manually and prepare the payment.		Actor : Facilitator - Clock out - Fill in bank detail form
Q07-FC	What processes do you follow when you are assigned to a new event?	I wait for the tentative schedule. On the event day, I go to the venue, set up equipment, run the activities, and finally clock out and submit my bank details for payment processing.	List of User : - Facilitator Domain : - User - Attendance	Actor : Facilitator - View Event Tentative - Clock out - Submit Bank Details
Q08-FC	How are you usually informed or selected to join an event?	The details are blasted on our main WhatsApp group. If I am selected, the Operation Manager assigns me to a specific committee group for that event.	List of User : - Operation Manager - Facilitator Domain : - User	-N/A-
Q09-OM	Is the operation manager involved in managing the events?	Yes, I am involved after the event is created. My role is to handle workforce planning, assigning facilitators, preparing logistics, and coordinating on-ground operations during the event	List of User: - Operation Manager Domain : - User	Actor : Operation Manager - View Event Details - Assign Facilitator to Specific Roles
Q10-FC	What steps do you take to confirm your participation in an	I usually reply in the WhatsApp group to confirm I am available and acknowledge the task assignment.	List of User: - Facilitator Domain :	Actor : Facilitator - Accept Event Assignation

	event?		- User - Assignment Business Rules: - Facilitator must respond to event assignment in the system	
Q11-FC	How do you currently submit your attendance or task completion?	Attendance is submitted using the Whatsapp live location feature. For task completion, I must fill in a bank detail form in the WhatsApp chat after the event is over.	List of User : - Facilitator Domain: - Attendance - User Business Rules: - Facilitator need to fill in bank detail form after completed the event - Facilitator must verify their attendance	Actor : Facilitator - Verify Attendance Submission
Q12-FC	How do you report any issues or feedback after the event?	We usually just discuss it when we meet each other or message each other in the group. There is no proper form or system to give performance feedback of other facilitators, so sometimes issues and feedback are usually forgotten.	Domain : PerformanceFeedback - feedbackDetails - rating Business Rules: - Facilitator can only rate other facilitators after event is completed	Actor: Facilitator - Feedback form to report issues after event
Q13-FC	From your experience, how could these	The most tiring part is filling in the bank details manually after every single	List of User : - Facilitator	Actor : Facilitator - Store facilitator bank details in

	operations be done more efficiently?	event. It is repetitive. A system that saves my details would be much better. Also, there could be a better way to attend events, instead of constantly sharing live location when clocking in and filling in the clock in and clock out time.		their profile - Clock in and Clock out using Image
Q14-FC	What information would you like to view in the system?	As a facilitator, I want to see my payment status, attendance record and my past event history records.	List of User: - Facilitator Domain : - Facilitator	Actor : Facilitator - View Payment Status - View attendance records - View past event history records

4.1.3 Mapping Interview Results with Rule-Based Logic

Table 4.3 : Rule-Based Logic Interview Results

Question ID	Question	Answer	Analysis	Requirement
Q15-OM	What problem do you personally face when you handle that many facilitators?	Currently, I often have to rely on assumptions or my own memory when assigning tasks, which unfortunately leads to frequent wrongly assigned roles. For example, I might assign someone to a technical role when their strength is actually in public speaking.	List of User : - Operation Manager Domain : - User	Actor : Operation Manager - Assign Facilitator
Q16-OM	Could a facilitator recommender make the assigning facilitator	Yes, absolutely. With a workforce of approximately 190 facilitators, it is	List of User : Operation Manager	Actor : Operation Manager - Generate recommendation

	process easier?	becoming impossible for me to manually remember the specific skills, strengths, and past performance of every single individual.	Domain: Facilitator Attributes : - skills - experience - pastperformance	for suitable facilitators
Q17-OM	To make an accurate recommendation, what specific information from a facilitator's profile should the system compare against the event requirements?"	"First, I want to be able to check their skills list. Then, I read their past experience description to see if they have handled similar events before. I also want to check if they have any specific certifications like a first-aid certificate."	Domain: Facilitator 1. skills 2. experience 3. certifications Domain: Event 1. eventDescription	Actor : Operation Manager - Generate Recommendation based on event and facilitator details
Q18-FC	There is no platform that stores your own information, would it be nice if there is one that stores your own information for assignment purposes?	“Currently, there is no such place that stores our own information. However, if it is needed for the operation manager to assign us to the event, it is nice because each facilitator will be treated fairly.”	List of User : Facilitator Domain : Facilitator	Actor: Facilitator - Store facilitator information

Q19-OM	If two facilitators have similar skills, how should the system decide who appears at the top of the recommendation list?	"I want the system to prioritize facilitators who have a higher Average Performance Rating. A 5-star facilitator should always be recommended before a 3-star one, even if their skills are the same."	List of User : - Operation Manager Domain : Facilitator - averageRating Business Rules: - The recommender should always recommend a higher rated facilitator than a lower facilitator.	Actor : Operation Manager - Prioritize higher average performance rating facilitators
Q20-OM	What happens if a facilitator is sick or already booked for another event on that day?	"The system must not recommend anyone who is already working on that date. Also, facilitators should be able to apply for leave. If they are on approved leave, they should be automatically excluded from the recommendation list."	List of User: - Facilitator - Operation Manager Domain : Leave - Start Date - End Date - Status Business Rules: - Facilitator can apply leave - System shall not recommend facilitator that	Actor: Facilitator - Request Leave Actor: Operation Manager - Approve Leave

			has same leave date with event date	

4.1.4 The Business Rules and Constraints

This section explains the business rules and constraints of domains to understand the limitations and the requirements of the system.

Table 4.4 : Interview Questions and Answers about the business rules and constraints.

