



# FPT UNIVERSITY

## Capstone Project Document

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### Learner Management and 3D Simulation System for Crane Training Center

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<b>Capstone Project code</b>	FA25SE097

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Finally, we are grateful to our families and friends for their unwavering support and encouragement during this journey. This project is the result of the hard work, collaboration, and dedication of all members of **Group GFA25SE59**.

## Definition and Acronyms

Acronym	Definition
LSSCTC	Learner Management and 3D Simulation System for Crane Training Center
BA	Business Analysis
BR	Business Rule
ERD	Entity Relationship Diagram
GUI	Graphical User Interface
PM	Project Manager
SDD	Software Design Description
SPMP	Software Project Management Plan
SRS	Software Requirement Specification
UAT	User Acceptance Test
UC	Use Case

API	Application Program Interface
FE	Feature
SI	Simulation Feature
LI	Limitation
EX	Exclusion
SIM	Simulation
VR	Virtual Reality
HTTPS	Hypertext Transfer Protocol Secure
CORS	Cross-Origin Resource Sharing
NCCER	National Center for Construction Education and Research
ITI	Industrial Training International
REST	Transmission Control Protocol
DBMS	Database Management System
ORM	Object-Relational Mapping
PK	Primary Key
FK	Foreign Key
SMTP	Simple Mail Transfer Protocol
SQL	Structured Query Language
TE	Theory Exam (of Final Exam)
SE	Simulation Exam (of Final Exam)
PE	Practical Exam (of Final Exam)

# I. Project Introduction

## 1. Overview

### 1.1 Project Information

- Project name: Learner Management and 3D Simulation System for Crane Training Center
- Project code: FA25SE097
- Group name: GFA25SE59
- Software type: Web App, Desktop App

### 1.2 Project Team

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## 2. Product Background

Crane operation training requires a combination of theoretical understanding and significant practical experience. Traditional training methods that rely exclusively on real cranes present several major challenges. These include high operational costs (fuel, maintenance, instructor time), limited availability of physical equipment for trainees, and most importantly, significant safety risks for beginners operating heavy machinery.

Training centers often struggle with the logistics of managing training schedules, effectively tracking the progress of numerous trainees, and ensuring a consistent quality of instruction. Furthermore, without modern simulation tools, trainees may lack sufficient and safe preparation before they are required to operate real, high-risk equipment. This situation leads to a demand for an integrated system that can streamline training center management while also providing a safe, realistic, and cost-effective 3D simulation environment to enhance learning efficiency and reduce operational risks.

## 3. Existing Systems

### 3.1 ITI (Industrial Training International)

Link 1: [ITI Simulator Capture](#)

Link 2: [ITI Courses](#)

ITI offers a complete ecosystem that combines its Learning Management System with a massive library of VR Crane Simulations. Performance metrics from the simulation (e.g., pass/fail, efficiency) are automatically fed back into the student's record in the LMS.

They offer a wide variety of scenarios and crane models. However, ITI Simulator relies on high-cost Virtual Reality (VR) hardware, which can be expensive to deploy to a large number of trainees simultaneously.

### **3.2 CM Labs Simulations (Vortex)**

Link: [CM Labs Main Site](#)

CM Labs is a market leader in high-fidelity, physics-based simulation for heavy equipment. They are widely regarded for providing the most accurate simulation of crane physics and machine behaviour. CM Labs support both normal setup and high-cost alternative.

However, they are not a complete LMS and require training center to maintain a separate LMS integration. That leads to significant complexity and cost.

### **3.3 NCCER (National Center for Construction Education and Research)**

Link: [NCCER Mobile Crane Course](#)

NCCER provides a standardized curriculum and a registry system (LMS) for managing craft training, assessments, and certifications, including for crane operators. This system is a leader in managing the theoretical and book-learning components of training.

However, NCCER is not integrated with any 3D Simulator, and highly relies on available devices. This creates a significant gap between theory and practice, introduces high safety risks for new trainees, and incurs high operational costs (fuel, machine wear, instructor time).

## **4. Business Opportunity**

The heavy equipment training industry faces persistent operational and financial challenges. Training centers are constrained by the high operational costs of machine fuel and maintenance, significant safety risks for novice operators, and the low scalability of one-on-one physical instruction. Concurrently, the administrative burden of managing trainee schedules, tracking theoretical progress, and logging practical results is a major logistical inefficiency.

There is a strong demand for a single, cost-effective system that can streamline workflows through a central web-based Learning Management System, while cutting the gap between theory and high-risk practice by providing a safe, low-cost, and repeatable 3D simulation environment.

## **5. Software Product Vision**

For crane training centers seeking to modernize their curriculum, enhance safety, and reduce operational costs, LSSCTC is an integrated software suite that provides a unified system for both theoretical and practical training.

The system combines a comprehensive web-based LMS for managing courses, users, and progress, with an accessible desktop 3D simulation application for hands-on practice. This approach empowers training centers to deliver a scalable and cost-effective program that improves trainee preparedness and safety, while simultaneously providing administrators and instructors with a centralized tool to manage the learning lifecycle.

## **6. Project Scope & Limitations**

### **6.1 Major Features**

#### **6.1.1 Web Application for Admin**

FE-01: Login/Logout.

FE-02: Manage personal profile: view profile, update profile, change password.

FE-03: Manage user account: view user account, add user account, deactivate user account.

FE-04: Manage program: view program, add new program, update program, assign course for program.

FE-05: Manage course: view course, add new course, update course.

FE-07: Manage class: view class, add new class for specific course, update class, assign instructor.

FE-08: Manage simulation timeslot: view slot, add new slot, update slot, assign practice to slot.

#### **6.1.2 Web Application for Simulation Manager**

FE-09: Manage personal profile: view profile, update profile, change password.

FE-10: Manage simulation component: view component, add new component, update component.

FE-11: Manage simulation task: view action, add new action, update action.

FE-12: Manage simulation practice: view practice, add new practice, update practice.

#### **6.1.3 Web Application for Instructor**

FE-13: Login/Logout.

FE-14: Manage personal profile: view profile, update profile, change password.

FE-15: Manage class member: view member, add new member.

FE-16: Manage class section: view section, add new section, update section.

FE-17: Manage learning material: view material, add new material, update material, assign material to section.

FE-18: Manage quiz: view quiz, add new quiz, update quiz, assign quiz to section.

FE-19: View list practices and can assign practices to class section.

FE-20: View trainee result on quizzes and practices and can provide direct feedback.

FE-21: View trainee overall performance in class and can confirm pass or fail result for each trainee in class.

FE-22: Manage final exam: setup Theory Exam, Simulation Exam, Practical Exam.

FE-23: Take attendance.

#### **6.1.4 Web Application for Trainee**

FE-24: Login/Logout.

FE-25: Manage personal profile: view profile, update profile, change password.

FE-26: View available programs, courses, classes, and can make enrolment.

FE-27: View class syllabus and sections.

FE-28: View learning material assigned to class section and can access or download material.

FE-29: View quizzes assigned to class section and can make attempt or view recorded results.

FE-30: View practices assigned to class section and can view recorded results.

FE-31: Take final exam

#### **6.1.5 3D Simulation Application for Trainee**

SI-01: Login/Logout.

SI-02: View list practices in which trainee is assigned to and can select a practice to make new attempt.

SI-03: View simulation guides and settings.

SI-04: View practice steps and step details (including target components, target actions, expected outcome).

SI-05: View simulation components, and can make action (inspect definition, lift, rotate).

SI-06: View step result and warning message when committing an error.

SI-07: View post-practice result (time, completion status).

## **6.2 Limitations & Exclusions**

Limitations:

LI-01: Simulation Platform: The 3D Simulation Application (6.1.5) is a desktop-only application (Windows/Linux/macOS) and is not accessible via web browser or mobile device.

LI-02: Simulation Scope: The simulation practice does not perfectly represent real-world crane models and physics.

LI-03: Content Management: The system provides feature to manage program content and simulation settings, but it does not include creating core assets and scripts inside simulation environment.

Exclusions:

EX-01: Payment and Billing: The system does not support any payment processing or billing features.

EX-02: Communication: The system does not support comments, live chat or discussion forum. Feedback feature is private.

EX-03: Final Examination: The system is a training and preparedness tool, not a final certification authority. All official, final examinations (the hands-on, practical test with real crane vehicle, in-person written exams) are conducted offline and are outside the scope of this system.

EX-04: Course Certificate: The system issues Certificate of Training / Certificate of Completion to validate that a trainee has finished a course within the training centre. The issuance does not connect to, or submit result to, any government and regulatory body.

## II. Project Management Plan

### 1. Overview

#### 1.1 Scope & Estimation

#	WBS Item	Complexity	Est. Effort (man-days)
1	<b>Web Application for Admin</b>		22
1.1	FE-01: Login/Logout	Simple	2
1.2	FE-02: Manage personal profile	Simple	2
1.3	FE-03: Manage user account	Medium	4
1.4	FE-04: Manage program (assign courses)	Medium	5
1.5	FE-05: Manage course	Simple	3
1.6	FE-07: Manage class (assign instructor)	Medium	6
2	<b>Web Application for Simulation Manager</b>		32
2.1	FE-08 & FE-09: Auth & Profile	Simple	2
2.2	FE-10: Manage simulation component	Complex	6
2.3	FE-11: Manage simulation action	Medium	5
2.4	FE-12: Manage simulation practice	Complex	7
2.5	FE-13: Manage practice step	Complex	6
2.6	FE-14: Manage practice warning	Medium	3
2.7	FE-15: Manage simulation timeslot	Medium	3
3	<b>Web Application for Instructor</b>		28
3.1	FE-16 & FE-17: Auth & Profile	Simple	2
3.2	FE-18: Manage class member	Simple	2

3.3	FE-19 & FE-20: Manage sections & materials	Medium	6
3.4	FE-21: Manage quiz (assign to section)	Medium	6
3.5	FE-22: View & assign practices	Simple	3
3.6	FE-23: View results & provide feedback	Medium	5
3.7	FE-24: View overall performance & grading	Medium	4
<b>4</b>	<b>Web Application for Trainee</b>		<b>24</b>
4.1	FE-25 & FE-26: Auth & Profile	Simple	2
4.2	FE-27: View programs/enrollment	Medium	4
4.3	FE-28 & FE-29: View syllabus & materials	Simple	3
4.4	FE-30: Quiz attempt & history	Complex	8
4.5	FE-31: View practice results	Simple	3
4.6	<b>System Integration (API &amp; Database)</b>	<b>Complex</b>	<b>4</b>
<b>5</b>	<b>3D Simulation Application (Desktop)</b>		<b>45</b>
5.1	SI-01: Login/Logout (API Integration)	Simple	3
5.2	SI-02: List practices & selection	Medium	4
5.3	SI-03 & SI-04: Guides, Settings & Steps UI	Medium	6
5.4	SI-05: Simulation Physics (Lift, Rotate, Inspect)	Complex	15
5.5	SI-06: Error detection & warning system	Complex	10
5.6	SI-07: Result calculation & submission	Medium	7
	<b>Total Estimated Effort (man-days)</b>		<b>151</b>

## 1.2 Project Objectives

#	Testing Stage	No. of Defects	% of Defect	Notes
1	Reviewing	40	35%	
2	System Test	45	40%	
3	Acceptance Test	20	25%	

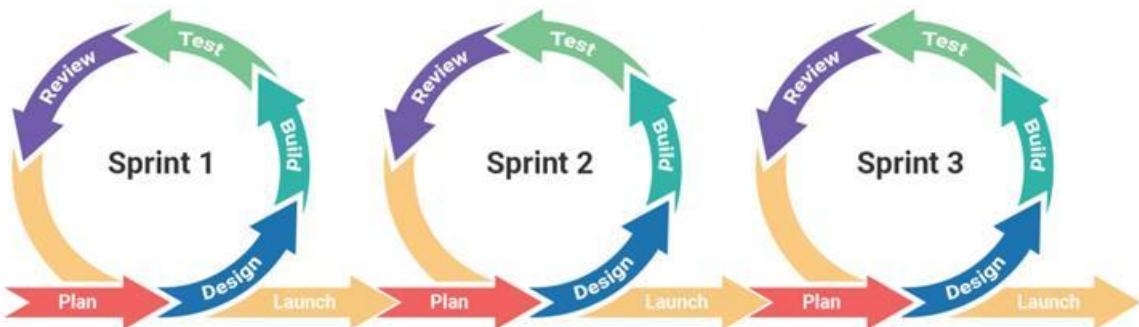
### 1.3 Project Risks

#	Risk Description	Impact	Possibility	Response Plans
1	Technology risk: to target available tools and framework for project overall requirements	High	Medium	Do research and testing of different technical solutions before developing main features.
2	Requirement misunderstanding risk: to correctly specify each requirement based on real-world scenarios and best-practice solution	High	High	Verify requirements with evaluation from realistic data or references, have reviews with stakeholders.

## 2. Management Approach

### 2.1 Project Process

The project will be executed using the Agile software development methodology, specifically the Scrum framework. This approach allows the team to adapt to changes quickly, deliver incremental value, and ensure continuous feedback throughout the development lifecycle.



**Sprints:** The development timeline is divided into 2-week Sprints. Each sprint focuses on delivering a specific set of features (from the Product Backlog) that results in a potentially shippable product increment.

#### Key Roles:

- **Product Owner (Leader):** Responsible for defining the product vision, managing the Product Backlog, and prioritizing features based on stakeholder value.

- Scrum Master (Rotational/Assigned): Ensures the team adheres to Scrum practices, removes obstacles (blockers), and facilitates meetings.
- Development Team (All Members): Cross-functional members responsible for designing, coding, testing, and integrating the software.

#### **Scrum Ceremonies:**

- Sprint Planning (Day 1 of Sprint): The team selects items from the Product Backlog to work on during the sprint and breaks them down into tasks.
- Daily Stand-up (15 mins): A brief daily meeting where members report what they did yesterday, what they will do today, and any blockers they are facing.
- Sprint Review (Last Day of Sprint): The team demonstrates the completed work to supervisors/stakeholders to gather feedback.
- Sprint Retrospective (After Review): The team discusses what went well, what didn't, and how to improve processes for the next sprint.

#### **2.2 Quality Management:**

To ensure the "Learner Management and 3D Simulation System" meets high-quality standards and functional requirements, the team will implement the following quality assurance measures:

##### **Defect Prevention:**

- Coding Standards: The team will adhere to standard C# (.NET) and JavaScript (React) coding conventions to ensure code readability and maintainability.
- Static Code Analysis: Tools will be used in the IDE (Visual Studio/VS Code) to catch syntax errors and potential bugs early during development.
- Clear Requirements: All User Stories must have defined "Acceptance Criteria" before development begins to prevent misunderstanding.

##### **Reviewing:**

- Peer Code Reviews: All code changes must be submitted via Pull Requests (PR) on GitHub. At least one other team member must review the code for logic errors, style violations, and potential performance issues before it is merged into the main or develop branch.
- Document Reviews: Project documents (SRS, SDD) are reviewed by the Supervisor and team members to ensure consistency and completeness.

##### **Testing Strategy:**

- Unit Testing: Developers are responsible for writing unit tests for critical business logic, particularly for the API (Backend) services and complex Simulation algorithms.
- Integration Testing: Verifying that different modules work together correctly.
  - Web App: Testing communication between the React Frontend and .NET Backend APIs.
  - Simulation: Testing the data exchange between the Unity Desktop App and the Backend Server (e.g., login, score submission).
- System Testing (Functional Testing): The team will execute manual test cases based on the SRS to verify that the system functions as a whole and meets all user requirements (e.g., An instructor assigning a quiz, a trainee completing a simulation).
- User Acceptance Testing (UAT): Conducted near the end of the project (or Sprint Reviews) where the Supervisors/Instructors test the system to confirm it meets their business needs.

**Bug Tracking:**

- Defects found during testing will be logged in GitHub Issues or the project management tool (Jira/Excel) with a priority level (Critical, High, Medium, Low) and assigned to a developer for fixing.

**2.3 Training Plan:**

Training Area	Participants	When, Duration	Waiver Criteria
Unity	All members	2 weeks	Mandatory
Blender	All members	2 weeks	Mandatory
ASP.NET	All members	2 weeks	Mandatory
React	All members	2 weeks	Mandatory
GitHub	All members	2 weeks	Mandatory

**3. Project Deliverables:**

#	Deliverable	Due Date	Notes
1	Project Introduction document	24/10/2025	Overall project description
2	Project Management document	26/10/2025	Project estimation and management approach
3	SRS document	05/11/2025	Software Requirement Specification
4	Software Design Document	15/11/2025	System Design, Detailed Design, Database
5	Software Testing Document	05/12/2025	Test Document, Test Report
6	Final Report Document	10/12/2025	Project Final Report
7	Web Application	10/12/2025	Project Web Application Product
8	3D Simulation Application	10/12/2025	Project Desktop Application Product
9	Source Code Repository	10/12/2025	Complete source code for all subsystems.
10	Project Package	10/12/2025	Final codes & documents

**4. Responsibility Assignments**

D-Do; R-Review; S-Support; I-Informed; &lt;blank&gt;- Omitted

Responsibility	NhatDNSE18223 6	DucDTSE18011 0	KhoiPDSE17046 2	QuangLNSE17041 5
Project Introduction document	D	R	R	R
Project Management document	D	R	R	R
SRS Document	S	R	D	D
Software Design Document	D	S	D	R
Software Testing Document	R	S	R	D
Final Report Document	D	R	S	S
Web Application	D	R	D	D
3D Simulation Application	R	D	R	S
Source Code Repository	D	R	R	R
Project Package	R	D	D	D

## 5. Project Communications

Communication Item	Who/ Target	Purpose	When, Frequency	Type, Tool, Method(s)
Working with supervisor	Supervisors (Mr. Ngo Dang Ha An and Mr. Pham Thanh Tri) and team members	<ul style="list-style-type: none"> <li>Review Project requirement and documentation</li> <li>Demonstrate Major features</li> <li>Evaluate technologies, solutions and result</li> </ul>	1 time per week	Face to face, Google Meet
Working in team	Team members	<ul style="list-style-type: none"> <li>Specify tasks, reviews and opinions</li> <li>Ask for member's help</li> </ul>	Always	Discord, Zalo, Face to face

		<ul style="list-style-type: none"> <li>• Report working status to leader</li> </ul>		
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## 6. Configuration Management

### 6.1 Document Management

- Using Google Drive to save documentations: [Documentations](#)
- Using Google Sheet to take notes: [Sheet notes](#)
- Using Draw.io to save design and diagrams: [Diagrams](#)

### 6.2 Source Code Management

- Using GitHub to store source code:
  - Backend API Repository: [github.com/hieuvau198/lssctc-api](https://github.com/hieuvau198/lssctc-api)
  - Frontend Web App Repository: [github.com/hieuvau198/lssctc-web](https://github.com/hieuvau198/lssctc-web)
  - Simulation Desktop App Repository: [github.com/hieuvau198/lssctc-simulator](https://github.com/hieuvau198/lssctc-simulator)
- Follow these rules when using Git:
  - Commit convention:
    - Commit code with syntax: git commit -m "type: what-commit-does"
    - Types of commits include:
      - feat: new feature
      - fix: handle bug
      - config: change related to config file
      - docs: changes related to config file documentation
      - test: adding testing code
  - Pull request convention:
    - Attach a link to the task on Notion in the description of the pull request.
    - Do not push code directly to main/master branch. Let's create a new branch for every new task.
    - Tag the leader for code review.

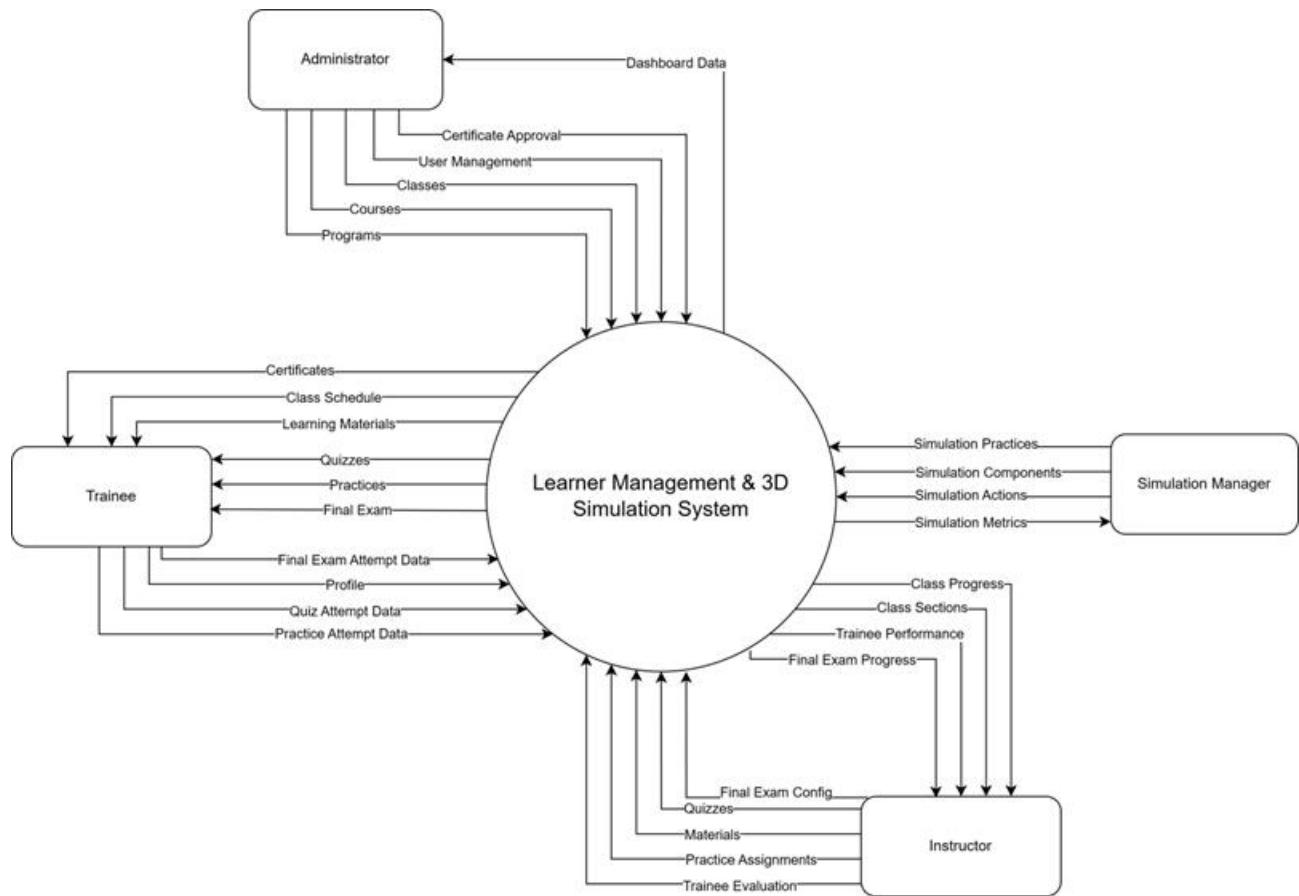
### 6.3 Tools & Infrastructures

Category	Tools / Infrastructure
Technology	Unity (Simulator), Blender (Modelling), .NET (Backend), React (frontend)
Database	Microsoft SQL Server
IDEs/Editors	Visual Studio, Visual Studio Code
Diagramming	Draw.io, Lucid chart
Documentation	Ms Office, Google Docs/Sheets
Version Control	GitHub (Source Codes), Google Drive (Documents)
Deployment server	Microsoft Azure
Project management	Jira, Google Sheets

### III. Software Requirement Specification

#### 1. Product Overview

The Learner Management and 3D Simulation System for Crane Training Center (LSSCTC) is an integrated software suite designed to address the high costs, significant safety risks, and logistical challenges of traditional crane operation training. The system provides a unified solution for both theoretical and simulated practical training.



#### 2. User Requirements

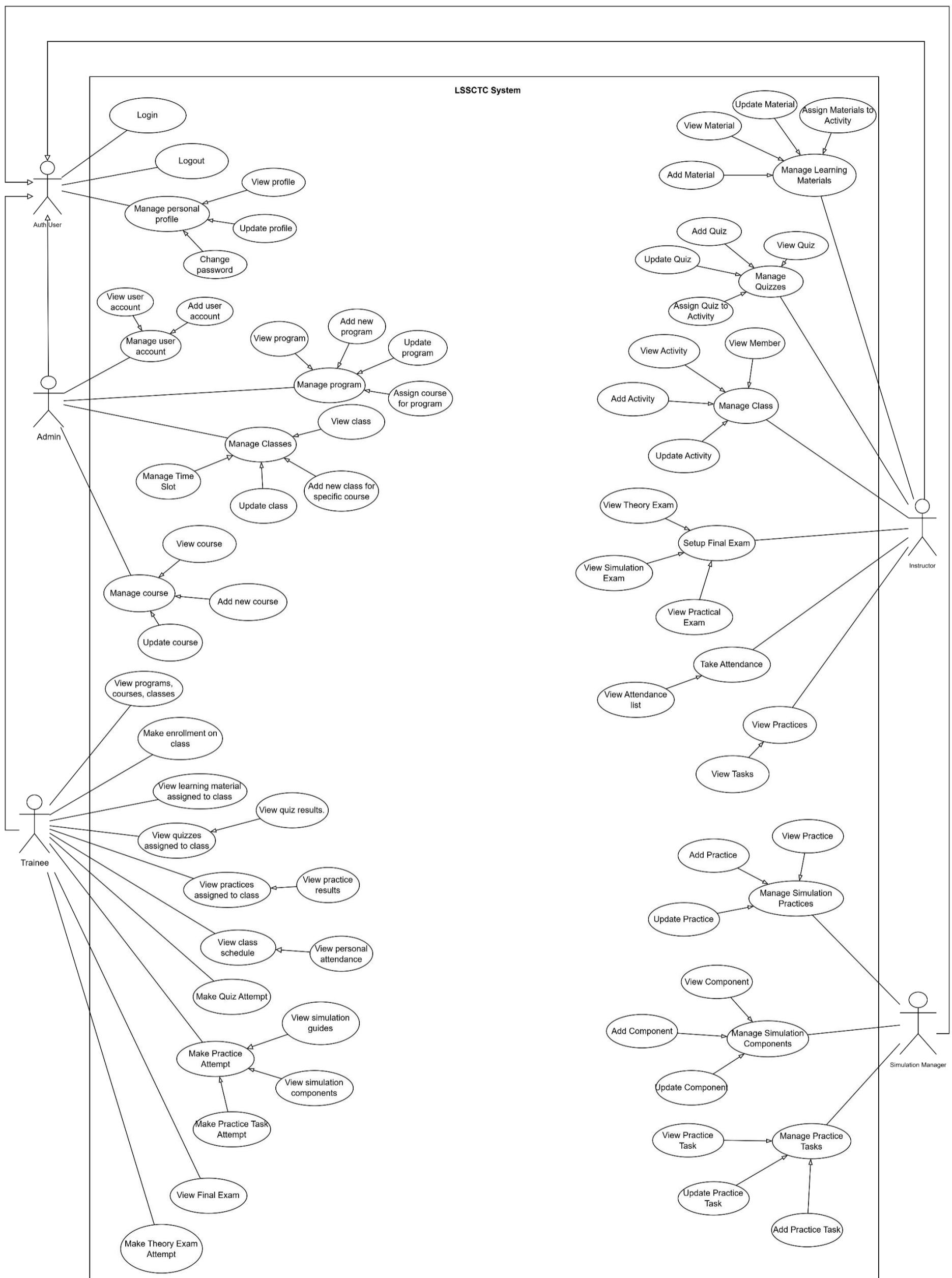
##### 2.1 Actors

#	Actor	Description
1	Administrator	The Administrator is the top-level user responsible for the overall system setup and user management. Using the web application, they manage all user accounts, create and organize the academic structure by managing programs, courses, and classes.

2	Simulation Manager	The Simulation Manager is responsible for defining all aspects of the 3D simulation content. They manage the simulation practices, including simulation components, actions, and warnings.
3	Instructor	The instructor is responsible for managing the content and trainees within their assigned classes. Using the web application, they manage class members, organize class sections, and upload learning materials and quizzes. They also assign simulation practices to the class and are responsible for tracking trainee results, providing feedback, and confirming the final status for each trainee.
4	Trainee	The Trainee is the primary learner in the system. They use the web application to manage their profile, enroll in classes, access learning materials, and complete theoretical quizzes. They also use the separate 3D simulation desktop application to log in and perform practical crane simulation exercises.

## 2.2 Use Case

### 2.2.1 Use Case Diagram



## 2.2.2 Descriptions

ID	Use Case	Actors	Use Case Description
UC-01	Add Material	Instructor	This feature allows instructor add a new learning material (PDF, video, link) for teaching.
UC-02	Update Material	Instructor	This feature allows instructor update an existing learning material's info or file.
UC-03	View Material	Instructor	This feature allows instructor view the list and details of learning materials.
UC-04	Assign Materials to Section	Instructor	This feature allows instructor link selected materials to a section/partition for trainees to access.
UC-05	Add Quiz	Instructor	This feature allows instructor create a new quiz with basic information.
UC-06	Update Quiz	Instructor	This feature allows instructor edit a quiz's information.
UC-07	View Quiz	Instructor	This feature allows instructor view quizzes and their details.
UC-08	Assign Quiz to Section	Instructor	This feature allows instructor attach a quiz to a specific section/partition for delivery.
UC-09	Add Member	Instructor	This feature allows instructor add a trainee to the class roster.
UC-10	View Member	Instructor	This feature allows instructor view trainee profiles and class membership.
UC-11	Track Member Process	Instructor	This feature allows instructor track each trainee's study progress and results.
UC-12	View Section	Instructor	This feature allows instructor track each trainee's study progress and results.
UC-13	Add Section	Instructor	This feature allows instructor create a new section for the class.
UC-14	Update Section	Instructor	This feature allows instructor edit

			section information.
UC-15	Assign Practices to Section	Instructor	This feature allows instructor link practice activities to a section/partition.
UC-16	View Practices	Instructor	This feature allows instructor view practice list and details in the class/section.
UC-17	Confirm Pass/Fail Results	Instructor	This feature allows instructor view practice list and details in the class/section.
UC-18	Add Practice	Instructor	This feature allows instructor create a new practice activity.
UC-19	Update Practice	Instructor	This feature allows instructor edit an existing practice activity.
UC-20	View Practices	Instructor	This feature allows instructor view details of a specific practice activity.
UC-21	Add Component	Instructor	This feature allows instructor add a simulation component needed for practice.
UC-22	Update Component	Instructor	This feature allows instructor update a simulation component's information.
UC-23	View Component	Instructor	This feature allows instructor view the list and details of simulation components.
UC-24	Add Action	Instructor	This feature allows instructor add a simulation action/step used in practices.
UC-25	Update Action	Instructor	This feature allows instructor update a simulation action/step.
UC-26	View Action	Instructor	This feature allows instructor view the list and details of simulation actions.
UC-27	Add Component	Simulation Manager	This feature allows the simulation manager to add a new simulation component to the system.
UC-28	Update Component	Simulation Manager	This feature allows the simulation manager to edit or update existing simulation component information.
UC-29	View Component	Simulation Manager	This feature allows the simulation manager to view the list and details of simulation components.

UC-30	Add Action	Simulation Manager	This feature allows the simulation manager to add a new simulation action used in training practices.
UC-31	Update Action	Simulation Manager	This feature allows the simulation manager to edit or update existing simulation actions.
UC-32	View Action	Simulation Manager	This feature allows the simulation manager to view the list and details of simulation actions.
UC-33	Add Slot	Simulation Manager	This feature allows the simulation manager to create a new simulation timeslot for scheduling practices.
UC-34	Update Slot	Simulation Manager	This feature allows the simulation manager to update or reschedule an existing simulation timeslot.
UC-35	View Slot	Simulation Manager	This feature allows the simulation manager to view all simulation timeslots and their details.
UC-36	Assign Practice to Slot	Simulation Manager	This feature allows the simulation manager to assign a specific practice activity to a simulation timeslot.
UC-37	Add Practice Step	Simulation Manager	This feature allows the simulation manager to define and add new steps for a practice scenario.
UC-38	Update Practice Step	Simulation Manager	This feature allows the simulation manager to modify or reorder steps within a practice scenario.
UC-39	View Practice Step	Simulation Manager	This feature allows the simulation manager to view practice steps assigned to each practice activity.
UC-40	Add Warning	Simulation Manager	This feature allows the simulation manager to create new warning messages or alerts for simulation steps.
UC-41	Update Warning	Simulation Manager	This feature allows the simulation manager to modify or remove existing simulation warnings.
UC-42	View Warning	Simulation Manager	This feature allows the simulation manager to view all defined warnings and their details.
UC-43	Make enrollment programs/courses/classes	Trainee	This feature allows trainee submit an enrolment request to a program,

			course, or class.
UC-44	View programs, courses, classes	Trainee	This feature allows trainee view the catalog and details of available programs, courses, and classes.
UC-45	Access learning material	Trainee	This feature allows trainee access learning materials provided for their study.
UC-46	View learning material assigned to class section	Trainee	This feature allows trainee view materials specifically assigned to their class section.
UC-47	Download material	Trainee	This feature allows trainee download learning files for offline use.
UC-48	View quizzes assigned to class section	Trainee	This feature allows trainee see newly assigned quizzes for their section.
UC-49	Make attempt quizzes	Trainee	This feature allows trainee start and submit a quiz attempt.
UC-50	View recorded results	Trainee	This feature allows trainee view their quiz scores and attempt history.
UC-51	View practices assigned to class section	Trainee	This feature allows trainee view the list of practices assigned to their section.
UC-52	Select a practice to make a new attempt	Trainee	This feature allows trainee choose a practice and create a new attempt.
UC-53	View list practices	Trainee	This feature allows trainee browse the practice list available to them.
UC-54	Settings simulation guides	Trainee	This feature allows trainee configure guidance options and hints for simulation.
UC-55	View simulation guides	Trainee	This feature allows trainee read the simulation guidance before or during practice.
UC-56	View practice steps and step details	Trainee	This feature allows trainee review each step and its detailed instructions.
UC-57	View simulation components	Trainee	This feature allows trainee view components used in the simulation scenario.
UC-58	Perform simulation actions	Trainee	This feature allows trainee perform the required actions in the simulator.
UC-59	View post-practice result	Trainee	This feature allows trainee see overall results after completing a practice.

UC-60	View step result and warning message	Trainee	This feature allows trainee check each step's result and any warning messages.
UC-61	View user account	Admin	This feature allows admin view the list and details of user accounts in the system.
UC-62	Add user account	Admin	This feature allows admin create a new user account and assign a role.
UC-63	Deactivate user account	Admin	This feature allows admin deactivate or disable a user account.
UC-64	Manage user account	Admin	This feature allows admin manage all user accounts, including creating, viewing, and deactivating users.
UC-65	View program	Admin	This feature allows admin view the list and details of existing training programs.
UC-66	Add new program	Admin	This feature allows admin create a new training program in the system.
UC-67	Update program	Admin	This feature allows admin edit information of an existing training program.
UC-68	Assign course for program	Admin	This feature allows admin assign specific courses to a training program.
UC-69	Manage program	Admin	This feature allows admin manage all training programs, including viewing, updating, and course assignment.
UC-70	View class	Admin	This feature allows admin view the list and details of all classes in the system.
UC-71	Add new class for specific course	Admin	This feature allows admin create a new class linked to a selected course.
UC-72	Update class	Admin	This feature allows admin modify class information such as schedule or instructor.
UC-73	Manage classes	Admin	This feature allows admin manage all classes, including creating, updating, and viewing them.
UC-74	View course	Admin	This feature allows admin view the list and details of all courses in the system.

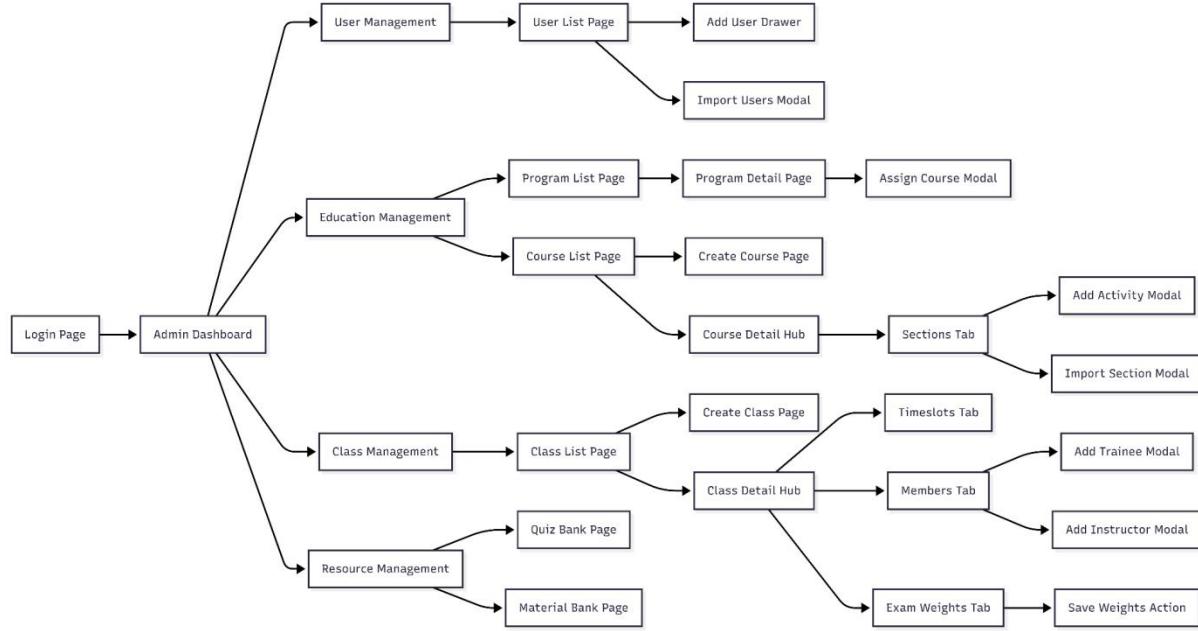
UC-75	Add new course	Admin	This feature allows admin create a new course record in the system.
UC-76	Update course	Admin	This feature allows admin edit the details of an existing course.
UC-77	Manage course	Admin	This feature allows admin manage all courses, including adding, updating, and viewing them.
UC-78	View programs, courses, classes	Admin	This feature allows admin view an overview list of all programs, courses, and classes in the system.
UC-79	Login	Auth User	This feature allows user login to the system by verifying their credentials and accessing authorized functions.
UC-80	Logout	Auth User	This feature allows user logout from the system securely and end their session.
UC-81	View profile	Auth User	This feature allows user view their personal profile information stored in the system.
UC-82	Update profile	Auth User	This feature allows user edit and update their personal profile details.
UC-83	Change password	Auth User	This feature allows user change their password for account security.
UC-84	Manage personal profile	Auth User	This feature allows user manage their personal profile, including viewing, editing, and changing password.

