**VIAHALE: TRANSPORT NETWORK VEHICLE SERVICE**

**ADMINISTRATIVE WITH QR CODE-BASED  
VISITOR REGISTRATION AND FACIAL   
RECOGNITION POWERED BY OPENCV**

A Capstone

Presented to the Faculty of

The College of Computer Studies

Bestlink College of the Philippines

In Partial Fulfilment

Of the Requirements for the Degree of

Bachelor of Science in Information Technology

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# **Chapter 1**

# **INTRODUCTION**

**BACKGROUND OF THE CAPSTONE PROJECT**

In the past few years, Transport Network Vehicle Service has rapidly grown in the Philippines, and a lot of commuters rely on ride-hailing platforms like Grab, Uber, and Angkas for convenience and accessibility. These services reduce dependencies on traditional taxis and public utility vehicles. In this transformation the administrative areas of TNVS operations have grown increasingly complex such as Facility Reservation, Visitor Management, and Data monitoring.

Administrative areas of TNVS companies are frequented by a diverse mix of visitors: drivers, applicants, delivery personnel, clients, and business partners. Managing this growth securely and efficiently is vital not only for facility protection but also for maintaining a smooth human resource and compliance workflows. Many of these offices still rely on manual logbooks and basic id checks. The traditional manual logbooks for physical management systems used in TNVS offices have shown limitations, from delays in check in, inaccurate tracking, unauthorized access to inefficient record keeping. With the increased demand for security, accountability, and real-time data in administrative areas, there's a drawing need for smart solutions.

In contrast, institutions such as local government units and corporate buildings have already adopted modern visitor tracking systems integrating QR code scanners and Facial Recognition. These technologies offer fast, contactless, and verifiable ways of managing people entering and exiting a facility. However, these advancements remaina noticeable gap in customized specifically for the administrative operations of TNVS providers where real-time monitoring, mobility, and data integration are essential.

This capstone project, titled ViaHale: Transport Network Vehicle Service Administrative with QR Code-Based Visitor Registration and Facial Recognition Powered by OpenCV, aims to address these gaps. It proposes a smart, centralized, and automated platform tailored to TNVS administrative functions. By integrating QR code check in, facial recognition, and real time visitor monitoring, the system will modernize the visitor entry process while improving data accuracy, operational visibility, and overall security for TNVS facilities.

**CONTEXT AND SCOPE**

This project is set in the context of the growing Transport Network Vehicle Services (TNVS) industry in the Philippines. As more people rely on apps like Grab and Angkas for daily transport, the internal operations of TNVS companies especially in handling visitors are also getting more demanding. Offices often receive walk-ins from drivers, job applicants, partners, and other guests, making visitor tracking an essential part of day-to-day operations.

At present, many companies still use manual logbooks for visitor entry. This method can be slow, disorganized, and prone to errors, especially during busy hours. It’s hard to keep track of who's coming in and out, and this can affect both security and efficiency in the workplace.

This project aims to develop ViaHale, a smart administrative system focused on visitor monitoring. The main goal is to make the check-in process faster and more organized through the use of Facial Recognition and QR codes. Instead of writing on paper, visitors can check in quickly using a contactless method. The system will also let admins monitor visitor flow in real time and access logs whenever needed, all in one place.

The system is focused solely on visitor management. It does not cover ride-booking, driver or fleet tracking, customer services, or mobile app functions. The focus is on improving the internal check-in process in TNVS offices through a smart, efficient, and easy-to-use system.

**PROBLEM STATEMENT**

The current administrative processes in Transport Network Vehicle Services (TNVS) suffer from inefficient manual check-ins, unsecured identity verification, and disconnected booking and visitor data systems resulting in security vulnerabilities, delayed operations, and poor coordination that affect staff, drivers, and clients alike.

**Why This Problem Matters:**

1. Manual check-in inefficiency slows down daily operations, especially during peak hours, causing frustration among visitors and administrative staff.
2. Security gaps in identity verification, due to lack of biometric or digital validation, allow risks such as unauthorized access and identity fraud a serious concern for safety and compliance.
3. Limited real-time oversight makes it difficult for administrators to monitor visitor flow, facility usage, and legal documentation accurately.
4. Disjointed systems for bookings and visitor management result in miscommunication between departments, scheduling conflicts, and delays in coordination.

According to recent studies, over 70% of administrative departments in service industries report significant inefficiencies due to fragmented data systems, while security breaches linked to poor identity verification cost organizations millions annually in operational and reputational damage.