Question ID	Question	Answer	Analysis	Requirement
Q21-OM	Are the facilitators allowed to join more than one event in a day?	The facilitator can not attend two events at one time. Unless the event time and date does not overlap.	List of User: - Facilitator Domain: - User - Event Business Rules: - Facilitator can attend more than one event on one day, but the event date	Actor : Facilitator

			and time must not overlap - The event can be attended by more than one facilitator.	
Q22-OM	Is there a limit to how many facilitators can join a specific event?	We will specify a quota. Once that number is reached, no more facilitators should be able to join.	Domain: - Event Business Rules: - Each event have their own quota	- N/A -
Q23-OM	Who is allowed to edit or delete an event if the details change?	Only the Marketing Manager should have the ability to create, edit, or delete events. The Operation Manager and Facilitators should only be able to view the details.	List of User: - Marketing Manager List of Domain: - User - Event Business Rules: - Only Marketing Manager can manage the event - Operation Manager and	Actor: - Marketing Manager List of Requirement: - Create Event - Edit Event - Delete Event - View Event Details Actor: - Facilitator

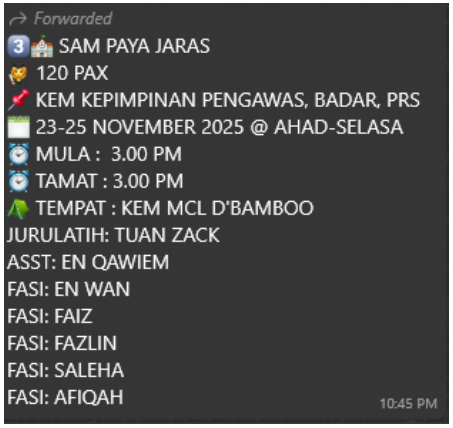
			Facilitator can only view the event.	- Operation Manager List of Requirements: - View Event Details

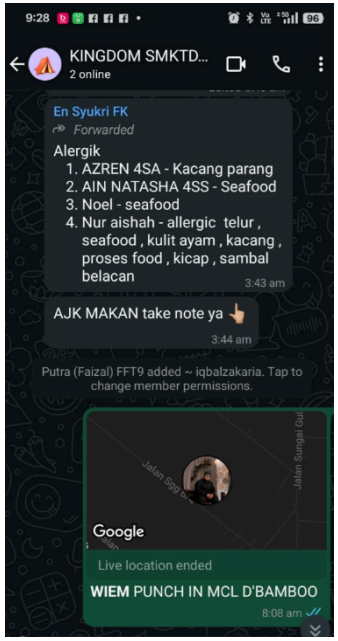
4.1.4 Documents Gathered From Falcon Kingdom Academy

During the requirement elicitation phase, a meeting was conducted with the Operation Manager of Falcon Kingdom Academy to understand the existing business processes. As a result of this session, four key documents were obtained, ranging from digital correspondence (WhatsApp) to promotional materials (posters). These artifacts were analyzed to identify necessary data attributes and domain requirements for use case diagram, use case descriptions and domain class diagram.

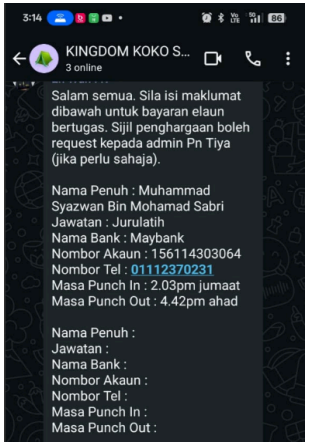
Table 4.5 : Documents List

Document ID	Document	Analysis	Requirement
DC-01	Facilitator Assignment	Domain : Event Attributes: 1. School Cooperation 2. Total Participants 3. Program Name 4. Start and End Date	-N/A-

	 This document shows the details of the event and facilitator that are assigned.	5. Start and End Time 6. Event Venue 7. Coach Name 8. Assistant Name 9. List of Facilitators Name	
DC-02	Employee Clock In using Live Location	User : Facilitator Domain : Attendance Attributes: - Clock In Time - Employee Name Domain : Event Attributes: - Remark	-N/A-

	 This document reveals the way of employee clock in to the event venue using live location in Whatsapp		
DC-03	Event Posters	Domain : Event Attributes : - Event Name - Event Venue - Event Date - Event Price - Event Image - Total Participants	-N/A-

		Business Rules: - An event can have a limit of participants.	
DC-04	Allowance Payment Form	List of User : Administrator, Facilitator Domain : Payment Attributes : 1. Name 2. Bank Name 3. Account number 4. Telephone Number	Requirement : 1. Request Payment 2. Request Certificate of Appreciation

		5. Punch In Time 6. Punch Out Time	

4.1.5 Result from Requirement Analysis

This section provides information extracted from the interview conducted with Operation Manager and Facilitator. After analyzing both the interview questions and the documents that relate to the workforce management system, a list of use cases, domain list, attributes, requirements and the business rules.

Table 4.6 : List of use cases derived from interview content analysis

User	Requirement	Use Case
Marketing Manager	● Create Event ● Delete Event ● View Event Details ● Arrange Event Tentative	Manage Event
Operation Manager	● Assign Facilitator to Event ● Scheduling Facilitators ● Ensure the right amount of facilitator assigned	Assign Facilitator
	● Track Facilitator Attendance ● Validate Facilitator Attendance ● Update Facilitator Attendance	Manage Attendance
	● Collect Payment Details ●	Manage Payroll
	Generate recommendation for suitable facilitators	Match Facilitators
	View Event Details	Manage Event
Facilitator	● View Assigned Roles ● Accept Event Assignation	Respond to Assignment

	View Event Tentative	Manage Event
	• Clock In Attendance • Clock Out Attendance • View Attendance Record • Verify Attendance Submission	Manage Attendance
	Request Certificate of Appreciation	Request Certificate
	Fill In Feedback Form	Submit Feedback Form
	• Create Profile • Edit Profile	Manage Profile
	• Submit Bank Details • View Payment Status • Request Allowance Payment	Manage Payroll
	View Past Event Involved	View Past Event

Explanation 4.7

Table 4.7 : List of domain,attributes and business rules derived from interview content analysis

Domain	Attributes	Business Rules
Facilitator	- Skills - Experience - Average Rating - Certifications - Bank Name - Bank Account Number - Phone Number - Username - Password	- Facilitators need to capture their own image for attendance - Facilitators can only view the event tentative once assigned to event - The facilitator can view the roles that they have been assigned. - Facilitators need to decide before accepting the event assignment. - Facilitators need to capture their own image after completing the event. - Facilitators need to fill in their bank details.