### 3. Functional Requirements

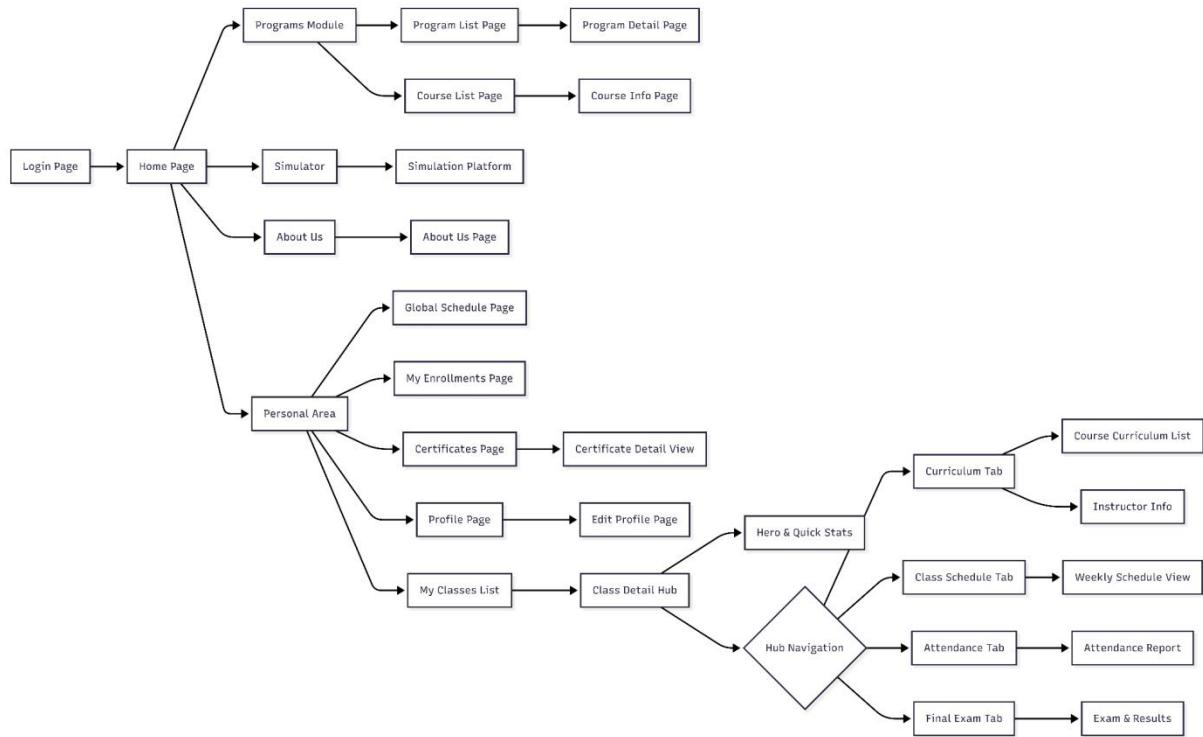
#### 3.1 System Functional Overview

##### 3.1.1 Screens Flow

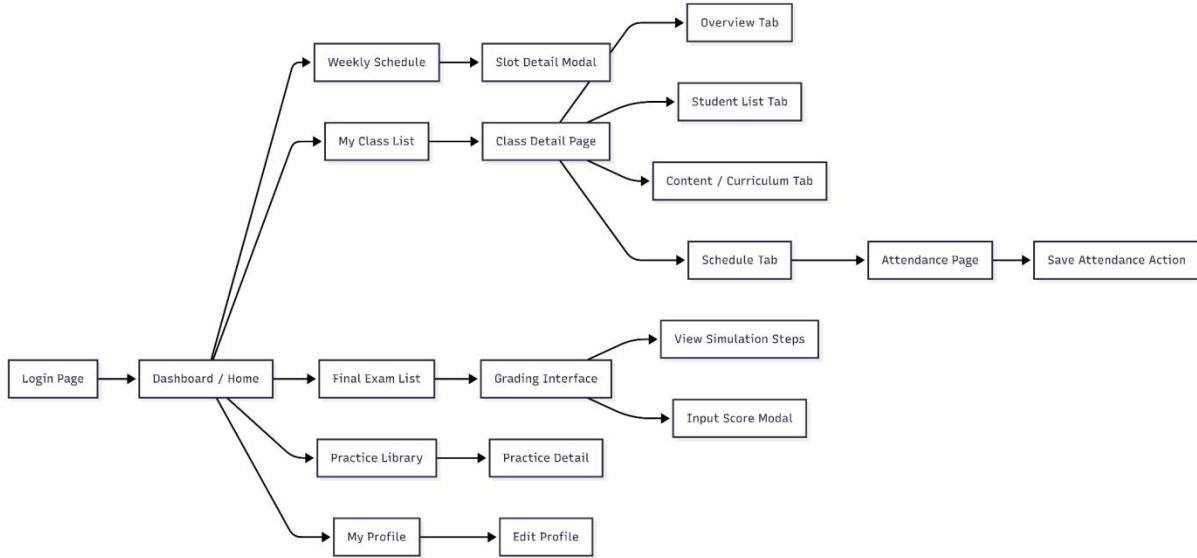
###### 3.1.1.1 Admin Flow



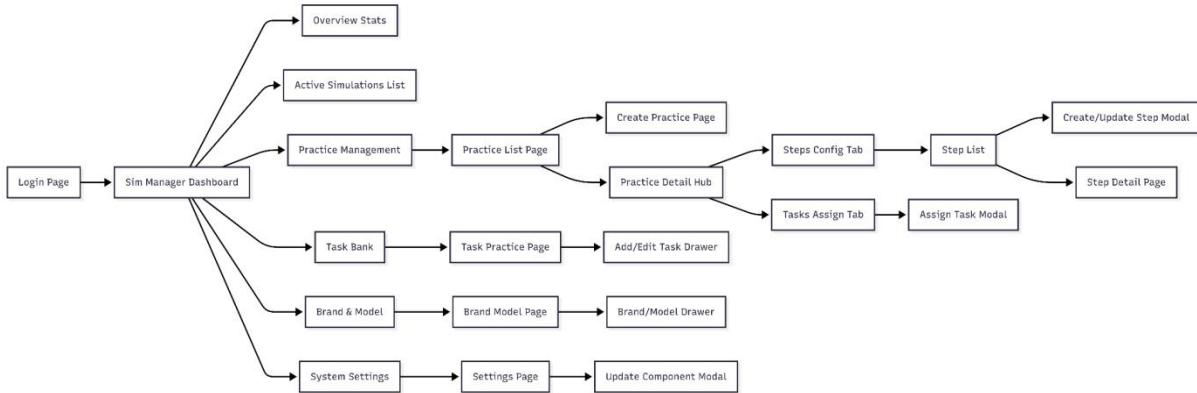
###### 3.1.1.2 Trainee Flow



### 3.1.1.2 Instructor Flow



### 3.1.1.2 Simulation Manager Flow



### 3.1.2 Screen Descriptions

#	Feature	Screen	Description
1	Authentication	Login Screen	Allows users (Admin, Instructor, Trainee, Sim Manager) to log into the system using Email/Password or Google OAuth. Supports a link to the "Forgot Password" page.
2	Authentication	Forgot Password Screen	Allows users to request a password reset via email verification and enter a new password.

<b>3</b>	<b>Common</b>	<b>Landing Page / Home</b>	Introductory page for the training center, displaying featured courses, featured instructors, and related news. Visible to unauthenticated users or Trainees.
<b>4</b>	<b>Common</b>	<b>User Profile Screen</b>	Allows users to view and update personal information, profile pictures, and change their password.
<b>5</b>	<b>Admin</b>	<b>Admin Dashboard</b>	Displays a statistical overview of the system: total users, class statuses, course completion rates, and role distribution charts.
<b>6</b>	<b>Admin</b>	<b>User Management Screen</b>	Lists all users in the system. Admins can add new users, edit details, disable accounts, or Import lists from Excel files.
<b>7</b>	<b>Admin</b>	<b>Program Management Screen</b>	Manages training programs (frameworks). Allows creating new programs, assigning courses to programs, and setting up hierarchical structures.
<b>8</b>	<b>Admin</b>	<b>Course Management Screen</b>	Manages the list of courses. Admins can create new courses, set up content (Sections, Lessons), upload learning materials, and configure Quizzes.
<b>9</b>	<b>Admin</b>	<b>Class Management Screen</b>	Manages active classes. Allows creating classes based on courses, scheduling sessions, assigning instructors, and adding trainees to classes.
<b>10</b>	<b>Admin</b>	<b>Certificate Template Screen</b>	Allows Admins to design and manage certificate templates to be issued to trainees upon course completion.
<b>11</b>	<b>Instructor</b>	<b>Instructor Dashboard</b>	Displays upcoming teaching schedules, statistics on the number of assigned classes, and the status of assignments/exams needing grading.
<b>12</b>	<b>Instructor</b>	<b>Teaching Schedule Screen</b>	Displays a detailed weekly or monthly schedule of the instructor's teaching time slots.

<b>13</b>	<b>Instructor</b>	<b>My Classes Screen</b>	Lists classes assigned to the instructor. Specific class details can be accessed from here for management.
<b>14</b>	<b>Instructor</b>	<b>Class Detail &amp; Attendance Screen</b>	Detailed management screen for a class: performing attendance checks per session, viewing the trainee list, and monitoring their learning progress.
<b>15</b>	<b>Instructor</b>	<b>Quiz &amp; Question Bank Screen</b>	Manages the multiple-choice question bank. Creates and configures Quizzes to assign to course content.
<b>16</b>	<b>Instructor</b>	<b>Grading Screen</b>	Allows instructors to view trainee submissions/results (including theoretical exams and simulation results) and enter grades.
<b>17</b>	<b>Trainee</b>	<b>My Learning/Classes Screen</b>	Displays the list of classes the trainee is enrolled in and the completion progress of each class.
<b>18</b>	<b>Trainee</b>	<b>Learning Player Screen</b>	The main interface for trainees to watch video lectures, read PDF materials, or take Quizzes following the course curriculum.
<b>19</b>	<b>Trainee</b>	<b>Exam Taking Screen</b>	Interface for taking multiple-choice exams (Final Exam/Quiz) with a countdown timer, question list, and submission function.

### 3.1.3 Screen Authorization

#	Screen	Admin	Instructor	Trainee	Sim Manager
1	Landing Page / Home	x	x	x	x
2	Login Screen	x			
3	Forgot Password Screen	x			

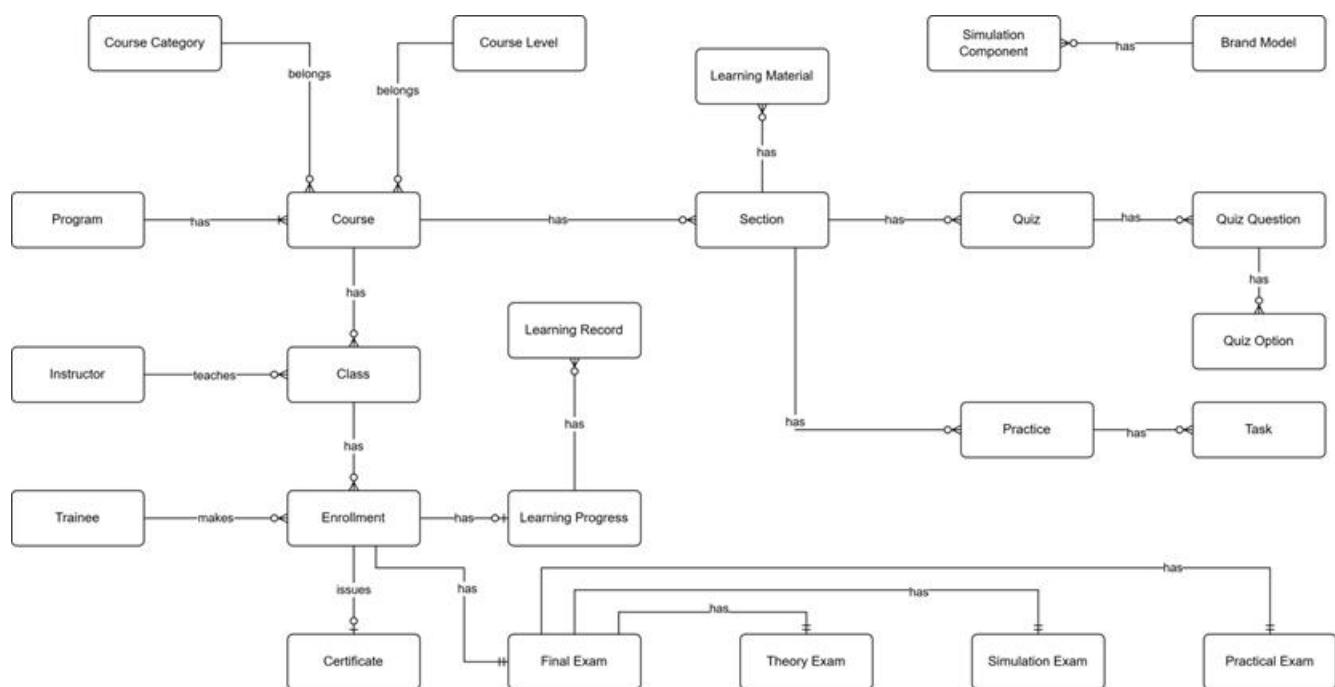
4	User Profile Screen		x	x	x
5	Admin Dashboard		x		
6	User Management Screen		x		
7	Program Management Screen		x		
8	Course Management Screen		x		
9	Class Management Screen		x		
10	Certificate Template Screen		x		
11	Instructor Dashboard			x	
12	Teaching Schedule Screen			x	
13	My Classes Screen (Instructor)			x	
14	Class Detail & Attendance Screen			x	
15	Quiz & Question Bank Screen			x	
16	Grading Screen			x	
17	My Learning/Classes Screen (Trainee)				x
18	Learning Player Screen				x

### 3.1.4 Non-Screen Functions

#	Feature	System Function	Description
1	<b>JWT Token Management</b>	User login or API request.	Generates Access Tokens and Refresh Tokens containing user claims and roles. Validates token signature and expiration on every incoming HTTP request to ensure secure access.
2	<b>Password Hashing</b>	User registration or password change.	Secures user passwords using <b>HMACSHA512</b> hashing algorithms with unique salts before storing them in the database, preventing plain-text storage.
3	<b>Google OAuth Validation</b>	"Login with Google" action.	Communicates directly with Google APIs to validate the <b>IdToken</b> received from the client, retrieving user profile information to authenticate or register the user automatically.
4	<b>Email Notification Service</b>	Forgot Password request or System Alerts.	Generates dynamic HTML email content (e.g., OTP codes) and dispatches emails to users via an SMTP server configuration.
5	<b>Excel Data Import Processor</b>	Admin uploads an Excel file.	Parses binary Excel files (.xlsx) to bulk import complex data structures such as User lists, Quiz Question banks, and Training Programs into the database.
6	<b>Cloud Storage Integration</b>	User uploads media (Avatar, Materials).	Handles file uploads to <b>Firebase Storage</b> . It manages file naming to prevent conflicts and generates public download URLs for storage in the database.
7	<b>Auto-Grading Engine</b>	Trainee submits a Quiz or Simulation task.	<p><b>For Quizzes:</b> Compares user answers with the answer key, calculates the final score, and determines Pass/Fail status.</p> <p><b>For Simulation:</b> Processes JSON telemetry data from the simulation client to evaluate safety violations and</p>

			execution time.
8	<b>Class Status Automation</b>	Scheduled task or Data change.	Automatically evaluates class schedules and progress to transition class statuses (e.g., automatically marking a class as <b>Completed</b> when the end date is passed and requirements are met).
9	<b>Data Cleanup Service</b>	Scheduled maintenance.	Identifies and removes orphaned records, temporary files, or soft-deleted data to optimize database performance and storage usage.

### 3.1.5 Entity Relationship Diagram



### 3.1.6 Entity Relationship Description

#	Entity	Description
1	Course Category	Classification or categorization of courses by subject area or domain (e.g., Basic Crane Operations, Safety Procedures, Advanced Techniques). Provides organizational structure for grouping related courses. Each course belongs to one category.

2	Course Level	Defines the difficulty or skill level of a course (e.g., Entry Level, Intermediate, Advanced). Used to establish learning progression paths and prerequisite requirements. Each course is assigned one level to indicate target trainee proficiency.
3	Program	Comprehensive training program consisting of multiple courses designed to achieve specific certification or skill objectives. Programs define structured learning paths for trainees, combining courses in a logical sequence to build competencies for crane operator certification.
4	Course	Individual training course representing a specific subject or skill area within the crane training curriculum. Contains course content structured into sections, can be assigned to multiple programs, and serves as the foundation for class creation. Belongs to one category and one level.
5	Instructor	Teaching staff member responsible for delivering course instruction, managing class activities, creating learning materials and assessments, and evaluating trainee performance. Instructors are assigned to teach specific classes and provide guidance throughout the learning process.
6	Class	Scheduled instance of a course with defined start/end dates, assigned instructor, and enrolled trainees. Represents the actual delivery of course content to a specific group of trainees. Classes are where learning activities, assessments, and instruction occur.
7	Trainee	Student or learner enrolled in training programs to become certified crane operators. Trainees make enrollments in classes, access learning materials, complete quizzes and practices, take final exams, and track their learning progress toward certification.
8	Enrollment	Record of a trainee's registration in a specific class. Creates the relationship between trainee and class, enabling access to course materials, activities, and assessments. Enrollment triggers creation of learning progress tracking and final exam records.
9	Learning Material	Educational content resources such as videos, documents, presentations, or external links used to deliver course instruction. Materials are assigned to sections to provide trainees with reference and study resources. Can be reused across multiple sections.
10	Section	Logical unit or module within a course syllabus representing a specific topic or learning objective. Sections organize course content into manageable chunks and contain learning materials, quizzes, and practices. Defines the structure and sequence of course curriculum.

11	Quiz	Assessment tool containing multiple questions used to evaluate trainee understanding of theoretical concepts. Quizzes are assigned to sections, have defined pass criteria and time limits, and contribute to overall learning progress. Results are tracked through quiz attempts.
12	Quiz Question	Individual question within a quiz presenting a problem or prompt for trainees to answer. Questions are assigned point values (contributing to total quiz score of 10 points) and can support single or multiple correct answers through associated quiz options.
13	Quiz Option	Possible answer choice for a quiz question. Each option is marked as correct or incorrect and may have associated explanations. Multiple options per question enable various question types (multiple choice, select all that apply).
14	Practice	Simulation-based training scenario performed in the 3D crane simulator environment. Practices consist of ordered tasks that trainees must complete to demonstrate hands-on skills. Assigned to sections as practical learning activities with defined difficulty levels and attempt limits.
15	Task	Individual step or action within a simulation practice that trainees must perform correctly. Tasks define expected results for validation, and task completion is tracked during practice attempts. Tasks are reusable components across different practices.
16	Simulation Component	3D virtual representation of crane parts, controls, or environment objects used in simulation practices. Components are linked to brand models to represent real-world equipment and are referenced in tasks for interaction requirements.
17	Brand Model	Specification of real crane equipment brands and models being simulated in the training system. Defines manufacturer information, specifications, and links to simulation components that represent the physical equipment in virtual environment.
18	Learning Record	Historical record of trainee interactions with course sections, tracking what content has been accessed and when. Maintains audit trail of learning activities for compliance, reporting, and progress monitoring purposes.
19	Learning Progress	Comprehensive tracking of trainee advancement through enrolled courses. Records overall progress percentage, theory and practical scores, completion status, and timestamps. Central entity for monitoring trainee performance and determining certification readiness.

20	Certificate	Official document template awarded to trainees upon successful course or program completion. Defines certificate design, content structure, and requirements. Issued certificates are permanent records of trainee achievement for verification and credentialing purposes.
21	Final Exam	Comprehensive assessment conducted at course completion to evaluate trainee readiness for certification. Consists of three components (Theory, Practical, Simulation) that are weighted and combined for total score. Results determine pass/fail status and certificate eligibility.
22	Theory Exam	Written assessment component of final exam evaluating trainee understanding of theoretical concepts and safety knowledge. Implemented using the quiz system with defined pass criteria. One of three partial exams that compose the final exam.
23	Simulation Exam	Performance-based assessment component conducted in 3D simulator requiring trainees to demonstrate crane operation skills. Uses practice system with task-by-task evaluation. One of three partial exams contributing to final exam score and certification decision.
24	Practical Exam	Hands-on assessment component where trainees demonstrate physical crane operation skills evaluated by instructors using predefined checklists. Assesses real-world competencies beyond simulation environment. One of three partial exams required for certification.

### 3.2 Feature 1: Trainee Learning & Progress Tracking

#### 3.2.1 Description

This is the core functional area for Trainees. It provides an interactive Learning Management System (LMS) interface where trainees perform their daily training activities. The system delivers multimedia content (Videos, PDFs), conducts assessments (Quizzes), and provides specifications for Simulation tasks. Crucially, it tracks the trainee's progress in real-time, ensuring they follow the structured curriculum path defined by the administration.

#### 3.2.2 Functional Requirements

ID	Require	Description
FR-LRN-01	Access My Classes	Trainees can view a list of all classes they are currently enrolled in, along with the current completion percentage and status (OnGoing, Completed) for each class.

<b>FR-LRN-02</b>	<b>View Course Curriculum</b>	Within a class, the system displays the full hierarchy of the course: Sections (Modules) and Activities (Lessons). It indicates which activities are completed, in progress, or locked.
<b>FR-LRN-03</b>	<b>Multimedia Player</b>	The system provides an embedded player to view MP4 video lectures and a PDF viewer for reading training manuals and safety guidelines directly within the browser.
<b>FR-LRN-04</b>	<b>Take Section Quizzes</b>	Trainees can attempt quizzes assigned to specific sections. The system records the attempts, scores, and pass/fail status. Infinite or limited retakes are enforced based on configuration.
<b>FR-LRN-05</b>	<b>Simulation Task Guidance</b>	For simulation activities, the web portal displays the task objectives, step-by-step instructions, and passing criteria (e.g., "Move container A to B within 5 minutes"), guiding the trainee before they enter the 3D simulator.
<b>FR-LRN-06</b>	<b>Automatic Progress Tracking</b>	The system automatically marks activities as "Completed" when specific conditions are met (e.g., video watched 90%, PDF scrolled to bottom, Quiz passed).
<b>FR-LRN-07</b>	<b>Sequential Learning Enforcement</b>	The system enforces a linear learning path (if configured), locking subsequent sections until the trainee has completed the prerequisite activities in the current section.
<b>FR-LRN-08</b>	<b>View Personal Profile &amp; History</b>	Trainees can view their own activity history, including past quiz scores, simulation practice results, and attendance records.

### 3.2.3 Screen Flow & UI Components

The learning experience involves two primary screens:

1. **My Learning Screen (Dashboard):**
  - o **UI:** A grid view of ClassCard components.
  - o **Information:** Class Name, Course Code, Instructor Name, Progress Bar (visual indicator of completion), and "Continue Learning" button.
2. **Learning Player Screen (The Classroom):**

- **Layout:** A split-screen layout (Sidebar on the left, Content Area on the right).
- **Sidebar:** Displays the CourseSection list (Accordion style). Icons indicate the type of activity (Video, Doc, Quiz) and its status (Green Check for done, Lock icon for locked).
- **Content Area:**
  - **Video:** Uses a custom video player wrapper (VideoContent.jsx).
  - **Document:** Embeds a PDF viewer (ReadingContent.jsx).
  - **Quiz:** Renders the quiz interface (QuizContent.jsx) with question navigation.
  - **Practice:** Shows simulation task details and history of attempts (PracticeContent.jsx).

### 3.2.4 Backend Implementation Logic

The backend manages state tracking and content delivery:

- **Controllers:**
  - ProgressController: Aggregates data to calculate the overall percentage (LearningProgress).
  - ActivityRecordsController: Handles the granular status of each item (e.g., POST /api/activity-records to mark a video as watched).
  - SectionRecordsController: Monitors the completion of entire sections to unlock new content.
- **Entities:**
  - ActivityRecord: The pivotal entity linking a Trainee, a Class, and a specific Activity. It stores Status (Completed/Incomplete) and timestamps.
  - LearningMaterial: Stores the URL (Firebase) and metadata for the content.
- **Business Logic:**
  - **Progress Calculation:** ProgressesService.cs calculates progress as:  $(Count\ of\ Completed\ Activities\ / Total\ Activities\ in\ Course) * 100$ .
  - **State Transition:** When a Trainee passes a Quiz, the QuizAttemptsService triggers an update to the ActivityRecord, setting it to Completed.
  - **Security:** Content URLs are often signed or verified to prevent unauthorized access outside the learning platform.

## 3.3 Feature 2: Trainee Simulation Practice

### 3.3.1 Description

This feature bridges the gap between theoretical knowledge and real-world application. It allows Trainees to engage in practical crane operation exercises within a safe, physics-based 3D virtual

environment. Unlike the Final Exam, these practices are part of the regular course curriculum (Learning Path). The system provides detailed scenario guides, tracks every movement and safety violation (collisions, dangerous swaying), and provides immediate automated grading and feedback.

### 3.3.2 Functional Requirements

ID	Require	Description
FR-SIM-01	<b>View Practice Objectives</b>	Before starting, the Trainee can view the specific tasks required for the session (e.g., "Lift the red container," "Navigate through the obstacle course") and the criteria for passing (e.g., "Complete within 10 minutes").
FR-SIM-02	<b>Launch Simulation</b>	The system initializes the 3D simulation environment directly within the browser (WebGL) or authenticates the user into a desktop client using a generated session token.
FR-SIM-03	<b>Real-time Telemetry Tracking</b>	While practicing, the simulation client tracks critical metrics: execution time, collision counts (crane-to-obstacle, load-to-ground), and limit switch violations.
FR-SIM-04	<b>Step-by-Step Guidance</b>	The system highlights the active task in the UI (e.g., "Step 1: Move to Point A"), updating automatically as the trainee completes actions in the 3D world.
FR-SIM-05	<b>Automatic Submission &amp; Grading</b>	Upon finishing the scenario or running out of time, the system automatically submits the performance data. The backend calculates a score (0-100) based on pre-defined penalties for safety violations.
FR-SIM-06	<b>View Attempt History</b>	Trainees can view a history of their attempts for a specific practice module, allowing them to track improvement in their scores and completion times over multiple tries.
FR-SIM-07	<b>Safety Violation Alerts</b>	Immediate visual feedback is provided in the simulation HUD (Heads-Up Display) if a safety rule is violated (e.g., "Warning: Load Swinging").

### 3.3.3 Screen Flow & UI Components

The feature utilizes an integrated approach within the Learning Player:

1. **Practice Overview Screen (LMS View):**
  - **Location:** Inside the *Learning Player Screen* (see Feature 5).
  - **Components:**
    - **Task List:** Displays the sequence of PracticeTask items.
    - **Stats Panel:** Shows Allowed Time, Max Score, and Passing Score.
    - **History Table:** Uses PracticeAttemptsHistory.jsx to list previous attempts (Date, Duration, Score, Status).
    - **Action:** "Start Practice" button launches the simulation.
2. **Simulation Platform Screen (Active State):**
  - **UI:** Full-screen or embedded 3D Canvas (SimulationPlatform.jsx).
  - **HUD Elements:**
    - **Dashboard:** Shows simulated crane indicators (wind speed, load weight, boom angle).
    - **Notifications:** Pop-ups for successful step completion or errors.
    - **Controls:** On-screen controls (if no hardware joystick is connected) or mapping overlay.

### 3.3.4 Backend Implementation Logic

The backend acts as the authoritative judge for the simulation results:

- **Controllers:**
  - PracticesController: Retrieves the scenario configuration (start positions, target zones) to initialize the 3D world.
  - PracticeAttemptsController: Handles the start (POST /start) and submission (POST /submit) of practice sessions.
- **Entities:**
  - Practice: Stores the metadata of the exercise.
  - PracticeTask: Defines the individual steps (e.g., "Lift", "Move", "Place").
  - PracticeAttempt: Stores the result of a single session.
- **Grading Algorithm (PracticeAttemptsService.cs):**
  - The system receives a SubmitPracticeTaskDto containing telemetry.
  - **Base Score:** Starts at 100 (or max defined).
  - **Deductions:** Subtracts points for:
    - Collisions (Severity \* Penalty Weight).
    - Time Overrun (Time exceeded \* Penalty per second).
    - Dangerous Operations (e.g., moving while load is too low).
  - **Pass/Fail:** Updates the ActivityRecord status based on whether the final score meets the PassScore threshold.

### **3.4 Feature 3: Program & Course Management**

#### **3.4.1 Description**

This feature serves as the academic backbone of the LSSCTC system. It empowers Administrators to construct and organize the educational hierarchy. The system allows for the creation of Training Programs (curriculum frameworks) and individual Courses. Furthermore, it enables the detailed structuring of course content into Sections and specific Activities (Lessons, Videos, PDFs, Quizzes), effectively digitizing the crane training curriculum.

#### **3.4.2 Functional Requirements**

ID	Requirement	Description
FR-PROG-01	<b>Manage Training Programs</b>	Admins can create, update, delete, and view Training Programs. A program acts as a container for multiple related courses (e.g., "Basic Crane Operation Program").
FR-PROG-02	<b>Program Hierarchy &amp; Assignment</b>	The system allows Admins to assign specific Courses to a Program. It maintains the relationship between programs and courses to structure the learning path.
FR-COURSE-01	<b>Manage Courses</b>	Admins can manage the lifecycle of a Course, defining its title, description, level (Beginner/Intermediate/Advanced), and category.
FR-COURSE-02	<b>Curriculum Builder</b>	The system provides an interface to structure a Course into <b>Sections</b> (Modules) and <b>Activities</b> (Lessons). Admins can arrange the order of learning content.
FR-MAT-01	<b>Learning Materials Management</b>	Admins can upload and manage digital learning resources. Supported formats include PDF documents for reading and MP4 videos for lectures.
FR-MAT-02	<b>Cloud Storage Integration</b>	The system integrates with <b>Firebase Storage</b> to securely upload and serve large media files (videos/documents), ensuring scalability and fast access.
FR-QUIZ-01	<b>Quiz Assignment</b>	Admins can attach Quizzes (created in the Quiz Management feature) to specific sections within a course to assess trainee understanding.

FR-IMP-01	<b>Bulk Import Programs</b>	The system supports importing complex program structures (Program -> Course -> Section) via Excel files to speed up initial data entry.
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### 3.4.3 Screen Flow & UI Components

The management flow involves the following key screens:

1. **Program Management Screen:**
  - **UI:** A list view of existing programs with options to "Add New Program" or "Import from Excel".
  - **Action:** Clicking on a program redirects to the *Program Detail View*, where linked courses are listed.
2. **Course Management Screen:**
  - **UI:** Displays a catalog of all courses. Filters available by Category and Status (Active/Inactive).
  - **Components:** "Create Course" modal collecting basic info (Name, Code, Image).
3. **Course Detail & Curriculum Editor:**
  - **UI:** A hierarchical view (often an Accordion or Tree view) displaying Sections.
  - **Actions:**
    - **Add Section:** Create a new topic/module.
    - **Add Activity:** Within a section, the Admin selects the type of activity: *Video, PDF, or Quiz*.
    - **Upload:** Drag-and-drop zone for uploading course materials.

### 3.4.4 Backend Implementation Logic

The backend handles the hierarchical data structure and file operations:

- **Controllers:**
  - ProgramsController: Manages the high-level program entities.
  - CoursesController: Handles course metadata.
  - SectionsController: Manages the subdivisions within a course.
  - MaterialsController & ActivitiesController: Handle the specific learning content.
- **Services & Patterns:**
  - **Onion Architecture:** Separates the domain entities (TrainingProgram, Course, Section) from the business logic.
  - **Firebase Storage Service:** The FirebaseStorageService.cs is invoked when uploading course materials. It returns a public URL which is then stored in the SQL Database.
  - **Import Logic:** ProgramImportService.cs uses NPOI to parse Excel files, automatically creating the necessary database relationships (Program-Course-Section) in a single transaction.
- **Data Integrity:**

- The system enforces foreign key constraints to ensure that if a Course is deleted, related Enrollments or Sections are handled appropriately (Soft Delete pattern).

### 3.5 Feature 4: Trainee Final Examination

#### 3.5.1 Description

The Final Examination feature is the culmination of the training process. To ensure comprehensive competency, the system evaluates Trainees through three distinct **Final Exam Partial**s:

1. **Theory Exam (TE)**: A computer-based multiple-choice test with a strict time limit.
2. **Simulation Exam (SE)**: A practical test performed in the 3D Simulation Platform, graded automatically by the system based on safety and precision.
3. **Practical Exam (PE)**: An offline, real-world crane operation test graded by an Instructor using a digital checklist.

The system aggregates scores from these three partials based on pre-configured weights to determine the final Pass/Fail status.

#### 3.5.2 Functional Requirements

ID	Require	Description
FR-EXAM-01	View Exam Structure	The Trainee can view the Final Exam dashboard, which lists the three partials (TE, SE, PE), their current status (Locked, Open, Completed), and their weightage (e.g., 30%, 40%, 30%).
FR-EXAM-02	Take Theory Exam (TE)	The system allows the Trainee to start the TE. The interface enables answering questions, flagging questions for review, and navigating between questions.
FR-EXAM-03	TE Timer Enforcement	A server-side and client-side countdown timer enforces the exam duration. The system automatically submits the exam when the timer reaches zero.
FR-EXAM-04	TE Auto-Grading	Upon submission, the system immediately calculates the score based on the answer key stored in the database and updates the TE status to "Completed".
FR-	Generate	To take the Simulation Exam, the Trainee must request a unique,

<b>EXAM-05</b>	<b>Simulation Code (SE)</b>	time-sensitive <b>Exam Code</b> via the web portal. This code is used to authenticate within the separate 3D Simulation Client.
<b>FR-EXAM-06</b>	<b>Process Simulation Results</b>	The system receives telemetry data (collisions, time taken, load handling) from the 3D Client, calculates a score (0-100), and updates the SE record in the web portal.
<b>FR-EXAM-07</b>	<b>View Practical Results (PE)</b>	Trainees cannot "take" the PE online. Instead, they view the grades and feedback checklist submitted by the Instructor after their real-world assessment.
<b>FR-EXAM-08</b>	<b>Final Grading Calculation</b>	Once all partials are graded, the system calculates the weighted average. If the score meets the threshold, the Final Exam status is updated to <b>Passed</b> .

### 3.5.3 Screen Flow & UI Components

The examination flow is managed through the **Final Exam Dashboard** and specific execution screens:

1. **Final Exam Dashboard:**
  - **UI:** A tabbed interface (IndustrialTabs) separating TE, SE, and PE.
  - **Information:** Displays current score, status badge (e.g., "In Progress"), and "Start" buttons (if applicable).
  - **Logic:** Locks specific tabs if the Class Schedule indicates the exam date has not arrived.
2. **Exam Taking Screen (TE):**
  - **Components:**
    - **Header:** Countdown Timer (HeaderTimer.jsx), Progress Bar.
    - **Body:** Question Text, Option Radio Buttons (QuestionCard.jsx).
    - **Sidebar:** Grid of question numbers color-coded by status (Answered, Flagged, Unseen) (QuestionSidebar.jsx).
  - **Action:** "Submit Exam" button triggers a confirmation modal (SubmitModal.jsx).
3. **Simulation Exam View (SE):**
  - **UI:** Informational card explaining the scenario.
  - **Action:** "Generate Exam Code" button.
  - **Display:** Shows the 6-digit code needed to login to the Unity Simulation.
4. **Exam Result View:**
  - **UI:** Shows the score (e.g., "85/100"), the outcome ("Passed"), and a breakdown of correct/incorrect answers (for TE).

### 3.5.4 Backend Implementation Logic

The backend uses a complex relational structure to manage these diverse exam types:

- **Entities:**
  - FinalExam: The root entity linking a Trainee to a Class.
  - FinalExamPartial: Represents the specific instance of a TE, SE, or PE.
  - FeTheory: Stores specific data for TE (Quiz ID, Answers).
  - FeSimulation: Stores specific data for SE (Exam Code, Safety Violations).
  - PeChecklist: Stores the Instructor's evaluation for PE.
- **Services (Lssctc.ProgramManagement):**
  - **FEService.cs:** The orchestrator. It checks if the trainee is eligible to take the exam (Enrollment Status = Approved) and aggregates the final result.
  - **FEPartialService.cs:** Manages the lifecycle of a specific partial (e.g., checking if EndTime has passed).
  - **SEService.cs:** Specifically handles the logic for Simulation. It generates a random alphanumeric code and stores it in the FeSimulation table. When the 3D Client sends results, this service validates the code and saves the score.
  - **QuizAttemptsService.cs:** Reused for the Theory Exam to handle question randomization and scoring logic.
- **Safety & Integrity:**
  - **TE:** Preventing "tab switching" or multiple submissions is handled via browser events and backend validation of IsSubmitted flags.
  - **SE:** The **Exam Code** is valid only for a specific TimeSlot, preventing trainees from practicing simulations at home and counting it as an exam.