This project seeks to resolve these challenges by creating an AI-powered TNVS administrative system that integrates smart visitor monitoring using Facial Recognition and QR check-in, streamlines document and legal management, enables facility reservation automation, and provides administrators with a real-time dashboard to optimize oversight and decision-making across operations.

**GOALS AND OBJECTIVES**

**The primary objectives and goals of ViaHale: Transport Network Vehicle Service Administrative System project are as follows:**

1. Develop a centralized TNVS administrative platform that integrates visitor management, facility reservations, legal case tracking, and document management to streamline internal operations.
2. Implement a smart visitor monitoring system utilizing QR code check-in/out, and facial recognition authentication to enhance security and efficiency in guest and personnel identification.
3. Design an administrative dashboard with real-time analytics and data visualization for improved decision-making and operational oversight.
4. Ensure data privacy and security compliance by applying secure protocols for managing personal, and legal data in accordance with the Data Privacy Act.
5. Provide comprehensive technical documentation and user manuals to support system deployment, onboarding, and long-term maintenance.
6. Gather feedback from administrative staff and stakeholders through surveys and testing to refine system functionality and improve user experience.

**SIGNIFICANCE OF THE STUDY**

### With Transport Network Vehicle Service (TNVS) such as Grab and Angkas booming in the Philippines, administrative offices are facing increased visitor traffic drivers, applicants, partners, and more while still relying on manual logbooks that slow down operations and pose security risks. ViaHale is important because it modernizes this administrative process by using Facial Recognition, QR codes, and real-time monitoring, resulting in faster check-ins, safer access control, and more accurate records. This transformation aligns with industry-wide shifts toward contactless, automated solutions. For instance, a 2022 McKinsey study found that organizations integrating automation into workflows can boost productivity by up to 30%. Moreover, robust identity verification measures like multifactor authentication (MFA) can reduce unauthorized access by over 99%, enhancing security for admin systems. By addressing real-world concerns from operational efficiency to facility security, ViaHale benefits administrative staff, TNVS companies, visitors, security personnel, and future researchers.

### **Who benefits from the project:**

1. Admin Staff – Less paperwork and faster check-in process
2. Visitors – A quicker and smoother experience
3. Companies – Better security and accurate visitor logs
4. Security Teams – Easier monitoring of who enters and leaves
5. Future Researchers – A helpful reference for building smart admin systems

In today’s world, where digital and contactless systems are becoming the norm, this project is relevant and timely.

### **Document Structure**

This document is structured into five main chapters, each designed to guide the reader through the research process, system development, and implementation of ViaHale:

● Chapter 1 – Introduction  
 Introduces the project by discussing the background of the study, its context and scope, the specific problems being addressed, the project objectives, its significance, and how the document is organized. This chapter sets the tone and explains why the project is necessary and valuable.

● Chapter 2 – Review of Related Literature and Studies  
 Covers existing technologies, previous systems, frameworks, and academic research that relate to visitor management, administrative systems, and smart check-in methods. This chapter provides both theoretical grounding and market context for the project.

● Chapter 3 – Methodology  
 Describes the approach used in developing the system, including the research design, development model (e.g., Agile or Waterfall), tools and technologies, and data gathering methods. It also outlines the steps followed in building and testing the system.

● Chapter 4 – System Design and Implementation  
 Presents the actual design of the system including data flow diagrams, user interface designs, ERD (Entity Relationship Diagrams), and key system features. It explains how the system works and includes screenshots and results from implementation.

● Chapter 5 – Summary, Conclusion, and Recommendations  
 Summarizes the key findings and project results, assesses whether the objectives were met, and offers recommendations for improvement or future development.

Each chapter is structured to build upon the last, providing a logical and comprehensive overview of the capstone—from concept to deployment. This ensures that readers can easily follow the development process, understand the technical decisions made, and see the real-world value of the solution.

**LITERATURE REVIEW**

**OVERVIEW OF THE AGILE SCRUM METHODOLOGY**

Agile Scrum is a framework within the Agile methodology that is widely used in software development projects. It emphasizes iterative and incremental development, allowing teams to deliver high-quality software while adapting to changing requirements. Scrum promotes collaboration, flexibility, and customer involvement throughout the development process.

**Principles of Agile Scrum**

Delivering valuable software to customers early and continuously is a primary goal of agile methodology, as emphasized by Schwaber and Sutherland (2020) in The Scrum Guide. This principle is particularly relevant for VIAHALE, which aims to enhance transportation network services through innovative technology. Daily collaboration between business stakeholders and developers is essential; for VIAHALE, this means engaging with transportation authorities, users, and technical teams to ensure that the QR code-based visitor registration and facial recognition features meet real-world needs. The most effective communication is face-to-face conversation, which can facilitate quick feedback and adjustments to the system.