		- Facilitators can see their own payment status of each event. - Facilitators can see their past event attendance. - Facilitators can request their allowance payment. - Facilitators can request their own certification of appreciation
User	- Username - Password - Email - Role	- Marketing Manager can create many events - One event created by one Marketing Manager - Operation can only view the event details of available event
Event	- Event Name - Venue - Event Description - Event Category - Required Skill Tag - Status - Quota - Start Date Time - End Date Time - Remark	- The number of assigned facilitators must not exceed the specified quota - End Date must be after Start Date - Event status must be completed before facilitators can receive certificate or payment. - The event must have at least one skill tag defined to generate facilitator recommendation. - The event can be attended by more than one facilitator.
EventRule	- Event Category - Required Skill - Minimum Experience - Minimum Rating - Intensity Level	
Attendance	- Clock In Time - Clock Out Time - Status - Image Proof	- Facilitators must clock in before event time. - Facilitators must take their own picture during clock in and clock out.
Assignment	- Date Assigned - Role	- Facilitator must respond to event assignment in the system - Facilitator can attend more than

		one event on one day, but the event date and time must not overlap
Payment	- Amount - Payment Status - Payment Date	- Payments are done after the event is completed
Leave	- Start Date - End Date - Status - Reason	- Facilitator can apply leave - System shall not recommend facilitator that has same leave date with event date
PerformanceFeedback	- Rating Score - Feedback Comment	- Facilitator need to give feedback after event is completed

4.1.6 Requirement Modelling

Based on the gathered requirements, the project moved into the modeling phase by creating a Use Case Diagram and a Domain Class Diagram via draw.io. The Use Case Diagram is designed to illustrate the system's capabilities and user interactions. In this visual model, the system's limits are marked by a rectangle, while users are depicted as stick figures outside these limits.

Table 4.8 : List of Potential Use Case with corresponding use cases

Use Case ID	**Potential Use Case**
UC-100	Manage Event
UC-200	Assign Facilitator
UC-201	Generate Facilitators
UC-300	Manage Attendance
UC-400	Manage Payroll
UC-500	Manage Profile
UC-600	Respond to Assignment
UC-700	Request Certificate
UC-800	Submit Feedback Form

UC-900	View Past Event

With the use cases that have been identified, the modelling of the use case diagram has been constructed. The use case diagram is constructed from requirement analysis and document review.

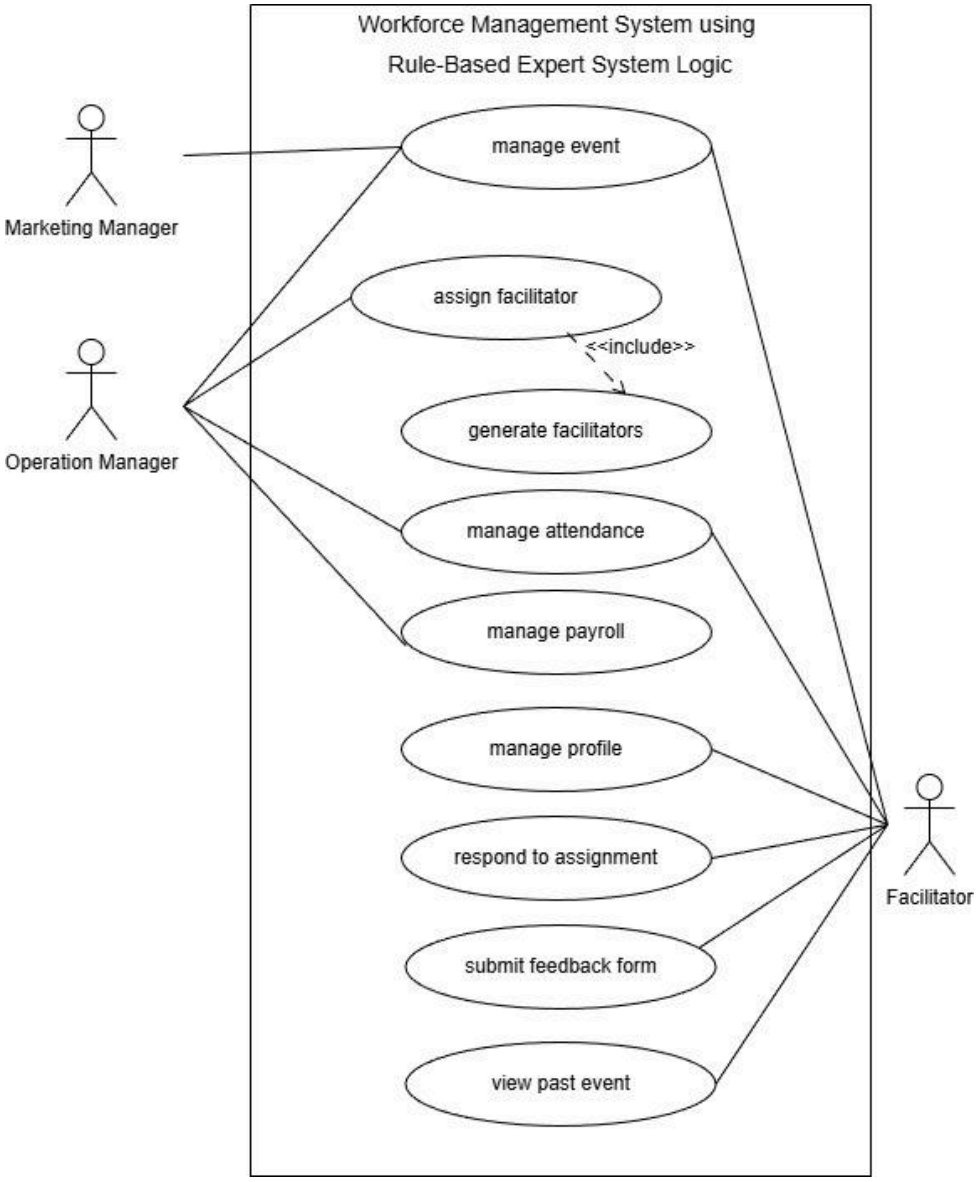


Figure 4.1 : Use Case Diagram of Workforce Management System for Falcon Kingdom Academy using Rule-Based Expert System Logic

