



**A VR-BASED PLATFORM FOR OPERATIONAL SKILL  
DEVELOPMENT: A CASE STUDY OF A RICE  
COOPERATIVE IN VIENTIANE, LAOS**

**CHITHTISACK KHANSULIVONG**

**MASTER OF SCIENCE  
IN  
INFORMATION TECHNOLOGY**

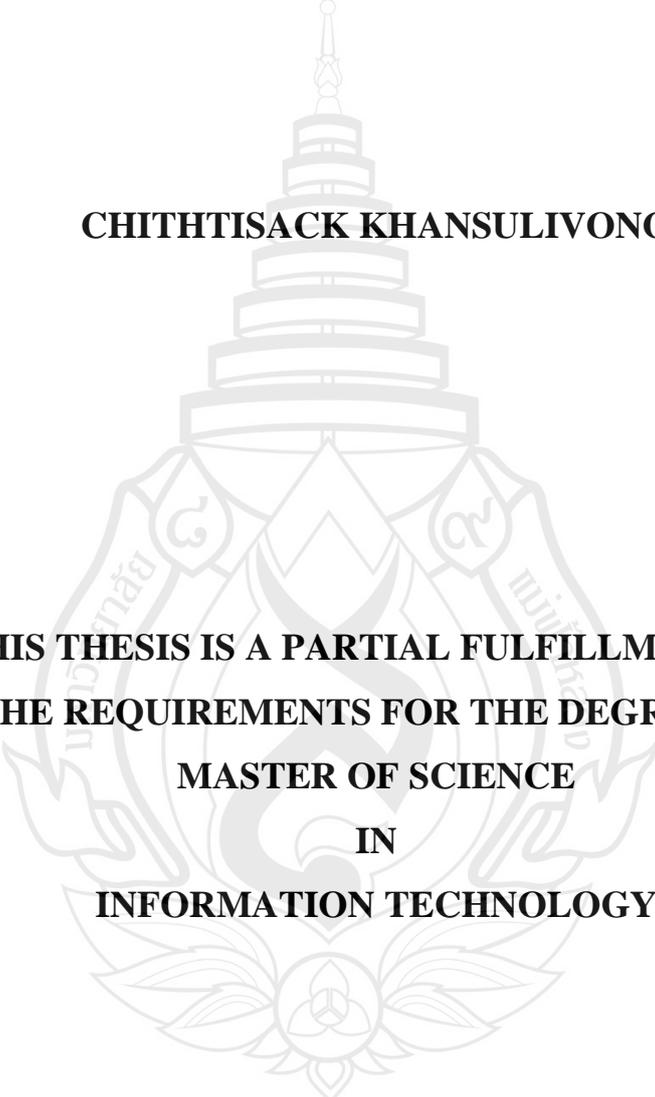
**SCHOOL OF APPLIED DIGITAL TECHNOLOGY  
MAE FAH LUANG UNIVERSITY**

**2024**

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**THIS THESIS IS A PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
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**THESIS APPROVAL**  
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**MASTER OF SCIENCE IN INFORMATION TECHNOLOGY**

**Thesis Title:** A VR-based Platform for Operational Skill Development: A Case Study  
of A Rice Cooperative in Vientiane, Laos

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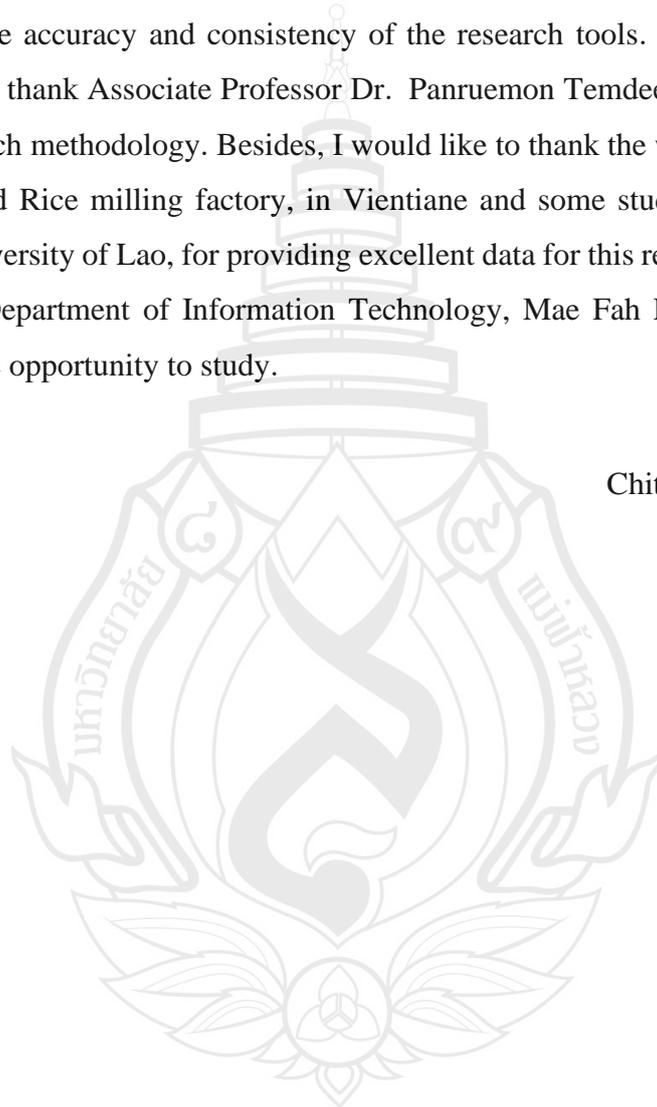
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Chithtisack Khansulivong



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### **ABSTRACT**

Rice production is main productivities of driving economy, growing of production in a lot of areas with technology making gap of knowledge transfer for current of farmers, workers and operators. New workers having a problem of using high technology and new machine which have a lot of bottoms and automation system, learning of workers for new technology delaying, The growing of production and risk of losing life and property which happen in accident in factory. Knowledge transfer in deep learning and immersive learning by Virtual Reality (VR) will be selection for resolve the issue. Importing knowledge and machine guideline to VR and explore to new workers in wearing 3D technology and simulate the machines in any part of productions for creating the deep and immersive learning for getting better learning of new users. These papers showing Theories of model and finding out Satisfaction and understanding in quantity and quality of using model.