Agile Scrum welcomes changing requirements, even late in development, allowing VIAHALE to adapt to new regulations or user feedback regarding visitor registration processes. This flexibility provides a competitive advantage in the rapidly evolving transportation sector. As noted in The Scrum Guide, agile processes promote sustainable development, maintaining a constant pace indefinitely, which is crucial for the ongoing updates and maintenance of the VIAHALE system.

Working software is delivered frequently, with a preference for shorter timescales; this approach allows VIAHALE to roll out features incrementally, such as initial QR code functionalities followed by advanced facial recognition capabilities. Continuous attention to technical excellence and good design enhances agility, ensuring that the VIAHALE system remains robust and user-friendly. The primary measure of progress is working software, which for VIAHALE translates to the successful deployment of its features that improve the efficiency and security of transportation services (Schwaber & Sutherland, 2020).

**Values of Agile Scrum**

The Agile Manifesto outlines four key values that underpin Scrum, which are particularly relevant for the development and implementation of VIAHALE: Transportation Network Vehicle Service Administrative with QR Code-Based Visitor Registration and Facial Recognition Powered by OpenCV.

**Individuals and Interactions over Processes and Tools** emphasizes team dynamics and communication for effective collaboration among developers, transportation authorities, and end-users. This ensures tailored QR code-based visitor registration and facial recognition features, fostering a culture of innovation and responsiveness, ultimately leading to a more effective system.

**Working Software over Comprehensive Documentation** prioritizes working software over comprehensive documentation to enhance transportation services. This approach allows for the development of functional features like QR code registration and facial recognition, which can be refined based on real-time user feedback, enhancing the overall user experience.

**Customer Collaboration over Contract Negotiation** approach to customer collaboration over contract negotiation promotes adaptability to user needs and regulatory requirements. It maintains open communication with transportation authorities and users, enabling system evolution and user experience improvement. This collaborative approach integrates feedback into the development process.

**Responding to Change over Following a Plan** VIAHALE prioritizes adaptability and responsiveness, a crucial aspect in the fast-paced transportation sector. This allows the project team to pivot as needed, incorporating new technologies or adjusting visitor registration processes. This approach ensures VIAHALE remains agile and relevant, effectively addressing user needs and regulatory environments.

By embracing these Agile Scrum values, VIAHALE can enhance its development process, leading to a more efficient, user-friendly, and secure transportation network service.

**Practices of Agile Scrum**

According to Haigh, A.J. (2025) Agile Scrum methodology development is structured around time-boxed iterations known as sprints, typically lasting 2-4 weeks. For VIAHALE, each sprint represents a critical opportunity to advance the development of its QR code-based visitor registration and facial recognition system. At the beginning of each sprint, the team collaborates to plan the specific features and enhancements to be completed, ensuring alignment with the project’s goals and user needs.

Short daily meetings, often referred to as stand-ups, are essential for maintaining momentum within the VIAHALE team. During these meetings, team members discuss their progress, outline plans for the day, and identify any obstacles they may be facing. This practice fosters open communication and quick problem-solving, which is vital for addressing challenges that may arise in the development of complex features like facial recognition technology.

At the end of each sprint, the team demonstrates the completed work to stakeholders, including transportation authorities and end-users, to gather valuable feedback. This iterative review process allows VIAHALE to ensure that the system is evolving in a way that meets real-world requirements and expectations, enabling timely adjustments based on user input.

The **Product Backlog** serves as a prioritized list of features, enhancements, and bug fixes that the VIAHALE team will work on. This dynamic list is continuously refined based on stakeholder feedback and changing requirements, ensuring that the most critical functionalities such as the QR code registration process and facial recognition capabilities are prioritized for development. By maintaining a clear and prioritized backlog, VIAHALE can effectively manage its resources and focus on delivering the most valuable features to enhance transportation network services.

**Iterative and Incremental Nature**

Agile Scrum is characterized by its iterative and incremental approach. Teams work in cycles (sprints) to refine and improve the product based on feedback and changing requirements. Each sprint results in a potentially shippable product increment, allowing for gradual enhancement of the software.

According to Magnussen, E. F., Havnelid, E., & Molléri, J. S. (2024) customer collaboration is a cornerstone of the Agile Scrum framework. The Product Owner plays a crucial role in representing stakeholders, defining the product vision, and prioritizing the backlog to ensure that the development team aligns with user needs. Regular feedback from customers is essential, as it allows the team to adjust priorities and refine features, such as the QR code registration and facial recognition functionalities, to better serve users. Additionally, Scrum's adaptability to changing requirements is particularly relevant in this project. The iterative nature of the framework enables the team to reassess priorities and make necessary adjustments based on stakeholder feedback, market dynamics, or new insights gained during development. This flexibility ensures that VIAHALE remains responsive to user needs and can effectively integrate advancements in technology, ultimately enhancing the overall user experience.