4.1.7 Use Case Description

Use Case	Description
Manage Event	Allows the Marketing Manager to create, update, delete, and view event details such as date, venue, and required skills.
Assign Facilitator	The Operation Manager selects specific facilitators for an event, often utilizing the system's recommendation engine to find the best match.
Generate Facilitators	The system uses a Rule-Based Logic algorithm to suggest suitable facilitators based on their skills, experience and past performance.
Manage Attendance	Handles the tracking of facilitator attendance clock in and clock out, then allows the Operation Manager to validate these records.
Manage Payroll	Facilitators submit their bank details, and the Operation Manager processes allowance payments based on validated attendance records.
Manage Profile	Facilitators can create their own profile and edit their profile.
Respond to Assignment	Facilitators receive notifications for new job offers and can choose to either accept or decline the assignment.
Request Certificate	Allows facilitators to automatically generate and download a digital Certificate of Appreciation after completing an event.
Submit Feedback Form	Facilitators can submit reports regarding issues or general feedback after an event to help improve future operations.
View Past Event	Users can view a history of the events they have been involved in, including dates, roles, and attendance status.

UCID	UC-200	
Use Case Name	Assign Facilitator	Created by: Amir Afham
Scenario	The Operation Manager assigns and selects the suitable facilitator	
Triggering Event	An event is created	
Brief Description	The Operation Manager assigns facilitators to specific roles.	
Actor	Operation Manager	
Related Use Cases	UC-201 : Generate Recommendation	
Stakeholders	Operation Manager , Facilitator	
Preconditions	1. The event must exist 2. Facilitators must have registered to the system	
Post conditions	1. Facilitators are selected to an event	
Flow of Activities	*Actor*	*System*
	2. Clicks available event 4.1. Clicks “Assign Facilitator” button 6.1 Clicks “Get Recommendation” button 7.1. Chooses facilitator for the event	1. Shows list of events available 3. Displays event details 4. Shows “Assign Facilitator” button 5. Shows list of facilitator names. 6. Shows “Get Recommendation” button 7. Shows recommended facilitator names. 8. Receives facilitator details 9. Verify facilitator information 10. Assign facilitator to an event ID 11. Saves facilitator assignment in database

Exception Conditions	**E1**: If the facilitator is already assigned to an event with a clash date, the system warns “Already Assigned to an event”.
Special requirements / Business Rules	Facilitator is unable to be assigned to an event that overlaps with an existing assignment.
Assumptions	- Not applicable -
Notes and issues	- Not applicable -

UCID	UC-201	
Use Case Name	Generate Recommendation	Created by: Amir Afham
Scenario	The system calculates the best facilitator match for an event.	
Triggering Event	Operation Manager clicks “Get Recommendation” button	
Brief Description	The system uses Content-Based Filtering to match event requirements with facilitator skills.	
Actor	Operation Manager	
Related Use Cases	UC-200 : Assign Facilitator	
Stakeholders	Operation Manager	
Preconditions	1. Facilitator with Skills 2. Event with Skill Tags	
Post conditions	1. A list of recommended facilitator is shown	
Flow of Activities	*Actor*	*System*

Normal flow/ Valid flow		1. Generates recommended facilitators
Exception Conditions	**E1** : If no facilitators are matched, system displays “No facilitators are found”	
Special requirements / Business Rules	- Not applicable -	
Assumptions	- Not applicable -	
Notes and issues	- Not applicable -	

UCID	UC-400	
Use Case name	Manage Payroll	Created by: Amir Afham
Scenario	Event-driven (external event)	
Triggering Event	Managing bank details and processing allowance claims.	
Brief Description	Event is completed and attendance is validated.	
Actor	Facilitators update bank info and Operation Managers process the payments based on attendance records.	
Related Use Cases	- Not applicable -	
Stakeholders	Facilitator, Operation Manager	
Preconditions	1. Attendance must be validated	

Post conditions	1. Payment status updated to "Paid".	
Flow of Activities	*Actor*	*System*
Normal flow/ Valid flow	1. Facilitator submits bank details in profile 4. Operation Manager clicks “Payroll” for a specific events 5. Clicks “Bank Details” on specific facilitator 6. Clicks payment status from “Pending” to “Paid”. 6.2. Fills in proof of payment	2. Verifies facilitator information 3. Saves bank information into the database. 4.1. Shows list of payment statuses from facilitators 4.2. Shows allowance request from facilitators. 5.1. Shows facilitator bank information 5.2. Shows payment status of facilitator. [Paid, Pending] 6.1. Shows proof of payment input 7. Verifies proof of payment 8. Updates facilitator payment status in database
Exception Conditions	**E1:** If the facilitator has not clocked out/verified attendance, the system shows "Attendance not verified. Cannot process payment."	
Special requirements / Business Rules	- Not applicable -	
Assumptions	- Not applicable -	
Notes and issues	- Not applicable -	