**Keywords:** Metaverse, 3D Visual Reality, AR, VR and MR Technology, Agriculture Online Learning, Online Learning, Rice Milling, Smart Farm, IOT, Bigdata, Machine Learning, Knowledge Transfer

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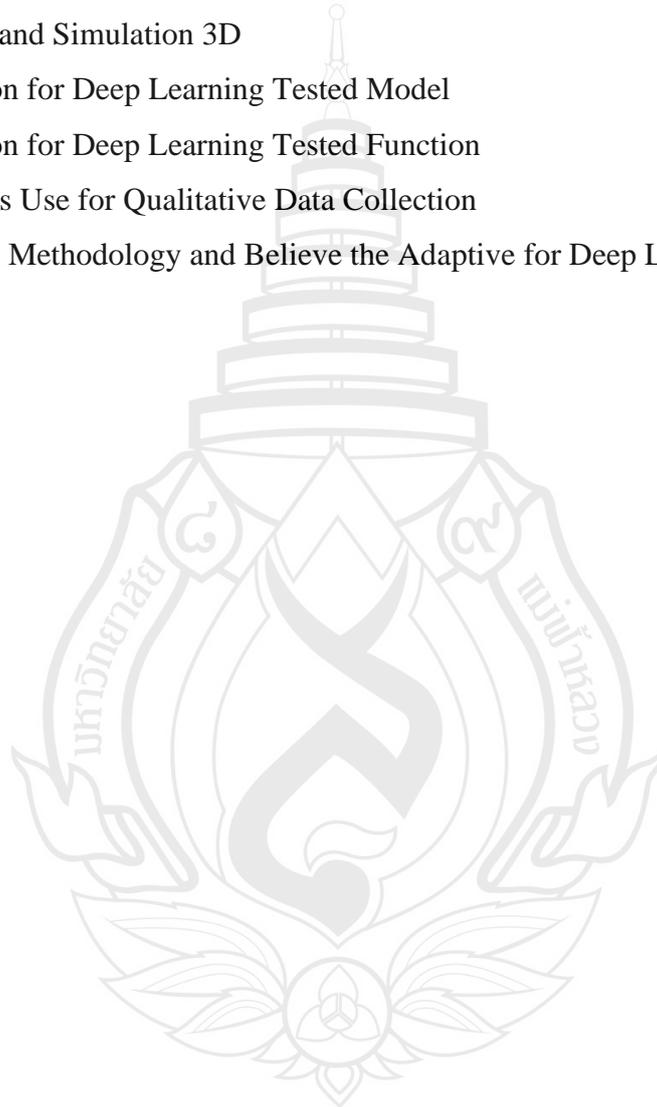
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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background and Rational

Agricultural work is recognized as a primary driver of socio-economic development in the Asian region. The production of agricultural products is fundamental to feeding the population and plays a significant role in the economic advancement of numerous countries. The Lao People's Democratic Republic (Lao PDR) implement a comprehensive policy aimed at enhancing rice production, as outlined in its 5-year and 10-year national economic development plans. The government has introduced policies to encourage entrepreneurship throughout the rice supply chain, from farmers to milling operations, and establishes pricing mechanisms based on prevailing socio-economic conditions.

Rice constitutes the staple food of the Lao PDR and is a product of considerable strategic importance. Its significance has led to increased investment from both domestic and international markets. This rise in investment is attributed to the incorporation of machinery in the production process, which enhances both efficiency and output, reducing production time through the use of tools such as threshers and milling machines. However, a concerning trend has emerged where young individuals choose to abandon their education in favor of employment for financial gain. This is often exacerbated by familial economic constraints, which hinder their ability to pursue further education.

The growth of enterprises employing modern technologies poses a challenge for individuals lacking experience in adapting to new job requirements and troubleshooting issues related to inadequate machinery. Such shortcomings can result in production delays and substandard outputs. Both experienced and novice workers frequently encounter difficulties with machinery as they initiate new tasks, often relying heavily on the guidance of seasoned professionals, yet they are still prone to errors that hinder operational efficiency. Moreover, workplace accidents pose a significant threat,

potentially resulting in injury or even loss of life. These issues, while possibly obscured from oversight due to the policies of the Ministry of Labor and Social Welfare, are prevalent within the industry.

Addressing these challenges with innovative technological solutions presents a formidable task, particularly given the apprehensions regarding acceptance from both entrepreneurs and workers.

Three-dimensional (3D) technology, which has been in existence for an extended period, provides a simulation of various events or environments, thus enhancing experiential learning applicable to both work and recreational activities. The vividness of 3D technology, reminiscent of video games that many individuals have encountered, offers an immersive environment that allows for risk-free experimentation.