## **CONCEPTS OF ENTERPRISE ARCHITECTURE (EA)**

Enterprise Architecture (EA) is a strategic framework that defines the structure and operation of an organization through a comprehensive view of its business processes, information systems, technologies, and strategies. It serves as a blueprint that ensures that an organization's IT infrastructure and business goals are aligned, sustainable, and scalable. It helps organizations to manage complexity, improve decision-making, and guide technology investments.

**Enterprise Architecture’s Role in Aligning Business and Technology**

#### EA helps translate high-level business strategies into actionable technology plans. It ensures that every IT project, software deployment, or infrastructure upgrade is aligned with the organization's operational needs and long-term objectives. Also defining common standards, architectures, and practices across the organization helps reduce redundancy, simplify system integration, and enhance data sharing across departments. By mapping current processes and systems, EA identifies gaps or inefficiencies. This enables organizations to adapt quickly to changes (e.g., market shifts or regulatory updates) while maintaining technological stability. Through careful planning and oversight, Enterprise Architecture (EA) reduces the risk of IT project failures, cost overruns, and system incompatibility by ensuring that technology decisions are made with a clear understanding of their business impact, thereby minimizing wasted resources. Lastly EA provides a framework for governance, offering leaders the information they need to make informed decisions. With visibility into both business processes and IT assets, organizations can prioritize initiatives that deliver the most value.

**Key Enterprise Architecture’s (EA) Frameworks and Standards**

TOGAF (The Open Group Architecture Framework): is one of the most widely used EA frameworks globally. It provides a methodology (ADM: Architecture Development Method) for designing, planning, implementing, and managing enterprise IT architecture

### **Areas of Architecture within Enterprise Architecture (EA)**

Business Architecture: The design and structure of an organization’s core processes, operational strategies, and organizational hierarchy. It defines how business goals are achieved through workflows, decision-making structures, and governance models. This includes the modeling of processes such as Facility Reservation, Visitor Check-In, and Document handling, ensuring that they align with institutional policies and strategic objectives. Application Architecture: It specifies the structure, behavior, and interactions of software applications within an enterprise. It defines how individual systems function independently and how they integrate with one another to support business processes. In a system context, this may include components such as the QR code scanning module, facial recognition application, and document tracking system, all working together to deliver a cohesive and efficient administrative platform. Data Architecture: Involves the design, structure, and management of data assets, including data models, storage systems, and the flow of information across various applications. It ensures that data is organized, accessible, and secure throughout its lifecycle. This includes elements such as secure Visitor logs, Audit trails for Legal records, and metadata associated with stored Documents, all of which support accurate tracking, retrieval, and compliance with organizational policies. Technology Architecture: Focuses on the underlying infrastructure that supports applications and data within an enterprise. This includes hardware, networks, servers, operating systems, and development tools. It defines how technologies are deployed and integrated to ensure performance, scalability, and security. Examples include the use of OpenCV for Facial Recognition, cloud storage for centralized data access, secure APIs for inter-module communication, and mobile or web platforms for user interaction.

### **Importance of Coherent Architecture**

A well-structured Enterprise Architecture (EA) ensures that an organization’s information systems are fully integrated, scalable, and adaptable to change. This is especially important in environments that involve real-time transactions, confidential data handling, and cross-departmental collaboration. A coherent architecture prevents the formation of system silos by promoting a unified structure in which all components operate in harmony. It enables interoperability between modules and platforms, ensuring seamless data exchange and system communication. Furthermore, it lays a strong foundation for future enhancements, allowing organizations to introduce new features or technologies without disrupting existing operations. By reducing redundancy, complexity, and operational costs, a coherent architecture becomes a critical enabler of long-term organizational success and digital transformation

**Microservices Architecture**

Microservice is an innovative architectural style that is becoming more and more popular. Numerous scholars support microservices as a solution to the outdated methods for monolithic architecture style. However, there is no comprehensive research study on the shift from monolithic architecture to MSA. Micro Service Architecture has made it necessary to create software development processes and architecture design is the continuous development of MSA to meet the needs of autonomous deployment, scalability, and maintenance Razzaq et al. (2022).

A study by Bushon et al. (2021) Microservices Architecture enhances scalability, reusability, and independent deployment essential features for Administrative system where several workflows must run simultaneously and independently.