## 4. Non-Functional Requirements

### 4.1 Security

- NFR-SEC-01 (Authentication): The system must use JWT (JSON Web Tokens) for stateless, secure API authentication.
- NFR-SEC-02 (Token Management): The system must support token revocation (blacklist) using Distributed Cache to prevent usage of compromised tokens before expiry.
- NFR-SEC-03 (Data Protection): Sensitive data (like passwords) must be hashed. The API must communicate over HTTPS (though RequireHttpsMetadata is currently false for dev, production requires true).
- NFR-SEC-04 (Access Control): API endpoints must be protected by Role-Based Authorization policies ensuring users can only access data pertinent to their role.

### 4.2 Performance & Scalability

- NFR-PERF-01: The system uses Distributed Memory Cache to handle high-frequency data access like token validation and OTP storage.
- NFR-PERF-02: Database interactions must use asynchronous operations (async/await) to prevent thread blocking under load.
- NFR-PERF-03: Large data sets (Users, Classes, Enrolments) must be returned via Pagination (Paged Result) to reduce network payload and database load.

#### 4.3 Interoperability & Compatibility

- NFR-INT-01: The API must expose a Swagger/OpenAPI documentation interface for client integration.
- NFR-INT-02: The system must support CORS (Cross-Origin Resource Sharing) to allow requests from specific web clients (e.g., lsstc.site, localhost).
- NFR-INT-03: The system must support standard file formats for imports/exports, specifically Excel (.xlsx) and CSV.

#### 4.4 Availability & Reliability

- NFR-REL-01: The system is built on .NET Core and Entity Framework Core, designed for cross-platform deployment.
- NFR-REL-02: External integrations (e.g., Email Service) must be implemented as Transient services to ensure fresh connections and reliability.

### 5. Business Rules

ID	Rule Definition
BR-01	Upon successful login to the web app, the system must redirect users to their role-based landing page: <ul style="list-style-type: none"><li>- Admin: Admin Dashboard</li><li>- Simulation Manager: Simulation Manager Dashboard</li><li>- Instructor: Instructor Dashboard</li><li>- Trainee: Trainee Home Page</li></ul>
BR-02	Upon successful login to the <b>simulation app</b> , users with the 'Trainee' role <b>must</b> be redirected to the home screen.
BR-03	Deactivated accounts <b>cannot</b> log in or interact with the system.
BR-04	The Username, Email, and Phone Number fields <b>must</b> be unique for each user account.
BR-05	A user's Phone Number <b>must</b> be between 4 and 15 digits.
BR-06	The Email field <b>must</b> adhere to a standard email format (e.g., user@domain.com).
BR-07	A user's account profile <b>can</b> only be updated by the account owner.
BR-07	A password reset request <b>must</b> require email verification.
BR-08	The 'Admin' role has exclusive permissions to manage 'Simulation Manager', 'Instructor', and 'Trainee' accounts.

BR-09	The 'Admin' role has exclusive permissions to: <ul style="list-style-type: none"> <li>- Create and update programs.</li> <li>- Assign courses to a program.</li> <li>- Create and update courses.</li> <li>- Create and update course syllabi.</li> <li>- Manage classes.</li> </ul>
BR-10	Instructors <b>can</b> only manage content for classes to which they are assigned.
BR-11	A new program <b>must</b> be created with a Name and an Active Status.
BR-12	A program <b>cannot</b> contain duplicate course assignments.
BR-13	A program <b>cannot</b> be assigned more than 10 courses.
BR-14	Each course <b>must</b> have a unique Name and a unique Course Code.
BR-15	A new course <b>must</b> be created with a Name, Course Code.
BR-16	A course's learning section <b>can</b> only be updated if no classes are currently assigned to that course.
BR-17	Each class <b>must</b> have a unique Name and a unique Class Code.
BR-18	A class <b>must</b> be linked to a specific course upon creation.
BR-19	A class <b>must</b> have exactly one assigned 'Instructor'.
BR-20	Before a class starts, its learning content <b>must</b> mirror the learning sections of its parent course.
BR-21	Class content <b>can</b> only be updated when class status is 'Draft' or 'Open'.
BR-22	A class <b>can</b> only be started if all conditions are met: <ul style="list-style-type: none"> <li>- At least one 'Trainee' is enrolled.</li> <li>- One 'Instructor' is assigned only.</li> <li>- Every class section contains at least one activity.</li> </ul>
BR-	Each class <b>must</b> have a unique Name and a unique Class Code.

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BR-24	A 'Trainee' <b>must</b> have a valid account before enrolling in any program.
BR-25	A 'Trainee' <b>cannot</b> be enrolled in the same class more than once.
BR-26	A 'Trainee' <b>cannot</b> be enrolled in two different classes that have conflicted schedules.
BR-27	'Trainees' <b>can</b> only attempt quiz and practice when their session is valid.
BR-28	Each learning activity <b>must</b> be one of the following types: 'Material', 'Quiz', or 'Practice'.
BR-29	A new activity <b>must</b> be created with a Name, Type, and Order (sequence) number.
BR-30	A new learning material (e.g., 'Video', 'Document') <b>must</b> include a Name and either a Source File or Source URL.
BR-31	A Source File for learning material <b>cannot</b> exceed 50MB in size.
BR-32	A new quiz <b>must</b> be created with a Name and a Max Attempts value.
BR-33	A quiz <b>must</b> contain one or more questions.
BR-34	Each question <b>must</b> include answer options, and each option <b>must</b> be flagged as 'Correct' or 'Incorrect'.
BR-35	A quiz <b>cannot</b> contain more than 100 questions.
BR-36	A quiz question <b>cannot</b> have more than 20 answer options.
BR-37	The total score for every quiz <b>must</b> be exactly 10 points.
BR-38	The score of any single question <b>must</b> be greater than 0 and less than 10.
BR-39	The sum of all question scores within a quiz <b>must</b> equal 10.
BR-	Only users with the 'Trainee' role <b>can</b> attempt a quiz.

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BR-41	Every quiz attempt by a 'Trainee' <b>must</b> be recorded.
BR-42	A 'Trainee's' final quiz score <b>must</b> be determined by their latest attempt.
BR-43	'Trainees' <b>cannot</b> retake a quiz after reaching the Max Attempts limit.
BR-44	A simulation practice <b>must</b> contain between 1 and 20 tasks.
BR-45	Each practice task <b>must</b> have a unique 'task_code'.
BR-46	Each practice must have a unique 'practice_code'.
BR-47	A task cannot be assigned to a practice more than once.
BR-48	A new practice task <b>must</b> be created with a Name, Description, and Task Code.
BR-49	A new simulation practice <b>must</b> have a unique Name and a unique Practice Code.
BR-50	A new simulation Component <b>must</b> have a unique Name, and a unique Component Code.
BR-51	'Trainees' <b>must</b> be authenticated before accessing a simulation practice.
BR-52	'Trainees' <b>can</b> only start practices that are marked as 'Active' and are part of their assigned class.
BR-53	'Trainees' <b>must</b> complete all simulation tasks to finish a practice.
BR-54	While a 'Trainee' is taking a simulation practice: <ul style="list-style-type: none"> <li>- The system <b>must</b> display guides and step descriptions.</li> <li>- The system <b>must</b> automatically advance to the next step upon successful completion of the current step.</li> <li>- The system <b>must</b> record the result of every step for evaluation.</li> </ul>
BR-	'Trainees' <b>cannot</b> retake a simulation practice after reaching the Max Attempts limit.

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BR-56	'Trainees' <b>must</b> be authenticated before accessing a simulation practice.
BR-57	'Trainees' <b>can</b> only start a simulation final exam after input a correct Exam Code.
BR-58	'Trainees' <b>can</b> only access to the simulation final exam belongs to their enrolled classes.
BR-59	While a 'Trainee' is taking a simulation final exam: - The system <b>must</b> display guides and step descriptions. - The system <b>must</b> automatically advance to the next task upon successful completion of the current step. - The system <b>must</b> record the result of every task for evaluation.
BR-60	'Trainees' <b>cannot</b> retake a simulation final exam after reaching the Max Attempts limit.
BR-61	New user accounts registered via email must complete <b>Email Verification</b> (via OTP or Link) before access is granted.
BR-62	Users with a status of Inactive or Banned must be blocked from logging into the system immediately, regardless of valid credentials.
BR-63	A Class cannot be created or set to Open status if its parent Course does not have a complete structure (at least one Section, Activity, and associated Material/Quiz).
BR-64	The Class EndDate must be strictly greater than the StartDate. The StartDate cannot be set more than 30 days in the past.
BR-65	The Class Code must be unique across the entire system (case-insensitive) to prevent data conflicts.
BR-66	A Class can only transition from Draft to Open status if it has at least one assigned Instructor and at least one defined TimeSlot.
BR-67	The sum of question max score for a quiz must explicitly equal 100%.
BR-68	Trainees can only self-enroll in classes that have the status Open. Enrollment is strictly disabled for classes in Draft, Completed, or Cancelled status.
BR-69	The system must prevent enrollment if the current class size (count of Enrolled + Pending trainees) has reached the defined MaxCapacity.
BR-70	A Trainee cannot enroll in a class if they already have an existing enrollment record with a status of Pending or Enrolled for that specific class.

BR-71	<p><b>Enrollment Status Default:</b></p> <ul style="list-style-type: none"> <li>- Self-enrollment by Trainee defaults to Pending (requires approval).</li> <li>- Manual addition by Staff/Instructor defaults to Enrolled (bypasses approval).</li> </ul>
BR-72	Sections of a specific course can only be edited if there is no active classes which are opened from that course.
BR-73	Access to specific class activities is restricted if the class status is 'Draft', or 'Cancelled', or 'Completed'
BR-74	To start a strictly controlled assessment (e.g., Final Exam), the Trainee must input a valid, case-sensitive <b>Exam Code</b> provided by the Instructor.
BR-75	Trainees are blocked from starting a Quiz or Practice session if their total attempts exceed the configured Max Attempts limit.
BR-76	The <b>Final Grade</b> must be automatically recalculated by the system whenever a component score (Theory/Practice/Exam) is updated, based on the defined Class Weights.
BR-77	<p>A <b>Certificate</b> is automatically issued to a Trainee only when <b>all</b> the following conditions are met:</p> <ol style="list-style-type: none"> <li>1. The Class status is set to Completed.</li> <li>2. The Trainee's learning progress is set to Completed.</li> <li>3. The Trainee's Final Exam is set to Completed and is graded as Pass.</li> </ol>
BR-78	Once a Certificate is issued and a Certificate Number (License ID) is generated, it cannot be modified or deleted unless the entire Enrollment record is reset by an Administrator.
BR-79	The system determines a Trainee's final exam result based on the weighted sum of: (Theory Exam Score * Weight) + (Practical Exam Score * Weight) + (Simulation Exam Score * Weight).
BR-80	Once an Instructor submits the grades for the "Final Exam" column and marks the status as Completed, the scores are <b>locked</b> (Read-only) and cannot be edited.
BR-81	<b>File Type Constraint:</b> The system must restrict file uploads for Learning Materials to specific formats: .pdf for documents and .mp4 for videos.
BR-82	A Course cannot be deleted if it has any associated Classes.
BR-83	<p>When importing data (User, Course, or Class) via Excel/CSV:</p> <ol style="list-style-type: none"> <li>1. The file structure must strictly match the system provided template.</li> </ol>

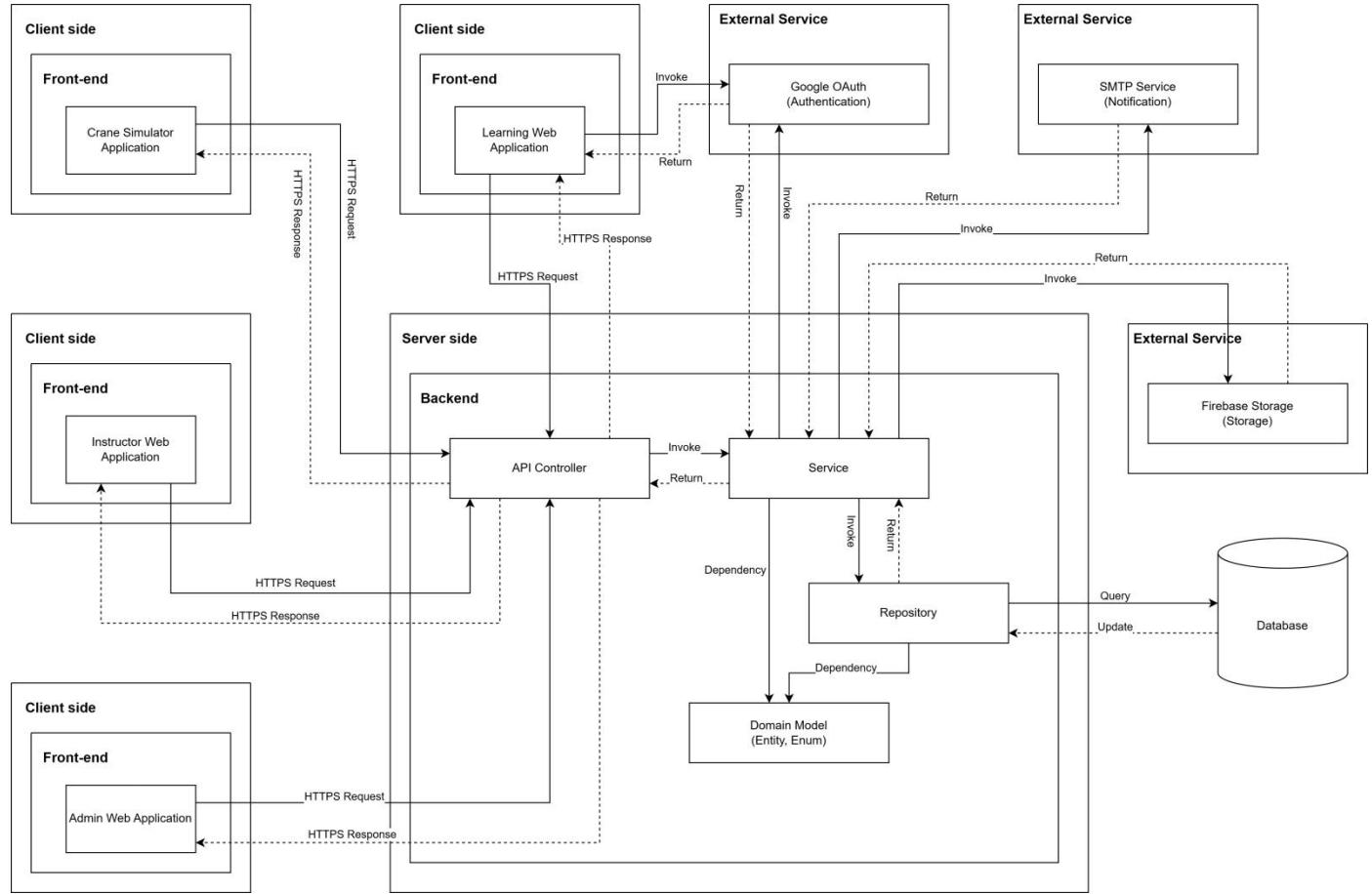
	2. If <b>any</b> row contains invalid data (e.g., invalid email format, duplicate code), the <b>entire</b> import batch must be rejected to prevent data inconsistency.
BR-84	Trainees can only access Practice Simulations when authorized via the class session check, typically enforcing access only within the assigned period.
BR-85	An Administrator cannot <b>Delete</b> their own account while logged in. They also cannot change their own Role.
BR-86	If a User authenticated session expires, the system provides a new session based on valid token.
BR-87	The sum of weight percentages for all Assessment components (Theory, Practical, and Simulation) within a single Class must strictly equal 100%. The system shall prevent saving grading configurations if the total weight deviates from this value.
BR-87	An Instructor cannot be assigned to a Class TimeSlot if they are already scheduled for another Class during the same time interval. The system must validate instructor availability before confirming the assignment.
BR-88	A Trainee is prohibited from enrolling in a new Class if its schedule overlaps with any TimeSlots of their currently active Classes. The system must detect and block conflicting enrollments.
BR-89	A Trainee is considered to have "Completed" a class only if they meet both of the following conditions: <ol style="list-style-type: none"> <li>1. The Final Exam Grade meets or exceeds the system-defined passing threshold (e.g., <math>\geq 5.0</math>).</li> <li>2. Learning progress is marked as completed.</li> </ol>
BR-90	A Class cannot be deleted if it contains any enrolled Trainees.
BR-91	A Trainee is restricted from participating in the Final Exam if their Enrollment Status is marked as "Cancelled" (due to excessive absence) or if they have not completed all mandatory prerequisites.
BR-92	Once a Class status transitions to "Completed" or "Cancelled", all associated Trainee grades and activity records shall become read-only. Instructors are restricted from modifying grades unless an Administrator explicitly re-opens the Class.
BR-93	The system must automatically reject new enrollment requests for a Class once the count of enrolled Trainees reaches the defined MaxCapacity limit set during Class creation.
BR-94	The total weight percentage of all final exam assessments (Theory, Practical, and Simulation) within a specific Class must exactly equal 100%. The system shall prevent the Instructor or Admin from saving the configuration if the sum deviates from 100.

BR-95	The system must restrict the deletion of any Course, Program, or Class if there are currently active Enrollments or associated Historical Data (e.g., Grades, Attendance records) linked to them to preserve data integrity.
BR-96	The final exam session of a specific class can only be opened and closed by the assigned instructors.
BR-97	For Simulation Exams, the system must follow the maximum number of attempts (e.g., 1 attempt for Final Exam). Any further attempts must be blocked.
BR-98	For Theory Exams, the system must follow the maximum number of attempts (e.g., 1 attempt for Final Exam). Any further attempts must be blocked.
BR-99	For Practical Exams, the overall status can only be graded as 'Pass' if more than half the checklists are passed.
BR-100	The system shall only generate a downloadable Certificate (PDF) for a Trainee when the Class Status is "Completed" and trainee passes the final exam.
BR-101	Once a user account is created or deactivated, the system must send a notification email to that user.
BR-102	Once a class status is changed, the system must send a notification email to assigned instructors and trainees.
BR-103	All system timestamps (Start Date, End Date, Logs) are stored and processed in UTC.

## IV. Software Design Description

### 1. System Design

#### 1.1 System Architecture Diagram

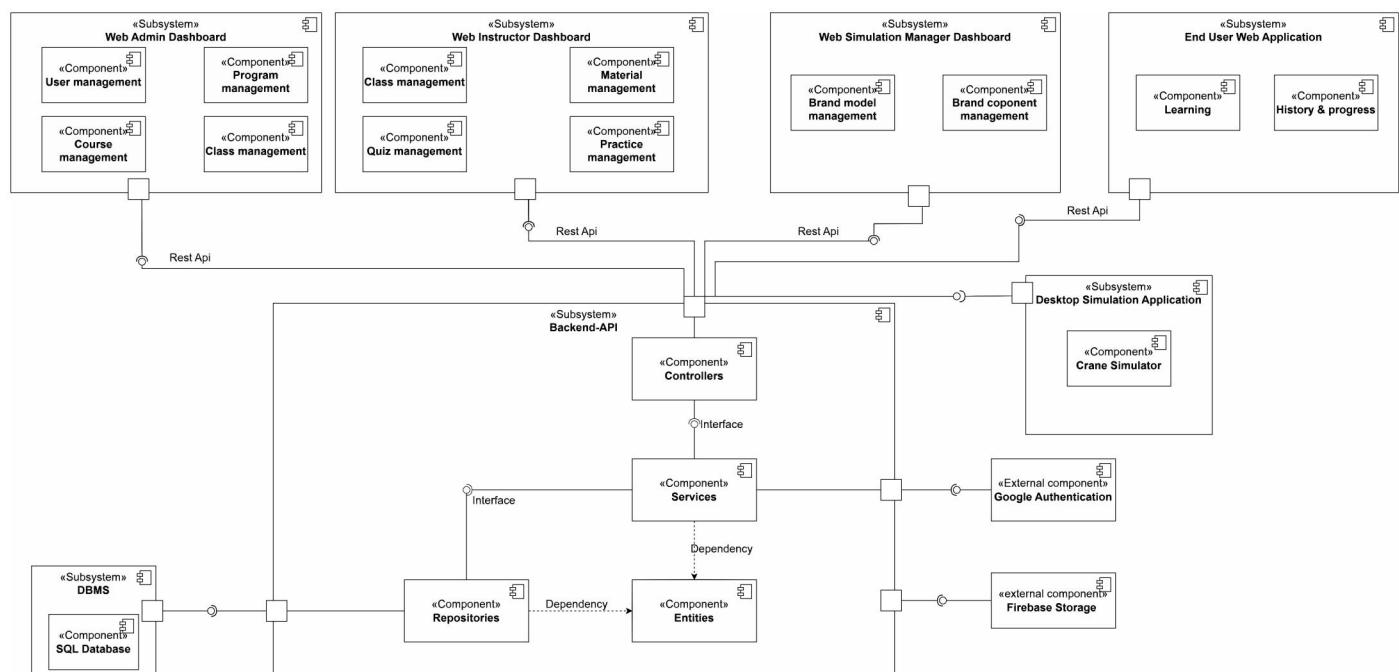


#### System Architecture Diagram Descriptions

No	Name	Description
1	Crane Simulator Application	Desktop application for practical crane operation training, communicates with backend via HTTPS to access training content and submit practice results
2	Learning Web Application	Web-based application for trainees to access learning materials, complete courses, take quizzes, and track their learning progress
3	Instructor Web Application	Web application for instructors to manage classes, create and grade quizzes, provide feedback, and monitor student progress
4	Admin Web Application	Web application for administrators to manage users, programs, courses, system settings, and overall platform administration
5	API Controller	RESTful API layer that receives HTTPS requests from client applications, routes them to appropriate services, and returns responses
6	Service	Business logic layer containing core application logic, processing business rules, orchestrating workflows, and coordinating between controllers and

		repositories
7	Repository	Data access layer that abstracts database operations, handles CRUD operations, and manages data persistence using Entity Framework or similar ORM
8	Domain Model (Entity, Enum)	Domain entities and enumerations representing the core business objects and data structures (Users, Courses, Classes, Quizzes, etc.)
9	Database	SQL Server database storing all system data including users, courses, enrollments, quiz attempts, practice results, and certificates
10	Google OAuth (Authentication)	External authentication service for user login using Google accounts, providing secure OAuth 2.0 authentication flow
11	SMTP Service (Notification)	External email service for sending notifications, alerts, password resets, and course-related communications to users
12	Firebase Storage (Storage)	Cloud storage service for storing and serving media files including course materials, videos, images, documents, and user-uploaded content

## 1.2 Component Diagram



### Component Diagram Descriptions

No	Name	Description
1	Web Admin Dashboard	Web administrative interface for Admin, including user management, program management, and course management features

2	User management	Component for managing users, handling account information, permissions, and user administration in the system
3	Program management	Component for managing training programs, organizing courses and curriculum
4	Course management	Component for managing courses, learning content, lectures, and materials
5	Web Instructor Dashboard	Web interface for instructors, including class management and quiz management
6	Class management	Component for managing classes, student lists, schedules, and attendance
7	Material management	Component for managing learning materials, lectures, videos, and attached files
8	Quiz management	Component for managing quizzes, questions, answers, and test results
9	Practice management	Component for managing practice exercises, assignments, and homework
10	Web Simulation Manager Dashboard	Simulation management interface, including brand model management and brand component management
11	Brand model management	Component for managing brand models in business simulation
12	Brand component management	Component for managing components and competitors in simulation
13	End User Web Application	Web application for end users (students), including learning features and history & progress tracking
14	Learning	Component handling the learning process, viewing lectures, and completing exercises for students
15	History & progress	Component tracking learning history and course completion progress for students
16	End User Desktop Application	Desktop application for end users, including practical training features
17	Practical Training	Component handling practical exercises on desktop application

18	Firebase Storage	Firebase file storage service for storing images, videos, documents, and attached files
19	Backend API	Backend API system handling business logic, including Controllers, Services, Repositories, and Entities
20	Controllers	Controller layer handling HTTP requests from clients, routing to corresponding services
21	Services	Business logic layer containing business rules and system processing logic
22	Repositories	Data access layer handling CRUD operations with the database
23	Entities	Layer defining data objects (data models) mapped to the database
24	Google Authentication	Component authenticating users through Google OAuth, supporting Google account login
25	DBMS	Database management system containing SQL Database storing all system data
26	SQL Database	SQL database (PostgreSQL/MySQL) storing user data, courses, exercises, and learning results

## 2. Database Design



## Table Descriptions

No	Table	Description
1	users	Stores the core account information for all system users including login credentials and contact info. - Primary keys: id - Foreign keys: None
2	admins	Stores specific information for users with the Admin role, linked to the main user record. - Primary keys: id - Foreign keys: id
3	simulation_managers	Stores specific information for Simulation Managers, linked to the main user record. - Primary keys: id - Foreign keys: id
4	instructors	Stores specific information for Instructors, including employment details. - Primary keys: id - Foreign keys: id
5	trainees	Stores specific information for Trainees/Learners. - Primary keys: id - Foreign keys: id
6	instructor_profiles	Contains detailed profile information for instructors such as experience and biography. - Primary keys: id - Foreign keys: id
7	trainee_profiles	Contains detailed profile information for trainees, including driver license and citizen card details. - Primary keys: id - Foreign keys: id
8	course_categories	Lookup table for defining different categories of courses. - Primary keys: id - Foreign keys: None
9	course_levels	Lookup table for defining the difficulty or progression levels of courses. - Primary keys: id - Foreign keys: None
10	course_codes	Lookup table for standardized course codes. - Primary keys: id - Foreign keys: None
11	courses	Stores the main course definitions including metadata like price and duration. - Primary keys: id - Foreign keys: category_id, level_id, course_code_id
12	training_programs	Defines high-level training programs that aggregate multiple courses. - Primary keys: id - Foreign keys: None
13	program_courses	Junction table linking Courses to Training Programs, defining the order of courses within a program. - Primary keys: id

		- Foreign keys: program_id, course_id
14	sections	Defines content sections that organize activities within a course. - Primary keys: Id - Foreign keys: None
15	course_sections	Junction table mapping sections to courses and defining their sequence. - Primary keys: Id - Foreign keys: course_id, section_id
16	activities	Stores individual learning activities (e.g., lessons, quizzes) that belong to sections. - Primary keys: id - Foreign keys: None
17	learning_materials	Stores information about study materials like documents or videos. - Primary keys: id - Foreign keys: None
18	material_authors	Links learning materials to the instructors who authored them. - Primary keys: id - Foreign keys: instructor_id, material_id
19	section_activities	Junction table mapping activities to specific sections and defining their order. - Primary keys: id - Foreign keys: section_id, activity_id
20	activity_materials	Links learning materials to specific activities. - Primary keys: id - Foreign keys: activity_id, learning_material_id
21	quizzes	Defines quiz assessments including time limits and passing criteria. - Primary keys: id - Foreign keys: None
22	quiz_authors	Links quizzes to the instructors who created them. - Primary keys: id - Foreign keys: instructor_id, quiz_id
23	quiz_questions	Stores questions belonging to a specific quiz. - Primary keys: id - Foreign keys: quiz_id
24	quiz_question_options	Stores the possible answer options for a quiz question. - Primary keys: id - Foreign keys: quiz_question_id
25	activity_quizzes	Junction table linking a Quiz to an Activity entity. - Primary keys: id - Foreign keys: quiz_id, activity_id
26	practices	Defines practical training exercises or simulation scenarios. - Primary keys: id - Foreign keys: None
27	sim_tasks	Defines specific tasks or steps required within a simulation. - Primary keys: id - Foreign keys: None
28	practice_tasks	Junction table linking simulation tasks to a practice scenario. - Primary keys: id - Foreign keys: practice_id, task_id
29	activity_practices	Junction table linking a Practice to an Activity entity. - Primary keys: id - Foreign keys: activity_id, practice_id

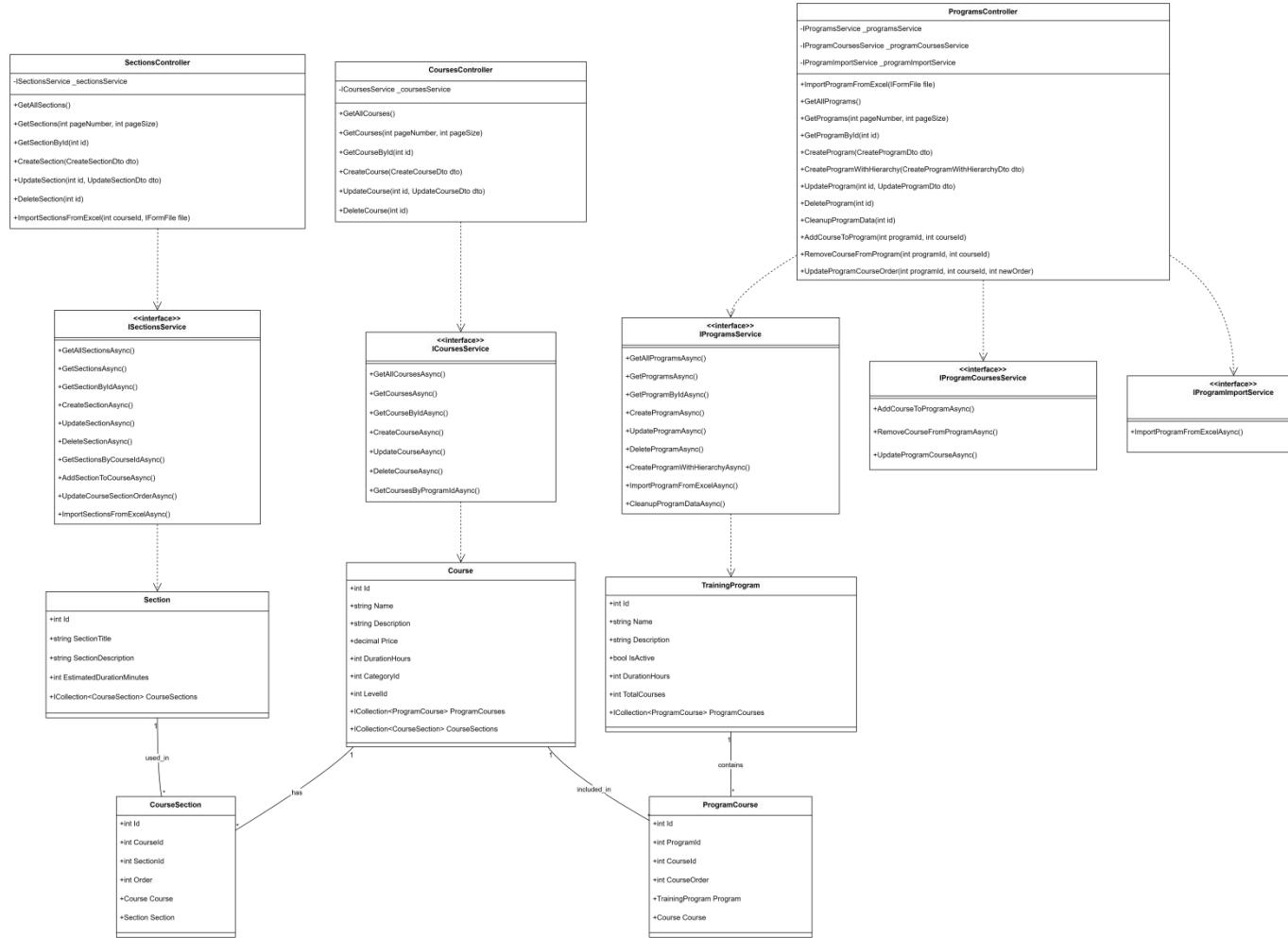
30	brand_models	Specific brand models of equipment (cranes) used in simulations. - Primary keys: id - Foreign keys: None
31	simulation_components	Stores detailed components associated with specific brand models. - Primary keys: id - Foreign keys: brand_model_id
32	class_codes	Lookup table for standardized class codes. - Primary keys: id - Foreign keys: None
33	classes	Represents a scheduled instance of a course (program course) with start/end dates. - Primary keys: id - Foreign keys: program_course_id, class_code_id
34	class_instructors	Assigns instructors to specific classes with a designated position. - Primary keys: id - Foreign keys: class_id, instructor_id
35	enrollments	Records the registration of a trainee in a specific class. - Primary keys: id - Foreign keys: class_id, trainee_id
36	timeslots	Defines specific scheduling slots (date/time/location) for a class. - Primary keys: id - Foreign keys: class_id
37	attendances	Tracks trainee attendance for specific timeslots. - Primary keys: id - Foreign keys: enrollment_id, timeslot_id
38	activity_sessions	Schedules specific activities within a class timeframe. - Primary keys: id - Foreign keys: class_id, activity_id
39	final_exams	Stores the overall record of a final exam for an enrollment. - Primary keys: id - Foreign keys: enrollment_id
40	final_exam_partials	Stores specific parts (theory/practical) of a final exam. - Primary keys: id - Foreign keys: final_exam_id
41	pe_checklist	Stores checklist items for grading practical final exams. - Primary keys: id - Foreign keys: final_exam_partial_id
42	fe_theory	Links a final exam partial to a specific theory quiz. - Primary keys: id - Foreign keys: final_exam_partial_id, quiz_id
43	fe_simulation	Links a final exam partial to a specific simulation practice. - Primary keys: id - Foreign keys: final_exam_partial_id, practice_id
44	se_tasks	Tracks the result of specific tasks within a simulation final exam. - Primary keys: id - Foreign keys: fe_simulation_id, sim_task_id
45	certificates	Defines certificate templates available in the system. - Primary keys: id - Foreign keys: None

46	course_certificates	Links certificates to courses, defining passing requirements. - Primary keys: id - Foreign keys: course_id, certificate_id
47	trainee_certificates	Records certificates issued to trainees upon course completion. - Primary keys: id - Foreign keys: enrollment_id, course_certificate_id
48	learning_progresses	Tracks the overall progress of a trainee within an enrollment. - Primary keys: id - Foreign keys: enrollment_id
49	section_records	Tracks a trainee's completion status for specific course sections. - Primary keys: id - Foreign keys: learning_progress_id
50	activity_records	Tracks the detailed status and score of a trainee for specific activities. - Primary keys: id - Foreign keys: section_record_id
51	instructor_feedbacks	Stores feedback provided by instructors on specific activity records. - Primary keys: id - Foreign keys: activity_record_id, instructor_id
52	practice_attempts	Records a specific attempt by a trainee to complete a practice activity. - Primary keys: id - Foreign keys: activity_record_id
53	practice_attempt_tasks	Records the result of individual tasks within a practice attempt. - Primary keys: id - Foreign keys: practice_attempt_id
54	quiz_attempts	Records a specific attempt by a trainee to complete a quiz. - Primary keys: id - Foreign keys: activity_record_id
55	quiz_attempt_questions	Records the trainee's answer/score for a specific question in a quiz attempt. - Primary keys: id - Foreign keys: quiz_attempt_id
56	quiz_attempt_answers	Records the specific option selected by a trainee for a question. - Primary keys: id - Foreign keys: quiz_attempt_question_id