## **1.2 Objectives and Data Analysis Alignment**

### **1.2.1 Survey the Rice Milling Factory Machine and Area Working**

1.2.1.1 Objective: Understand the existing machinery and workflow in the rice milling factory.

1.2.1.2 Data Collection: Use surveys and observations to gather data about the current setup and processes.

1.2.1.3 Analysis:

1. Descriptive Statistics: Summarize the types and number of machines, the workflow, and any identified bottlenecks.

2. Qualitative Analysis: Identify common themes and issues based on observations and open-ended survey responses.

### **1.2.2 Simulate Rice Factory to 3D Methods**

1.2.2.1 Objective: Develop a virtual simulation of the rice factory.

1.2.2.2 Data Collection: Use design documentation and user feedback during the simulation development phase.

1.2.2.3 Analysis:

1. User Feedback: Collect data on user experiences with the 3D simulation.

2. Iterative Improvement: Use feedback to improve the simulation's accuracy and usability.

### **1.2.3 Testing to Workers and Take Survey for Experience Before and After Using Methods**

1.2.3.1 Objective: Evaluate the effectiveness of the 3D simulation in improving workers' skills and understanding.

1.2.3.2 Data Collection: Use pre- and post-surveys to assess the impact of the simulation on workers.

1.2.3.3 Analysis:

1. Pre- and Post-Test Comparison: Compare survey results before and after using the 3D simulation.

2. Descriptive Statistics: Calculate mean, median, mode, and standard deviation for responses on confidence, skills, and understanding.

3. Inferential Statistics: Use t-tests or ANOVA to compare mean scores between different groups.

4. Qualitative Analysis: Analyze open-ended responses for insights on user satisfaction and challenges.

Example Analysis for Objective:

1. Data Collection:

1) Pre-Survey: Collect data on workers' initial confidence and skills.

2) Post-Survey: Collect data after they have used the VR simulation.

2. Statistical Analysis:

1) Descriptive Statistics: Calculate the average confidence and skill levels before and after the simulation.

2) T-Test: Perform a paired t-test to determine if there is a significant improvement in scores.

Example Calculation:

Pre-Survey Mean Score=3.2, Post-Survey Mean Score=4.5

$$t = \frac{\text{Post-Mean} - \text{Pre-Mean}}{\text{Standard Error of Difference}}$$

Visual Representation:

1. Bar Graph: Compare pre- and post-survey scores.
2. Pie Chart: Show the distribution of responses for qualitative feedback.

### 1.3 Scope

- 1.3.1 Requirement analysis from stakeholder.
- 1.3.2 Model selection for workers and individual
- 1.3.3 Build a positive correlation prediction model before and after.
- 1.3.4 Evaluation process.

### 1.4 Expected Benefits from Research Project

#### 1.4.1 Understanding Production Challenges

It is essential to have a comprehensive understanding of the challenges encountered in the production process. Identifying these issues is the first step toward implementing effective solutions.

#### 1.4.2 Selecting Solutions for Production Issues

A systematic approach must be taken to evaluate and choose appropriate strategies for addressing the problems identified in the production workflow. This requires careful consideration of both immediate and long-term impacts on operational efficiency.

#### 1.4.3 Promoting the Integration of Technology in Production

Encouraging the adoption of technology within the production process is vital. By leveraging advanced technological tools and systems, organizations can enhance productivity, reduce costs, and improve the overall quality of outputs.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Related Works

The main agriculture of Association of Southeast Asian Nations ASEAN is rice, rice have been main food for long time, population in countryside were farmers and livestock in main job, Report of Overseas Trade Promotion Office in Manila/Foreign Trade Promotion Office in Singapore in April 2021 show that ASEAN to be the world's rice capitals, with the population of (ASEAN) primarily consumes rice as a staple food, with rice being the most extensively cultivated crop in the region, yielding a total production of over 120 million tons. Rice consumed within the region is about 105 million tons of rice and there is a surplus of about 15 million tons, approximately 4 to 5 million tons of rice are traded within the ASEAN region, while the remainder of the production is exported to markets outside the region. Presently, the rice market in ASEAN is becoming increasingly competitive, with several member countries possessing significant potential for rice production that can satisfy both domestic consumption and export demands on a global scale. However, despite the ability of some countries to cultivate substantial quantities of rice, they are still unable to meet their domestic consumption needs fully, so it is necessary to import more rice, which can be divided into 3 groups of rice producing and exporting countries in ASEAN below:

1. Produce and export: Thailand; Vietnam; Myanmar; Cambodia; Lao PDR.
2. Produce and import: Burnie; Singapore.
3. Not enough production: Philippine; Indonesia; Malaysia.

Smart factory is selected for growing production of rice in some sections, using the high technology of international standard are extracting round the country, there were a lot of machines imported, which from China, America, Europe, Japan.

The machine including full functions of rice production which start from cleaning paddy until AI selection the quality of rice such as Satake rice milling machines from Japan, which were very popular machine.

Rice milling machine supported productivity lines for the detail of production, operators can design and choose what part of production that they need machine or full functions supporting, the products list of Stake including: Drying and storage; Rice milling; Rice Processing System & Full Plant System; Optical Sorting; Wheat Milling; Maize & Other Grain Milling; Analytical Equipment; Rice Cooking System; Foods; Analysis Service; Sorting & Processing Integrated Center.

The new born of the environment of productions found a lot of problems from human resources and tools of produces systems which causing production delays and not on target in number of production and times such as losing of yield from weather, delays caused by workers ability and accident of machine, thief and animals disturbing that's consequences to life and property of factories.

At present, some of factories still go on with the traditional ways, which using people ability working with their limited functions, that's making a lot of problems of production above especially case of accident cause injury and death these are problem of production disturbing

The research focuses in rice processing system, which research found that popular machine in rice cooperative in Vientiane Lao PDR. Quality of machine changed normal factory to smart factory by a lot of automatic part flow in the line of productions such as the tube of rice transportation to any section of rice milling without workers hands to take it, rice color selection by Ai for quality analyzing, weigh of rice in packaging. These aren't using people for doing, but still some part that need workers support such as monitoring temperature of rice breaking, resolving the issue of system error, some of by pass and a lot of parts of machine controlling.