Calp and Karakose (2023) highlighted the growing popularity of AI-assisted service deconstruction and dynamic orchestration in a recent review on artificial intelligence based microservice architecture. This is particularly useful in complex Administrative systems where processes such as legal compliance and document approval can be modularized and automated.

Microservices have also been found to be effective in edge computing environments, where real-time visitor data needs to be processed efficiently. Gharavi and Hu (2023) investigated this in the context of distributed this in the context of distributed microservices across cloud and edge, highlighting latency reduction and improved user responsiveness key factors in Visitor Management systems.

Zia et al. (2024) showed the benefits of Microservice Architecture in building responsive and scalable reservation systems. The framework allowed real-time analytics and predictive processing, improving both administrative planning and user experience, an ideal fit for the Facility Reservation module.

**DevOps and CI/CD**

DevOps integrate people, processes, and technology in application design, development, and operations. DevOps has made it possible for development, IT operations, quality engineering, and security to work together and coordinate. DevOps culture, practices, and technology help organizations create high-quality applications on schedule, become more responsive to customer needs, and accomplish business goals more quickly. Through the development of more reliability Pradeep Chintale(2024).

Continuous Integration (CI) and Continuous Delivery (CD) are pivotal DevOps practices that automate software testing and deployment, enabling frequent, reliable releases. Soares et al. (2021) synthesized 101 empirical studies and found that CI improves collaboration, integration systems, and code quality while introducing some technical challenges. According to Lakshmi Prasad Rongali (February 2025) the deployment of CI/CD pipelines enhances AI workflows' scalability and operational efficiency in software development. These technologies automate critical deployment and development tasks over time. By being incorporated into the pipelines that the systems run continually, integration functions have the ability to decrease human error and speed up the release of products. Continuous automation of routine operations in the CI/CD pipelines frees up resources and allows teams to work on strategic projects at the same productive levels.

Scales of operation are essential in the times of Continuous Integration/Continuous Deployment pipelines. The deployment across diverse environments requires the execution of periodic updates by CI/CD pipelines because of its sophisticated requirements pipeline deploys consistent model versions across all the environments by using version control capabilities by applying methods that maintain stability and repeatability.

Successful DevOps adoption hinges on a combination of technical, organizational, and cultural readiness. Gwangwadza & Hanslo (2022) identified factors like collaborative culture, tooling, and continuous practices as key drivers, while Al‑Debagy & Martinek (2023) proposed a comprehensive framework of nearly 100 critical success factors2

**RELEVANT STUDIES AND RESEARCH**

This section presents a review of previous studies, scholarly articles, and research related to the development of RFID, QR-based systems, and administrative technologies. It aims to summarize key findings, methods, and conclusions that are relevant to the proposed capstone project. By analyzing these studies, this section identifies best practices, existing gaps, and opportunities for innovation. The insights gathered help establish a strong foundation for the project and ensure that it builds upon proven research and real-world applications.

**RELATED STUDIES AND RESEARCH**

**Gallera (2023)** authored *"Designing and Evaluating a QR Code-Based Monitoring System for School Visitor Logs"*, where a school portal and mobile app allowed visitors to check in via QR codes, with positive usability, security, and maintainability results.

**INTEGRATION OF INFORMATION SYSTEMS**

Integrating information systems into the business environment is a critical endeavor for organizations like VIAHALE, which seeks to enhance its operational capabilities and maintain a competitive edge in the transportation sector. This involves ensuring that various information systems, such as QR code-based visitor registration systems, facial recognition technology powered by OpenCV, and backend databases, work together seamlessly. This integration can improve efficiency, consistency, and decision-making, benefiting both transportation authorities and visitors. By combining these systems, VIAHALE can create a single platform that makes visitor registration easier and improves security. Challenges include data compatibility, tracking system updates, and security issues. However, successful integration can lead to real-time data sharing, accurate visitor identification, and improved reporting capabilities. Common integration tools like Application Programming Interfaces (APIs) and middleware solutions are essential for building a strong infrastructure that can handle changing transportation network needs. These integration efforts align with Enterprise Architecture (EA) ideas, ensuring that VIAHALE's information systems can adapt to future technology and rules changes. Kohansal, M. A. (2024).

**Challenges of Integrating Information System**

*Complexity of Systems:* VIAHALE may need to operate with a mix of legacy systems and modern applications, which can lead to compatibility issues. Integrating these diverse systems such as existing visitor management systems with the new QR code registration and facial recognition technologies can be technically challenging and resource-intensive. This complexity requires careful planning and execution to ensure a smooth integration process.