4.1.8 Domain Class Diagram

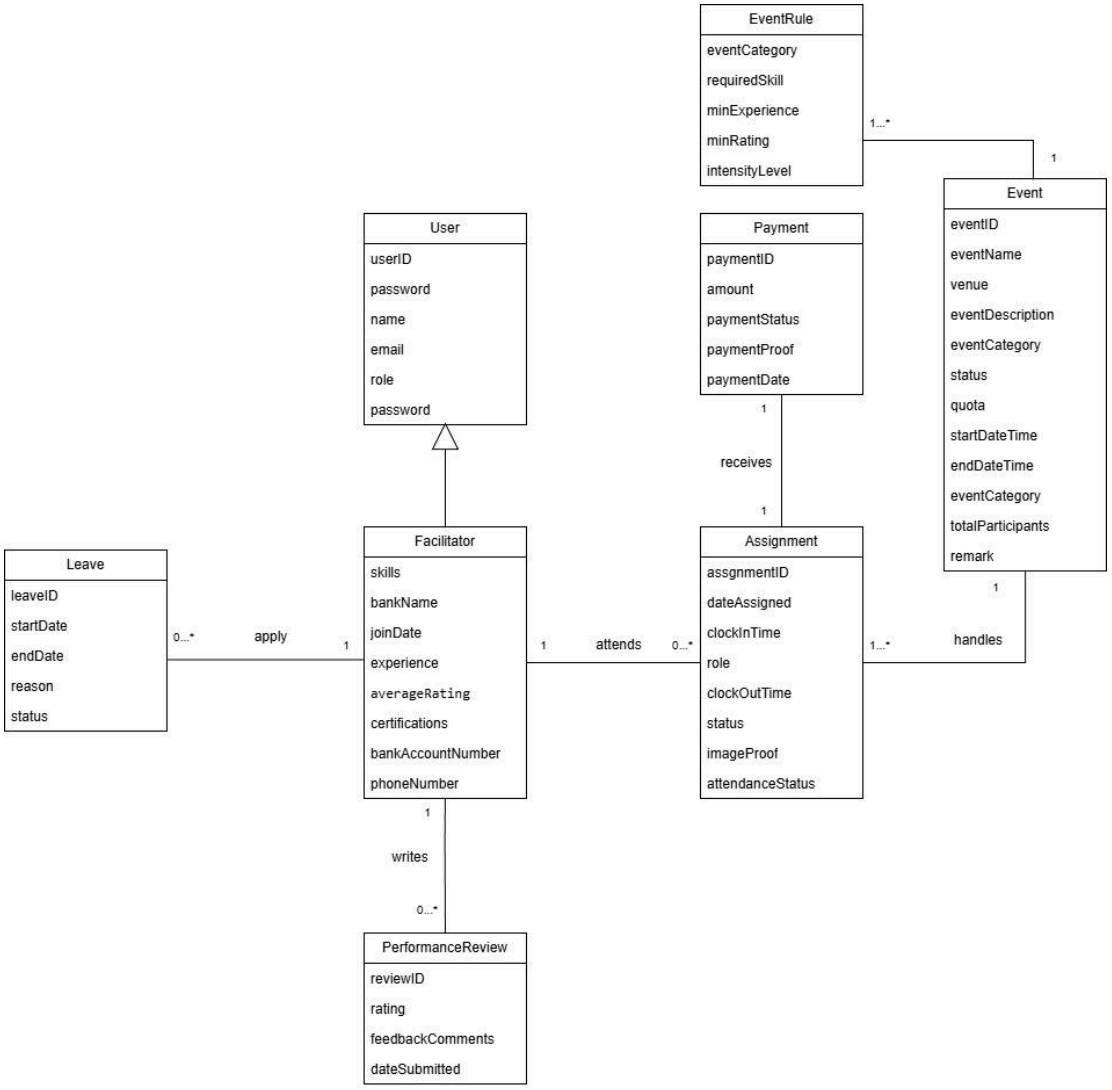


Figure 4.2 : Domain Class Diagram of Workforce Management System using Rule-Based Expert System Logic

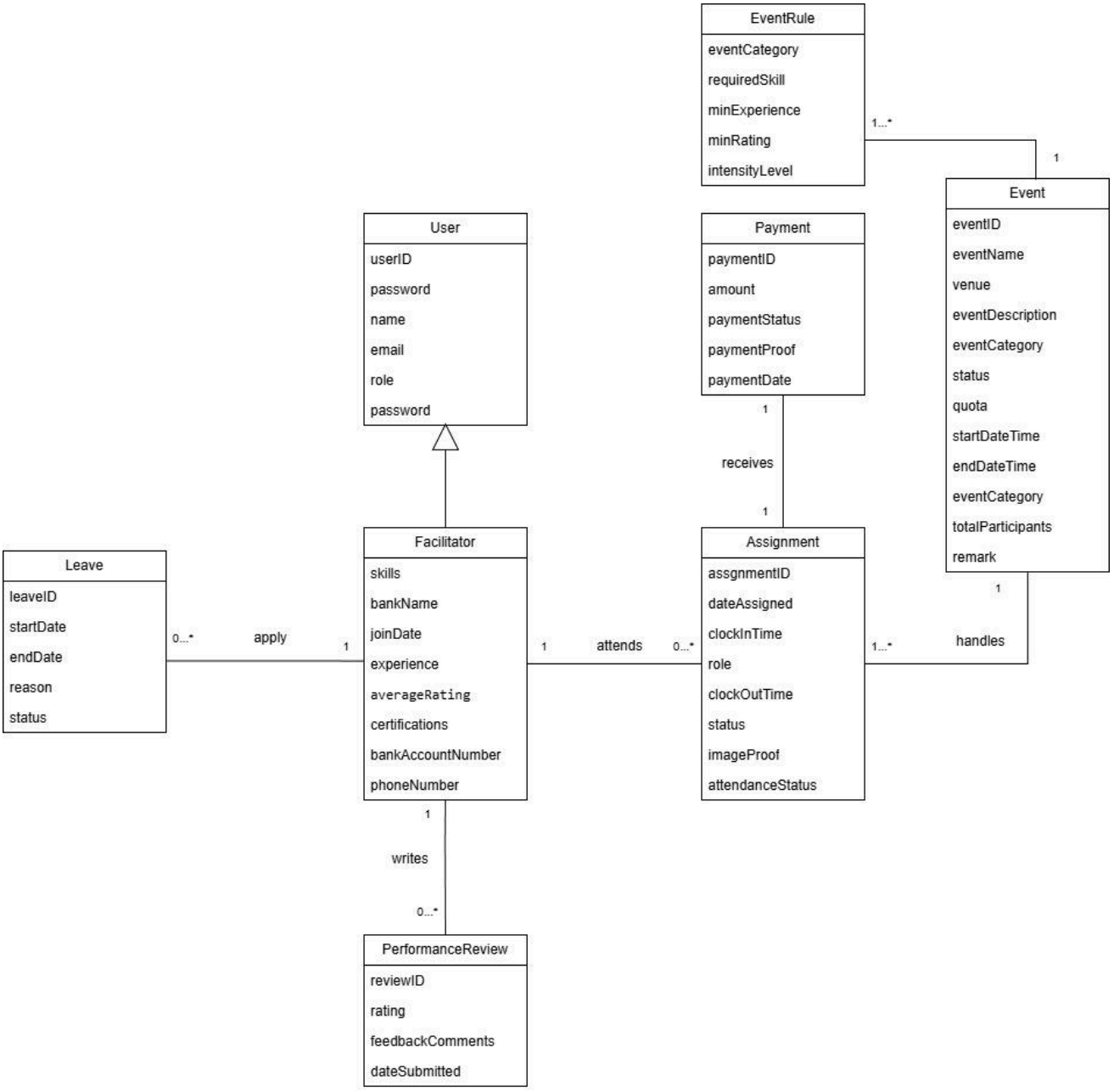
4.2 The Design of Workforce Management System