Rice milling machine are very high technology and difficult to understanding of farmers, new workers and operators, knowledge transfer is very important. Inputting technology to Material and Methods will be good support for knowledge transfer from current worker experience to new workers and new generation for support productivity and Safety in factory.

Workplace Hazards Machinery-related accidents: Injuries caused by contact with moving parts, entanglement, or improper operation of machinery. Slip and fall accidents: Wet floors, uneven surfaces, and poor lighting can lead to slips, trips, and falls. Fire hazards: Accumulation of dust, flammable materials, and electrical issues can increase the risk of fire. Noise pollution: Prolonged exposure to loud machinery can damage hearing. Health Hazard, dust inhalation: Exposure to rice dust can cause respiratory problems. Chemical exposure: Use of pesticides or other chemicals can harm workers' health. Physical strain: Repetitive tasks and heavy lifting can lead to musculoskeletal disorders. Other Safety Issues. Lack of safety training for workers can increase the risk of accidents. The research adapted social media methods the spatial application with VR box, HoloLens, and other devices for access to 3D presentation and training.

## 2.2 Theoretical

A VR-based platform for operational skill development offers a unique opportunity to provide immersive, realistic, and safe training experiences. Several theoretical frameworks can underpin the development and implementation of such a platform.

Experiential Learning Theory (Kolb, 1984). Concrete Experience: VR provides a rich, sensory-based experience that allows learners to actively engage with simulated scenarios. Reflective Observation: Learners can analyze their performance in the VR environment, identifying strengths and weaknesses. Abstract Conceptualization: Learners can develop a deeper understanding of the underlying concepts and principles. Active Experimentation: Learners can apply their knowledge and skills in new and challenging situations within the VR environment.

Cognitive Load Theory (Sweller, 1988) Intrinsic Cognitive Load: VR can reduce intrinsic cognitive load by presenting information in a visually appealing and interactive format. Extraneous Cognitive Load: Well-designed VR environments can minimize extraneous cognitive load by providing clear instructions, intuitive interfaces, and

relevant feedback. Germane Cognitive Load: VR can enhance germane cognitive load by promoting deep learning and problem-solving skills.

Social Cognitive Theory (Bandura, 1977). Observational Learning: Learners can observe expert models performing tasks in the VR environment, and then imitate their behaviors. Self-Efficacy: VR can boost self-efficacy by providing opportunities for learners to successfully complete tasks and receive positive reinforcement. Self-Regulation: Learners can set goals, monitor their progress, and adjust their strategies based on feedback and self-assessment within the VR environment. Observational Learning: Learners can observe expert models performing tasks in the VR environment, and then imitate their behaviors. Self-Efficacy: VR can boost self-efficacy by providing opportunities for learners to successfully complete tasks and receive positive reinforcement. Self-Regulation: Learners can set goals, monitor their progress, and adjust their strategies based on feedback and self-assessment within the VR environment.

### **2.2.1 Embodied Cognition Theory**

Grounding Cognition in Physical Experience: VR allows learners to physically interact with the simulated environment, enhancing their understanding of concepts and procedures. Sensorimotor Learning: VR can facilitate the acquisition of motor skills through practice and feedback.

### **2.2.2 Key Considerations for VR-Based Skill Development Platforms**

Immersion and Realism: The VR environment should be as realistic as possible, including realistic graphics, sounds, and haptic feedback. Interactive Scenarios: The platform should offer a variety of scenarios that challenge learners to apply their skills in different contexts. Adaptive Learning: The platform should be able to adapt to the learner's individual needs and progress. Real-time Feedback: Learners should receive immediate feedback on their performance, both quantitative and qualitative. Social Learning: The platform should support collaborative learning and knowledge sharing among learners. Data Analytics: The platform should collect data on learner performance to identify areas for improvement and optimize the training experience.

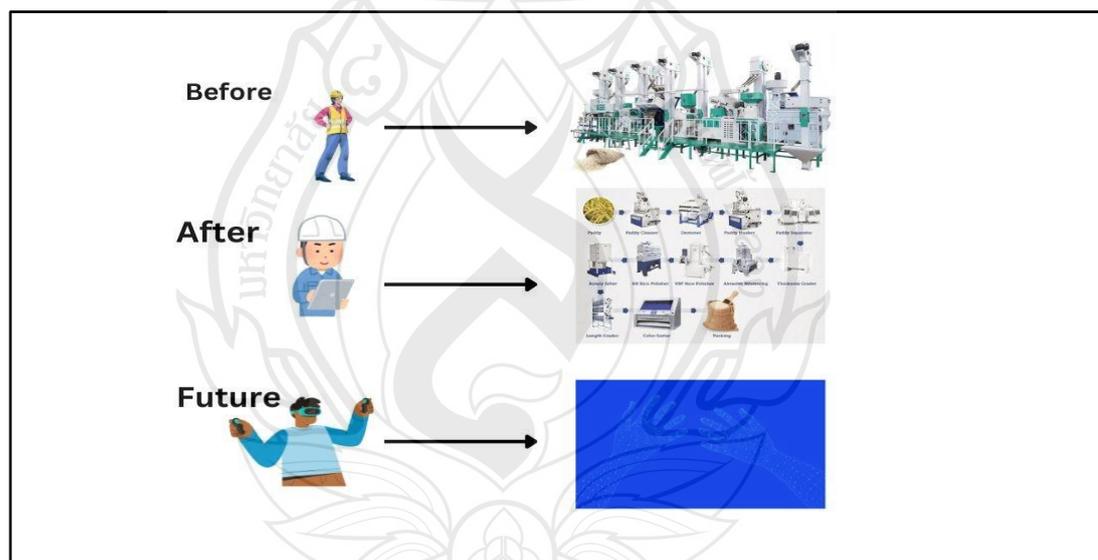
By carefully considering these theoretical frameworks and design principles, VR-based platforms can revolutionize operational skill development, providing efficient, effective, and engaging training experiences.