*Data Silos:* Different departments within the transportation network may utilize separate systems that do not communicate with each other, resulting in data silos. For VIAHALE, this fragmentation can hinder collaboration among stakeholders, such as transportation authorities and security personnel, and lead to inconsistent data regarding visitor registrations and identifications. Breaking down these silos is essential for achieving a unified and efficient operational framework.

*Resistance to Change:* Employees and stakeholders may be accustomed to existing processes and systems, making them resistant to adopting new integrated solutions. For VIAHALE, effective change management strategies are crucial to address this resistance, ensuring that all users understand the benefits of the new QR code-based visitor registration and facial recognition system and are trained to use it effectively.

*Security Risks:* Integrating systems can expose vulnerabilities, especially when sensitive data, such as personal identification information, is involved. VIAHALE must implement robust security measures to protect against data breaches and ensure compliance with privacy regulations. This includes securing data transmission between the QR code system and facial recognition software, as well as safeguarding stored data.

*Interoperability Issues:* Different systems may use varying data formats and protocols, complicating the integration process. For VIAHALE, ensuring interoperability between the QR code registration system, facial recognition technology, and existing databases will require additional development work. This may involve creating APIs or middleware solutions to facilitate seamless communication between systems.

**Benefits of Integrating Information Systems**

*Improved Efficiency:* Integration automates the data flow between systems, significantly reducing manual data entry and minimizing errors. For VIAHALE, this streamlining of processes means that visitor registrations can be processed more quickly and accurately, leading to faster operations and lower operational costs. The automation of tasks such as data capture from QR codes and facial recognition enhances overall service delivery in the transportation network.

*Data Consistency:* A unified information system ensures that all departments within VIAHALE access the same data, reducing discrepancies and improving the reliability of information. This consistency is crucial for accurate reporting and analysis, particularly when it comes to tracking visitor patterns and security metrics. Reliable data supports better decision-making and enhances the effectiveness of the transportation network.

*Better Decision Making:* Integrated systems provide decision-makers with real-time access to comprehensive data and analytics. For VIAHALE, this means that transportation authorities can quickly assess visitor traffic, identify trends, and make informed decisions regarding resource allocation and operational adjustments. The ability to analyze data from both the QR code registration and facial recognition systems enables more effective management of transportation services.

*Enhanced Collaboration:* Integration fosters collaboration among departments by providing a shared platform for communication and data sharing. For VIAHALE, this leads to improved teamwork among security personnel, administrative staff, and transportation authorities, ultimately resulting in better project outcomes. A collaborative environment enhances the ability to respond to visitor needs and operational challenges effectively.

*Scalability:* Integrated systems can be more easily scaled to accommodate growth, as they provide a cohesive framework for adding new functionalities or systems without disrupting existing operations. For VIAHALE, this means that as the transportation network expands or as new technologies emerge, the system can adapt and integrate these advancements seamlessly, ensuring continued efficiency and effectiveness.

**Integration Techniques and Technologies**

Middleware Solutions: Middleware acts as an intermediary that facilitates communication between different systems. API Integration: Application Programming Interfaces (APIs) allow different software applications to communicate with each other, enabling seamless data exchange and functionality sharing. Data Warehousing: Centralized data warehouses aggregate data from various sources, providing a single source of truth for reporting and analysis. This approach enhances data consistency and accessibility. ETL Processes: Extract, Transform, Load (ETL) processes are used to consolidate data from multiple sources into a single database, ensuring that data is clean, consistent, and ready for analysis. Cloud Integration: Cloud-based integration platforms enable organizations to connect on-premises systems with cloud applications, facilitating hybrid environments and improving flexibility.

# **METHODOLOGY**

**AGILE SCRUM METHODOLOGY IN THE PROJECT**

In line with the project's goals of flexibility, rapid adaptation, and stakeholder-driven development, researchers have chosen to implement the Agile Scrum methodology. Agile Scrum is a collaborative and iterative framework that emphasizes regular communication, teamwork, and responsiveness to change. This methodology is particularly well-suited for software development projects in higher education, especially those like VIAHALE, which require close coordination between multiple functional modules and emerging technologies such as QR code-based check-ins and facial recognition powered by OpenCV.