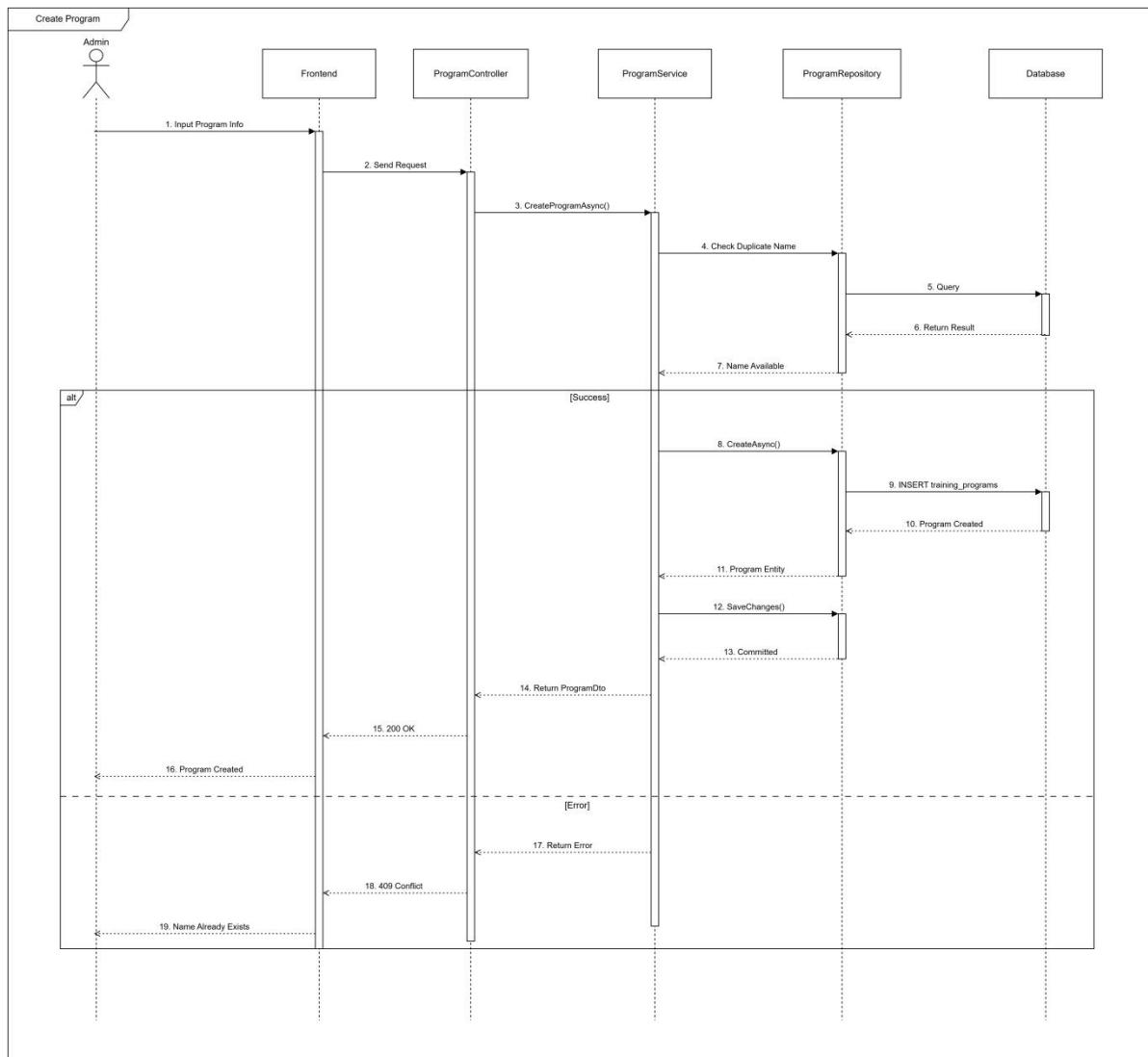
### 3. Detailed Design

#### 3.1 Program & Course Management

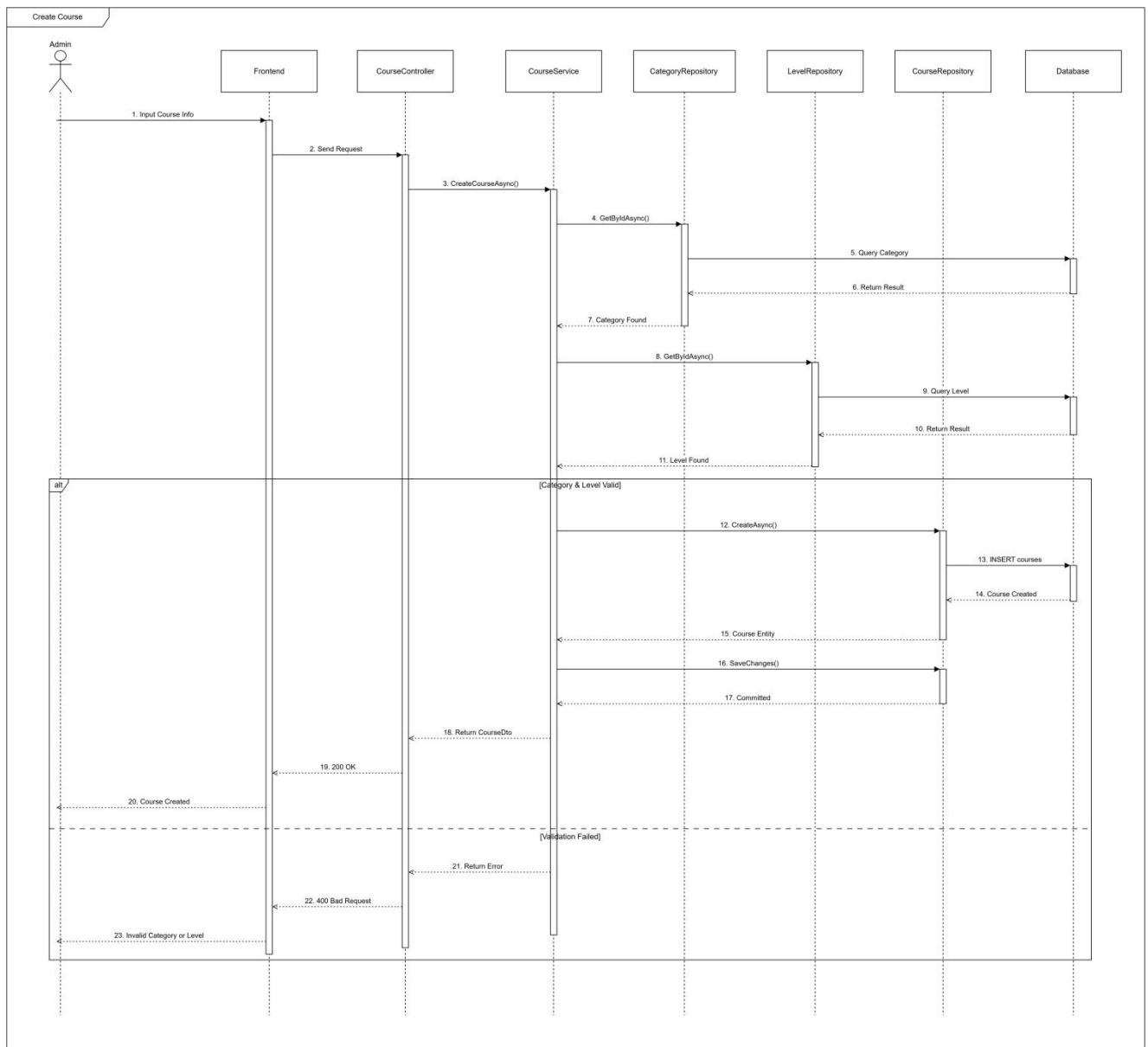
##### 3.1.1 Class Diagram



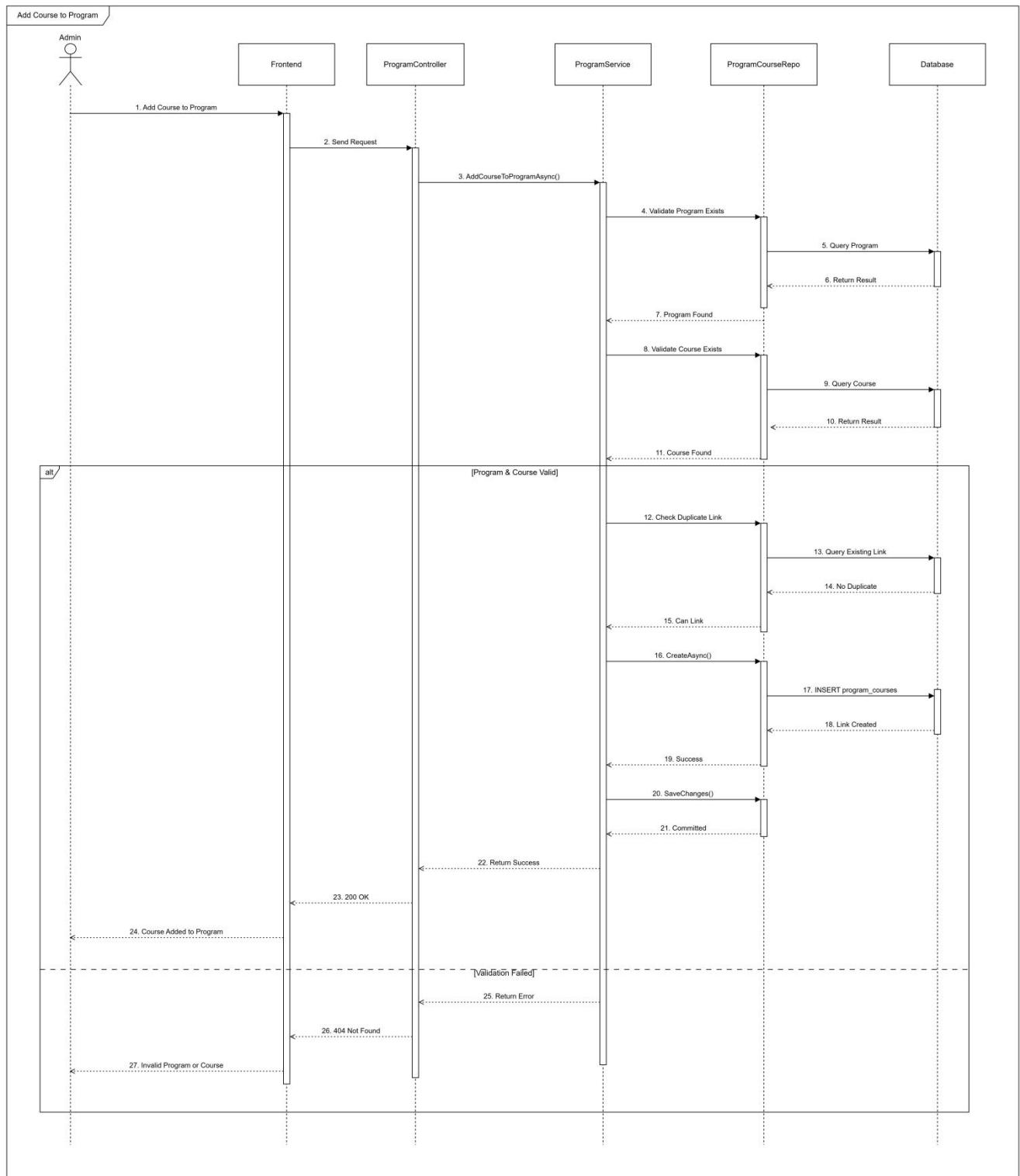
### 3.1.2 Sequence Diagram - Admin Creates Program