## 2.3 Literature Review

Despite their importance to the international agricultural community, smallholders have historically been neglected in national and international forums (John & Fielding, 2014). In response to a food crisis in the early 1970s, the International Fund for Agricultural Development (IFAD) established a strategic priority of supporting smallholders, and a growing number of international organizations are putting smallholders at the top of their agendas today. According to pathologist, New agriculture involves using scientific research to modify and improve farming systems (Cuaton & Delina, 2022). For example, the Green Revolution helped boost agricultural production in developing countries by sharing new agricultural technologies. The concept of “smart” farming emphasizes the utilization of technological advancements such as the Internet of Things (IoT) and artificial intelligence (AI) to enhance agricultural productivity (Amiri-Zarandi et al., 2022). In a smart farming context, substantial quantities of data are acquired from multiple sources, including wireless sensor networks, network-connected weather stations, surveillance cameras, and mobile devices. When used in services and systems that rely on data and help with decision-making these data are important resources. Smart farming and production is an emerging paradigm in agriculture that seeks to transition traditional techniques into innovative solutions underpinned by Information and Communication Technologies (ICT) (Moysiadis et al., 2021). Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), Image Processing, Machine Learning, Big Data, Cloud Computing, and Wireless Sensor Networks (WSNs) are anticipated to make substantial contributions to this field. The anticipated benefits encompass increased output, reduced input costs (such as fuel, fertilizer, and pesticides), decreased labor requirements, and enhanced final product quality. Smart production systems can be implemented with a variety of focal points, including IoT, AI and machine learning, or big data, for example The analysis demonstrates that Big Data applications in Smart Farming have a much wider impact than just primary production, having an impact on the entire food supply chain (Wolfert et al., 2017). Big data powers real-time decisions, streamlines processes, and predicts outcomes in agriculture. The Internet of Things

(IoT) Can help farmers manage their crops better, resource management, and agricultural efficiency (Dagar et al., 2018). IoT sensors like temperature, pH, moisture, and water volume sensors can be used to monitor crops and fields. The system combines IoT and machine learning to create a smart module (Varghese & Sharma, (2018). This module uses advanced techniques to improve accuracy and automate crop monitoring, reducing the need for manual labor. The increasing digitization of manufacturing has led to a surge in interest in using machine learning and optimization techniques to improve production processes (Weichert et al., 2019). Because of the availability of vast amounts of data and the need to address resource constraints, such as energy and material shortages. By employing machine learning, manufacturers can save time, energy, and resources, while also reducing waste. Enhancing Production Planning and Control (PPC) functions might result in a global enhancement of manufacturing systems due to their cross-functional character in the organization (Cadavid et al., 2020). Machine learning (ML) approaches have become an interesting approach to address manufacturing misery with the introduction of Industry 4.0, which is characterized by substantial data availability, high processing potency, and big capacity. All ability of high technology above can be adapted to learning and training in deep functional for better experience such as adapting knowhow to technology platform of learning like 3D model for getting new ways of learning and knowledge transfer. Mixed Reality, Virtual Reality, and Augmented Reality have been employed as training tools across diverse domains (Kaplan et al., 2020). However, the efficacy of these immersive technologies for training purposes remains a subject of quantitative and conclusive inquiry. While extended realities often present time-saving and cost-effective training mechanisms, their effectiveness as training tools continues to be debated. Virtual reality (VR) technology, in particular, will play a significant role in the modernization and future of agriculture (Li, 2008). Both computer science and information technology are crucial to the growth of agriculture/proctions and rural communities worldwide. The virtual agricultural technology investigated new approaches to understanding and utilizing farm information technology by fusing agriculture/productions science with IT and VR. The composition, scope of application, and development trajectory of virtual agriculture were examined in light of the conceptual framework provided. Virtual reality technology is used to build virtual

learning environments, expanding the physical learning environment and giving students access to more materials and richer learning opportunities (Wang, 2021). It possesses immersion, engagement, and imaginative qualities. The development of agricultural talents' higher-order thinking skills is facilitated by virtual reality technology. While increasing rice yields is important, improving the quality of milled rice is equally crucial to reduce post-harvest losses and ensure food security (Singh et al., 2012). This requires careful attention to the entire production process, including human labor, which remains a vital component of efficient and sustainable rice production. Many rice milling processes, like cleaning and drying, still rely on manual labor, which contributes to energy consumption (Rahman et al., 2013). Furthermore, the byproducts of the rice milling process can provide an additional economic benefit for rice-producing countries, Countries that grow rice can make more money from the stuff left over from milling (Rahman et al., 2015).



**Figure 2.1** Review of Research Methodology

## CHAPTER 3

### METHODOLOGY

This research finds the different of groups participants before and after presentation and training by 3D method and find out more understanding of pinpoint and possible solution by survey to problem and survey improvement.