*Figure 1. System Development Life Cycle Diagram of Transport Network Vehicle Service Administrative System*

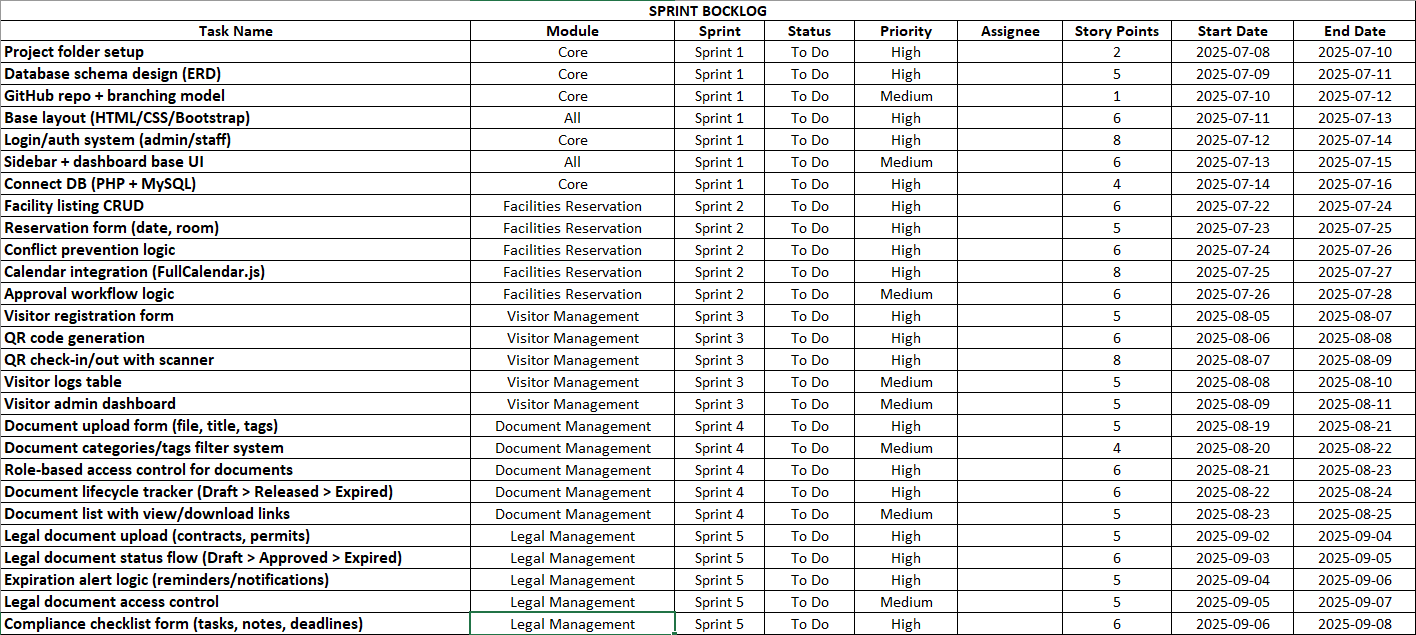
**ROLES**

The project team is structured according to Scrum best practices:

|  |  |  |
| --- | --- | --- |
| **Name** | **Role** | **Responsibility** |
|  | Product Owner | Defines requirements, prioritizes features in the product backlog, and ensures the team delivers value. |
|  | Scrum Master | Ensures Scrum process is followed, facilitates events, coaches team, and removes impediments. |
| Ramos, Lance Steven  Honrado, Glen | Development Team | Responsible for designing, coding, testing, and delivering product features collaboratively. |
|  | Document Specialist | Creates, maintains, and manages project documentation, ensuring accuracy and accessibility for communication |
|  | Quality Assurance (QA) | Ensures product meets quality standards, develops and executes test plans, and verifies feature functionality. |

**Sprint Cycles**

The Figure 2. show Sprint Backlog for a project system development. A list of tasks needs to accomplished by submodules (like Facilities Reservation, Visitor Management, Legal Management, And Document Management) and scheduled across five sprints. Each task includes its priority, estimated effort (story points), and target dates

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*Figure 1. Sprint Backlog: A planning document used in Agile project management to track tasks across different sprints.*

**SCRUM ARTIFACTS**

The Scrum artifacts were crucial in directing the development process and guaranteeing alignment with stakeholder needs in the study of VIAHALE: Transport Network Vehicle Service Administrative with QR Code-Based Visitor Registration and Facial Recognition Powered by OpenCV. All necessary features, enhancements, and technical tasks to the project were documented in the Product Backlog, which functioned as a dynamic document. This backlog was updated and improved on a regular basis by the Product Owner in response to feedback from stakeholders and users. This allowed them to prioritize important tasks like integrating facial recognition and QR code registration. The team was able to stay focused on providing value and adjusting to any new needs or insights to this flexible strategy.