4.2.1 Design Class Diagram

After the domain class is constructed and the domains have been identified, before start developing the system, the detailed design class diagram is created to be the blueprint for the development of the system.

4.2.2 User Interface Design

4.2.3 Database Design



4.2.4 Sequence Diagram

4.2.1 Expert System Design

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APPENDIX A

$IDF = log \frac{D}{DF}$ .....(1)

$W = TF * (IDF)$ .....(2)

TF-IDF formula

$$Wk,j = \frac{\mathrm{TF} - \mathrm{IDF}(\mathrm{tk}, \mathrm{dj})}{\sqrt{\sum_{s=1}^{T} \mathrm{TF} - \mathrm{IDF}(\mathrm{ts}, \mathrm{dj})^2}} \quad (1)$$

Fig. 2. *Formula TF-IDF*

a document. While the IDF value can be calculated using the formula:

$$\mathbf{idf_i = log\left(sin \frac{n}{df_i}\right)} \quad (1)$$

Where:

$$sim(di, dj) = \frac{\sum_k (wki \, .wkj)}{\sqrt{\sum_k (wki)^2} \, . \sqrt{\sum_k (wkj)^2}} \quad (2)$$

Fig. 3. *Formula Cosine Similarity*

- Root Mean Squared Error (RMSE)

  In Eq. (1), the RMSE value is the average magnitude of the errors between the test dataset's actual ratings and the predicted ratings.

$$RMSE = \sqrt{\frac{1}{|\hat{R}|} \sum_{\hat{r}_{ui} \in \hat{R}} (r_{ui} - \hat{r}_{ui})^2} \quad (1)$$

user to another. Thus, in addition, we used FCP to evaluate the algorithms using Eq. (2)-(4).

$$FCP = \frac{n_c}{n_c + n_d} \quad (2)$$

Where,

$$n_c = \sum | \{ (i,j) \mid \hat{r}_{ui} > \hat{r}_{uj} \text{ and } r_{ui} > r_{uj} \} | \quad (3)$$

$$n_d = \sum | \{ (i,j) \mid \hat{r}_{ui} < \hat{r}_{uj} \text{ and } r_{ui} < r_{uj} \} | \quad (4)$$

A higher value of FCP indicates a higher accuracy.

APPENDIX B : Interview Session

This interview session was conducted physically. The participants in this session included Mr. Qawiem, operation manager from Falcon Kingdom Academy, and myself, Muhammad Amir Afham,

No	Question	Answer
1	Can you briefly explain the business that Falcon Kingdom Academy is doing?	Certainly. Falcon Kingdom Academy is a training and event consultancy under the MH Kingdom Empire. We specialize in conducting motivational events and training programs. This includes organizing team building sessions, workshops, camps, educational trips, and family programs. We rely heavily on team-based and hands-on experiences to deliver these programs. To run these operations, we currently manage a workforce of approximately 190 workers, which includes permanent staff as well as part-time and full-time facilitators.
2	How frequent an event is created in a month?	We handle a growing number of programs and facilitators. While the exact number varies by season, the frequency is high enough that our current manual processes for scheduling and tracking have become inefficient and error-prone. We have daily operational needs involving scheduling and workforce allocation.
3	What is your role or position in Falcon Kingdom Academy?	Right now, I act as the operation manager that handles the facilitators assignment in this company. Before this, I worked as a facilitator in this company.
4.	Can you explain the flow of the activity from creating events until the completion of the events?	The process starts with the Marketing Manager, who creates the event and blasts the details to social media to attract participants.Once the event is confirmed, the responsibility shifts to me as the Operation Manager. I start by assigning tasks to the committee, calculating the necessary costs and equipment, and arranging the event tentative. I then share the specific committee roles with the team.On the event day, the Facilitators take over the execution. They join the event, attend the venue, set up the equipment, and organize the activities. Once the event concludes, they handle the closing and clock out.After the event, the flow comes back to me to validate their attendance. I then spread the bank detail form to them. Finally, the facilitators fill in their bank details to process their allowance, which ends the cycle
5	Can you describe your main responsibilities in managing facilitators for events?	As the operation manager, my main responsibilities include assigning facilitators to events, managing their schedules, tracking attendance, and ensuring each event has the right number of facilitators based on the event requirements.
6	Who is responsible for creating the events?	The marketing manager is responsible for creating and planning the events, including designing the program and promoting it to clients.