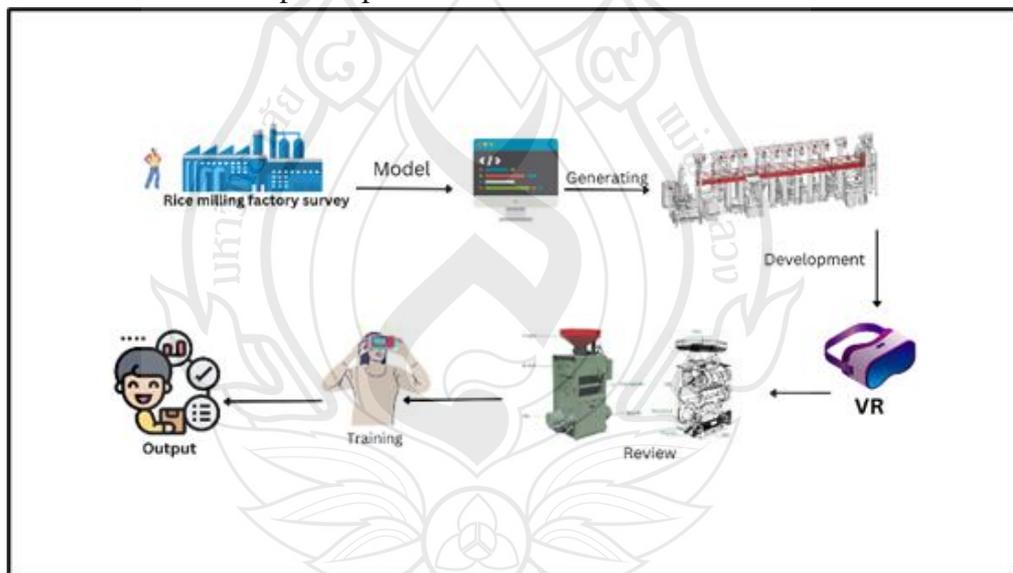
Virtual reality (VR) is a simulated experience that uses pose tracking and 3D near-eye displays to immerse the user in a virtual world. Virtual reality has applications in entertainment (particularly video games), education (such as medical or military training), and business (such as virtual meetings). Other types of VR-style technology include augmented reality and mixed reality, which are sometimes referred to as extended reality or XR, though definitions are changing due to the industry's infancy. To provide realistic visuals, sounds, and other sensations that simulate a user's physical presence in a virtual world, current standard virtual reality systems either use virtual reality headsets or multi-projected environments. User can see around the virtual world, move around in it, and interact with virtual features or objects while utilizing virtual reality technology. The impression can also be produced by specially built rooms with numerous large screens, although it is most regularly produced by VR headsets that have a head-mounted display with a small screen in front of the eyes. Virtual reality normally includes audio and visual feedback, but haptic technology may also enable additional types of sensory and force feedback.

3D Technology can preview for easy ways to access by low-cost technology such as smart phone that every worker's current using. Finding the available application of smart phone for preview the 3D technology such as the spatial application which can input the 3D model of factory for expanding how is the machine working, this is the compatible for workers to strong understanding with their own devices to accessing and deep learning for getting the result.

3D can be supporting the part of knowledge transfer in the immersive learning, 3D can explore the new experience of knowledge from traditional ways of farming or current ways of apprenticeship, which including risk of life and Property. 3D is the

technology show the ability of simulation for objects and places for doing activities such as: playing games, shopping, sports, classroom, cooking, computer crafting, machine crafting, travelling, practices and other activities, that we don't need to go put to do it. The ability of 3D can create the second world for getting new experience nearly the real world like the movies, users can test everything that they want without dangerous, injure or dead.

1. Survey rice milling factories in the cooperative in the target area (Vientiane, Lao PDR) for finding problems of production and working.
2. Making understanding of processing of production and processing of machine.
3. Design and simulate factory to 3d model.
4. Test and retest simulation to workers for getting result of understanding in using machines by 3D platform.
5. Interview participants for result.



**Figure 3.1** Diagram of idea for research

Local survey for rice milling factory, the big machine with a lot of detail makes difficult for understanding and hard to generate to the model, the possible of accessing under the environmental without local mesh and right positions of area are difficult to complete making model, some interview and location survey can more support the difficult part for 3D generation Challenges in Creating 3D Models of Machines.

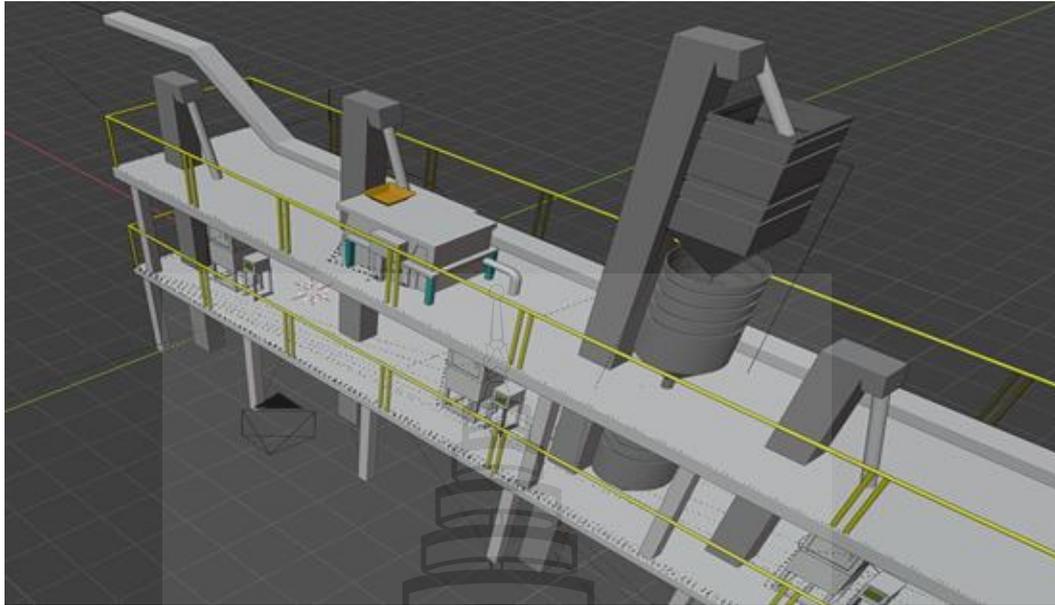
Creating accurate and detailed 3D models of machines can be a complex process fraught with challenges.