Additionally, the team's work was organized according to the Sprint Backlog for each sprint. By selecting specific items from the Product Backlog. The Development Team pledged to complete a set of user stories and tasks that were required to advance the project. Throughout the sprint, the team actively managed the Sprint Backlog, monitoring progress and making the required changes. This adaptability was important, particularly when new challenges emerged or stakeholder input suggested that adjustments to functionality were necessary. In terms of Srum artifacts, the backlog duration is estimated to span between 2 to 8 weeks. This timeframe indicates that the team is prepared to work on the project over multiple sprints, allowing for flexibility and responsiveness to emerging stakeholder needs. By using these Scrum artifacts, the VIAHALE project was able to maintain a clear focus on offering a dependable and user-friendly service while also ensuring that the development process remained flexible and responsive to the evolving needs of its customers.

**Microservices Architecture**

To enhance scalability, modularity, and system resilience, the proposed system adopts a Microservices Architecture. Each core function of the system is broken down into independently deployable services, communicating via REST APIs. Below is a breakdown of each service, their purpose, key endpoints, and interactions.

**Facility Reservation Service**

Purpose: Manages booking of rooms, equipment, and facility spaces.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Create reservation | POST /api/reservations/create |
| View availability | GET /api/facilities/availability |
| Cancel reservation | DELETE /api/reservations/cancel/:id |
| Approve/reject request | PATCH /api/reservations/approve/:id |

**Visitor Management Service**

Purpose: Handles pre-registration, check-ins, QR code generation, and visitor notifications.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Register visitor | POST /api/visitors/register |
| Generate QR code | GET /api/visitors/qr/:id |
| Visitor check-in/out | POST /api/visitors/checkin/:qr\_id |
| Host notification | POST /api/visitors/notify-host/:visitor\_id |

**Document Management Service**

Purpose: Secure storage, retrieval, sharing, and archiving of files.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Upload document | POST /api/documents/upload |
| View/download document | GET /api/documents/:id/view |
| Assign document access | POST /api/documents/share |
| Track document history | GET /api/documents/audit/:id |

**Legal Management Service**

Purpose: Handles contracts, permits, licensing, and compliance notifications.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Create contract | POST /api/legal/contracts/create |
| Track renewal | GET /api/legal/compliance/track |
| Notify expiry | GET /api/legal/reminder/:contract\_id |
| Upload permits | POST /api/legal/permits/upload |

**User & Role Management Service**

Purpose: Centralized user login, authentication, and role control.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| User login/register | POST /api/auth/login |
| Assign role | PATCH /api/auth/roles/assign |
| Reset password | POST /api/auth/reset |
| User profile | GET /api/users/:id/profile |

**Notification Service**

Purpose: Handles all system notifications (email, SMS, push, in-app).

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Send email | POST /api/notify/email |
| SMS blast | POST /api/notify/sms |
| Notify on approval | POST /api/notify/reservation/:id |

**Audit Trail / Logging Service**

Purpose: Logs user/system actions for traceability and legal auditing.

|  |  |
| --- | --- |
| **Function** | **Endpoint** |
| Log action | POST /api/logs/create |
| View logs | GET /api/logs?user=123 |
| Export logs | GET /api/logs/export |

**DevOps Implementation**

This section outlines the tools and practices involved in each phase of the CI/CD pipeline for the system.

|  |  |  |
| --- | --- | --- |
| **Stage** | **Tools** | **Description** |
| Version Control | Git + GitHub | All code pushed and reviewed in branches via PRs. |
| CI – Continuous Integration | GitHub Actions / Jenkins | Run unit tests and syntax checks on code push/merge. |
| Build Phase | Docker | Containerize each microservice with its own Dockerfile. |
| CD – Continuous Delivery | GitHub Actions / Jenkins | Push Docker images to a container registry. |
| Deployment | Docker Compose / Kubernetes | Deploy services and restart with no downtime. |
| Reverse Proxy | NGINX | Route requests to appropriate services. |
| Monitoring/Logging | Prometheus + Grafana / ELK Stack | Monitor system health and logs. |

**Integration Approach for Information System**

The integration of ViaHale’s administrative modules such as Visitor Management, Facilities Reservation, Document Management, and Legal Management is achieved through a modular, API-driven approach. Each service communicates using RESTful APIs and standardized JSON formats to ensure smooth data exchange. Key integration techniques include data mapping for aligning fields like visitor ID and timestamps, and data transformation for formatting consistency. The system uses asynchronous communication protocols and a shared cloud database with role-based access control to maintain real-time synchronization and data integrity. This setup allows for seamless collaboration among microservices, improves operational visibility, and supports scalable deployment through CI/CD pipelines in a DevOps environment.

**Introduction to TOGAF and the Four Architectural Domains**

**Requirement Analysis**

**Stakeholder Identification**

**Requirements Gathering Techniques**

**User Stories and Use Cases**

**Functional Requirements for Integration**

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