### 3.1.3 Sequence Diagram - Admin Creates Course

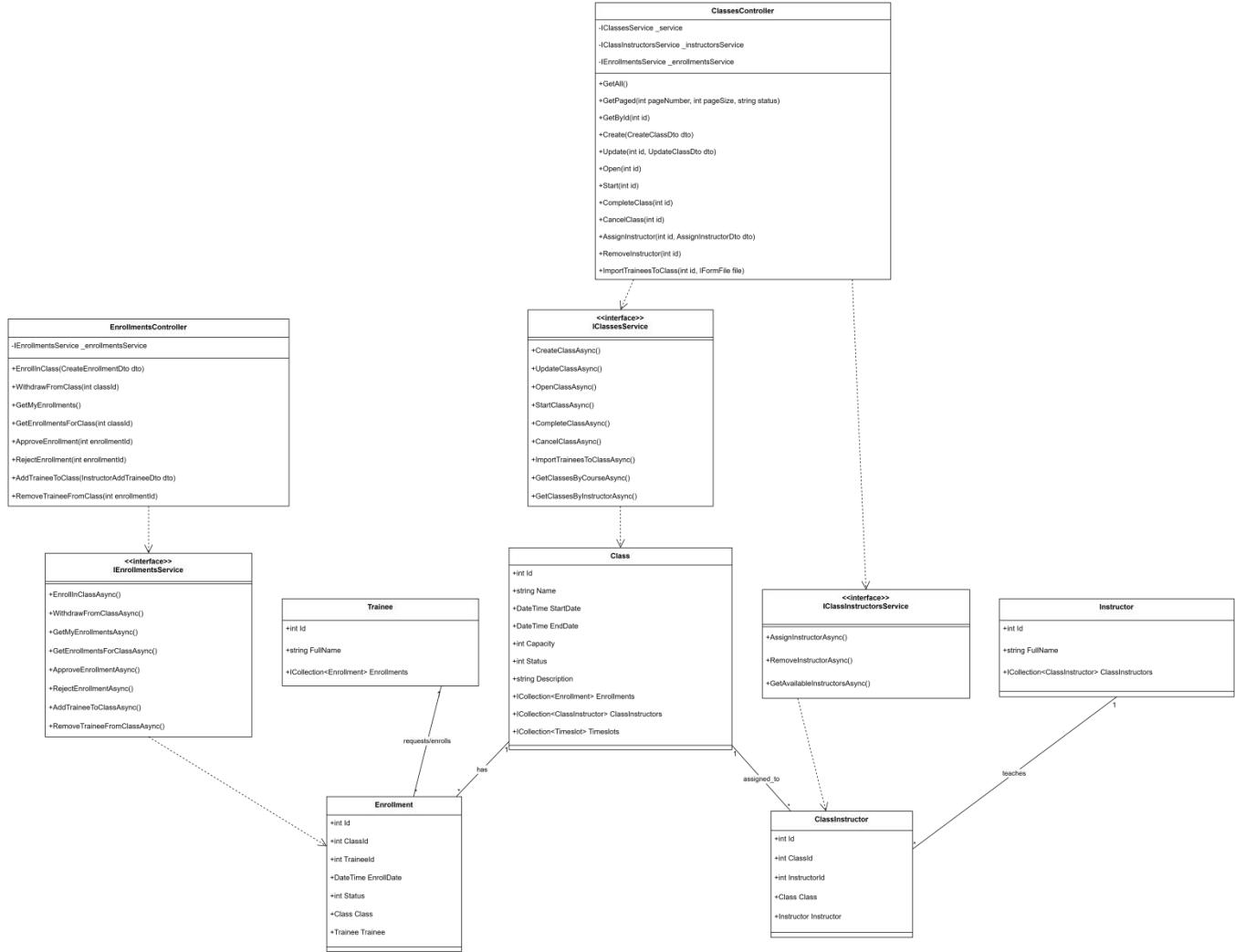


### 3.1.4 Sequence Diagram - Admin Adds Course To Program

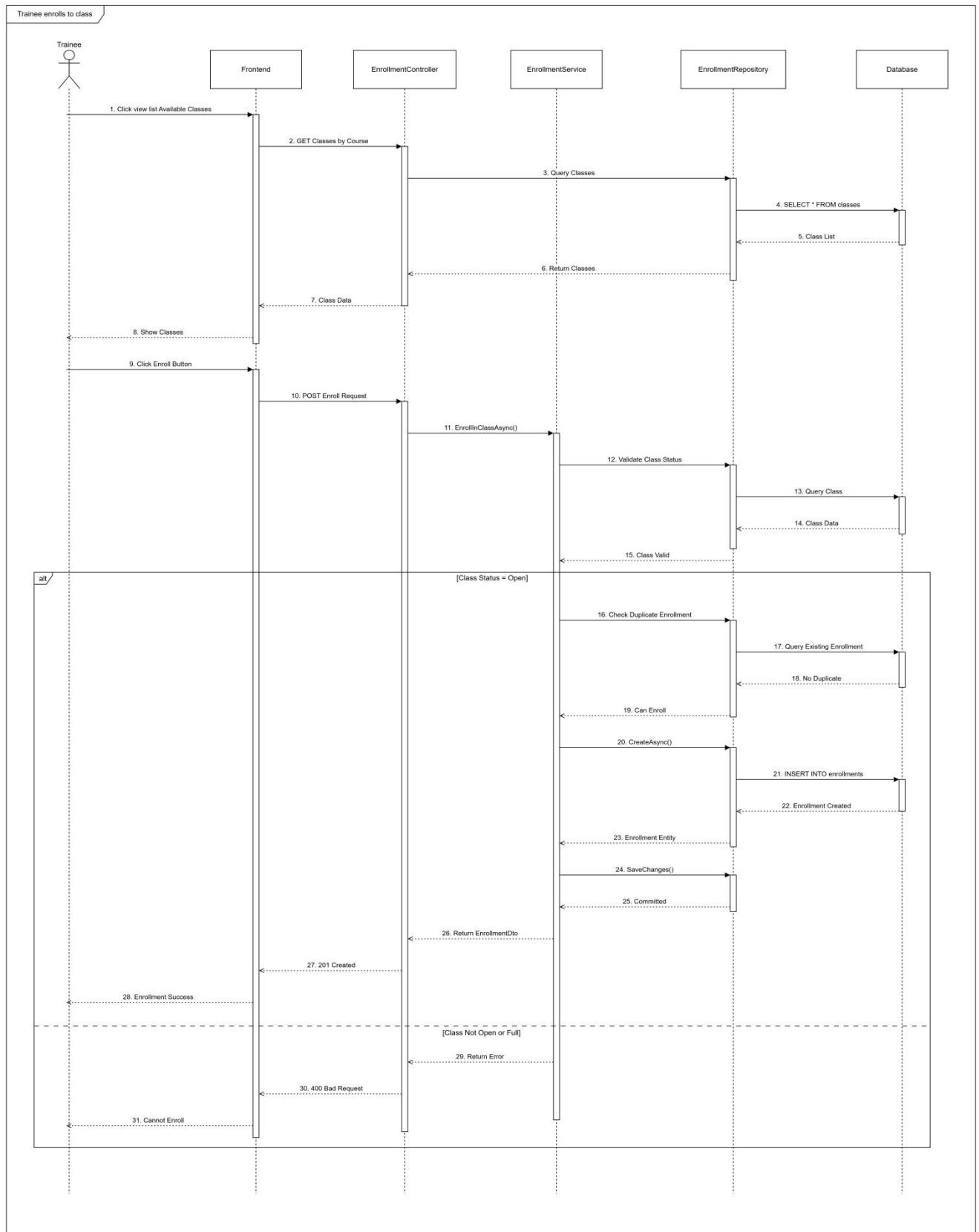


## 3.2 Class Management & Enrollment

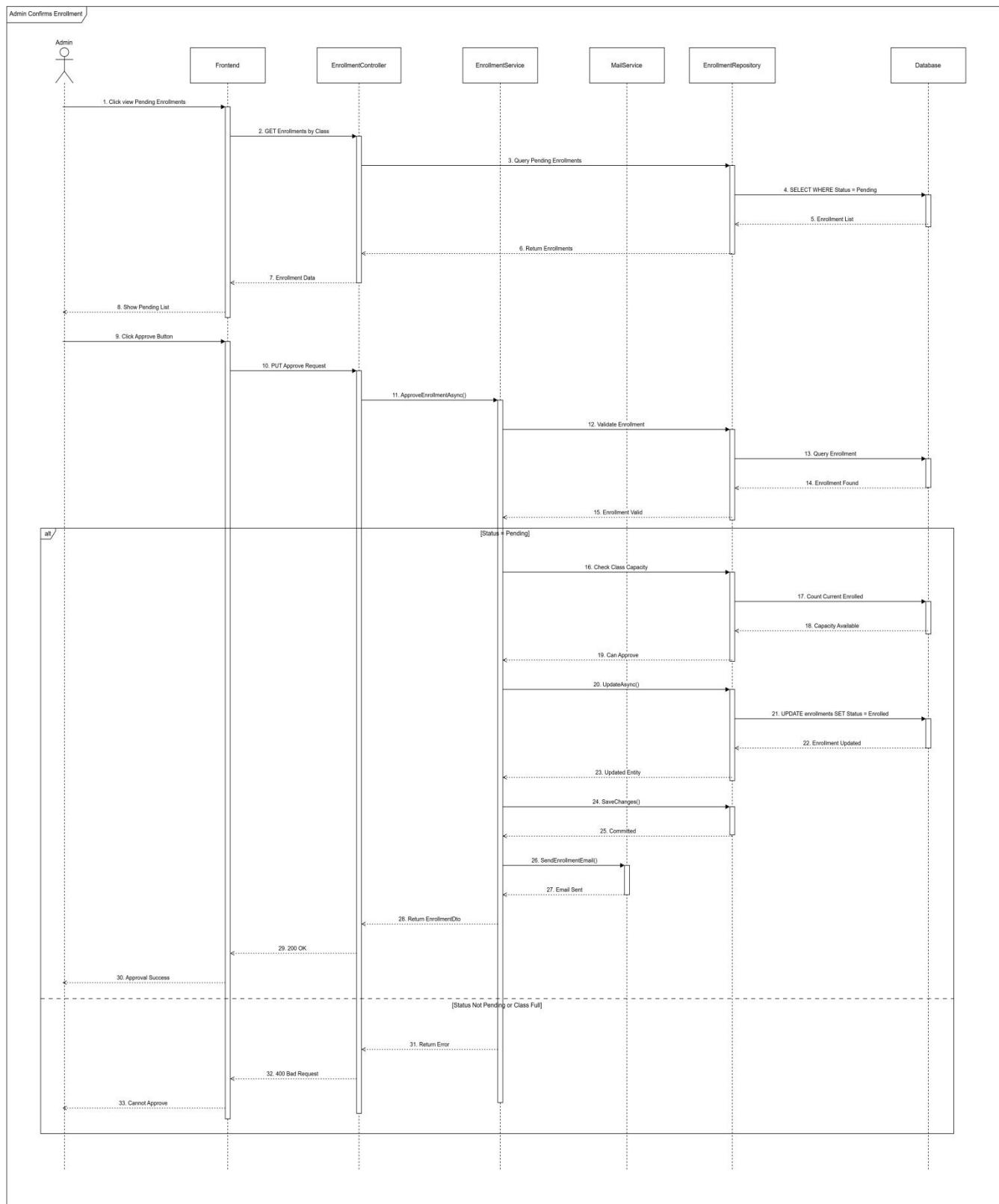
### 3.2.1 Class Diagram



### 3.2.2 Sequence Diagram - Trainee Enrolls to Class

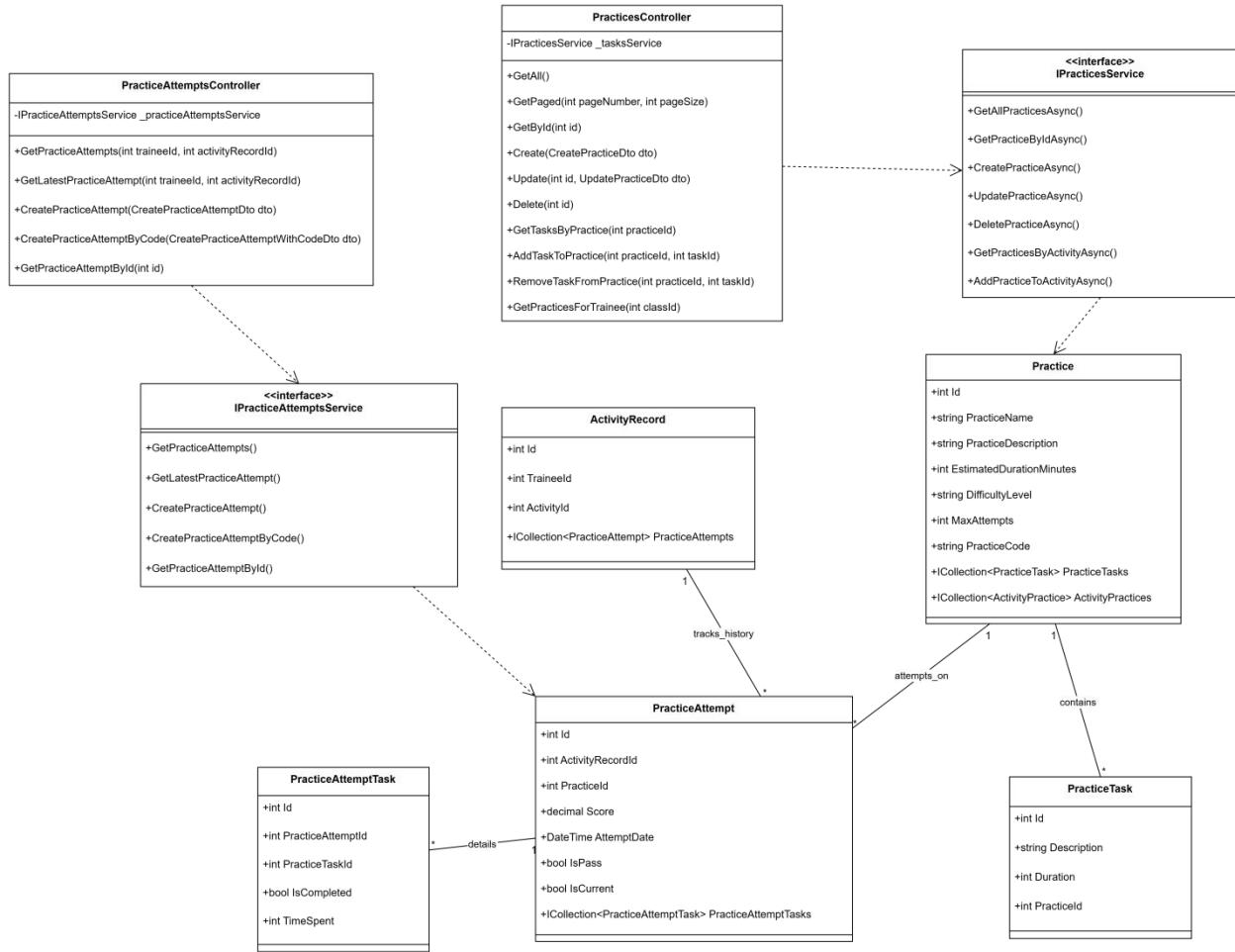


### 3.2.3 Sequence Diagram - Admin Confirms Enrollment

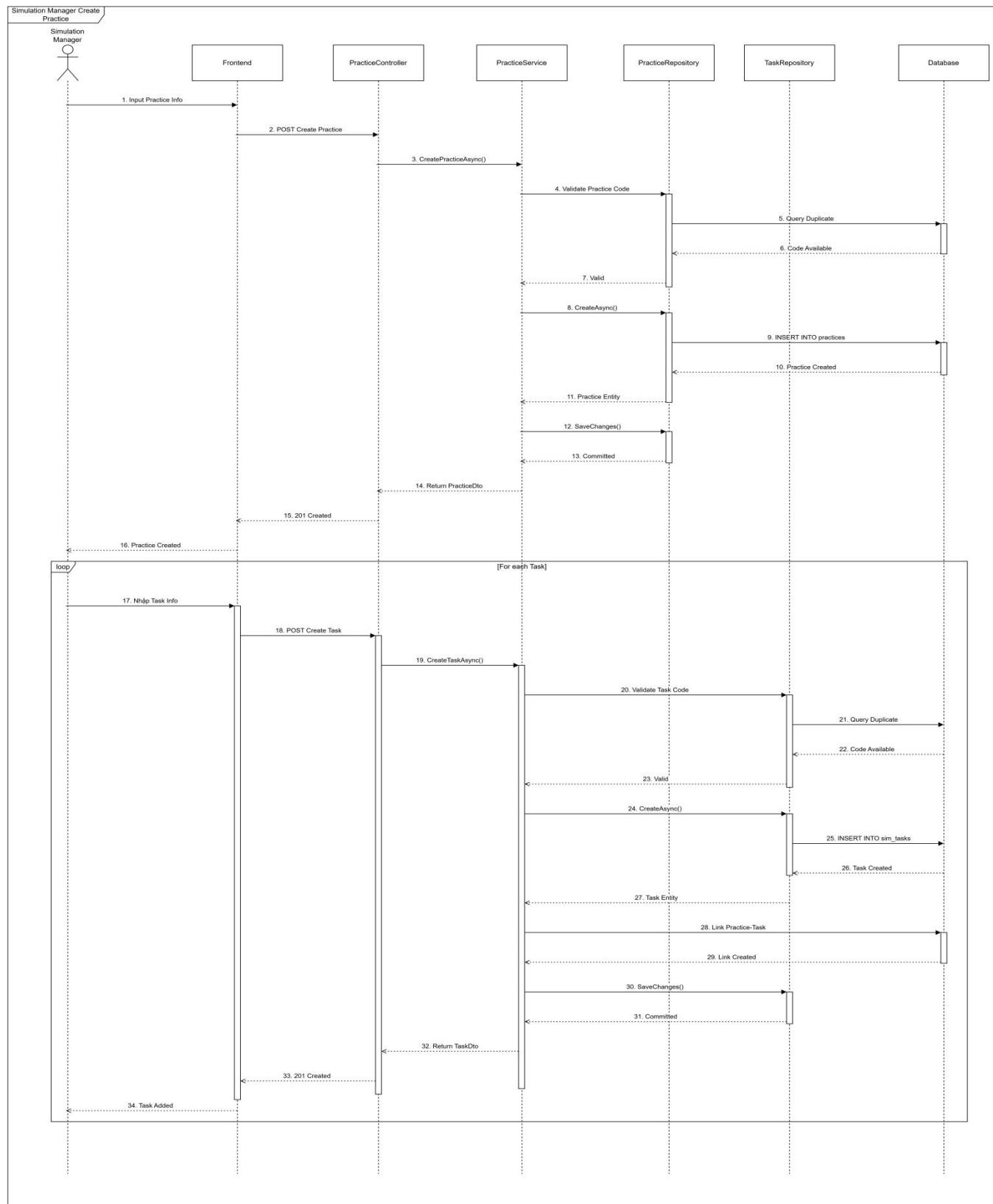


### 3.3 Simulation Practice Management

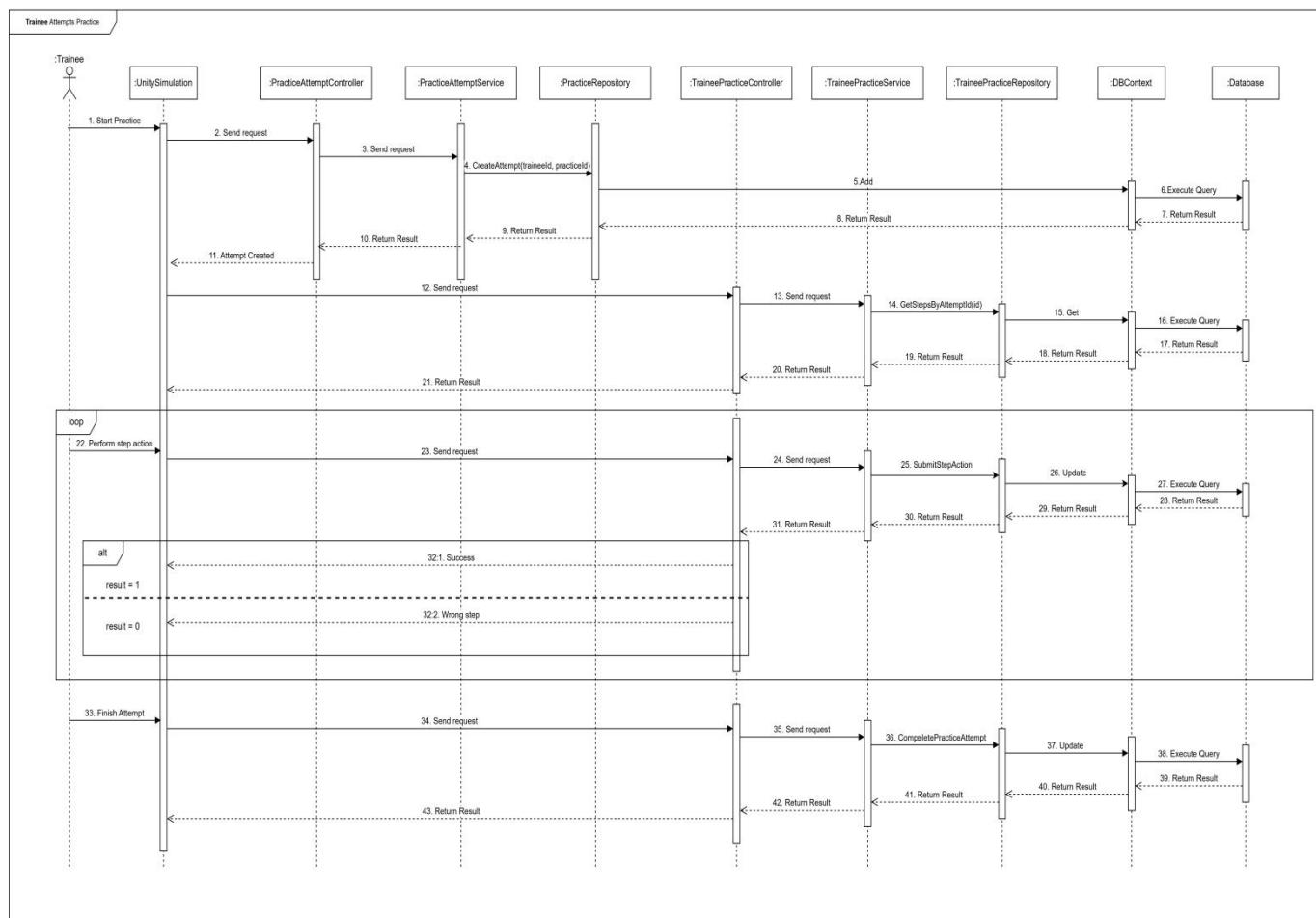
#### 3.3.1 Class Diagram



### 3.3.2 Sequence Diagram - Simulation Manager Creates Practice

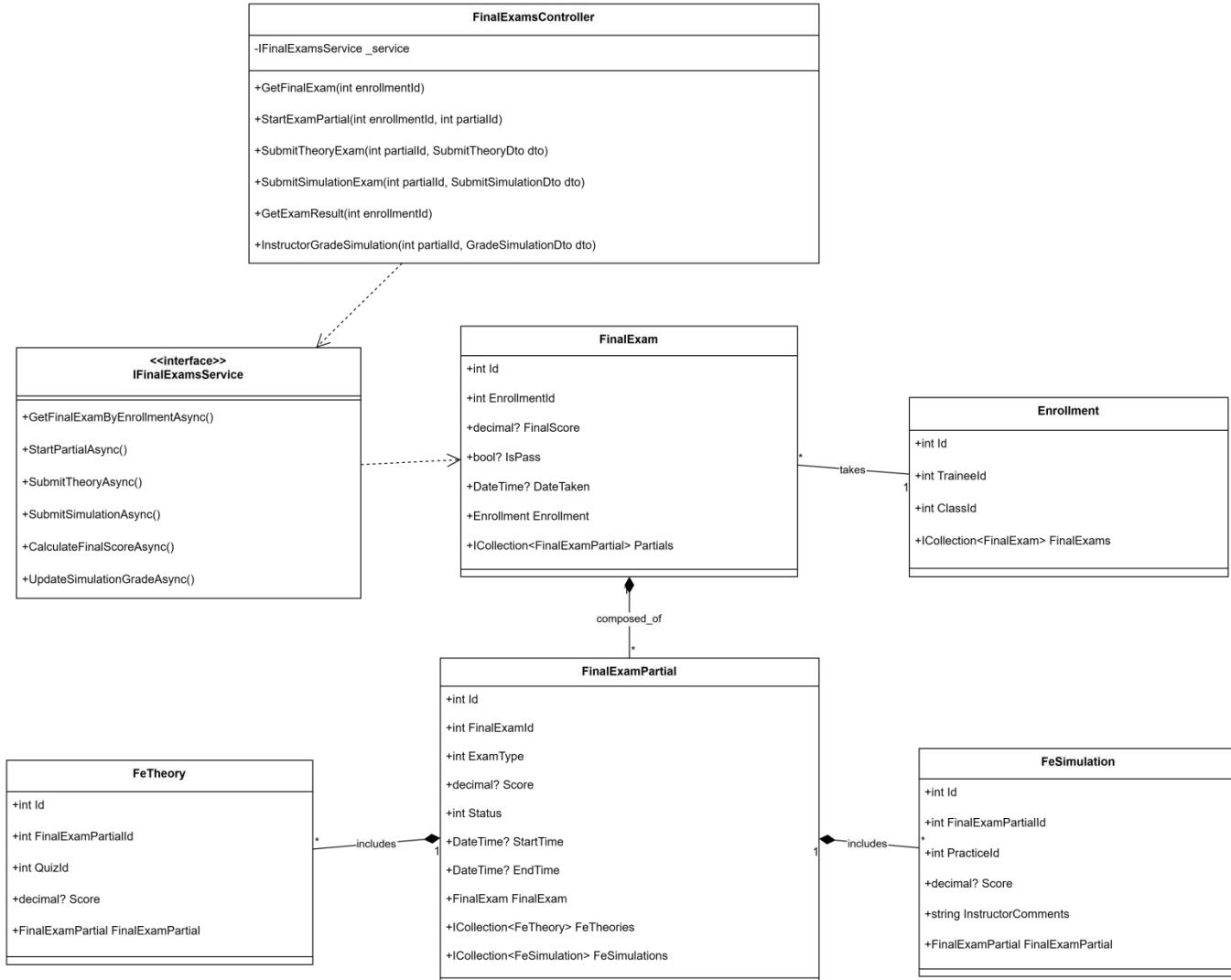


### 3.3.3 Sequence Diagram - Trainees Attempt Practice

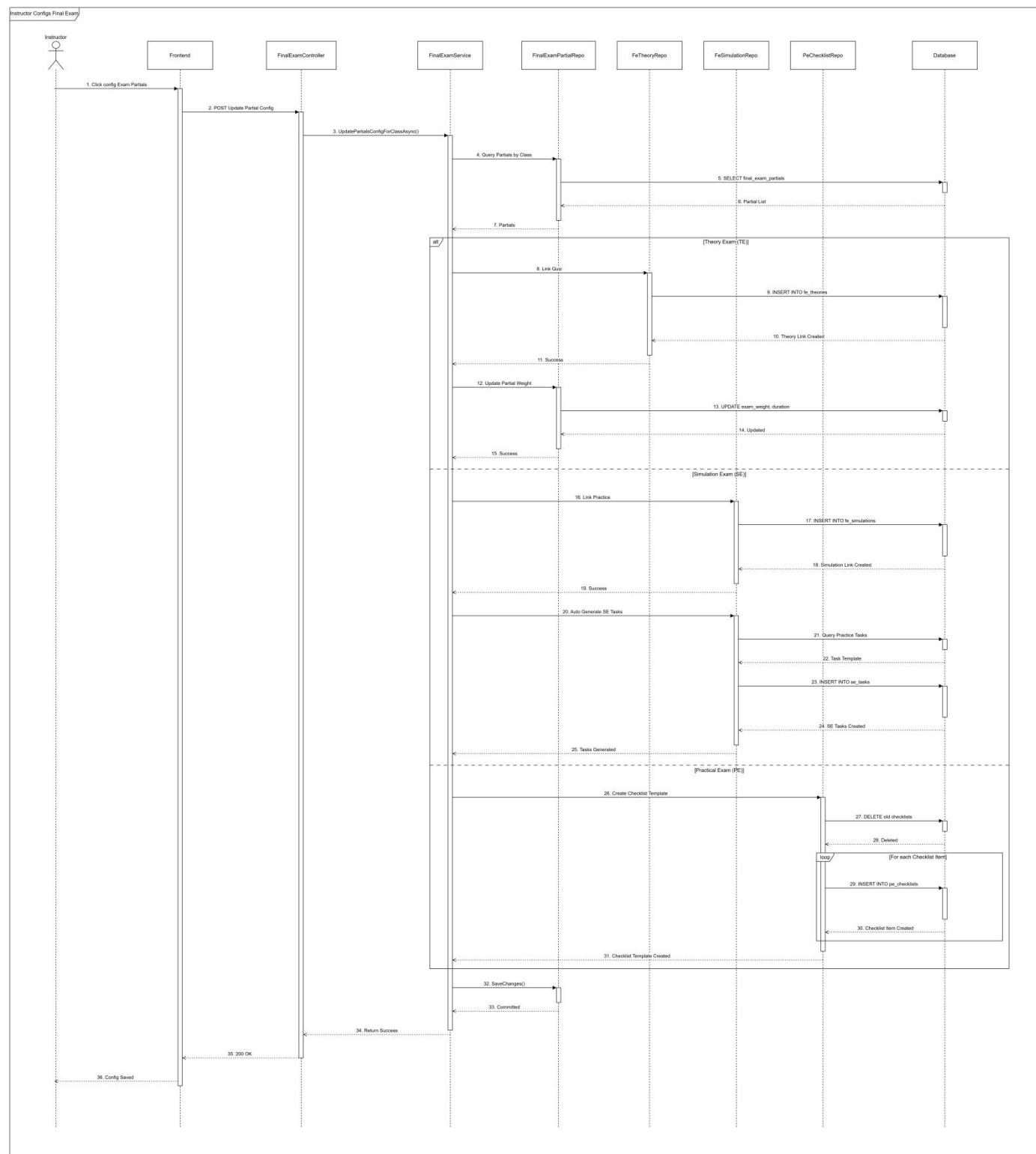


## 3.4 Final Exam Management

### 3.4.1 Class Diagram

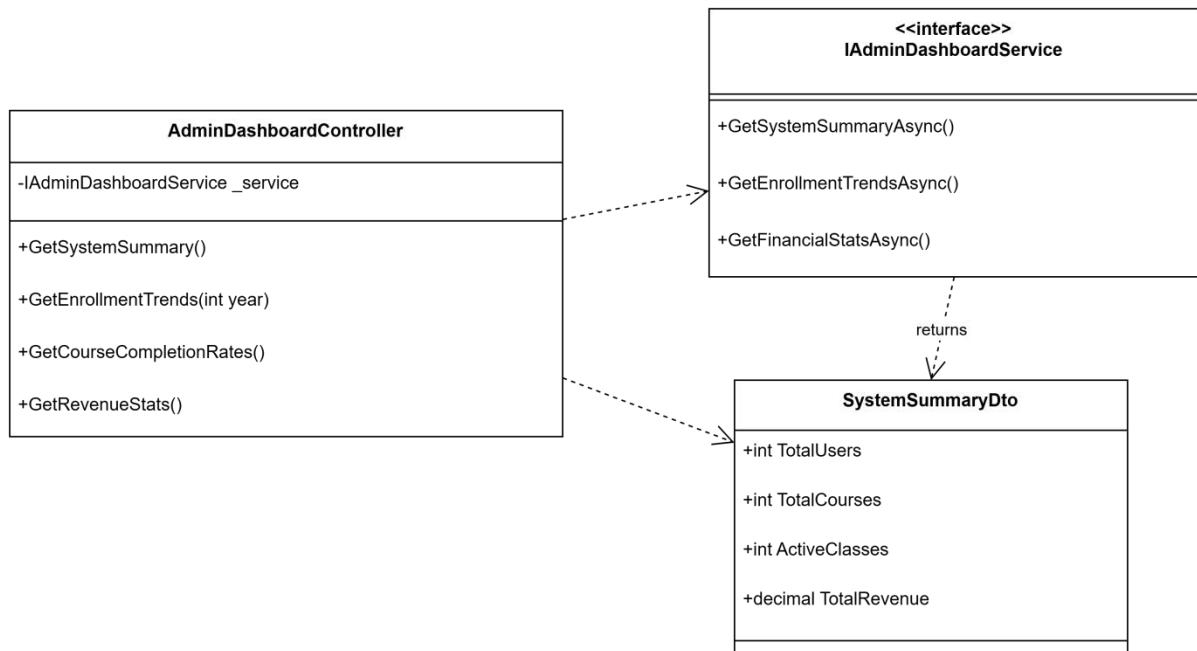


### 3.4.2 Sequence Diagram - Final Exam Configuration

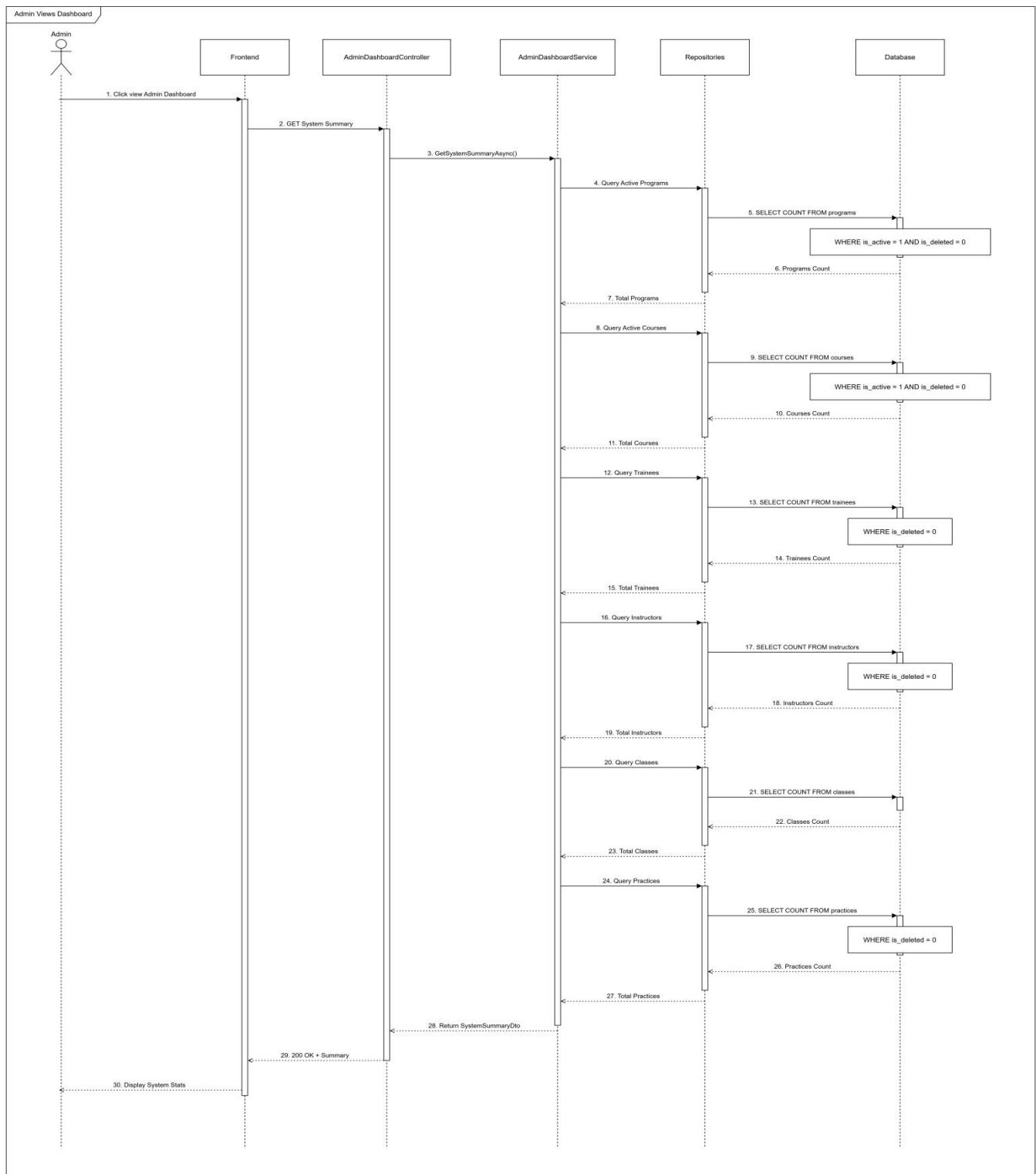


## 3.5 Dashboard & Reports

### 3.5.1 Class Diagram



### 3.5.2 Sequence Diagram - Admin Views Dashboard



## V. Software Testing Documentation

### 1. Overall Description

#### 1.1 Test Model

The project follows the Agile Testing Model. Testing is performed continuously alongside development sprints (Sprint 1 to Sprint 4).

- Requirement Analysis: Analyze SRS to identify test scenarios.
- Test Design: Create Test Cases (Excel).
- Test Execution: Execute Functional and Integration tests.
- Defect Tracking: Log issues on GitHub and re-test after fixing.

#### 1.2 Testing Levels

- **Unit Testing:** Performed by Developers using xUnit (BE) and localized component testing (FE).
- **Integration Testing:** Verifying communication between React FE, .NET API, and the Simulation Client.
- **System Testing:** End-to-end testing of full workflows (e.g., Enrollment -> Learning -> Exam -> Certificate).
- **Acceptance Testing (UAT):** Validating the system against user requirements (Admin, Instructor, Trainee flows).

#### 1.3 Testing Types

- **Functional Testing:** Verifying all features against SRS (CRUD, Workflows).
- **UI/UX Testing:** Ensuring responsiveness and usability (React components).
- **API Testing:** Validating data integrity using Postman.
- **Security Testing:** Verifying Role-based Access Control (RBAC) and JWT Authentication.

## 2. Test Plan

### 2.1 Test Stages

Type of Test	Stage of Test			
	Unit	Integration	System	Acceptance
Function Test	X	X	X	X
User Interface Test			X	X
Performance Tests		X	X	
Security Test		X	X	
Data Integrity Test	X	X	X	

### 2.2 Resources

- a. Human Resources (Refer to Team Involvements table in Section I.2)
- b. Environment

Purpose	Tool	Provider	Version
Backend Server	.NET 8 Web API	Microsoft	Hosted on Azure/Localhost
Frontend Client	ReactJS (Vite)	Open Source	Node.js v18+
Database	SQL Server	Microsoft	Azure SQL / SQL Server 2019
Simulation Client	Unity Build	Unity Tech	Windows Executable (.exe)
Browser	Google Chrome	Google	Latest Version
API Testing	Swagger / Swagger UI / Swagger Editor	OpenAPI Initiative	Latest Version
IDE	VS Code / Visual Studio	Microsoft	Code Editing

### 2.3 Test Milestones

Milestone Task	Effort (md)	Start Date	End Date
Test Planning	2	10/11/2025	11/11/2025
Test Case Design	5	12/11/2025	18/11/2025
Environment Setup	1	19/11/2025	19/11/2025
Test Execution (Round 1)	5	20/11/2025	26/11/2025
Bug Fixing & Retest	3	27/11/2025	05/12/2025
Final Report Generation	1	06/12/2025	12/12/2025

### 2.4 Deliverables

No	Deliverables	Due Date
1	Report 5 - Test Documentation (This document)	14/12/2025
2	Report 5 - Test Cases (Excel File)	14/12/2025
3	Test Execution Reports (CSV/Excel)	14/12/2025
4	Bug Log / Defect List	14/12/2025

## 3. Test Cases

Detailed test cases are provided in the attached file: [Report5\\_Test Report.xlsx](#). The test suite covers the following modules:

- Training Content & Curriculum Management:** Program, Course, Class, Section management.
- Trainee Enrollment & Learning Process:** Enrollment flow, "My Classes", learning materials.
- Simulation Integration:** Launching Sim client, syncing scores and results.
- Trainee Final Exam Module:** Theory and Simulation exams, grading logic.
- Dashboard Management:** Admin, Instructor, and Sim Manager analytics.

## 4. Test Reports

**Summary of Test Execution (Source: Test Statistics.csv):**

- **Total Test Cases:** 197
- **Passed:** 191
- **Failed:** 0
- **Pending/NA:** 6 (Skipped scenarios or future features)
- **Pass Rate:** ~96.95%

No	Module Name	Passed	Failed	Pending	N/A	Total TCs
1	<i>Training Content &amp; Curriculum Management</i>	50	0	0	0	56
2	<i>Trainee Enrollment &amp; Learning Process</i>	73	0	0	0	73
3	<i>Simulation Integration &amp; Practice Session</i>	9	0	0	0	9
4	<i>Trainee Final Exam Module</i>	36	0	0	0	36
5	<i>Dashboard Management</i>	23	0	0	0	23
<b>Total</b>		<b>191</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>197</b>

## VI. Release Package & User Guides

### 1. Deliverable Package

#### 1.1 Source codes & documents

No.	Items	Sub-Items	Type	Version
	<b>Code Package</b>			

No.	Items	Sub-Items	Type	Version
1	LSSCTC Backend API	Web Service	Modify	10.5
2	LSSCTC Frontend Web App	User Web Application	Modify	9.3
3	LSSCTC Simulator Desktop App	User Desktop Application	Modify	3.0
<b>Database</b>				
1	Tables	lssctc_db_script.sql	Modify	N/A
<b>Documents</b>				
1	Project Introduction	Report1_Project Introduction.docx	Modify	1.0
2	Project Management Plan	Report2_Project Management Plan.docx	Modify	1.0
3	Software Requirement Specification	Report3_Software Requirement Specification.docx	Modify	1.0
4	Software Design Document	Report4_Software Design Document.docx	Modify	1.0
5	Test Documentation	Report5_Test Documentation.docx	Modify	1.0
6	Software User Guides	Report6_Software User Guides.docx	Modify	1.0
7	Final Project Report	Report7_FinalProjectReport.docx	Modify	1.0

## 1.2 Known Issues, Limitations & Restrictions

- npm install fails: Delete the node\_modules folder and package-lock.json file, then run npm install again.
- Port 5173 already in use: Stop the process currently using the port or change the port number in the vite.config.js file.
- API calls fail with CORS error: Verify that the backend server is running and configured to accept requests from http://localhost:5173.
- Google OAuth not working: Ensure the Client ID in the .env file is correct and the Redirect URIs in the Google Cloud Console match your local URL.
- Blank page appears after loading: Open the browser developer tools console to check for JavaScript errors or missing environment variables.
- Module not found errors: Run npm install again to ensure all required dependencies are downloaded.

## 2. Installation Guides

### 2.1 System Requirements

#### 2.1.1 Hardware Requirements

Component	Minimum	Recommended
CPU	At least 2 GHz x64-bit CPU	Intel Core I5, 4GHz
Memory	At least 8GB RAM	16GB RAM
Storage	10GB SSD	15GB SSD

Network	Internet Connection	500 Mbps
---------	---------------------	----------

**Table 1: Hardware Requirements**

### 2.1.2 Software Requirements

Component	Software & Version	Description
Operating System	Windows 10/11, macOS 10.15+, or Linux (Ubuntu 20.04+)	Operating system for running project
DBMS	SQL Server 2019 or Azure SQL Database	Database management system
Server Environment	.NET 8.0 SDK	Environment for running backend API
Frontend Environment	Node.js 18.17.0 or higher	Environment for running frontend application
Package Manager	NPM 9.x or higher	Package manager for frontend dependencies
IDE	Visual Studio Code 1.80+ or Visual Studio 2022	Tool for viewing and editing code
VCS	Git 2.30+	Tool for managing code version
Web Browser	Chrome 90+, Firefox 88+, Edge 90+, or Safari 14+	Browser for accessing web application
Database Tool	SQL Server Management Studio (SSMS) 19+ or Azure Data Studio	Tool for database management

**Table 2: Software Requirements**

## 2.2 Setup Files

### 2.2.1 Database Files

- **lssctc\_db-script.sql:** Complete database schema script for SQL Server
- **seed-data.sql:** Initial seed data for system (users, roles, course categories, etc.)

### 2.2.2 Backend Files

- **lssctc-api.zip:** Complete backend API solution
  - Contains: Controllers, Services, Models, Repositories, and Configuration files
  - Main project: Lssctc.ProgramManagement
  - Shared library: Lssctc.Share

### 2.2.3 Frontend Files

- **lssctc-web.zip:** Complete frontend web application
  - Contains: React components, Pages, Routes, Layouts, and Assets
  - Main entry: src/main.jsx

- Configuration: vite.config.js, package.json

#### 2.2.4 Configuration Files

- **appsettings.json**: Backend API configuration (connection strings, JWT settings)
- **appsettings.Development.json**: Development-specific settings
- **.env. example**: Frontend environment variables template

### 2.3 Installation Instruction

#### 2.3.1 Setup Environment

##### Step 1: Install Required Software

- **Download and Install .NET 8.0 SDK**
  - Visit: <https://dotnet.microsoft.com/download/dotnet/8.0>
  - Download .NET 8.0 SDK for your operating system
  - Run installer and follow installation wizard
- **Download and Install Node.js 18.17.0 or higher**
  - Visit: <https://nodejs.org/>
  - Download LTS version (18.17.0 or newer)
  - Run installer and follow installation wizard
- **Download and Install SQL Server 2019**
  - Visit: <https://www.microsoft.com/en-us/sql-server/sql-server-downloads>
  - Download SQL Server 2019 Developer Edition (free)
  - Run installer and follow installation wizard
  - Configure authentication mode: **Mixed Mode** (SQL Server and Windows Authentication)
  - Verify installation using SQL Server Configuration Manager
- **Download and Install SQL Server Management Studio (SSMS)**
  - Visit: <https://docs.microsoft.com/en-us/sql/ssms/download-sql-server-management-studio-ssms>
  - Download latest version
  - Run installer and follow installation wizard
  - Launch SSMS and connect to local SQL Server instance
- **Download and Install Visual Studio Code**
  - Visit: <https://code.visualstudio.com/>
  - Download for your operating system
  - Install recommended extensions

- **Download and Install Git**

- Visit: <https://git-scm.com/downloads>
- Download for your operating system
- Run installer with default options

### **Step 2: Configure Git**

- Set your name and email
- Verify configuration

### **Step 3: Clone Repositories**

- Create project directory
- Clone backend repository
- Clone frontend repository
- Clone simulation application repository

#### **2.3.2 Setup Database**

##### **Step 1: Create Database**

- Open **SQL Server Management Studio (SSMS)**
- Connect to your local SQL Server instance
- Right-click on **Databases** → Select **New Database**
- Database name: `lssctc_db`
- Click **OK**

##### **Step 2: Execute Database Script**

- Open `lssctc_db-script.sql` in SSMS
  - File → Open → File → Select `lssctc_db-script.sql`
- Ensure `lssctc_db` database is selected in database dropdown
- Click **Execute** button or press F5
- Wait for script execution to complete
- Verify tables are created:
- Expected output: 40+ tables including users, roles, courses, classes, quizzes, etc.

##### **Step 3: Execute Seed Data (Optional)**

- Open `seed-data.sql` in SSMS
- Execute script to populate initial data:
  - Default admin account

- Course categories and levels
- Course and class codes
- Material types
- Verify seed data

#### **Step 4: Verify Database Connection String**

- Your server name
- Database name: lssctc\_db
- Authentication: SQL Server Authentication or Windows Authentication
- Example connection string:
  - Server=localhost;Database=LSSCTC\_DB;User Id=sa;Password=YourPassword;TrustServerCertificate=True

### **2.3.3 Setup and Run Backend API**

#### **Step 1: Navigate to Backend Project**

- cd lssctc-project/lssctc-api/Lssctc/Lssctc.ProgramManagement

#### **Step 2: Configure Application Settings**

- Open **appsettings.json** in text editor or VS Code
- Update your custom value for: "ConnectionStrings", "JwtConfig", "EmailSettings"
- **Generate JWT Secret Key** (recommended):
  - Generate random 32-character key using PowerShell (Windows)
  - Generate random 32-character key using openssl (macOS/Linux)
- **Configure Email Settings** (for OTP functionality):
  - Use Gmail account
  - Enable 2-Factor Authentication
  - Generate App Password: <https://myaccount.google.com/apppasswords>
  - Use App Password in configuration (not your Gmail password)

#### **Step 3: Restore NuGet Packages**

- Restore all dependencies
  - dotnet restore

#### **Step 4: Build Project**

- Build project
  - dotnet build
  - Expected output: Build succeeded.

## Step 5: Run Backend API

- Run in development mode
  - dotnet run

## Step 6: Verify API is Running

- Open web browser
- Navigate to default port
- If you setup the project to display the Swagger UI in production environment (recommend for testing only), you should see this page with all API endpoints

The screenshot shows a web browser displaying the Swagger UI for the Lssctc.ProgramManagement v1 API. The title bar reads "lssctc.azurewebsites.net/swagger/index.html". The main content area is titled "Lssctc.ProgramManagement 1.0 OAS 3.0". Below the title, it says "https://lssctc.azurewebsites.net/swagger/v1/swagger.json". On the right side, there is a "Select a definition" dropdown set to "Lssctc.ProgramManagement v1" and a green "Authorize" button. The left sidebar has a "Activities" section. Under "Activities", there are several API operations listed: GET /api/Activities, POST /api/Activities, GET /api/Activities/paged, GET /api/Activities/{id}, PUT /api/Activities/{id} (which is highlighted with a yellow background), and DELETE /api/Activities/{id}. Each operation has a lock icon and a dropdown arrow to its right.

Or a json format:

The screenshot shows a web browser displaying the Swagger UI for the Lssctc.ProgramManagement v1 API. The title bar reads "lssctc.azurewebsites.net/swagger/v1/swagger.json". The main content area is titled "lssctc.azurewebsites.net/swagger/v1/swagger.json". Below the title, it says "pretty-print □". The content is a large JSON object representing the API's OpenAPI specification. It includes sections for "openapi", "info", "paths", and "components". The "paths" section contains definitions for the "/api/Activities" endpoint, including "get", "post", and "put" methods, along with their descriptions, responses, and request bodies. The "components" section defines the "CreateActivityDto" schema used in the "post" and "put" methods.

4. Test authentication endpoint:

- Expand **POST /api/Authens/login-username**
- Click **Try it out**
- Enter test credentials (if seeded)
- Click **Execute**
- Verify 200 OK response with JWT token

The screenshot shows a POST request to the endpoint `/api/Authens/login-username`. The request body is set to `application/json` and contains the following JSON payload:

```
{
  "username": "admin1",
  "password": "admin1"
}
```

At the bottom of the interface, there is a prominent blue **Execute** button.

### 2.3.4 Setup and Run Frontend Web Application

This section outlines how to configure, run, and verify the frontend client interface.

#### Step 1: Installation

- Navigate to the project directory and install the required dependencies.

#### Step 2: Environment Configuration

- Set up the connection to the backend and external services.
  - Create the configuration file (`.env`)
  - Edit the `.env` file with your own configuration (backend endpoints, service keys)
- Google OAuth Setup To enable "Sign in with Google," create a project in the Google Cloud Console:
  - Type: OAuth 2.0 Web Application
  - Origin: `http://localhost:5173`
  - RedirectURI: `http://localhost:5173/auth/callback`
  - Paste the generated Client ID into your `.env` file.

#### Step 5: Production Build (Optional)

- To prepare the application for final deployment:
- Build: Run `npm run build` to generate the `dist/` folder.

- Preview: Run `npm run preview` to test the build at `http://localhost:5173`.

### **2.3.5 Deployment to Production**

#### **Backend Deployment Options:**

##### **Option 1: Deploy to Azure App Service**

1. Install Azure CLI
2. Login to Azure
3. Create App Service:
4. Deploy with `dotnet publish` option
5. Access Azure Portal and navigate to your app service
6. Configure connection string in Azure Portal
7. Update environment variable settings

##### **Option 2: Deploy to Docker Container**

1. Create Dockerfile in backend project root with publish option
2. Build and run
3. Access Docker application to view your running projects.

#### **Frontend Deployment Options:**

##### **Option 1: Deploy to Vercel**

1. Create an account in `vercel.com` (or using an existed one)
2. Connect your Vercel account with `github` repository
3. Create a new Vercel project
4. Setup deployment configuration
5. Configure environment variables in Vercel dashboard
6. Confirm deployment and view the project in Vercel dashboard
7. Vercel project will automatically update after change in `github` repository

##### **Option 2: Deploy to Azure Static Web Apps**

1. Create a Azure account in Azure Portal (or using an existed one)
2. In Azure Portal, create a new resource
3. Select Static Web App
4. Setup your `github` repository of frontend project (or using a zip file)
5. Azure will automatically build and deploy your web app

#### **Database Deployment:**

## **Deploy to Azure SQL Database**

1. Create Azure SQL Database in Azure Portal
2. Connect to Azure SQL Database using SSMS
3. Execute script to create tables and seed data
4. Update backend environment variables to match your database

## **3. User Manual**

### **3.1 Terms and definitions**

Term	Definition
LSSCTC	Learner Management and 3D Simulation System for Crane Training Center
Admin	System administrator with full access to all features and user management
Instructor	Teacher/trainer who creates course content, quizzes, and evaluates trainees
Trainee	Student enrolled in crane operation training courses
Program Manager	Role responsible for curriculum design and course orchestration
Simulation Manager	Role responsible for managing 3D simulation components and scenarios
Training Program	Complete curriculum consisting of multiple courses leading to certification
Course	Individual training module covering specific crane operation topics
Section	Subdivision within a course containing organized activities
Activity	Learning task within a section (material, quiz, or practice)
Learning Material	Educational content (PDF, video, image, URL) provided to trainees
Quiz	Assessment containing multiple-choice or single-choice questions
Practice	Hands-on simulation task for skill development and evaluation
Class	Group of trainees enrolled in a program with scheduled sessions
Timeslot	Scheduled session for class instruction with date, time, and instructor
Enrollment	Trainee's registration and participation in a specific class

Activity Record	Trainee's progress and completion status for an activity
Quiz Attempt	Trainee's submission of a quiz with scored results
Practice Attempt	Trainee's completion of a practice session with performance metrics
Simulation Component	3D model or asset used in crane operation simulation environment
Brand Model	Specific crane manufacturer and model configuration
JWT	JSON Web Token - authentication token for API access
OTP	One-Time Password - 6-digit code for password reset verification
WebGL	Web Graphics Library - browser technology for 3D rendering

### 3.2 System requirements

For End Users (Trainees, Instructors):

- Operating System:
  - Windows 10/11 (64-bit)
  - macOS 10.15 (Catalina) or later
  - Linux (Ubuntu 20.04+ or equivalent)
- Web Browser:
  - Google Chrome 90+ (Recommended)
  - Mozilla Firefox 88+
  - Safari 14+ (macOS only)
  - Microsoft Edge 90+
- Internet Connection:
  - Minimum: 5 Mbps (for video streaming and general use)
  - Recommended: 10 Mbps (for 3D simulation)
- Display Resolution:
  - Minimum: 1366x768
  - Recommended: 1920x1080 or higher
- Input Devices:
  - Mouse and keyboard (required)
  - Trackpad supported but not recommended for simulation

For Simulation Features:

- RAM:
  - Minimum: 8GB
  - Recommended: 16GB
- Graphics Card:
  - Dedicated GPU with WebGL 2.0 support

- NVIDIA GTX 1050 or equivalent
  - AMD Radeon RX 560 or equivalent
- Storage:
  - 2GB free space for cached 3D models and textures
- CPU:
  - Minimum: Intel Core i5 or AMD Ryzen 5
  - Recommended: Intel Core i7 or AMD Ryzen 7

For System Administrators:

- All of the above, plus:
- Access to SQL Server Management Studio or Azure Data Studio
- Network access to application server and database server

Remote desktop or SSH access to servers (for on-premise deployment)

### **3.3 Application Usage**

#### **3.3.1 Overview**

The LSSCTC system is a web-based Learning Management System integrated with 3D crane operation simulation capabilities. It consists of:

1. Frontend (Web Application): React-based single-page application
2. Backend (API): .NET 8 RESTful API with JWT authentication
3. Database: SQL Server relational database
4. 3D Engine: Desktop application (.exe file) or WebGL-based environment

#### **3.3.2 Feature 1: Authentication & User Management**

Purpose: Secured user authentication with multiple login methods and role-based access control

Available Functions:

1. Login with Username/Password
2. Login with Google account
3. Password Reset
4. Logout
5. Manage Personal Profile
6. Manage User (Admin role)
  - a. Add User
  - b. Edit User information

#### **3.3.3 Feature 2: Program & Course Management**

Purpose: Create, organize, and manage training program and courses

Available Functions:

1. View all Training Programs

#	HÌNH ANH	TÊN CHƯƠNG TRÌNH	KHÓA HỌC	NGÀY TẠO	TRANG THÁI
1		Vận hành cần cẩu cơ bản KS7	1	29-12-2025	HOẠT ĐỘNG
2		Chương trình Đào tạo Vận hành Cần cẩu	1	26-12-2025	HOẠT ĐỘNG
3		Kỹ thuật vận hành cần cẩu tự hành-V1	1	26-12-2025	HOẠT ĐỘNG
4		Kỹ thuật Vận Hành Xe cẩu Tự hành (UNIC UR-V Series)	7	22-12-2025	HOẠT ĐỘNG
5		Chương trình Đào tạo Vận hành Cần cẩu trực 2025	1	16-12-2025	HOẠT ĐỘNG

## 2. Create Training Program



## TAO CHƯƠNG TRÌNH

Điền thông tin chi tiết chương trình



### THÔNG TIN CƠ BẢN

\* TÊN CHƯƠNG TRÌNH

Nhập tên chương trình

0 / 120



### HÌNH ẢNH CHƯƠNG TRÌNH

\* URL HÌNH ẢNH

<https://www-assets.liebherr.com/media/l>

XEM TRƯỚC HÌNH ẢNH



URL ẢNH NỀN

<https://templates.framework-y.com/light>

XEM TRƯỚC ẢNH NỀN



### MÔ TẢ

Nhập mô tả chương trình

0 / 1000

Hủy

Tạo chương trình

### 3. Edit Training Program details

[← Quay lại](#) [HOẠT ĐỘNG](#)

## VẬN HÀNH CẦN CẨU CƠ BẢN K57

[x Hủy](#) [Lưu](#)

**THÔNG TIN CƠ BẢN**

\* TÊN CHƯƠNG TRÌNH  
 27 / 120

**HÌNH ẢNH CHƯƠNG TRÌNH**

\* URL HÌNH ÁNH  
 [XEM TRƯỚC HÌNH ÁNH](#)



\* URL ẢNH NỀN  
 [XEM TRƯỚC ẢNH NỀN](#)



**MÔ TẢ**

Vận hành cần cẩu cơ bản K57

27 / 1000

#### 4. Delete Training Program

[← Quay lại](#) [HOẠT ĐỘNG](#)

## VẬN HÀNH CẦN CẨU CƠ BẢN K57

**Xóa chương trình**  
 Bạn có chắc chắn muốn xóa chương trình này?

[Sửa](#)  [Xóa](#)



<a href="#">NGÀY TẠO</a>	TỔNG KHÓA HỌC	NGÀY TẠO	NGÀY CẬP NHẬT
29-12-2025	1	29-12-2025	29-12-2025

**MÔ TẢ**

Vận hành cần cẩu cơ bản K57

**KHÓA HỌC** 1



[+ Gán khóa học](#)

#### 5. View All Courses

The screenshot displays a web-based application for managing courses. On the left, a sidebar titled 'QUẢN TRỊ VIÊN' (Administrator) contains navigation links: TỔNG QUAN, NGƯỜI DÙNG, CHƯƠNG TRÌNH, KHÓA HỌC (highlighted in yellow), LỚP HỌC, TÀI LIỆU, BÀI KIỂM TRA, and CHỨNG NHÂN. The main area is titled 'QUẢN LÝ KHÓA HỌC' (Course Management) and shows a list of courses. The columns include HÌNH ẢNH (Image), TÊN KHÓA HỌC (Course Name), DANH MỤC (Category), CẤP ĐỘ (Level), and TRẠNG THÁI (Status). A search bar at the top right allows users to search for specific courses.

HÌNH ẢNH	TÊN KHÓA HỌC	DANH MỤC	CẤP ĐỘ	TRẠNG THÁI
	Vận hành và điều khiển cần cẩu cơ bản K57 COURSE-57	Kỹ Thuật Điều Khiển	Trung cấp	HOẠT ĐỘNG
	Ứng phó sự cố và Kết thúc công việc- V2 COURSE-578	Cần Trục Tự Hành	Sơ cấp III	HOẠT ĐỘNG
	Ứng phó sự cố và Kết thúc công việc- V1 COURSE-577	Cần Trục Tự Hành	Sơ cấp III	HOẠT ĐỘNG
	Kỹ thuật vận hành cầu tự hành xe tải COURSE-576	Cần Trục Tự Hành	Chuyên viên	HOẠT ĐỘNG
	Kỹ thuật Vận hành COURSE-575	Cần Trục Tự Hành	Sơ cấp III	HOẠT ĐỘNG
	Ứng phó sự cố và Kết thúc công việc COURSE-574	Cần Trục Tự Hành	Chuyên viên	HOẠT ĐỘNG
	Kỹ thuật Vận hành (Operation) COURSE-188	Cần Trục Tự Hành	Sơ cấp III	HOẠT ĐỘNG
	Kiểm tra và Bảo dưỡng thiết bị COURSE-189	Cần Trục Tự Hành	Sơ cấp	HOẠT ĐỘNG

1-10 / 11 khóa học | < | 1 | 2 | > | 10 / page |

## 6. Create Course

## TAO KHÓA HỌC

Điền thông tin chi tiết khóa học

X

### THÔNG TIN CƠ BẢN

\* TÊN KHÓA HỌC

Nhập tên khóa học 0 / 200

\* MÃ KHÓA HỌC

Nhập mã khóa học 0 / 50

### PHÂN LOẠI

\* DANH MỤC

Chọn danh mục

\* CẤP ĐỘ

Chọn cấp độ

\* THỜI LƯỢNG (GIỜ)

ví dụ: 40

### HÌNH ẢNH KHÓA HỌC

\* URL HÌNH ẢNH

https://encrypted-tbn0.gstatic.com/images/

XEM TRƯỚC



URL ẢNH NỀN

https://templates.framework-y.com/lightv

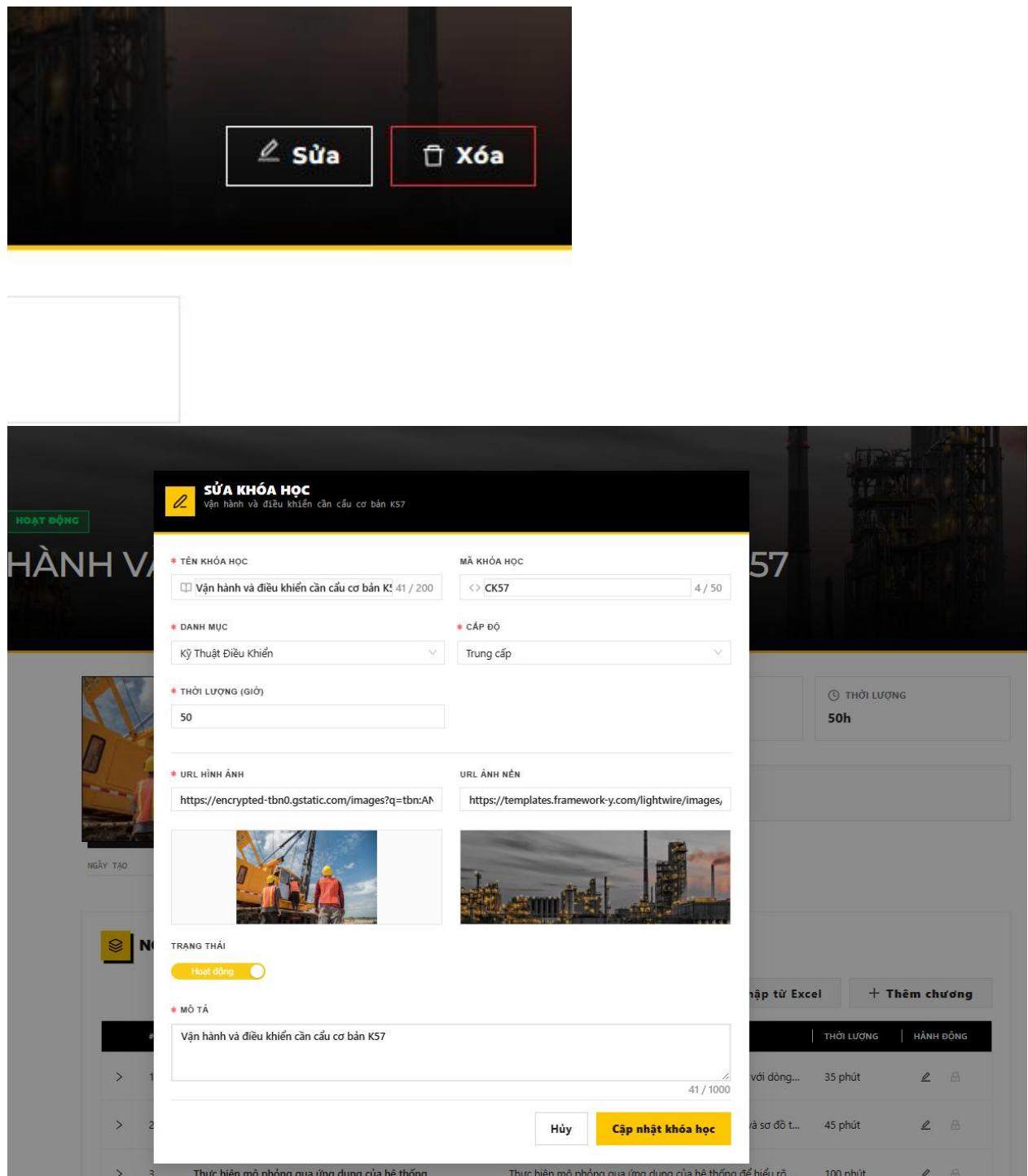
XEM TRƯỚC ẢNH NỀN



### MÔ TẢ

Nhập mô tả khóa học

## 7. Edit Course details



The screenshot shows a mobile application interface for editing course details. At the top, there are two buttons: a white button with a blue outline containing the text "Sửa" (Edit) and a red button with a white outline containing the text "Xóa" (Delete). Below this, a large modal window titled "SỬA KHÓA HỌC" (Edit Course) is displayed. The modal contains the following fields:

- TÊN KHÓA HỌC:** Vận hành và điều khiển cẩu cầu cơ bản K57
- MÃ KHÓA HỌC:** CK57
- DANH MỤC:** Kỹ Thuật Điều Khiển
- CẤP ĐỘ:** Trung cấp
- THỜI LƯỢNG (GIỜ):** 50
- URL HÌNH ẢNH:** https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQ...
- URL ẢNH NỀN:** https://templates.framework-y.com/lightwire/images/...
- TRẠNG THÁI:** Hoạt động (highlighted)
- MÔ TẢ:** Vận hành và điều khiển cẩu cầu cơ bản K57

At the bottom right of the modal, there are two buttons: "Hủy" (Cancel) and "Cập nhật khóa học" (Update Course). To the right of the modal, a blurred background shows a list of courses with columns for "THỜI LƯỢNG" (Time), "HÀNH ĐỘNG" (Action), and other details.