7	How is an event created?	The marketing manager will first discuss the event details with the client, prepare a program plan, and confirm it with management. Once the event is approved, the event information is shared with the operations department to begin facilitator assigning and logistics planning.
8	Is the operation manager involved in managing the events?	Yes, I am involved after the event is created. My role is to handle workforce planning, assigning facilitators, preparing logistics, and coordinating on-ground operations during the event
9	How do you currently validate attendance for facilitators?	Right now, facilitators send their live location through WhatsApp when they arrive and leave. We manually check the live location and confirm by referring to the payment form.
10	How do you monitor or evaluate facilitator performance after events?	I usually rely on feedback from facilitators, managers, personal observations, and cooperation during the event.
11	What information do you need when assigning facilitators to an event?	I need their experience, past involvement in similar programs, skills, behavior, availability, and sometimes their strengths or weaknesses reported by team leaders.
12	What kind of data or reports do you produce for management?	I prepare reports on attendance, number of facilitators involved, issues during the event, and sometimes performance summaries. Most of these are manually written and shared when requested.
13	What documents or tools do you currently use to manage this information?	We mainly use WhatsApp. Some information is also stored in chat or in paper files.
14	What kind of features would you expect from a Workforce Management System?	I would expect features for scheduling facilitators, attendance tracking, performance tracking, facilitator profiles, and a salary tracking would also be very helpful.
15	Would a facilitator recommender be useful for assigning them to such events?	Yes, absolutely. With a workforce of approximately 190 facilitators, it is becoming impossible for me to manually remember the specific skills, strengths, and past performance of every single individual
16	What problem do you personally face when you handle that many facilitators?	Currently, I often have to rely on assumptions or my own memory when assigning tasks, which unfortunately leads to frequent wrongly assigned roles. For example, I might assign someone to a technical role when their strength is actually in public speaking. A recommender system would solve this by objectively analyzing their profiles and past history to suggest the best match for each event, ensuring we have the right people in the right places without relying on guesswork.

17	What type of users should access this system?	Operation department staff, the marketing manager, facilitators.

APPENDIX C : Interview Session with Mr. Shafiq

Table of Question for Mr. Shafiq :

No	Question	Answer
1	Can you describe your role and responsibilities as a facilitator in Falcon Kingdom Academy events?	My job is to execute the programs on the ground. This includes attending the venue, setting up the necessary equipment, organizing the activities for participants, and ensuring the event runs smoothly until the closing ceremony.
2	What processes do you follow when you are assigned to a new event?	I wait for the tentative schedule. On the event day, I go to the venue, set up equipment, run the activities, and finally clock out and submit my bank details for payment processing.
3	How are you usually informed or selected to join an event?	Usually, the details are blasted on our main WhatsApp group. If I am selected, the Operation Manager assigns me to a specific committee group for that event.
4	How do you currently record or report your attendance during events?	Currently, we have to share our live location via WhatsApp when we arrive at the venue to prove we are there. We do the same when we leave to clock out.
5	How do you usually prepare before attending an event?	I review the tentative schedule shared inside the Whatsapp group and check what role I have been assigned, for example, logistics or speaker, so I can prepare the right mental state or equipment.
6	What steps do you take to confirm your participation in an event?	I usually reply in the WhatsApp group to confirm I am available and acknowledge the task assignment.
7	How do you currently submit your attendance or task completion?	Attendance is submitted using the Whatsapp live location feature. For task completion, I must fill in a bank detail form in the WhatsApp chat after the event is over.
8	How do you report any issues or feedback after the event?	We usually just discuss it when we meet each other or message each other in the group. There is no proper form or system to record feedback, so sometimes issues and feedback are usually forgotten.
9	From your experience, how could these operations be done more efficiently?	The most tiring part is filling in the bank details manually after every single event. It is repetitive. A system that saves my details would be much better. Also, there could be a better way to attend events, instead of constantly sharing live location when clocking in and filling in the clock in and clock out time.

10	What difficulties do you face when checking in or validating your attendance?	There are times when the line signal is bad due to the location, or I forget to share the location immediately. Also, since everyone shares locations in the group, the chat gets messy, and it is hard to trace back my specific attendance time.
11	Have you ever experienced confusion or delays in communication about event schedules?	Yes, definitely. The main delay is usually with salary payments. Because the bank details are collected manually using text, sometimes they get overlooked, and I receive my payment late.
12	What information do you receive before joining an event?	I receive the date, venue, and my assigned role.
13	What information do you wish you had access to when preparing for an event?	I wish I could see the full list of facilitators and their skills so we can coordinate better. I also want to see my past history to know which types of events I perform best in.
14	What outputs or reports do you produce after an event?	I only fill in the salary payment form in the Whatsapp group
15	What information would you like to view in the system?	I want to see my payment status, attendance record and my past event history records.

APPENDIX D : INTERVIEW TRANSCRIPT WITH MR.QAWIEM

Date: 25th November 2025

Location: Abang Topi Cool Station

Interviewer: Muhammad Amir Afham (Student)

Interviewee: Mr. Muhammad Qawiem Mustaqim (Operation Manager)

1. Amir: Can you briefly explain the business that Falcon Kingdom Academy is doing?

Mr. Qawiem: Falcon Kingdom Academy is a training and event consultancy. We specialize in training and motivational events such as team building, workshops, camps, educational trips, and family programs.

2. Amir: Thank you. Before we go into more detail, maybe we can start with a bit of background. Can you briefly explain the business that Falcon Kingdom Academy is doing?

Mr. Qawiem: Falcon Kingdom Academy is a training and event consultancy. We specialize in training and motivational events such as team building, workshops, camps, educational trips, and family programs.

3. Amir: That is a very impressive workforce size. With so many facilitators, how frequent an event

is created in a month?

Mr. Qawiem: We have a growing number of programs. It varies, but we handle a wide variety of events regularly which requires a large workforce of around 190 facilitators.

4. Amir: Can you describe your main responsibilities in managing facilitators for events?

Mr. Qawiem: As the operation manager, my main responsibilities include assigning facilitators to events, managing their schedules, tracking attendance, and ensuring each event has the right number of facilitators based on the event requirements.

5. Amir: Who is responsible for creating the events?

Mr. Qawiem: The marketing manager is responsible for creating and planning the events, including designing the program and promoting it to clients.