**Data Acquisition and Preparation** Accurate measurements: Obtaining precise dimensions and tolerances can be difficult, especially for existing machines. Converting data from different sources (CAD drawings, point clouds, images) into a usable format can be time-consuming. Incomplete or missing data: Often, critical information about the machine's components or assembly is unavailable.

**Modelling and Design.** Geometric complexity: Many machines have intricate shapes and features, making modelling challenging. Assembly and interference: Ensuring components fit together correctly and don't interfere with each other requires careful attention. Software Limitations, software capabilities: Not all software packages can handle the complexity of certain machine components or assemblies. Computational resources: Creating large and complex models can be demanding on computer hardware. User interface challenges: Some software interfaces may be difficult to use or lack essential features. Visualization and Rendering. Realism: Achieving a realistic appearance can be challenging, especially for materials like metal and plastic. Performance: Rendering complex scenes can be time-consuming, especially for real-time applications. Accuracy: Ensuring the 3D model accurately represents the machine's appearance and functionality is crucial. **Specific Challenges Based on Machine Type.** Moving parts: Modelling mechanisms and linkages can be complex and require careful attention to kinematics. Electrical and electronic components: Representing these components accurately can be challenging due to their small size and complexity. Hydraulic and pneumatic systems: Modelling fluid flow and pressure systems can be complex and requires specialized knowledge.

**Detail level:** Deciding on the appropriate level of detail can be difficult, as too much detail can slow down the modelling process, while too little can compromise accuracy.

This research design for normal scale which can easy to understand of participants and complete for matching with method (Spatial), trying low code and no code for time limited of research doing. Adaption the Bender and Spatial is the best solution for the research situation focusing on parts of line production like machine number 1 to final machine and function of machines.



**Figure 3.2** Design and Simulation 3D

Spatial applications in the metaverse are software tools or platforms that leverage spatial computing to create immersive and interactive digital experiences. They focus on creating a sense of presence and realism by allowing users to interact with virtual objects and environments in a way that mimics real-world interactions. **3D Environment:** These applications operate within a three-dimensional virtual space. **User Interaction:** Users can manipulate objects and navigate the environment using natural gestures or controllers.

**Real-time Rendering:** Visuals are updated instantly to reflect user actions. **Immersive Experience:** The goal is to create a sense of presence and engagement. **Examples of Spatial Applications in the Metaverse.** **Virtual Events and Conferences:** Hosting meetings, workshops, and conferences in virtual spaces with features like virtual stages, audience interactions, and networking opportunities.

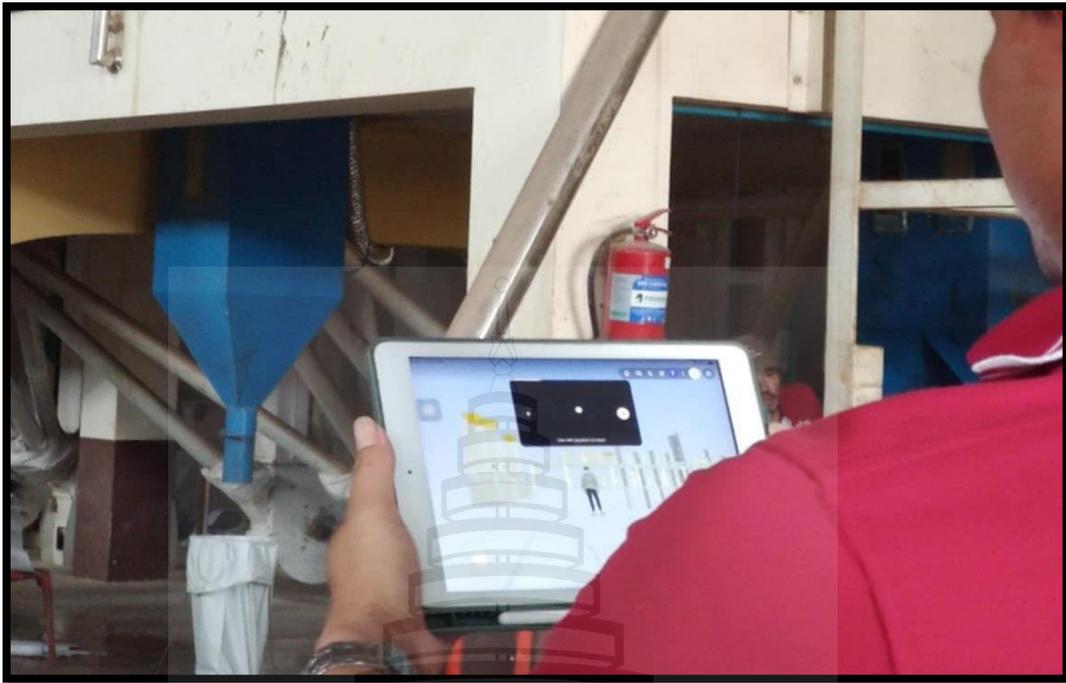
**Virtual Showrooms and Retail:** Creating interactive product demonstrations, virtual try-ons, and online shopping experiences. **Virtual Collaboration and Design:** Enabling teams to collaborate on projects in a shared virtual space, allowing for real-time feedback and ideation. **Virtual Gaming and Entertainment:** Developing immersive gaming experiences, virtual concerts, and interactive storytelling. **Education and Training:** Creating virtual classrooms, simulations, and training programs. In essence,

spatial applications are the building blocks of the metaverse, providing the foundation for creating engaging and interactive virtual experiences.