## 8. Delete Course



## 9. Assign Course to Programs

NGÀY TẠO 29-12-2025

### GÁN KHÓA HỌC

Vận hành cẩu cẩu cơ bản K57

<input type="checkbox"/> TÊN KHÓA HỌC	MÔ TẢ	TRẠNG THÁI
<input type="checkbox"/> Ứng phó sự cố và Kết thúc công việc- V2	Ứng phó sự cố và Kết thúc công việc- ...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Ứng phó sự cố và Kết thúc công việc- V1	Ứng phó sự cố và Kết thúc công việc- ...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Kỹ thuật vận hành cẩu tự hành xe tải	Chinh phục kỹ năng vận hành cốt lõi: ...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Kỹ thuật Vận hành	Trọng tâm của chương trình, kết hợp ...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Ứng phó sự cố và Kết thúc công việc	Đánh giá: Quy trình xử lý tình huống k...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Kỹ thuật Vận hành (Operation)	Học phần thực hành chuyên sâu: Tập t...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Kiểm tra và Bảo dưỡng thiết bị	Đánh giá: Thiên về nhận biết dấu hiệu ...	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/> Lập kế hoạch và An toàn lao động	Đánh giá: Học phần quan trọng, chia...	<b>HOẠT ĐỘNG</b>

Total 11 courses 1 2 >

X Hủy + Gán đã chọn (0)

## 10. Add new section

 ADD NEW SECTION

Remaining time: 1800 minutes (Course: 1800 min, Used: 0 min)

\* SECTION TITLE

Enter section title

DESCRIPTION

Enter section description

DURATION (MINUTES)

60

**Cancel** **Create**

11. Import Sections and Activity from Excel

## IMPORT SECTIONS FROM EXCEL



ID: 64

**(i) DOWNLOAD THE TEMPLATE, FILL EACH ROW, THEN UPLOAD THE FILE.**

- Template row example
- Column A: Section Name
- Column B: Order
- Column C: Duration (hours)



CHANGE EXCEL FILE

section\_activity (6).xlsx



section\_activity (6).xlsx

Cancel

Import

12. Add New Activity



## ADD NEW ACTIVITY

\* Activity Title

e.g., Introduction Video

\* Type

Material

\* Duration (Mins)

10

Description

Cancel

Save Activity

12. Assign the Materialto activity.

## EDIT ACTIVITY

ID: 146

\* Activity Title

Danh mục kiểm tra (Inspection Checklist)

\* Type

\* Duration (Mins)

Material

10

Assign Material

TCVN 10837:2015 (Document)

Furukawa UNIC UR-V Series Specifications. (Document)

Giới thiệu cầu tự hành UNIC UR-V340 (Video)

Video Cấu tạo & Vận hành (Video)

QCVN 29:2016/BLĐTBXH (Document)

**TCVN 10837:2015 (Document)**

AN TOÀN TRONG QUẢN LÝ VÀ VẬN HÀNH XE CẦU (Video)

Hướng dẫn vận hành cầu UNIC (Video)

Hướng dẫn đọc biểu đồ tải và tính toán an toàn (Document)

13. Assign the Practice activity.

n kỹ thuật huấn luyện (Planning Guide)

hồi h

dướ

y Inspect

TLE

kiểm

n bả

c hiệ

TLE

hộ ph

ng Hàng

hàng hóa

àng Qua Chương Ngoại vật

14. Assign the quiz to activity.

## EDIT ACTIVITY

ID: 149

\* Activity Title

Điều hướng Hàng hóa Zigzag

\* Type

Practice

\* Duration (Mins)

40

Assign Practice

Điều hướng Hàng hóa Zigzag

- Outrigger Deployment Drill
- Load Radius Practical
- Crane Operation
- Standard Signals Roleplay
- Emergency Response Simulation
- Kiểm tra bộ phận
- Điều hướng Hàng hóa Zigzag
- Di chuyển hàng hóa

**EDIT ACTIVITY**

ID: 143

\* Activity Title  
Biểu đồ tải trọng Quiz

\* Type Quiz \* Duration (Mins) 30

Assign Quiz

Kiểm tra Lý thuyết Vận hành Cẩu (10 pts)

Hướng dẫn vận hành cẩu UNIC T1 (10 pts)  
Hướng dẫn vận hành cẩu UNIC T1 (10 pts)  
Hướng dẫn vận hành cẩu UNIC T1 (10 pts)  
Hướng dẫn vận hành cẩu UNIC T1 (10 pts)  
Kiểm tra biểu đồ tải trọng- V1 (10 pts)  
**Kiểm tra Lý thuyết Vận hành Cẩu (10 pts)**  
Final Exam kỹ thuật vận hành cẩu tự hành xe tải (10 pts)  
Bài kiểm tra checklist an toàn trước khi vận hành (10 pts)

15. Add Quiz to Theory Exam( Final Exam)

### CẤU HÌNH BÀI THI LÝ THUYẾT

\* Bài kiểm tra

\* Thời lượng (phút) \* Trọng số (%)

 30

\* Thời gian Bắt đầu Thời gian Kết thúc

 Select date  Select date  

### CẤU HÌNH BÀI THI LÝ THUYẾT

\* Bài kiểm tra

- Hướng dẫn vận hành cầu UNIC T1 (20m)
- Hướng dẫn vận hành cầu UNIC T1 (20m)
- Hướng dẫn vận hành cầu UNIC T1 (20m)
- Hướng dẫn vận hành cầu UNIC T1 (20m)
- Kiểm tra biểu đồ tải trọng- V1 (20m)
- Kiểm tra Lý thuyết Vận hành Cầu (20m)
- Final Exam kỹ thuật vận hành cầu tự hành xe tải (30m)
- Bài kiểm tra checklist an toàn trước khi vận hành (20m)

**CẤU HÌNH BÀI THI LÝ THUYẾT**

\* Bài kiểm tra

Hướng dẫn vận hành cầu UNIC T1 (20m)

\* Thời lượng (phút) \* Trọng số (%)

20 30

Tối thiểu yêu cầu: 20 phút

\* Thời gian Bắt đầu Thời gian Kết thúc

Select date Select date

<< < > >>

Su	Mo	Tu	We	Th	Fr	Sa	00	00
28	29	30	31	1	2	3	01	01
4	5	6	7	8	9	10	02	02
11	12	13	14	15	16	17	03	03
18	19	20	21	22	23	24	04	04
25	26	27	28	29	30	31	05	05
1	2	3	4	5	6	7	06	06
							07	07
							08	08

Lưu

Now OK

16. Add Practice to Simulation Exam( Final Exam)

**CẤU HÌNH BÀI THI MÔ PHỎNG**

\* Thực hành

\* Thời lượng (phút) \* Trọng số (%)

\* Thời gian Bắt đầu Thời gian Kết thúc

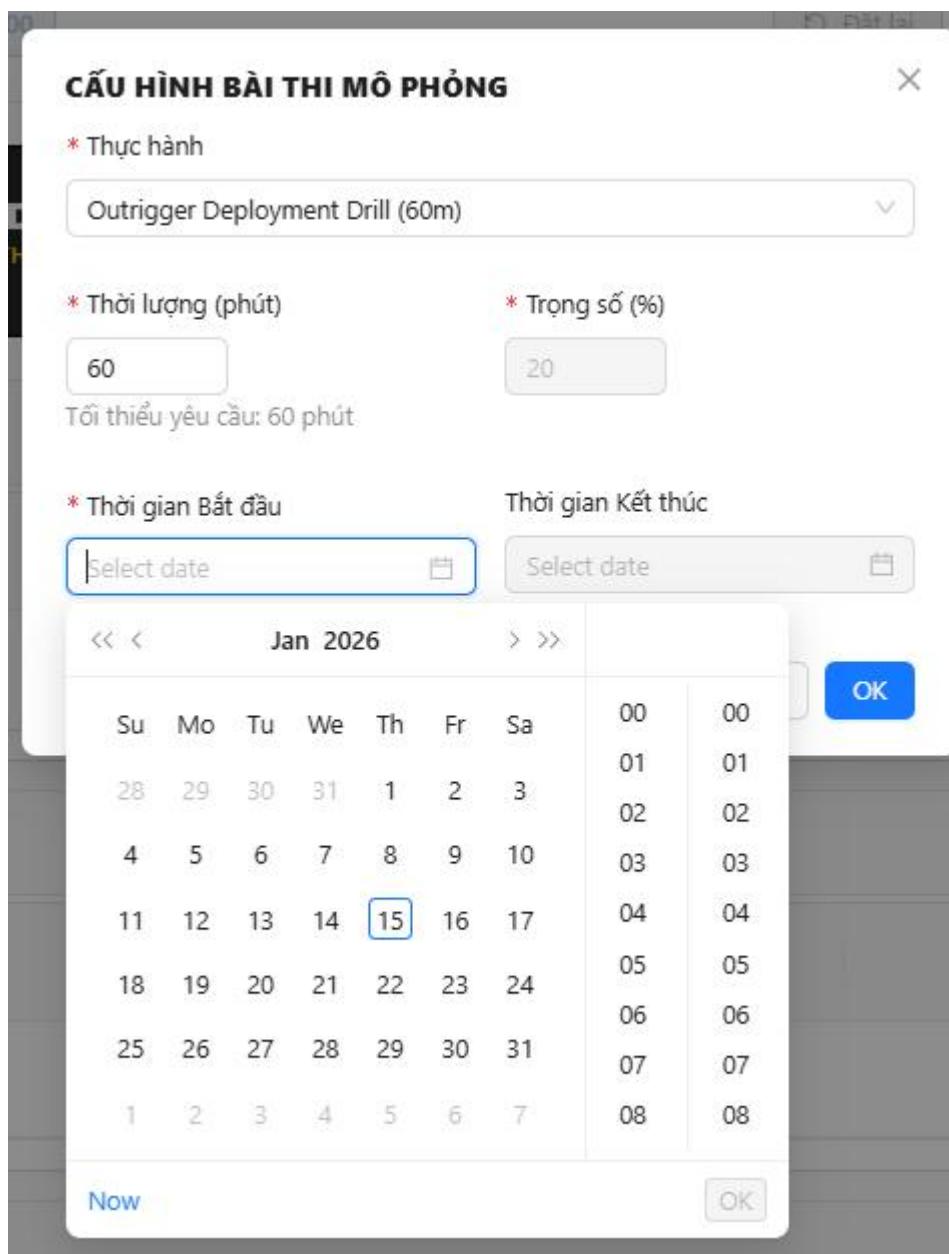
Select date Select date

Cancel OK

**CẤU HÌNH BÀI THI MÔ PHỎNG**

\* Thực hành

- Outrigger Deployment Drill (60m)
- Load Radius Practical (60m)
- Crane Operation (150m)
- Standard Signals Roleplay (45m)
- Emergency Response Simulation (60m)
- Kiểm tra bộ phận (10m)
- Điều hướng Hàng hóa Zigzag (15m)
- Di chuyển hàng hóa (8m)



17. Add Practical to Practical Exam( Final Exam)

**CẤU HÌNH BÀI THI THỰC HÀNH**

* Thời lượng (phút)	* Trọng số (%)
90	50
* Thời gian Bắt đầu	Thời gian Kết thúc
Select date	Select date

**DANH SÁCH TIÊU CHÍ**

+ Thêm Tiêu chí

**Cancel** **OK**

**CẤU HÌNH BÀI THI THỰC HÀNH**

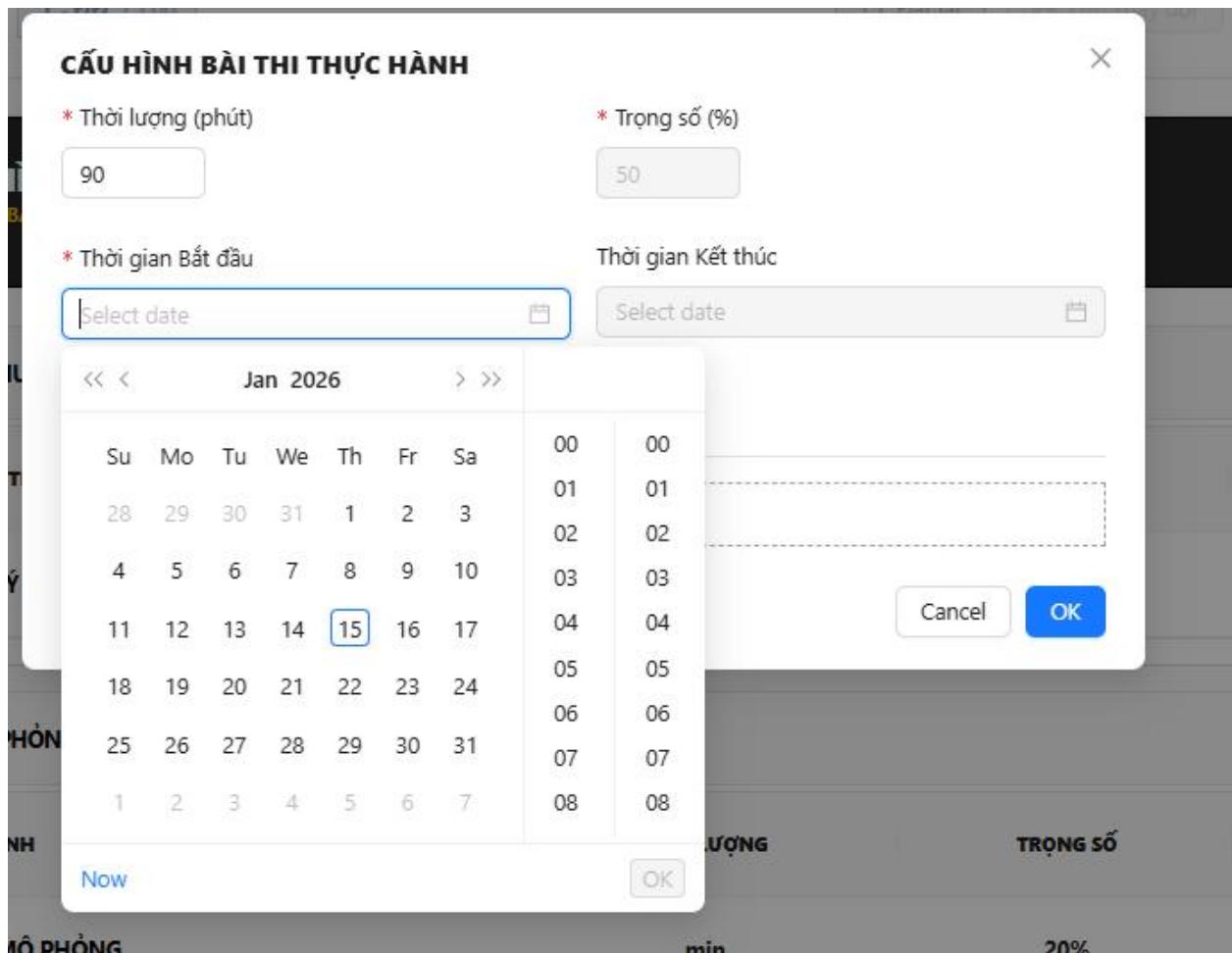
* Thời lượng (phút)	* Trọng số (%)
90	50
* Thời gian Bắt đầu	Thời gian Kết thúc
15-01-2026 00:00	15-01-2026 01:30

**DANH SÁCH TIÊU CHÍ**

kỹ thuật	mở được cẩu	<input type="checkbox"/>
Kiến thức vận hành	Điều khiển được cẩu tốt	<input type="checkbox"/>
Tên Tiêu chí	Mô tả	<input type="checkbox"/>

+ Thêm Tiêu chí

**Cancel** **OK**



### 3.3.4 Feature 3: Class Management

Purpose: Create and edit learning classes (organize trainees into classes, assign instructors, and manage schedules)

Available Functions:

1. View All Classes
  - a. Navigate to Class management / Quản lý lớp học (Admin portal)
  - b. A table of all classes shall be displayed in the page

#	TÊN LỚP HỌC	MÃ LỚP HỌC	NGÀY BẮT ĐẦU	NGÀY KẾT THÚC	TRANG THÁI
1	Lớp điều khiển cần cầu cơ bản K57-001	LK57-001	30-12-2025	02-02-2026	DANG DIỄN RA
2	Lop 1	Lop 1	27-12-2025	27-01-2026	CHUA MỞ
3	Khóa học vận hành cầu tự hành K25-V002	K25-V002	27-12-2025	27-01-2026	CHUA MỞ
4	Khóa học vận hành cầu tự hành K25-V001	K25-V001	26-12-2025	26-01-2026	ĐÃ HOÀN THÀNH
5	C5 - Xử lý sự cố & Thu dọn thiết bị - K24.03	C5-SAFE-2403	26-12-2025	26-01-2026	ĐÃ HOÀN THÀNH
6	C5 - Xử lý sự cố & Thu dọn thiết bị - K24.02	C5-SAFE-2402	26-12-2025	26-01-2026	DANG DIỄN RA
7	Lớp Kỹ Thuật Xe Cẩu Chuyên Nghiệp	CCO-M25	26-12-2025	26-01-2026	DANG DIỄN RA
8	C5 - Xử lý sự cố & Thu dọn thiết bị - K24.01	C5-SAFE-2401	24-12-2025	24-01-2026	DANG DIỄN RA
9	Thực hành Vận hành Cầu & Xử lý Sự cố (K24-N1)	CLS-OP04-K24-01	23-12-2025	30-12-2025	MỞ
10	Tổng quan và Cơ sở pháp lý xe cầu tự hành	UNIC-K01	21-12-2025	30-12-2025	DANG DIỄN RA

- c. There is a search bar at the top of the page (search by name and by code)
- d. There is a filter by class status next to search bar.

## 2. Create New Class

- a. Click Create / Thêm lớp học

- b. Fill the class information in the popup screen

 **TẠO LỚP HỌC**  
Điền thông tin chi tiết lớp học



 **THÔNG TIN CƠ BẢN**

\* TÊN LỚP HỌC

 Nhập tên lớp học 0 / 120

\* MÃ LỚP HỌC

 Nhập mã lớp học 0 / 50

 **CHƯƠNG TRÌNH & KHÓA HỌC**

\* CHƯƠNG TRÌNH

Chọn chương trình 

\* KHÓA HỌC

Chọn khóa học 

 **LỊCH TRÌNH**

\* NGÀY BẮT ĐẦU

15-01-2026 

\* NGÀY KẾT THÚC

15-02-2026 

\* SỨC CHỨA

10

 **MÔ TẢ**

Mô tả

0 / 500

X Hủy

+ Tạo lớp học

c. We shall select program and course from existed list.

<p>* CHƯƠNG TRÌNH</p> <input type="text" value="Chọn chương trình"/>	<p>* KHÓA HỌC</p> <input type="text" value="Chọn khóa học"/>
Chương trình Đào tạo Vận hành Cần cẩu 20...	
Kỹ thuật Vận hành Xe cầu Tự hành (UNIC U...	
Kỹ thuật vận hành cầu tự hành-V1	
Chương trình Đào tạo Vận hành Cần cẩu...	
Vận hành cần cẩu cơ bản K57	

\* NGÀY KẾT THÚC

15-02-2026

- d. No duplicated class code or class name
- e. Confirm the process by clicking Create / Tạo
- f. Any violation of the system rules shall cancel the process

### 3. Edit Class Details

- a. Click onto a target class in the table to view its details.

#	TÊN LỚP HỌC	MÃ LỚP HỌC	NGÀY BẮT ĐẦU	NGÀY KẾT THÚC	TRẠNG THÁI
1	Lớp điều khiển cần cẩu cơ bản K57-001	LK57-001	30-12-2025	02-02-2026	DANG DIỄN RA
2	Lop 1	Lop 1	27-12-2025	27-01-2026	CHUA MỞ

- b. In the class detail page, click Edit / Sửa



- c. Change the editable information (with blocked information printed gray)

**CHỈNH SỬA LỚP**

**THÔNG TIN CƠ BẢN**

\* TÊN LỚP HỌC  
Khóa học vận hành cầu tự hành K25-V001 38 / 120

MÃ LỚP HỌC  
K25-V001

**CHƯƠNG TRÌNH & KHÓA HỌC**

\* CHƯƠNG TRÌNH  
Kỹ thuật vận hành cầu tự hành-V1

\* KHÓA HỌC  
Ứng phó sự cố và Kết thúc công việc- V2 (Sơ cấp III)

**LỊCH TRÌNH & SỨC CHỨA**

\* NGÀY BẮT ĐẦU  
26-12-2025

\* NGÀY KẾT THÚC  
26-01-2026

\* SỨC CHỨA  
10

**HÌNH ẢNH**

d. Confirm the change by clicking Save / Cập nhật

33 / 500

X Hủy Cập nhật lớp học

#### 4. Manage Class Enrollments

**Thêm học viên vào lớp**

Search by name or email...					
<input type="checkbox"/>	Avatar	Họ và tên	Email	Điện thoại	Trạng thái
<input type="checkbox"/>		Nguyễn Văn An	annguyensiunhan@gmail.com	0901234567	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Phạm Thị Hương	huongphammientay@gmail.com	0987654321	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Phạm Tiến Dũng	dungphambentre@gmail.com	0905550101	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Trần Việt Hoàng	hoangtranfanj97@gmail.com	0905550303	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Trần Thanh Tân	hocketv@gmail.com	0901234567	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Đặng Thành Trung	cungquanghoctap@gmail.com	0902345678	<b>HOẠT ĐỘNG</b>
<input type="checkbox"/>		Lưu Trọng Nghĩa	gemininhavin@gmail.com	0901234567	<b>HOẠT ĐỘNG</b>

TOTAL 23 TRAINEES < 1 2 3 >

Select trainees to enroll Hủy + Đăng ký đã chọn (0)

## 5. Manage Class Instructor

**GIẢNG VIÊN**

Chọn giảng viên

**NGUYỄN ĐẠT**  
INS6WFFWR

Chưa có giảng viên được gán

## 6. Manage Class Timeslots (Schedule)

### THÊM BUỔI MỚI

\* TÊN BUỔI  
ví dụ: Buổi 1: Giới thiệu

\* THỜI GIAN BẮT ĐẦU      \* THỜI GIAN KẾT THÚC  
Chọn thời gian bắt đầu      Chọn thời gian kết thúc

\* TÒA NHÀ      \* PHÒNG  
Trung Tâm Dạy Xe Cầu Quận 9      P.218

\* CHI TIẾT ĐỊA ĐIỂM  
487A Đ. Lê Văn Việt, Tăng Nhơn Phú A, Quận 9, Thành phố Hồ Chí Minh, Vietnam

Cancel      OK

#### 7. Manage Class Final Exam

TÊN BÀI KIỂM TRA	THỜI LƯỢNG	TRỌNG SỐ	THỜI GIAN	HÀNH ĐỘNG
KIỂM TRA BIỂU ĐỒ TẢI TRONG- V1	25 min	30%	27-12-2025 08:00:00	
DI CHUYỂN HÀNG HÓA	15 min	20%	30-12-2025 08:00:00	
NỘI DUNG BÀI THI	THỜI LƯỢNG	TRỌNG SỐ	THỜI GIAN	HÀNH ĐỘNG
DANH SÁCH KIỂM TRA THỰC HÀNH (2 MỤC)	45 min	50%	31-12-2025 08:00:00	

## 8. View issued certificates (for class completion)

HỌC VIÊN	NGÀY CẤP	MÃ CHỨNG CHỈ
Chưa có chứng chỉ nào được cấp.		

### 3.3.5 Feature 4: Learning Content Management

Purpose: Create assessments to evaluate trainee knowledge and understanding

Available Functions:

1. Create Quiz (Tạo bài kiểm tra)
2. Import Quiz (Nhập file bài kiểm tra)
  - a. Click Import / Nhập Bài kiểm tra button on the task bar

- b. The import file should follow system provided format (you can download the template to see detail)

	Question Name	Score	Is Multiple	Description	Option Name	Is Correct	Explanation
1	What must the operator check before operating the crane?	2.5	FALSE	Safety Check	Check engine oil, coolant, tires, and brake system.	TRUE	Mandatory safety procedure.
2	What must the operator check before operating the crane?	2.5	FALSE	Safety Check	Just check if the key is present.	FALSE	Incorrect and dangerous.
3	When deploying outriggers, which requirement is correct?	2.5	FALSE	Crane Technique	Fully extend outriggers and use pads on soft ground.	TRUE	Ensures maximum stability.
4	When deploying outriggers, which requirement is correct?	2.5	FALSE	Crane Technique	Extend outriggers halfway to save space.	FALSE	Risk of tipping over.
5	Hand signal: Arm extended, palm down, moving hand horizontally means?	2.5	FALSE	Hand Signals	Emergency Stop.	TRUE	Standard ISO signal.
6	Hand signal: Arm extended, palm down, moving hand horizontally means?	2.5	FALSE	Hand Signals	Raise the boom.	FALSE	Incorrect signal.
7	Which action is STRICTLY PROHIBITED when operating a crane?	2.5	FALSE	Safety Rules	Using the crane hook/bucket to lift people.	TRUE	Strictly forbidden by safety regulations.
8	Which action is STRICTLY PROHIBITED when operating a crane?	2.5	FALSE	Safety Rules	Operating at night with proper lighting.	FALSE	Allowed if visibility is good.
9							
10							
11							
12							
13							
14							
15							
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27							
28							
29							
30							
31							

### 3. Edit Quiz (Sửa Bài kiểm tra)

- Click Edit / Sửa on a specific quiz in the table
- Change the quiz content which includes questions and answers
- Confirm the change by clicking Save / Lưu

- d. Any violation of the system rules will make this progress cancelled.

#### 4. Delete Quiz (Xóa Bài kiểm tra)

- Click Delete / Xóa button on a specific quiz in the table
- Confirm deletion
- Any violation of the system rules shall block this progress

#### 5. Create Learning Material (Tạo Tài liệu học tập)

- Navigate to Material Management / Quản lý tài liệu (Admin role)

- Click Create / Thêm Tài liệu on the task bar in the top of the page

- Fill details for the new learning material.

**+ TÀI LIỆU MỚI**

**TÊN TÀI LIỆU**  
VD: Hướng dẫn an toàn 2024

**MÔ TẢ (optional)**  
Mô tả ngắn về tài liệu...

**LOẠI NỘI DUNG** **NGUỒN**

Tài liệu Liên kết ngoài

**ĐỊA CHỈ URL**  
<https://example.com/resource>

**Hủy** **Tạo mới**

- d. For material source, there are two options, which are Link / File

**LOẠI NỘI DUNG** **NGUỒN**

Tài liệu Tải file lên



**LOẠI NỘI DUNG** **NGUỒN**

Tài liệu Liên kết ngoài

**ĐỊA CHỈ URL**  
<https://example.com/resource>

- e. Confirm the creating by clicking Save / Tạo mới  
f. Any violation of the system rules shall cancel this process.

## 6. Edit Learning Material (Sửa Tài liệu học tập)

- a. Click Edit icon on a specific learning material in the table.

TÊN	LOẠI	TRUY CẬP	HÀNH ĐỘNG
Furukawa UNIC UR-V Series Specifications. Đây là trang chủ của UNIC toàn cầu...	TÀI LIỆU	Truy cập	

- b. A editable screen shall display after the previous step. You can now change the material details such as name, description, type and source.

- c. There are two available types: Video and PDF (Đoạn ghi hình và tài liệu đọc)

- d. There are two available sources: Link and File (Đường dẫn và tài liệu gốc)  
e. Confirm the process by clicking Save / Cập nhật  
f. Any violation of the system rules shall cancel the process.

## 7. Delete Learning Material (Xóa Tài liệu học tập)

- a. Click Delete icon on a specific learning material in the table.

TÊN	LOẠI	TRUY CẬP	HÀNH ĐỘNG
Furukawa UNIC UR-V Series Specifications. Đây là trang chủ của UNIC toàn cầu,...	TÀI LIỆU	Truy cập	Xóa

- b. Confirm the deletion by clicking Delete / Xóa or cancel the deletion by clicking Cancel / Hủy

- c. Any violation of the system rules shall cancel the process

### 3.3.6 Feature 5: Simulation Practice

#### 1. Download file exe

- Navigate to Simulation page by selecting Simulation / Mô phỏng in the web task bar.

- The simulation engine provided by the center shall be listed in the simulation page

- Read all the details about hardware requirements and implementation guide.

BƯỚC 1  
**CÀI ĐẶT ỨNG DỤNG**



- Downloading the File: Click the "Tải Mô phỏng" (Download Simulator) button to download the .exe installer.
- Connection Stability: Ensure you have a stable internet connection (at least 100 Mbps recommended) throughout the download process to avoid file corruption.



- Download Failure: If the download fails or the file does not open, delete the partial file and restart the download from the beginning.
- There is a contact information for troubleshooting or feedback about the engine at the bottom of the page.

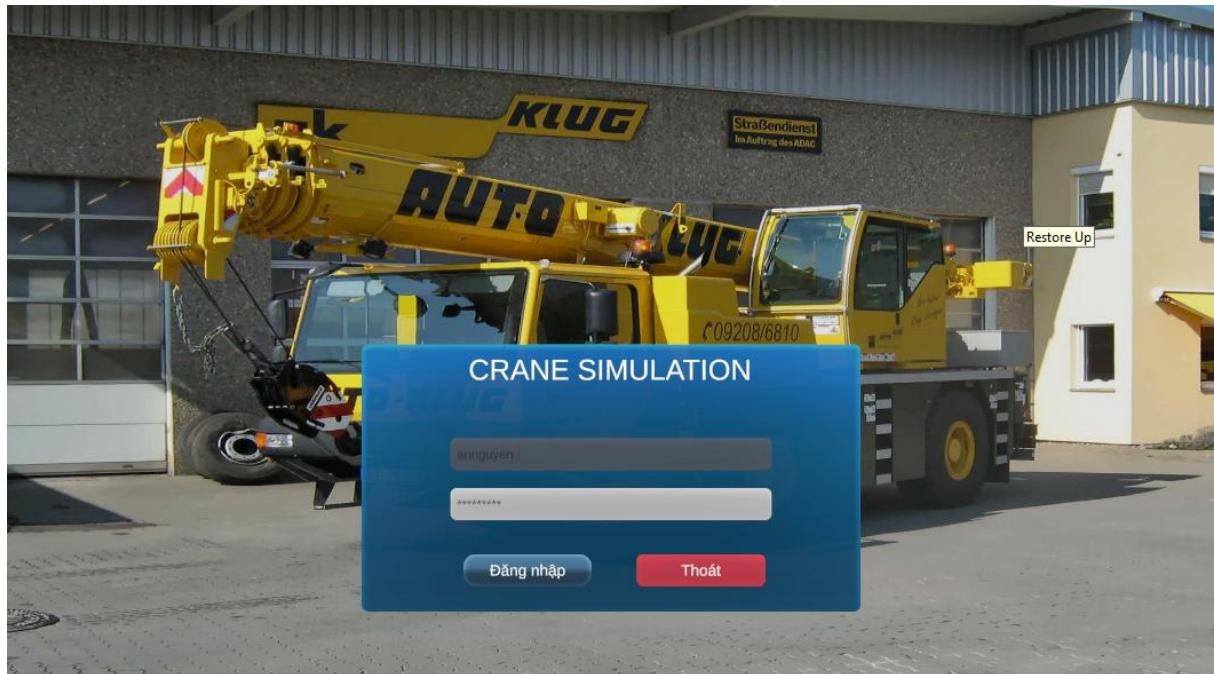
Gặp vấn đề cài đặt? Gửi email [NHATDMSE182236@FPT.EDU.VN](mailto:NHATDMSE182236@FPT.EDU.VN)

## 2. Open CraneSimulator.exe file

- Security Warnings: When launching the application, your operating system (Windows) may display a security alert such as "Windows protected your PC" or "Unknown Publisher." \* Action: Click "More info" and select "Run anyway" to bypass the warning.

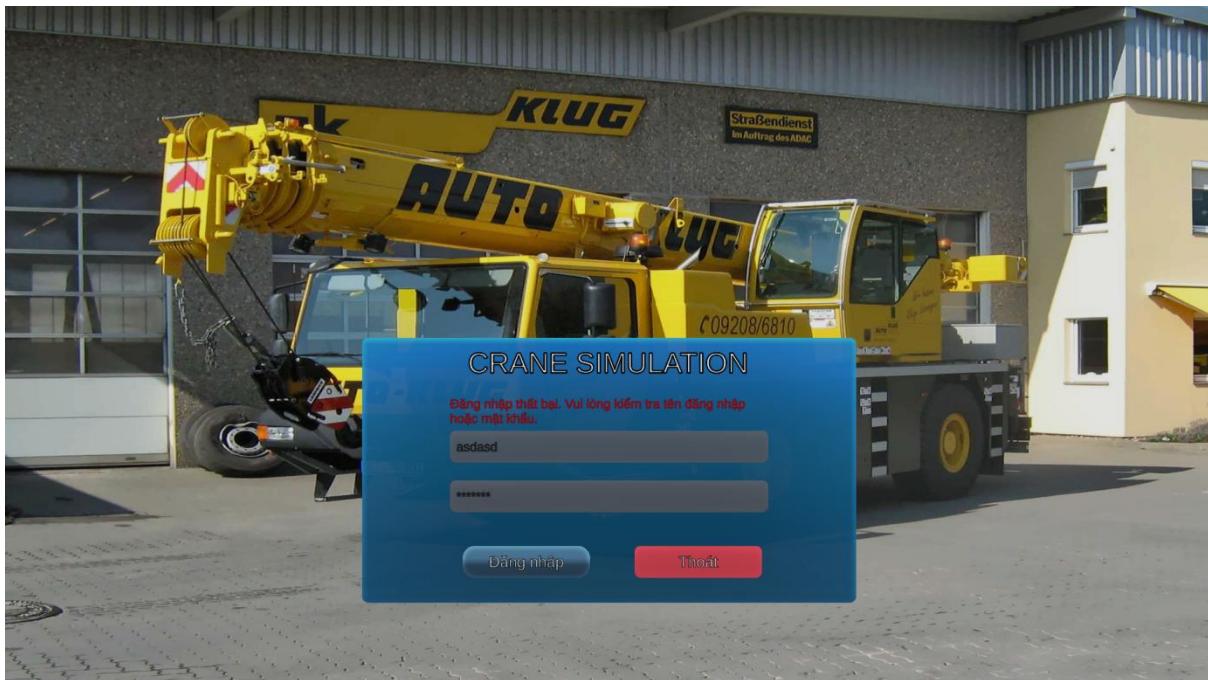
Name	Date modified	Type	Size
CraneSimulator_BurstDebugInformation...	12/19/2025 9:08 PM	File folder	
CraneSimulator_Data	12/19/2025 9:08 PM	File folder	
D3D12	12/19/2025 9:08 PM	File folder	
MonoBleedingEdge	12/19/2025 9:08 PM	File folder	
CraneSimulator.exe	12/18/2025 5:37 AM	Application	657 KB
UnityCrashHandler64.exe	12/18/2025 5:37 AM	Application	1,496 KB
UnityPlayer.dll	12/18/2025 5:37 AM	Application extens...	32,888 KB

### 3. Login with username and password of an active trainee account



Login problems:

- If the login fails, please try to login again in website to make sure the credentials are correct
- In case you do not remember your login information, use your assigned email to renew the credentials in student portal website.
- Contact center hotline number or email to gain better help.