6. Amir: How is an event created?

Mr. Qawiem: The marketing manager will first discuss the event details with the client, prepare a program plan, and confirm it with management. Once the event is approved, the event information is shared with the operations department to begin facilitator assigning and logistics planning.

7. Amir: Is the operation manager involved in managing the events?

Mr. Qawiem: Yes, I am involved after the event is created. My role is to handle workforce planning, assigning facilitators, preparing logistics, and coordinating on-ground operations during the event.

8. Amir: How do you currently validate attendance for facilitators?

Mr. Qawiem: Right now, facilitators send their live location through WhatsApp when they arrive and leave. We manually check the live location and confirm by referring to the payment form.

9. Amir: How do you monitor or evaluate facilitator performance after events?

Mr. Qawiem: I usually rely on feedback from facilitators, managers, personal observations, and cooperation during the event.

10. Amir: What information do you need when assigning facilitators to an event?

Mr. Qawiem: I need their experience, past involvement in similar programs, skills, behavior, availability, and sometimes their strengths or weaknesses reported by team leaders.

11. Amir: What kind of data or reports do you produce for management?

Mr. Qawiem: I prepare reports on attendance, number of facilitators involved, issues during the event, and sometimes performance summaries. Most of these are manually written and shared when requested.

12. Amir: What documents or tools do you currently use to manage this information?

Mr. Qawiem: We mainly use WhatsApp. Some information is also stored in chat or in paper files.

13. Amir: What kind of features would you expect from a Workforce Management System?

Mr. Qawiem: I would expect features for scheduling facilitators, attendance tracking, performance tracking, facilitator profiles, and salary tracking would also be very helpful.

14. Amir: What type of users should access this system?

Mr. Qawiem: Operation department staff, the marketing manager, and facilitators.

APPENDIX E: INTERVIEW TRANSCRIPT WITH MR.SHAFIQ

Date: 25th November 2025

Location: Abang Topi Cool Station

Interviewer: Muhammad Amir Afham (Student)

Interviewee: Mr. Muhammad Shafiq Shauqi (Facilitator)

1. Amir: Assalamualaikum and good afternoon, Mr. Shafiq. Thank you for taking the time to meet with me today. I am currently conducting requirement gathering for my Final Year Project to develop a Workforce Management System for Falcon Kingdom Academy. Your input as a facilitator is very important.

Mr. Shafiq: Waalaikumussalam, Amir. Good afternoon. No problem at all, I am happy to help with your project.

2. Amir: Thank you. Let's start with your background here. Can you describe your role and responsibilities as a facilitator in Falcon Kingdom Academy events?

Mr. Shafiq: My job is to execute the programs on the ground. This includes attending the venue, setting up the necessary equipment, organizing the activities for participants, and ensuring the event runs smoothly until the closing ceremony.

3. Amir: I see. What processes do you follow when you are assigned to a new event?

Mr. Shafiq: I wait for the tentative schedule. On the event day, I go to the venue, set up equipment, run the activities, and finally clock out and submit my bank details for payment processing.

4. Amir: Before you get to the venue, how are you usually informed or selected to join an event?

Mr. Shafiq: Usually, the details are blasted on our main WhatsApp group. If I am selected, the Operation Manager assigns me to a specific committee group for that event.

5. Amir: Once you are in that group, what information do you receive before joining an event?

Mr. Shafiq: I receive the date, venue, and my assigned role.

6. Amir: Is that information usually enough? What information do you wish you had access to when preparing for an event?

Mr. Shafiq: I wish I could see the full list of facilitators and their skills so we can coordinate better. I also want to see my past history to know which types of events I perform best in.

7. Amir: That makes sense for coordination. How do you usually prepare before attending an event?

Mr. Shafiq: I review the tentative schedule shared inside the Whatsapp group and check what role I have been assigned, for example, logistics or speaker, so I can prepare the right mental state or equipment.

8. Amir: And what steps do you take to confirm your participation in an event?

Mr. Shafiq: I usually reply in the WhatsApp group to confirm I am available and acknowledge the task assignment.

9. Amir: Moving on to the day of the event. How do you currently record or report your attendance during events?

Mr. Shafiq: Currently, we have to share our live location via WhatsApp when we arrive at the venue to prove we are there. We do the same when we leave to clock out.

10. Amir: Using live location sounds a bit dependent on internet connectivity. What difficulties do you face when checking in or validating your attendance?

Mr. Shafiq: There are times when the line signal is bad due to the location, or I forget to share the location immediately. Also, since everyone shares locations in the group, the chat gets messy, and it is hard to trace back my specific attendance time.

11. Amir: After the event concludes, how do you currently submit your attendance or task completion?

Mr. Shafiq: Attendance is submitted using the Whatsapp live location feature. For task completion, I must fill in a bank detail form in the WhatsApp chat after the event is over.

12. Amir: Aside from the bank details, what outputs or reports do you produce after an event?

Mr. Shafiq: I only fill in the salary payment form in the Whatsapp group.

13. Amir: Since this is all done manually via text, have you ever experienced confusion or delays in communication about event schedules?

Mr. Shafiq: Yes, definitely. The main delay is usually with salary payments. Because the bank details are collected manually using text, sometimes they get overlooked, and I receive my payment

late.

14. Amir: Regarding the workflow, how do you report any issues or feedback after the event?

Mr. Shafiq: We usually just discuss it when we meet each other or message each other in the group. There is no proper form or system to record feedback, so sometimes issues and feedback are usually forgotten.

15. Amir: Looking at the whole process, from your experience, how could these operations be done more efficiently?

Mr. Shafiq: The most tiring part is filling in the bank details manually after every single event. It is repetitive. A system that saves my details would be much better. Also, there could be a better way to attend events, instead of constantly sharing live location when clocking in and filling in the clock in and clock out time.

16. Amir: Finally, if we develop this new system, what information would you like to view in the system?

Mr. Shafiq: I want to see my payment status, attendance record and my past event history records.

17. Amir: That covers everything I needed. Thank you very much for your honest feedback, Mr. Shafiq.

Mr. Shafiq: You are welcome, Amir. Good luck with the project.