#### 4. Select practice mode.

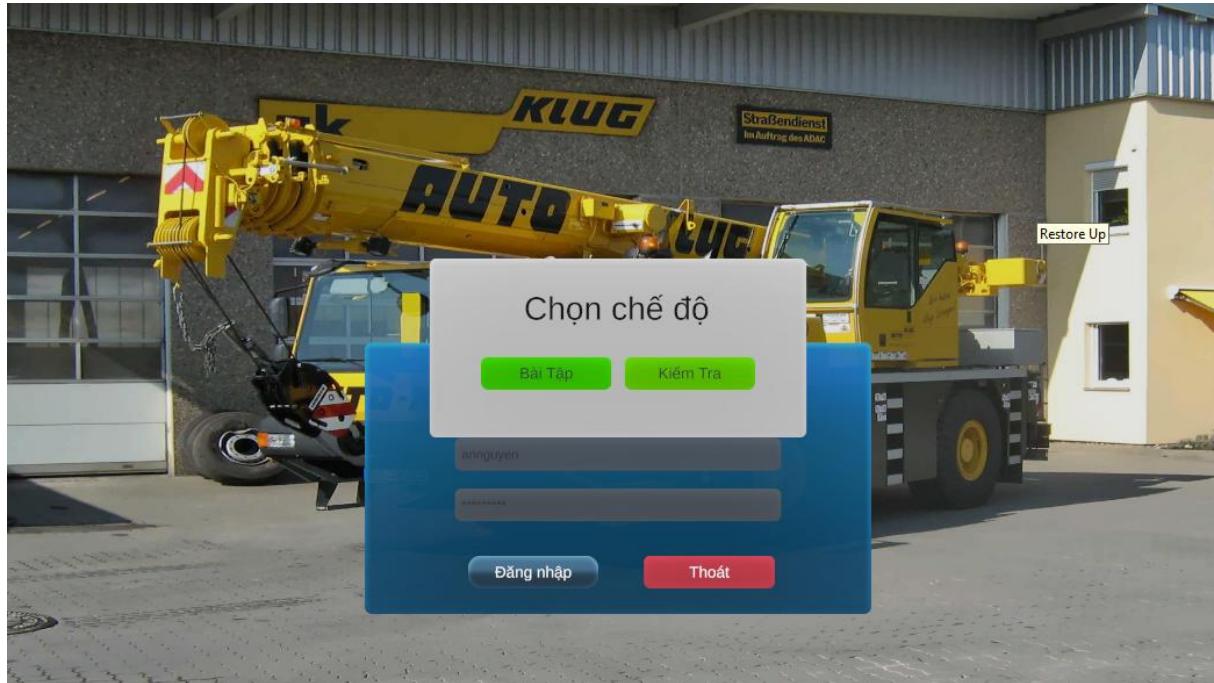
- Once logged into the LSSCTC Simulator, you will be presented with two distinct modes. The availability of these modes depends on your current enrollment status and the permissions granted by your Instructor.

##### 4.1. "Bài Tập" (Practice) Mode

- 
- Purpose:** To allow trainees to familiarize themselves with the crane controls without the pressure of a final score.
- Accessibility: This mode is usually unlocked automatically once you are assigned to a class.
- Repetition: You can restart this mode as many times as needed to perfect your practice.

##### 4.1. "Kiểm Tra" (Exam) Mode

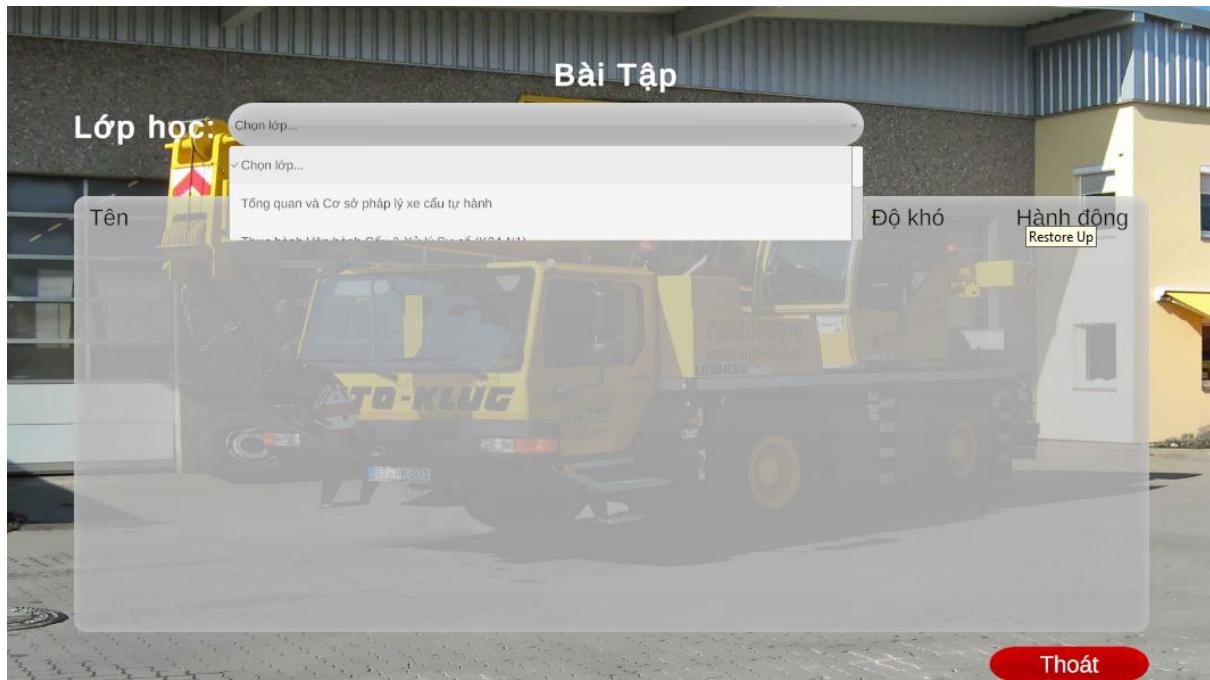
- Access Requirements:
  - Instructor Activation: This mode will only be visible if an Instructor or Admin has scheduled and activated an exam for your specific class.
  - Access Code (Security): To enter the exam, you must provide a unique Access Code. This code is provided only by your Instructor or the Program Manager at the beginning of the testing session.
- Limit Attempt: Unlike Practice Mode, Exam Mode may limit the number of attempts you can make, and your performance metrics (score and time) are sent directly to the Instructor's dashboard.
- Technical Safety: Ensure you have a stable connection before starting; if the application crashes or you lose internet, you must immediately contact your Instructor to reset your session.



##### 5. Select Class.

After choosing your desired mode (Practice or Exam), you must specify the training group you are participating in to ensure your progress is recorded correctly.

- Class Selection Logic: The system will display a dropdown list of Classes that you are currently enrolled in.
- Enrollment Requirement: A class will only appear in this list if your Enrollment has been officially Approved by the Admin or Instructor.
- Course Coordination: Each class is tied to a specific Training Program or Course; ensure you select the one corresponding to your current curriculum.



#### 6. Select practice to start.

After selecting the correct class, the system will display the list of available simulation scenarios assigned to that specific group. This step ensures you are entering the correct training environment for your current module.



#### 7. Read practice guide before doing the practice.

Once you select a scenario, a Practice Guide overlay will appear. This is a critical preparation phase—do not skip it, as it contains the specific rules for the simulation environment.

##### 7.1 Key Information to Review

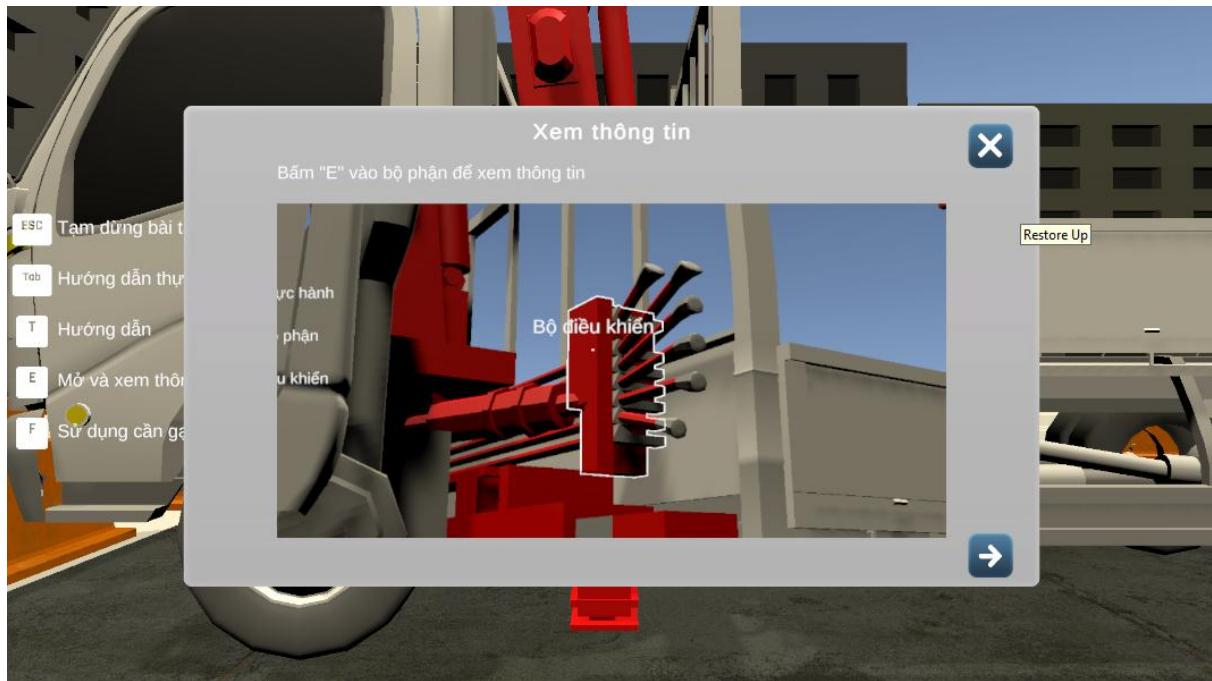
- Operational Objectives: Understand the exact start and end points of the cargo (e.g., from the ground to the truck bed).
- Safety Constraints: Review the "ZigZac" path requirements; the system will not count progress if you deviate from this specific path.
- Penalty Rules: Be aware that every time the cargo or hook touches a pole, your score will be automatically reduced by 0.5 points.

## 7.2 Understanding Phase Transitions

- Phase 1: Focuses on navigating the obstacle course (the ZigZac poles).
- Phase 2: Activates only after Phase 1 is completed successfully; the target text will change, signaling you to move the cargo to the final drop-off point (the truck).

## 7.3 Operational Tips

- Lever Identification: Use the guide to familiarize yourself with which levers control the boom, the winch, and the rotation before you engage them with the "F" key.
- Visual Cues: Look for "Target Point" in the 3D world which indicate where the cargo needs to be positioned next.



## 8. Important key when doing practice.

Operating the crane simulator requires precise coordination between keyboard inputs and visual cues. Familiarize yourself with these essential controls before engaging the crane components.



## 9. Lever Identification and Focus.

Before engaging the crane, you must identify which control component you wish to operate. The simulator uses a proximity-based "Focus" system to prevent accidental movements.

- First-Person Interaction: Use your mouse to look around the crane cabin or control station.
- Visual Hover: Move your crosshair (reticle) directly over a specific crane lever.
- Name Recognition: Wait for the Lever Name to appear on your screen (e.g., "Main Hoist," "Boom Luffing," or "Swing Control").
- Contextual Awareness: Different levers correspond to different 3D components of the crane; always verify the lever name matches your intended action before pressing the interaction key.



10. Press "F" to the lever to control the Crane with Corresponding components.

Once the name of the lever is visible, you are ready to begin the operation.

- Engage: Press the "F" key to lock your focus onto that specific lever
- Dynamic Controls: As soon as you engage a lever, the Hint Keys at the bottom right will update to show you the movement controls for that specific part of the crane (e.g., Forward/Backward or Left/Right).
- Switching Controls: To move to a different lever, press "F" again to release the current one, then repeat the hover process for the next control.



11. Hints.

- Control Labels: Use the hint key display on the bottom right of your screen as a constant reference for operating the crane's components.
- Real-time Guidance: These hint keys will change dynamically based on which lever you have selected, helping you move the crane accurately toward the target cargo.



## 12. Operating the Crane Using Dynamic Hints

The simulator provides real-time guidance to help you master the crane's complex movements. The hint system ensures you always know which keys correspond to your current lever selection.

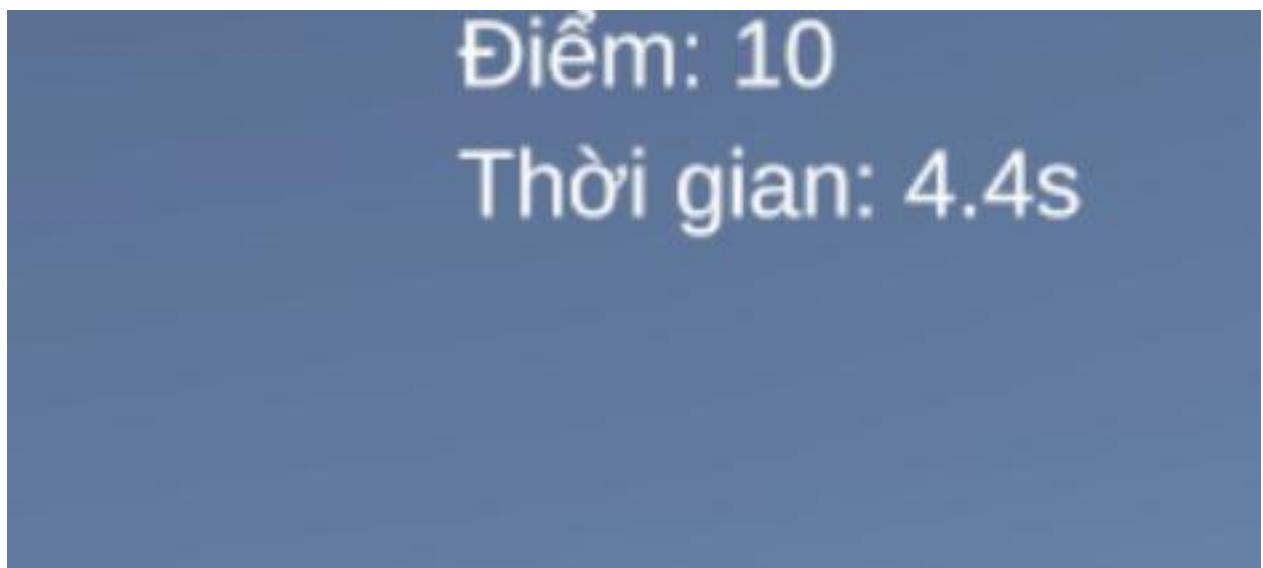
- Dynamic Mapping: Once you have engaged a lever with the "F" key, look at the bottom right corner of your screen.
- Contextual Control: The hint panel will update instantly to show you the specific keys (e.g., Arrow Keys or W/A/S/D) required to move the current component (Boom, Swing, or Hoist).
- Precision Movement:
  - Tap vs. Hold: For fine adjustments when approaching a target, tap the keys lightly.
  - Coordinated Control: While only one lever is controlled at a time, you must sequence your movements (lifting, then swinging, then luffing) to maintain a smooth path.



### 13. Monitoring Performance Metrics.

As you use the hint keys to move the crane, stay aware of your operational status:

- Score and Timer: These are visible at the top right of the screen.
- Penalty Awareness: Remember that jerky movements or over-swinging can lead to collisions with the ZigZac poles, resulting in a 0.5 point deduction per hit.



14. Move the crane to the target cargo.

- Identify Destination: Use the camera to locate the Target Cargo in the simulation area.
- Approach: Move the crane steadily until the hook block is centered over the load, preparing for the attachment phase.



15. Press "B" to attach the cargo to the hook block.

- Attachment Protocol: Lower the hook block until it is within the attachment radius of the cargo.
- Locking: Press "B" to secure the cargo to the hook.



16.Lift the cargo up and doing the practice.

Once the cargo is securely attached using the "B" key, you must perform a controlled lift to begin the maneuver.

- Vertical Control: Use the Hoist/Winch lever to lift the cargo vertically.
- Safety Clearance: Lift the cargo to a height that clears ground obstacles but remains low enough to maintain a low center of gravity.
- Swing Dampening: Wait for any initial pendulum swing to settle before starting horizontal movement to avoid immediate collisions with the first set of poles.
- Telemetry Monitoring: Check the top right of the screen to ensure the weight load is balanced and the timer has officially started for the practice session.



17. Move the Cargo to the target point.

The ZigZac practice is divided into two distinct phases. You must complete the objective of Phase 1 before the system will allow you to proceed to Phase 2.

#### 17.1. “Zigzag” practice target.

“Zigzag” practice phase 1 target.

- Primary Goal: You must navigate the suspended cargo through the pole course following the designated zigzag trajectory.
- Path Accuracy: The cargo must stay within the zigzag boundary; if you skip a section of the path, the maneuver will not be counted as valid.
- Landing Zone: Phase 1 concludes when you move the cargo to the first target point and lower it to the designated surface.
- Collision Monitoring: Throughout this phase, ensure the cargo does not touch the poles, as each contact results in a 0.5 point deduction from your score.



“Zigzag” practice phase 2 target.

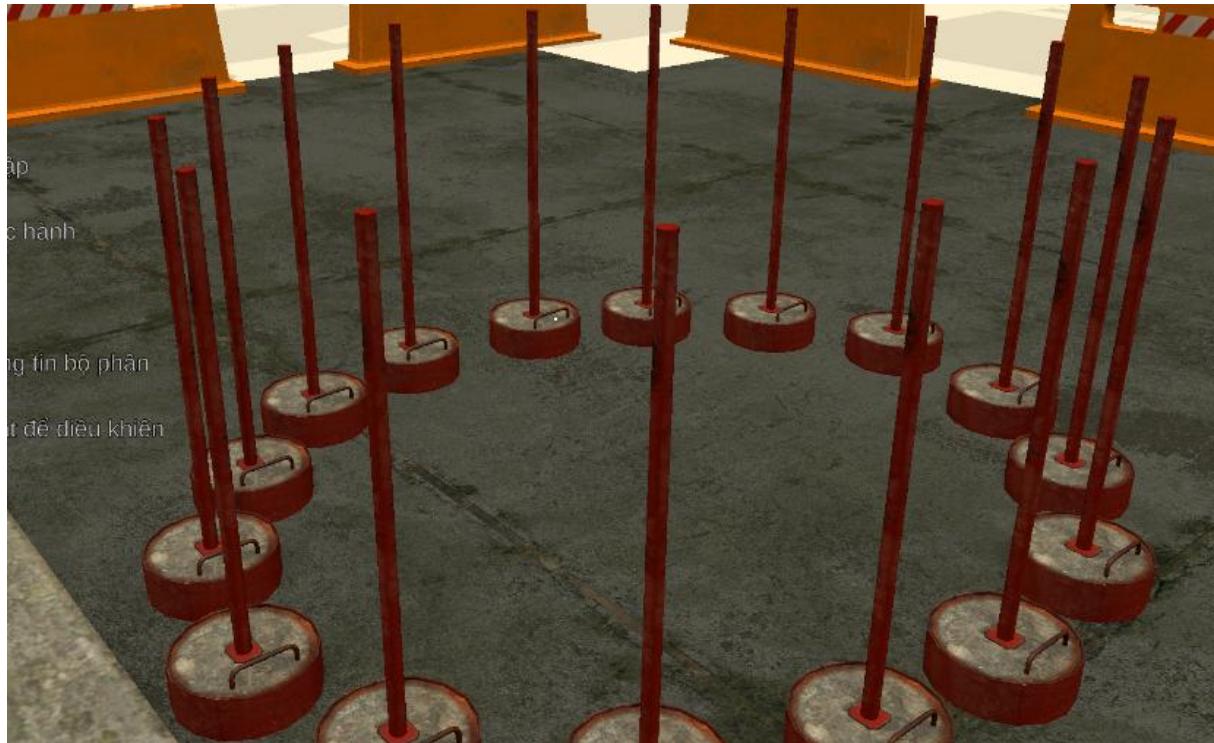
- Transition: Once Phase 1 is completed, the objective text on your screen will update, signaling the start of Phase 2.
- Primary Goal: Move the cargo from the Phase 1 landing zone to the back of the transport truck (Target 2).
- Precision Control: Carefully align the cargo over the truck bed using the hint keys to coordinate swing and boom movements.
- Completion: Lower the cargo onto the truck bed before opening the menu to submit your results.



17.2. Cargo positioning practice target.

This scenario focuses exclusively on your ability to perform precise vertical and horizontal adjustments to center a load.

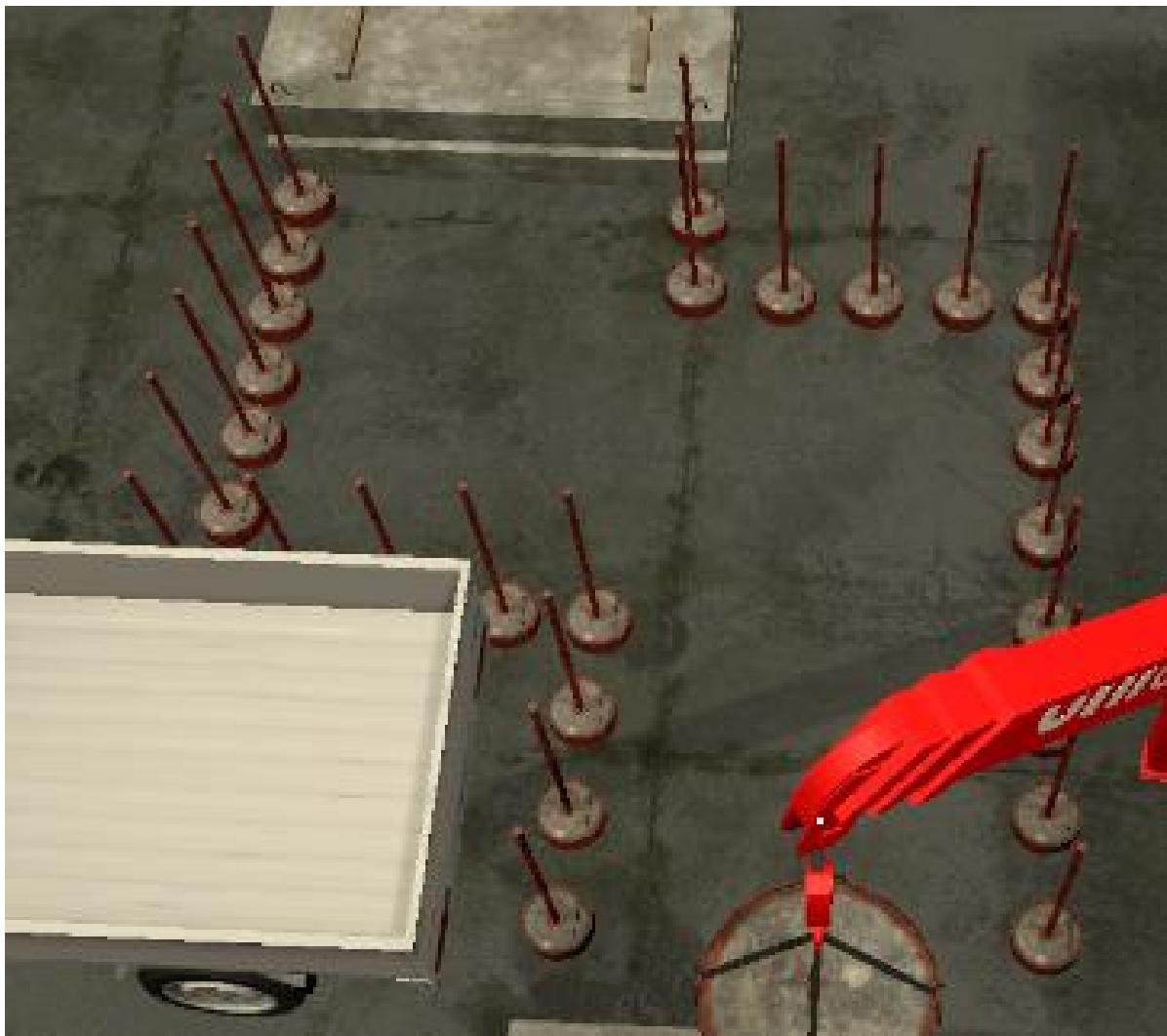
- Primary Goal: Move the cargo from its starting position and land it directly in the center of the target circle.
- Accuracy Metrics: The system calculates your final score based on how close the center of the cargo is to the center point of the circle.
- Vertical Control: Use the Hoist/Winch lever to ensure the cargo does not sway as you lower it toward the ground.



18. The path must be in the zigzag, if it's not it won't be counted.

The simulator is programmed with a strict path-tracking algorithm. To pass the evaluation, you must adhere to the designated route.

- Non-Negotiable Trajectory: The cargo must pass between every set of poles in the specific "ZigZac" sequence.
- Checkpoint System: The system utilizes invisible checkpoints; if you attempt to "shortcut" the course by bypassing a pole, the maneuver will not be recognized, and the task will not be marked as complete.
- Validation Logic: Progress is only recorded when the cargo centers through each gap; failing to follow the sequence means the final phase will not trigger.



## 19. Precision Handling and Penalty System

Safety is the highest priority in crane operation. The simulator enforces this through a real-time scoring deduction system.

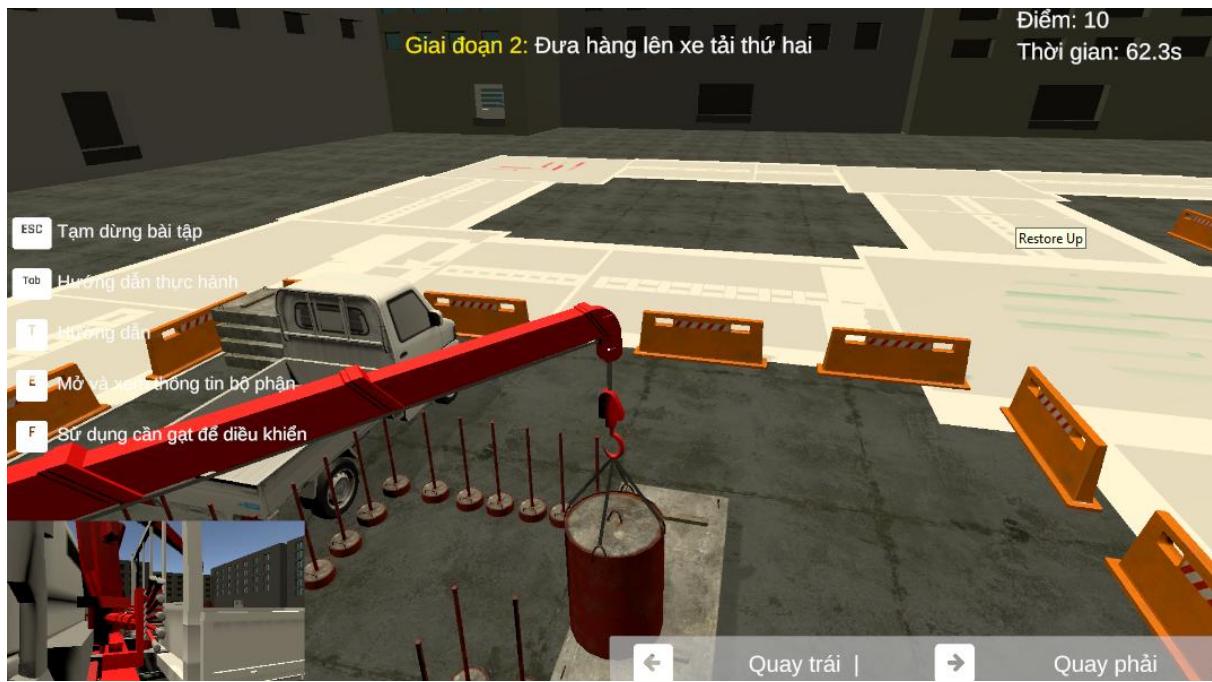
- Collision Detection: The physics engine detects any contact between the cargo, the hook block, or the crane's boom and the boundary poles.
- Scoring Penalties: Each instance of contact results in an immediate -0.5 point deduction from your total performance score.
- Swing Control: You must manage the "pendulum effect" by making small, counter-movements with the levers; excessive cargo swaying is the primary cause of pole collisions.
- Monitoring: Keep a constant eye on the top-right HUD to track your current score during the maneuver.



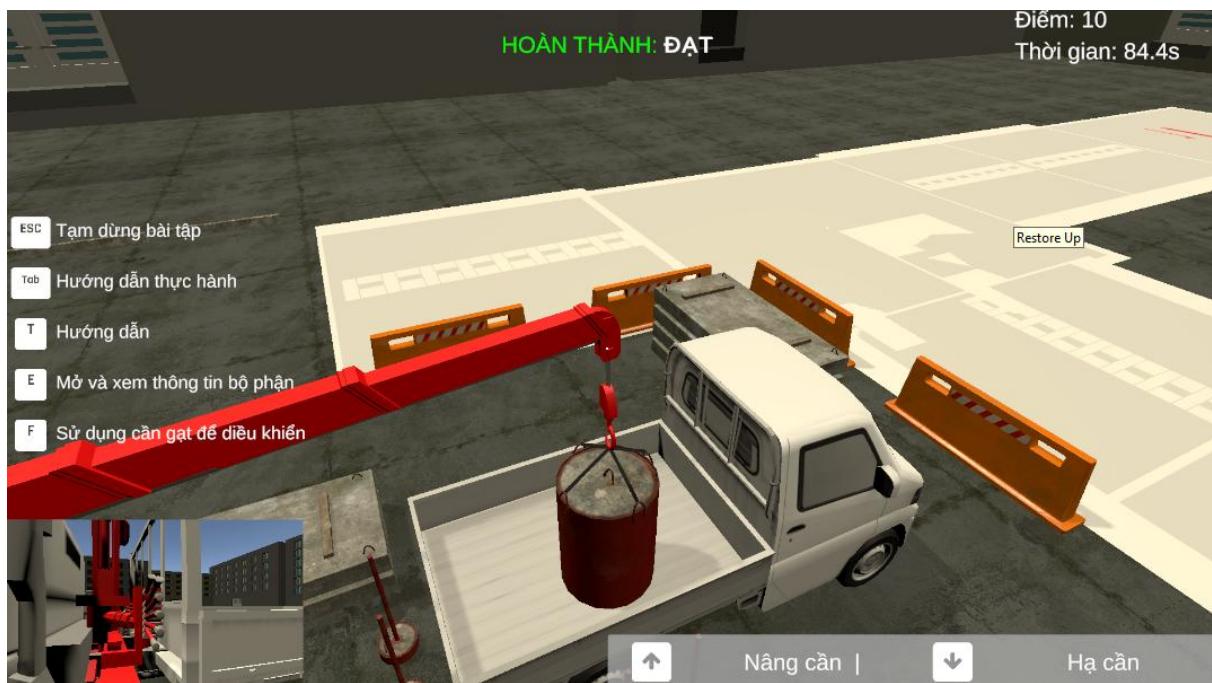
20. Objective Transition: Phase 1 to Phase 2.

The simulator provides clear visual and textual feedback when a major milestone is reached.

- State Change: Once the cargo successfully clears the final "ZigZac" checkpoint, the system will automatically transition to Phase 2.
- Visual Notification: The instruction text on your screen will update to reflect the new objective.

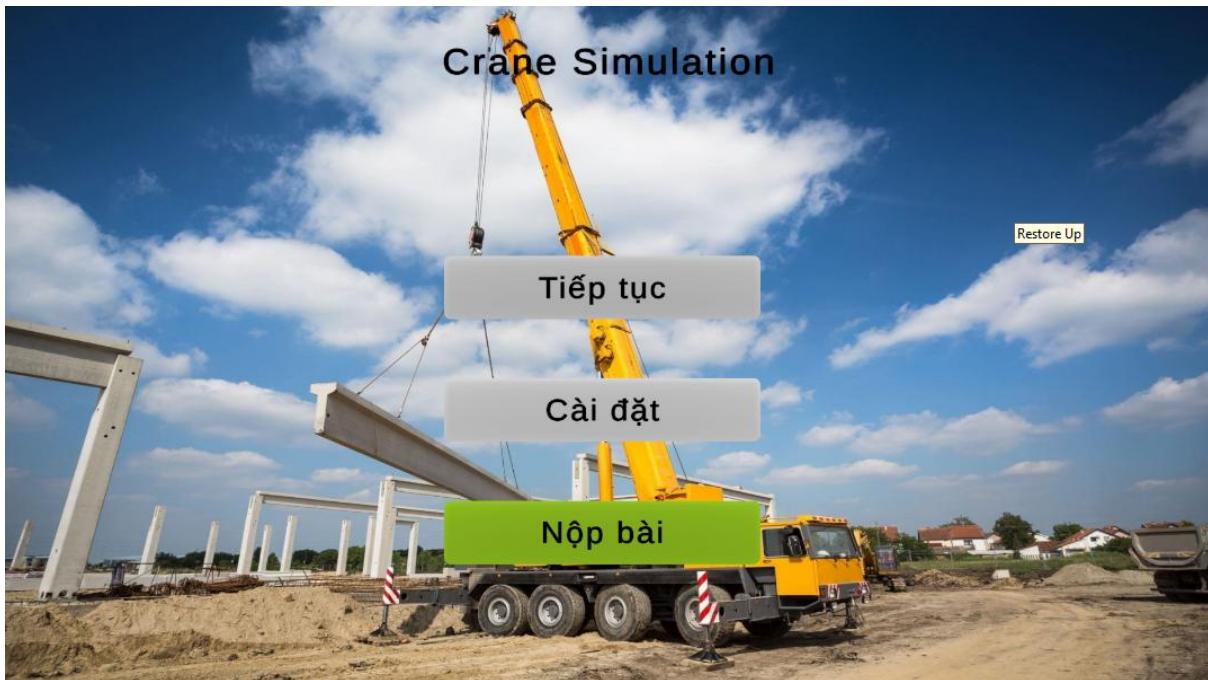


21. Move the cargo to the back of the truck to finish the practice.



22. Final Review and Process Completion.

- Opening the Menu: After placing the cargo, press "ESC" on your keyboard to pause the simulation and open the settings/submission menu.
- Submission ("Nộp bài"): Click the "Nộp bài" button to finalize your attempt and transmit your score, time, and penalty data to the instructor's dashboard.



### 3.3.7 Feature 6: Simulation Management

**Overview:** This feature is the control center for the simulation ecosystem. It allows the **Simulation Manager** to configure physics parameters, manage 3D assets, and design training scenarios. These configurations directly synchronize with the Desktop Client to ensure accurate simulation behavior.

**Actor:** Simulation Manager **Pre-condition:** User must be logged in successfully with the Simulation Manager role.

#### Manage Brand Models (Quản lý Thương hiệu & Model)

- **Description:** Defines the technical specifications (physics profiles) of different crane models. The Unity Client uses these parameters to calculate real-time physics limits.
- **Trigger:** Select "**Thương hiệu và model**" (Brand Models) from the Sidebar.
- **URL:** /simulation-manager/brand-model

#### Usage Steps:

1. **View List:** The interface displays a table of registered crane models.
2. **Create New Model:**
  - Click the "**Tạo mới**" (Create) button on the top right.
  - **[Action]:** A drawer form appears.
  - Input the required fields:
    - **Tên Model** (Model Name): e.g., *SCC550A*.
    - **Tải trọng tối đa** (Max Lifting Capacity): e.g., *55 tons*.
    - **Bán kính tối đa** (Max Radius): e.g., *40m*.
  - Click "**Lưu**" (Save) or "**Xác nhận**" (Submit) to finish.
3. **Edit/Delete:** Click the "**Chỉnh sửa**" (Edit icon) or "**Xóa**" (Delete icon) on specific rows.

### Create New Brand Model (Tạo mới Thương hiệu & Model)

**Description:** Provides a drawer interface for Simulation Managers to register a new crane model identity (e.g., KATO, SANY) into the system. This establishes the brand profile before physical parameters are configured.

**Trigger:** Click the "Thêm mới" (Create) button (icon dấu cộng +) located at the top-right corner of the management table.

#### Usage Steps:

- [Action]:** A drawer form slides in from the right side of the screen titled "**THÊM MỚI THƯƠNG HIỆU**" (Create Brand Model).
- Input the required fields:**
  - Tên thương hiệu (Brand Name):**
    - Input:** Text field.
    - Validation:** Required, unique in the system (Duplicate Check).
    - Example:** "SANY SCC550A".
  - Mô tả (Description):**
    - Input:** Text Area.
    - Validation:** Optional, max 500 characters.
    - Example:** "Cẩu bánh xích 55 tấn - Model tiêu chuẩn 2024".
  - Trạng thái (Status):**
    - Input:** Toggle Switch.
    - Default:** Active (Hoạt động).
- Submission:** Click "**Lưu**" (Save) to submit the data to the server (POST /api/BrandModels).

#### System Logic (Backend Verification):

- Name Normalization:** The system automatically trims whitespace (e.g., " KATO ") before saving.

- **Integrity Check:** If the entered name already exists, the system returns a 400 Bad Request: "*Tên thương hiệu đã tồn tại*" (Brand name already exists).

X



## TẠO MẪU THƯƠNG HIỆU

### \* TÊN MẪU THƯƠNG HIỆU

Nhập tên mẫu thương hiệu

0 / 100

### MÔ TẢ

Nhập mô tả

0 / 500

### TRẠNG THÁI HOẠT ĐỘNG

Không hoạt động

Hủy

+ Tạo

## Edit Brand Model (Sửa mẫu thương hiệu)

**Description:** Allows authorized users to modify the details of an existing crane model. This function ensures that any updates to the brand identity (Name, Description) do not violate system integrity rules.

**Trigger:** Click the "**Chỉnh sửa**" (Edit - icon bút chì) button on a specific row in the Brand Model list.

### Usage Steps:

1. **[Action]:** The drawer form slides in from the right, titled "**CẬP NHẬT THƯƠNG HIỆU**" (Edit Brand Model).
2. **Data Population:** The form automatically pre-fills with the selected model's current information:
  - **Tên thương hiệu (Brand Name):** Displays current name (e.g., "SANY SCC550A").
  - **Mô tả (Description):** Displays current description.
  - **Trạng thái (Status):** Shows the current Active/Inactive switch state.
3. **Modification:** User updates the desired fields.
  - *Input:* Text field / Text Area / Switch.
  - *Validation:* Standard validation rules apply (Required, Max length).
4. **Submission:** Click "**Cập nhật**" (Save/Update) to commit changes to the server (PUT /api/BrandModels/{id}).

### System Logic (Backend Verification):

- **Existence Check:** The system verifies if the record exists and has not been deleted.
- **Self-Exclusion Duplicate Check:** The system checks if the new name exists in the database *excluding the current record itself*.
  - *Logic:* if (Name == NewName AND Id != CurrentId) -> Error.
  - *Purpose:* Allows the user to keep the same name while updating the description, but prevents renaming the model to a name that belongs to another brand.



## SỬA MẪU THƯƠNG HIỆU

\* TÊN MẪU THƯƠNG HIỆU

URV 340

7 / 100

### MÔ TẢ

A series of truck-mounted cranes with a maximum lifting capacity of 3,030 kg, designed for medium-duty trucks. Available in multiple models differentiated by boom sections and working radius, including URV 342, URV 343, URV 344, URV 345, and URV 346.

250 / 500

### TRẠNG THÁI HOẠT ĐỘNG

Hoạt động



Hủy

Cập nhật

Delete Brand Model (Xóa mẫu thương hiệu)

**Description:** Allows the removal of a crane model from the active system. This action is protected by strict dependency checks to prevent breaking simulation configurations.

**Trigger:** Click the "Xóa" (Delete - icon thùng rác) button on a specific row.

#### Usage Steps:

1. **[Action]:** A confirmation dialog appears asking the user to confirm the deletion.
2. **Confirmation:** Click "Xóa" (Confirm) to proceed.
3. **Result:** The record is removed from the table view.

#### System Logic (Critical Integrity Rule):

- **Dependency Check:** Before deletion, the backend scans the SimulationComponents table.
- **Blocking Rule:** If this Brand Model is currently linked to any Simulation Component (used in physics calculations), the system **BLOCKS** the deletion and returns an error: "*Cannot delete brand model that has simulation components.*".
- **Soft Delete:** If no dependencies exist, the system performs a "Soft Delete" (sets IsDeleted = true) to preserve historical data integrity.

### Manage Simulation Tasks (Quản lý Nhiệm vụ Mô phỏng)

**Description:** Allows the Simulation Manager to define a library of atomic tasks (objectives) such as "Lift Cargo", "Navigate Zigzag", or "Emergency Stop". These tasks serve as building blocks that are later assigned to specific Practice Sessions.

**Trigger:** Select "Nhiệm vụ thực hành" (Task Practice) from the Simulation Manager Sidebar.

#### View Task List (Xem Nhiệm vụ Mô Phỏng)

#### Usage Steps:

1. **Access:** The page loads the list of existing tasks via API GET /api/Tasks/paged.
2. **View Modes:** Users can toggle between **Table View** and **Card View** using the toggle button at the top right.
3. **Display Data:**
  - **Task Name:** Descriptive name (e.g., "Nâng hàng an toàn").
  - **Task Code:** Unique identifier (e.g., "TASK-001").
  - **Description:** Operational details.
  - **Expected Result:** The criterion for success (e.g., "Cargo placed within 5cm of target").

#	MÃ NHIỆM VỤ	TÊN NHIỆM VỤ	KẾT QUẢ MONG ĐỢI	THAO TÁC
1	TASK_UNKNOWN_2111	Task Test 18:13 PM 3/11/2025	Task Test 18:13 PM 3/11/2025	
2	TASK UNKNOWN_X	Task Test 18:15 PM 3/11/2025	Task Test 18:15 PM 3/11/2025	
3	TASK_UNKNOWN_A	Position the Crane	Crane correctly aligned and ground is stable.	
4	TASK_UNKNOWN_B	Deploy Outriggers	Outriggers fully extended with balanced load distribution.	
5	TASK_UNKNOWN_C	Place Packing Pads	Pads centered and stable.	
6	TASK_UNKNOWN_E	Measure Radius	Radius measured within ±0.2m.	
7	TASK_UNKNOWN_F	Check Load Chart	Capacity within safe limits.	

1-10 / 29 quản lý nhiệm vụ | < | 1 | 2 | 3 | > | 10 / page |

## Create New Task (Tạo mới Nhiệm vụ)

### Usage Steps:

- Trigger:** Click the "CREATE TASK" button (or icon +) at the top right.
- Action:** A drawer form slides in titled "CREATE NEW TASK".
- Input the required fields :**
  - Tên nhiệm vụ (Task Name):**
    - Validation:** Required, Max 100 chars.
  - Mã nhiệm vụ (Task Code):**
    - Validation:** Required, Max 50 chars, Must be unique.
    - Example:** "LIFT-OP-01".
  - Mô tả (Description):**
    - Validation:** Optional, Max 500 chars.
  - Kết quả mong đợi (Expected Result):**
    - Validation:** Optional, Max 100 chars.
- Submission:** Click "Create" (Tạo ) to submit to POST /api/Tasks.

### System Logic (Backend Verification - TasksService.cs):

- Uniqueness Check:** The system verifies if TaskCode already exists (case-insensitive). If duplicated, it throws an error: "Task code '{code}' already exists."
- Data Cleaning:** Automatically trims whitespace from all text inputs.

  **TẠO NHIỆM VỤ**

**\* TÊN NHIỆM VỤ**

Nhập tên nhiệm vụ

0 / 100

**\* MÃ NHIỆM VỤ**

Nhập mã nhiệm vụ

0 / 50

**MÔ TẢ NHIỆM VỤ**

Nhập mô tả nhiệm vụ

0 / 500

**KẾT QUẢ MONG ĐỢI**

Nhập kết quả mong đợi

0 / 150

Hủy

+ Tạo

**Edit Task (Cập nhật Nhiệm vụ)**

**Usage Steps:**

- Trigger:** Click the "Edit" (Pencil icon) on a task card or table row.
- Action:** The drawer opens with title "EDIT TASK", pre-filled with current data.

3. **Modification:** Update fields as needed. Note that TaskCode can be changed but must remain unique across the system.
4. **Submission:** Click "**Update**" to save changes (PUT /api/Tasks/{id}).

**Business Rules:**

- **Self-Exclusion Check:** When checking for duplicate TaskCode, the system ignores the current task being edited.

  **SỬA NHIỆM VỤ**

\* TÊN NHIỆM VỤ

Deploy Outriggers

17 / 100

\* MÃ NHIỆM VỤ

TASK\_UNKNOWN\_B

14 / 50

MÔ TẢ NHIỆM VỤ

Extend outriggers evenly and lower them to ensure chassis stability.

68 / 500

KẾT QUẢ MONG ĐỢI

Outriggers fully extended with balanced load distribution.

58 / 150

Hủy

 Cập nhật

## Delete Task (Xóa Nhiệm vụ)

### Usage Steps:

1. **Trigger:** Click the "Delete" (Trash icon) on a task.
2. **Confirmation:** A modal appears: "Are you sure you want to delete {taskName}?".
3. **Action:** Click "Delete" to confirm.

### System Logic (Critical Integrity Rule):

- **Dependency Block:** The backend (TasksService.cs) checks if this Task is currently assigned to any Practice Scenario (PracticeTasks table).
- **Rule:** If the task is in use, the system **BLOCKS** the deletion and returns an error: "Cannot delete a task associated with one or more practices."
- **Soft Delete:** If safe to delete, the system sets IsDeleted = true.

## Manage Simulation Practices (Quản lý Bài Thực hành Mô phỏng)

**Description:** Allows Simulation Managers to define complete practice scenarios by combining metadata (Duration, Difficulty) with specific operational tasks. These practices are the core content assigned to trainees for simulation training.

**Trigger:** Select "Bài thực hành" (Practices) from the Simulation Manager Sidebar.

**URL:** /simulation-manager/practices

### View Practice List

### Usage Steps:

1. **Access:** Upon loading the page, the system automatically fetches the list of existing practices.
2. **Display Data:** The table displays the following information:
  - **Mã bài thực hành (Practice Code):** Unique identifier for the scenario (e.g., "PRAC-001").
  - **Tên bài thực hành (Practice Name):** The descriptive title of the practice (e.g., "Vận hành cầu cơ bản").
  - **Thời lượng (Duration):** Estimated time required to complete the practice (in minutes).
  - **Độ khó (Difficulty):** The skill level required, visualized by color-coded badges:
    - *Entry* (Easy/Green)
    - *Intermediate* (Medium/Yellow)
    - *Advanced* (Hard/Red)
  - **Số lần thử (Max Attempts):** The maximum number of retries allowed for a trainee.
  - **Trạng thái (Status):** Indicates availability (*Active* / *Inactive*).

3. **Actions:** Users can click the **Edit icon** (Eye/Pencil) to view details or the **Delete icon** (Trash bin) to remove a practice.

#	MÃ BÀI THỰC HÀNH	TÊN BÀI THỰC HÀNH	THỜI LƯỢNG (PHÚT)	ĐỘ KHÓ	SỐ LẦN THỬ TỐI ĐA	TRẠNG THÁI	HÀNH ĐỘNG
1	PRACTICE_03	OUTRIGGER DEPLOYMENT DRILL	60	ENTRY	5	KHÔNG HOẠT ĐỘNG	
2	PRACTICE_04	LOAD RADIUS PRACTICAL	60	ENTRY	5	KHÔNG HOẠT ĐỘNG	
3	PRACTICE_05	CRANE OPERATION	150	ENTRY	5	KHÔNG HOẠT ĐỘNG	
4	PRACTICE_06	STANDARD SIGNALS ROLEPLAY	45	ENTRY	5	KHÔNG HOẠT ĐỘNG	
5	PRACTICE_07	EMERGENCY RESPONSE SIMULATION	60	ENTRY	5	KHÔNG HOẠT ĐỘNG	
6	PRACTICE_08	WATERFALL DRAKE	60	ENTRY	5	KHÔNG HOẠT ĐỘNG	

1-10 / 10 bài thực hành mô phỏng

### Create New Practice (Tạo mới Bài thực hành)

#### Usage Steps:

- Trigger:** Click the "**Tạo mới**" (Create) button (icon +) at the top-right corner of the page.
- [Action]:** The system navigates to the Create Practice form (/practices/create).
- Input the required fields :**
  - **Tên bài thực hành (Practice Name):**
    - *Input:* Text field.
    - *Validation:* Required, max 200 characters.
  - **Mã bài thực hành (Practice Code):**
    - *Input:* Text field.
    - *Validation:* Required, max 50 characters, must be uppercase and unique.
  - **Mô tả (Description):**
    - *Input:* Text Area.
    - *Validation:* Optional, max 1000 characters.
  - **Thời lượng (Duration):**
    - *Input:* Number field.
    - *Unit:* Minutes.
  - **Độ khó (Difficulty):**
    - *Input:* Dropdown menu.
    - *Options:* Entry, Intermediate, Advanced.
  - **Số lần thử (Max Attempts):**
    - *Input:* Number field.
    - *Constraint:* Must be between 1 and 10.
  - **Trạng thái (Active):**
    - *Input:* Toggle Switch.

- *Default:* Active (On).
- 4. **Submission:** Click "Tạo bài thực hành" (Save) to submit the data.

### System Logic:

- **Duplicate Check:** The system verifies if the PracticeCode already exists in the database. If a duplicate is found, it returns an error: "*Practice code already exists.*"

### Edit Practice & Manage Tasks (Cập nhật & Gán Nhiệm vụ)

**Description:** This interface allows updating practice metadata and assigning specific operational tasks (from the Task Library) to the practice.

**Trigger:** Click the "Chi tiết" (View/Edit) button on a specific row in the list.

### Usage Steps:

#### A. Edit General Information:

1. Modify the fields in the "**Thông tin cơ bản**" (Basic Information) section.
2. Click "**Lưu thay đổi**" (Save Changes) to update the metadata.

#### B. Assign Tasks (Task Configuration):

1. **Trigger:** Scroll to the "**Danh sách nhiệm vụ**" (Task List) section and click "**Thêm nhiệm vụ**" (Add Task / Assign Task).
2. **Selection:** A modal appears listing available tasks from the library.
3. **Action:** Check the boxes next to the desired tasks (e.g., "Nâng hàng", "Di chuyển zig-zag").

- Note: Tasks already assigned to this practice are hidden or disabled to prevent duplicates.
4. **Confirm:** Click "Gán" (Assign) to link the selected tasks to the practice.  
5. **Remove Task:** To unassign a task, click the **Delete icon** on the specific task row within the list.

## CẬP NHẬT BÀI THỰC HÀNH

\* TÊN BÀI THỰC HÀNH  
Outrigger Deployment Drill 26 / 200

MÃ BÀI THỰC HÀNH  
PRACTICE\_03 11 / 50

MÔ TẢ  
Set, level, and pack outriggers for varied ground conditions. 61 / 1000

THỜI GIAN ƯỚC TÍNH (PHÚT) \* ĐỘ KHÓ  
60 Cơ bản

SỐ LẦN THỬ TỐI ĐA TRẠNG THÁI  
5 Không hoạt động

Hủy ✓ Sửa

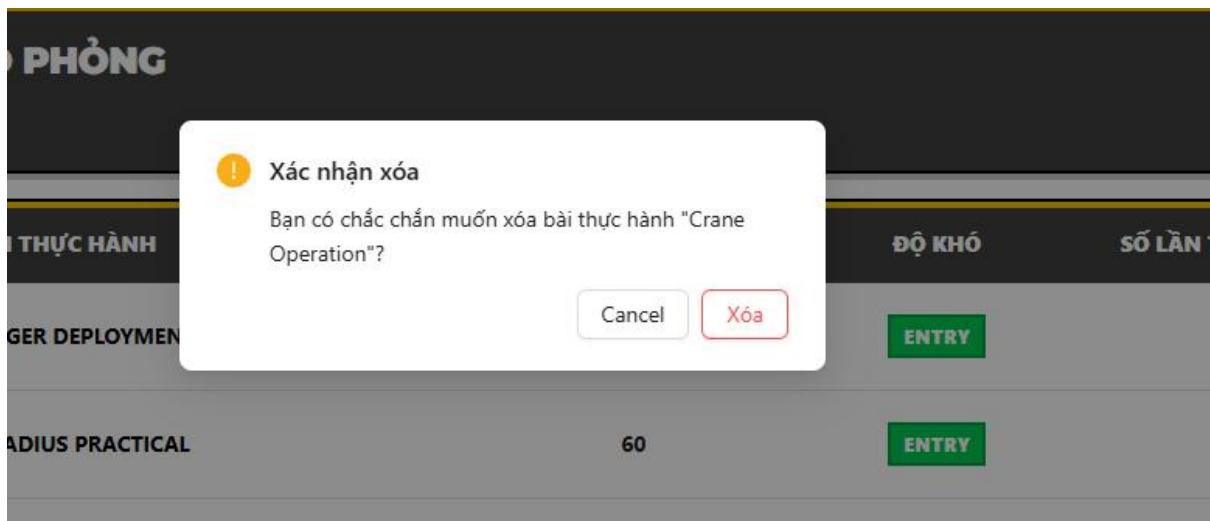
Delete Practice (Xóa Bài thực hành)

Usage Steps:

- Trigger:** Click the "Xóa" (Delete) button (icon Trash bin) on a specific row in the main list.
- Confirmation:** A dialog appears asking: "Bạn có chắc chắn muốn xóa bài thực hành này?" (Are you sure you want to delete this practice?).
- Action:** Click "Xóa" (Confirm) to proceed.

#### System Logic (Integrity Check):

- Dependency Block:** The backend checks if this Practice is currently linked to any active **Training Curriculum** (Activities).
- Rule:** If the practice is in use, the system **BLOCKS** the deletion to prevent breaking the course structure.



#### Simulation Manager Dashboard (Bảng điều khiển quản lý mô phỏng)

**Description:** Provides a comprehensive analytical view of the simulation training system. It aggregates real-time data regarding trainees, practice scenarios, and system usage to help managers assess training throughput and effectiveness.

**Trigger:** Select "**Tổng quan**" (Dashboard) from the Simulation Manager Sidebar.

**URL:** /simulation-manager/dashboard

#### System Overview Statistics (Thống kê tổng quan)

##### Usage Steps:

- Access:** Upon accessing the dashboard, the top section ("StatsOverview") automatically loads data from the server.
- Display Data:** Four key metric cards are displayed:
  - **Tổng học viên (Total Trainees):** Total number of active trainees in the system.
  - **Tổng thực hành (Total Practices):** Total number of practice scenarios defined.
  - **Tổng nhiệm vụ (Total Tasks):** Total number of atomic tasks available in the library.
  - **Tổng phiên mô phỏng (Total Simulation Sessions):** Cumulative count of all practice attempts made by trainees.

#### System Logic (Backend Analysis - SimulationManagerDashboardService.cs):

- **Data Aggregation:** The system queries the database using CountAsync filters.
- **Exclusion Rule:** All queries strictly filter out deleted records (IsDeleted == false) to ensure accuracy.
- **Role Validation:** The backend enforces a security check to ensure the requesting user has the SimulationManager role before returning data.



#### Monthly Practice Completion Analytics (Phân tích hoàn thành thực hành)

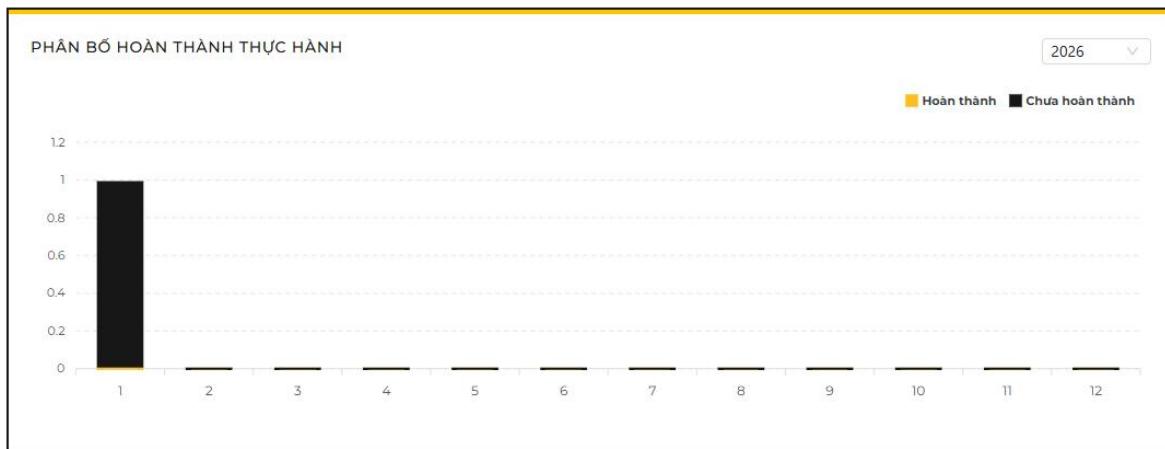
**Description:** A chart visualization showing the trend of successful vs. failed practice attempts over the months of a selected year.

#### Usage Steps:

- View Chart:** A bar chart displays two datasets per month:
  - **Completed (Hoàn thành):** Number of attempts where the trainee passed (IsPass == true).
  - **Not Completed (Chưa hoàn thành):** Number of attempts failed (IsPass == false).
- Filter by Year:** Use the year selector (Dropdown/Input) at the top of the chart to change the reporting period (Default is the current year).

#### System Logic:

- **API Call:** GET /api/simulation-manager/dashboard/completion-distribution?year={year}.
- **Grouping:** Data is aggregated from the PracticeAttempts table, grouped by Month.
- **Metric Definition:** "Completion" is strictly defined by the IsPass boolean flag in the database attempt record.



### Practice Duration Distribution (Phân bố thời lượng thực hành)

Description:

A pie/donut chart categorizing simulation sessions based on the complexity/length of the practices being attempted. This helps managers understand if trainees are focusing on short drills or long, complex scenarios.

Usage Steps:

- View Distribution:** The chart segments usage into three categories:
  - **Fast (< 15 mins):** Short exercises.
  - **Moderate (15-45 mins):** Standard training sessions.
  - **Slow (> 45 mins):** Long/Complex scenarios.
- Interaction:** Hover over chart segments to see the exact count of trainees/attempts in each category.

System Logic (Code Insight):

- **Classification Source:** The category is determined by the **Estimated Duration** (`EstimatedDurationMinutes`) defined in the *Practice configuration*, not the actual time the student spent.
  - *Logic:* `Join(PracticeRepository) Check EstimatedDuration.`
- **Buckets:**
  - Fast: Duration < 15.
  - Moderate:  $15 \leq \text{Duration} \leq 45$ .
  - Slow: Duration > 45.

## PHÂN BỐ THỜI LƯỢNG THỰC HÀNH

Tổng

0

🟡 Fast (< 15 mins) ● Moderate (15-45 mins) ● Slow (> 45 mins)

### 3.3.8 Feature 7: Trainee Learning Portal

**Overview:** This feature serves as the primary interface for trainees to engage with the training program. It consolidates daily schedules, course materials (video/documents), simulation practice tracking, assessments, and certification. The system enforces progression rules (e.g., video completion triggers) to ensure training integrity.

**Actor:** Trainee **Pre-condition:** User must be logged in successfully with the **Trainee** role.

#### View Weekly Schedule (Xem Lịch học)

**Description:** Allows trainees to view their assigned class sessions. The system organizes time slots into a weekly grid view, helping trainees track upcoming theory lessons or simulation practice sessions. **Trigger:** Select "Lịch học" (Schedule) from the Sidebar. **URL:** /trainee/schedule

#### Usage Steps:

1. View Weekly Grid:
  - The interface calculates the current week (starting Monday) and displays a calendar grid.
  - Columns represent days (Monday - Sunday), and rows represent assigned Time Slots (e.g., Slot 1: 07:00 - 09:15).

- [System Logic]: The system calls GET /api/timeslots/trainee/weekly with the dateInWeek parameter to fetch relevant sessions.
2. Navigation:
    - Click the "<" (Previous) or ">" (Next) buttons to navigate between weeks.
    - Click "Hôm nay" (Today) to return to the current week.
  3. Session Details:
    - Occupied slots display the Class Name, Room/Lab location, and Attendance Status (e.g., "Có mặt", "Vắng").

LSSCTC ACADEMY • LỊCH HỌC

## LỊCH HỌC CỦA BẠN

Xem lịch học hàng tuần và quản lý thời gian học tập hiệu quả

**TUẦN 12/1 - 18/1**

2026

Hôm nay

SLOT	MONDAY 12/1	TUESDAY <b>13/1</b> <b>TODAY</b>	WEDNESDAY 14/1	THURSDAY 15/1	FRIDAY 16/1	SATURDAY 17/1	SUNDAY 18/1
<b>SLOT 1</b> 07:00 - 09:00	—	—	—	—	<b>BUỔI 1</b> Buổi 1 NOTSTARTED P.218	—	<b>BUỔI 2</b> Buổi 2 NOTSTARTED P.218
<b>SLOT 2</b> 09:15 - 11:15	—	—	—	—	—	—	—

#### 4. Attendance List:

- Click onto the “Attendance” or “Điểm danh” button to navigate to all of your attendance records in the class

lssctc.site/my-classes/39

TRANG CHỦ CHƯƠNG TRÌNH MÔ PHÒNG GIỚI THIỆU

Điểm danh

Học tập	Lịch học lớp	Điểm danh	Thi Cuối Khóa
Buổi 1 08:45 AM - 09:03 AM	23/12/2025	P.218 - Trung Tâm Đào Tạo Quận 9	Chưa bắt đầu

## Learn Course Material (Học tập)

**Description:** The core learning interface where trainees consume lecture videos and reading materials. The system tracks engagement time and automatically updates progress status based on specific completion thresholds. **Trigger:** Select a specific Class > Course > Section > Activity from the "Program" menu. **URL:** /trainee/learn/:courseId/:sectionId/:partitionId

### Usage Steps:

#### 1. Access Content:

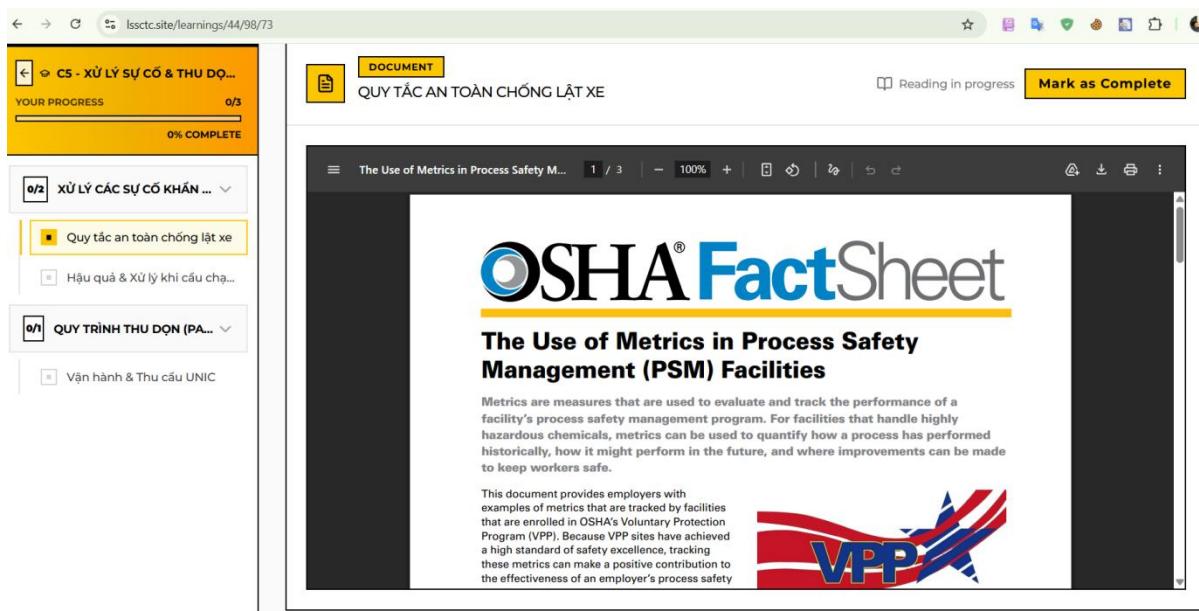
- The sidebar displays the course curriculum tree (Sections and Activities).
- Click on a "Video" or "Document" activity to load the content.

#### 2. Watch Video (Video Material):

- The embedded video player loads the lecture URL (supports YouTube integration).
- [Constraint]: The system monitors the timeUpdate event.
- [Business Rule]: The activity is marked as "**Completed**" only when the viewing progress reaches  $\geq 95\%$ . A notification "User watched the video completely" is logged, and the status is synced to the backend.

#### 3. Read Document:

- For PDF/Text materials, the interface displays the content directly.
- Click the "Hoàn thành" (Mark as Done) button (if manual completion is enabled) to update progress.



### Take Quiz (Làm bài kiểm tra)

**Description:** Trainees take multiple-choice assessments to validate their knowledge. The system manages attempt limits, calculates scores in real-time, and provides immediate feedback. **Trigger:** Select a "Quiz" activity from the Course Sidebar. **URL:** /trainee/learn/.../quiz/:quizId

#### Usage Steps:

1. **View Quiz Info:**
  - The start screen displays: Quiz Title, Description, Time Limit, and Remaining Attempts (calculated via MaxAttempts - CurrentAttempts).
2. **Attempt Quiz:**
  - Click "Bắt đầu làm bài" (Start Quiz).
  - Select answers for each question. The system supports Single Choice and Multiple Choice formats.
  - A countdown timer (HeaderTimer) tracks the remaining time.
3. **Submit & Review:**
  - Click "Nộp bài" (Submit). The system calculates the score based on: (Correct Answers / Total Questions) \* 10.
  - **Pass/Fail Logic:** If Score ≥ PassingScore, the activity status updates to "Passed".
  - The "Result" screen displays the final score and allows reviewing answers (if configured).

Landing page showing course progress and available modules:

- LỚP ĐIỀU KHIỂN CẨM CẤU**
- YOUR PROGRESS**: 0/8, 0% COMPLETE
- MODULES**:
  - 0/2 GIỚI THIỆU CHUNG VỀ XE
  - 0/2 ĐẶC TÍNH KỸ THUẬT VÀ AN TOÀN
  - 0/4 THỰC HIỆN MÔ PHÒNG

**BIỂU ĐỒ TẢI TRỌNG QUIZ**

0/5 ANSWERED

19:52 | **Submit**

**TRONG BIỂU ĐỒ TẢI TRỌNG, "TẦM VƯƠN" (WORKING RADIUS) ĐƯỢC TÍNH THẾ NÀO?** UNANSWERED

Biểu đồ tải trọng

Từ ghế ngồi vận hành đến vật nâng.

Chiều dài thực tế của cần (Boom Length).

Khoảng cách ngang từ tâm quay đến trọng tâm vật nâng.

Từ chân chống trước đến vật nâng.

**KHI TẦM VƯƠN (BÁN KÍNH) CÀNG LỚN, SỨC NĂNG CHO PHÉP THAY ĐỔI RA SAO?** UNANSWERED

Biểu đồ tải trọng

INSTRUCTIONS (Visible in yellow box):
 

- The quiz will auto-submit when time runs out
- Make sure you have a stable internet connection

**Start Quiz**

**ATTEMPT HISTORY (1)**

#1 13/01/2026 10:20 **LATEST**

Score: 0 / 10

**FAILED**

**BIỂU ĐỒ TẢI TRỌNG QUIZ**

Bài kiểm tra này nhằm đánh giá khả năng đọc hiểu và phân tích Biểu đồ tải trọng (Load Chart) - tài liệu kỹ thuật quan trọng nhất để vận hành xe cầu an toàn. Học viên cần chứng minh sự hiểu biết về các giới hạn vật lý của thiết bị để tránh các sự cố lật xe hoặc gây chấn thương.

**TIME LIMIT**: 20 mins

**QUESTIONS**: 5

**PASS SCORE**: 5/10

**ATTEMPTS**: 2/2

**INSTRUCTIONS**

- Read each question carefully before answering  
 - You can navigate between questions  
 - The quiz will auto-submit when time runs out  
 - Make sure you have a stable internet connection

**ATTEMPT LIMIT REACHED**  
 You have used all available attempts for this quiz.

**Start Quiz**

## View & Take Final Exam (Thi cuối khóa)

**Description:** Trainees shall see their available status for the final exam of a specific class, and they can check related information with the final exam policy or results.

### Usage steps:

1. Navigate to a specific class that you are enrolled in.
2. Click “Final exam” or “Thi cuối khóa”

The screenshot shows the LSSCTC website's main dashboard. At the top, there is a banner with the text "Tiêu Chuẩn LSSCTC", "Tỷ Lệ 95%", "+40% Lương", and "6 Tuần". Below the banner, there are four tabs: "Học tập", "Lịch học lớp", "Điểm danh", and "Thi Cuối Khóa". The "Thi Cuối Khóa" tab is highlighted with a yellow underline.

3. View the final exam open status and your prerequisites (if there is any). Final exam open status should be one of “Open” (Đang mở), “Not yet” (Chưa mở), “Closed” (Đã đóng).

This screenshot shows the "Thi Cuối Khóa" section. It features a summary box with a yellow Q&A icon, the text "BÀI THI CUỐI KHÓA", and "Nguyễn Văn An - CSLK26IS". To the right is a yellow "OPEN" button. Below this, a message box contains a green checkmark icon, the text "ĐỦ ĐIỀU KIỆN THI CUỐI KHÓA", and the message "Bạn đã hoàn thành tất cả các yêu cầu của khóa học và có thể bắt đầu bài thi cuối khóa."

4. View the final exam detail partials and the specific date that the training center provides.

This screenshot shows the "CÁC PHẦN THI" section. It displays a table with three rows, each representing a type of exam: "Theory", "Simulation", and "Practical". The columns are labeled "LOẠI", "THỜI LƯỢNG", "ĐIỂM", "TRẠNG THÁI", "KHUNG THỜI GIAN", and "HÀNH ĐỘNG". In the "HÀNH ĐỘNG" column, there is a yellow "Bắt Đầu Thi" button for each row. The "TRẠNG THÁI" column shows "CHUA LÀM" for all rows. The "KHUNG THỜI GIAN" column shows dates like "24-12-2025" and "29-12-2025".

5. Follow instructor guide and allowance to attempt the exam. Usually, you should be appeared at a target place which is notified by the training center before the attempt.

6. Theory Exam requires access code (Mã làm bài) which is provided by instructor or center staff.

THEORY EXAM

THỜI GIAN  
**15 phút**

WEIGHT  
**30%**

MARKS  
**0**

TRẠNG THÁI  
**NOT YET**

START TIME  
lúc 21:10 24 tháng 12, 2025

NHẬP MÃ MỞ ĐỀ ĐỂ BẮT ĐẦU

MÃ MỞ ĐỀ

Nhập mã mở đề

7. Simulation Exam is taken inside simulation engine in the same way with simulation practice.

8. Practical Exam is graded by instructor or assigned examiner. Trainees shall follow instructor / examiner steps to finish the practical exam.

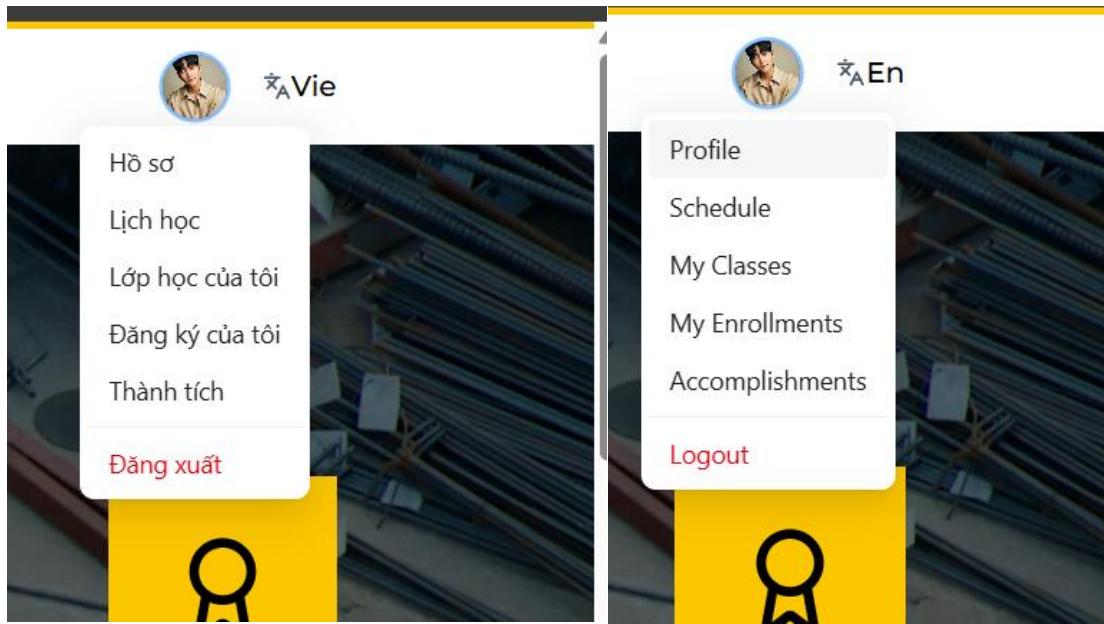
### View & Download Certificate (Chứng chỉ)

**Description:** A display of all certifications earned by the trainee upon completing courses. It provides visual indicators for certificate validity and allows downloading the official certificate file. **Trigger:** Select "Chứng chỉ" (Certificates) from the Sidebar. **URL:** /trainee/certificates

#### Usage Steps:

##### 1. View List:

- Click on user avatar and select Accomplishments / Thành tích.



- The page displays cards for each earned certificate containing: Course Name, Issue Date, and Expiration Date.

Xem và quản lý các chứng chỉ bạn đã đạt được trong quá trình đào tạo.

8 CHỨNG CHỈ

DANH SÁCH  
CHỨNG CHỈ CỦA BẠN

CHỨNG NHẬN HOÀN THÀNH

CHỨNG NHẬN HOÀN THÀNH

CHỨNG NHẬN HOÀN THÀNH

CHỨNG NHẬN HOÀN THÀNH

## 2. Detail Preview:

- Click on a specific certificate to see the detail preview on website, information included in a certificate should includes:
  - Valid:** Displayed with a **Yellow/Standard** badge if the expiration date is far in the future.
  - Expiring Soon:** Displayed with an **Amber** badge if the certificate expires in less than **90 days**.
  - Expired:** Displayed with a **Red** badge if ExpireDate < CurrentDate.

The screenshot shows a certificate page from the LSSCTC website. At the top, there's a navigation bar with links to HOME, PROGRAMS, SIMULATOR, and ABOUT. A user profile icon and language selection (En) are also present. The main content area features a large image of a construction worker in an orange vest. Below the image, the title 'UNG PHÓ SỰ CỐ VÀ KẾT THÚC CÔNG VIỆC- VI' is displayed, along with the identifier '39CFBC6E'. A yellow button labeled 'Tải PDF' (Download PDF) is visible. The bottom part of the page shows a detailed view of the certificate document, which includes the name 'Lưu Trọng Nghĩa', the date 'Cấp ngày: Dec 26, 2025', and a yellow button labeled 'SƠ LƯU CẤP' (Issued) with the date '26 Dec 2025'.

### 3. Download:

- o Click the "Download" or "Tải PDF" button to retrieve the generated PDF certificate from the center.



- PDF format of the certificate should be opened on a new tab, and we can download it by clicking onto the download icon on the right side of task bar.



LSSCTC ACADEMY

**CHỨNG NHẬN HOÀN THÀNH**

DÃ TỐT NGHIỆP KHÓA HỌC

TRÂN TRỌNG TRAO TẶNG CHO

**LƯU TRỌNG NGHĨA**

Đã hoàn thành xuất sắc yêu cầu của khóa đào tạo

**ỨNG PHÓ SỰ CỐ VÀ KẾT THÚC CÔNG VIỆC- V1**

NGÀY CẤP  
26 Dec 2025

- For a different approach, we shall print the certificate directly instead of downloading it.