Simulation the production traffic, production line, safety introduction, exit and the important is function of machine for deep learning before real action and real working of new workers and current workers.



Figure 3.3 Adaption for Deep Learning Tested Model



**Figure 3.4** Adaption for Deep Learning Tested Function

More development in technical details

#### 1. VR Platform Architecture

The VR platform for the rice milling factory was developed using Unity, a versatile and powerful game engine. Unity was chosen for its robust support for VR development and cross-platform capabilities. The primary programming language used was C#, given its strong integration with Unity.

Hardware Requirements: VR Headsets: Oculus Rift or HTC Vive, which provide high resolution and accurate motion tracking.

Computers: High-performance PCs with at least an Intel i7 processor, 16GB RAM, and NVIDIA GeForce GTX 1080 GPU or equivalent, ensuring smooth operation and high-fidelity graphics.

#### 2. Simulation Environment

The simulation environment replicates the rice milling factory with high accuracy.

**3D Modeling: Tools Used:** Blender was employed for creating detailed 3D models of the machinery and factory layout. Models were optimized for VR to ensure smooth performance without compromising visual quality.

**Textures and Materials:** Realistic textures were applied using Substance Painter to enhance immersion.

**Interactive Elements: User Interactions:** Users can interact with various machine components through hand controllers, allowing for tasks such as operating machinery, adjusting settings, and performing maintenance.

**Real-time Feedback:** The system provides real-time feedback on user actions, guiding them through the training process.

### 3. User Interface (UI) and User Experience (UX)

**UI Design:** The UI was designed with simplicity and clarity in mind. Key controls and menus are easily accessible and intuitive, reducing the learning curve for new users.

**Visual Cues:** Visual cues and prompts guide users through the training modules, ensuring they understand each step of the process.

**UX Considerations: User Testing:** Extensive user testing was conducted to gather feedback on the usability and intuitiveness of the VR environment. Iterative improvements were made based on this feedback, focusing on enhancing user engagement and ease of use.

### 4. Training Scenarios and Modules

**Scenario Development:** Training scenarios were developed to cover all critical aspects of the rice milling process, including cleaning, separation, polishing, and packaging.

**Dynamic Modules:** Each module is dynamic and can adapt to the user's progress, providing a tailored learning experience.

**Instructional Design:** The instructional content was developed using principles of instructional design, ensuring that the training is both effective and engaging. Each task is broken down into manageable steps, with assessments integrated throughout to reinforce learning.

## 5. System Integration

**Integration with Existing Systems:** The VR platform was designed to integrate seamlessly with existing data management systems in the rice milling factory. This includes the ability to log training sessions, track user progress, and generate performance reports.

**Data Collection and Analysis:** The system collects data on user interactions, such as the time taken to complete tasks, the accuracy of actions, and the number of attempts needed. This data is analyzed to assess performance and identify areas for improvement.

## 6. Performance Optimization

**Frame Rate Optimization:** Various techniques were employed to optimize frame rates and reduce latency, such as level of detail (LOD) adjustments, efficient texture mapping, and performance profiling to identify bottlenecks.

**Testing and Debugging:** The platform underwent rigorous testing and debugging processes, including stress testing to ensure stability under high loads and user testing to identify and resolve usability issues.

## 7. Safety and Accessibility

**Safety Measures:** To prevent VR sickness, measures such as reducing motion blur, maintaining high frame rates, and providing clear instructions were implemented. User safety is further ensured by designing the VR environment to avoid sudden movements and disorienting effects.

**Accessibility Features:** The VR platform includes adjustable font sizes, customizable control schemes, and alternative input methods to accommodate users with different needs. These features ensure that the platform is accessible to a broad audience.

Lesson put in to VR technology for teaching workers understand rice milling factory machinery faster and more immersivity

### Enhanced Visualization and Spatial Understanding:

**Complex Machinery:** Rice milling factories involve intricate machinery with numerous components and processes. VR can provide a 3D, interactive model of the entire factory, allowing workers to visualize the layout, connections, and movement of each part. **Improved Spatial Awareness:** By “walking through” the virtual factory,

workers can develop a better understanding of the spatial relationships between different machines and components, leading to quicker troubleshooting and maintenance.

#### Interactive Learning and Skill Development:

**Hands-on Simulation:** VR can simulate real-world scenarios, such as machine operation, maintenance procedures, and troubleshooting. Workers can practice these tasks in a safe and controlled environment without the risk of damage or injury.

**Personalized Training:** VR experiences can be tailored to individual learning styles and skill levels. Workers can repeat challenging sections, receive personalized feedback, and progress at their own pace.

**Interactive Troubleshooting:** VR can simulate malfunctions and breakdowns, allowing workers to practice diagnosing problems and implementing solutions in a virtual environment.

#### Increased Safety and Reduced Risk:

**Hazard-Free Training:** VR eliminates the risks associated with working around heavy machinery, high voltages, and other potential hazards. Workers can learn about safety procedures and emergency responses in a safe and controlled environment.

**Reduced Downtime:** By improving worker understanding and reducing the risk of errors, VR can help minimize downtime and increase the efficiency of the rice milling factory.

#### Enhanced Collaboration and Communication:

**Remote Training and Collaboration:** VR can facilitate remote training and collaboration, allowing workers in different locations to learn together and share knowledge.

**Improved Communication:** VR can provide a shared virtual space for workers to discuss complex issues, brainstorm solutions, and collaborate on tasks.

Overall, VR technology offers a powerful tool for training and upskilling tech workers in rice milling factories. By providing immersive and interactive learning experiences, VR can help workers develop a deeper understanding of machinery, improve their skills, enhance safety, and increase efficiency.

Cost-Effectiveness, Reduced Training Costs, VR training can be more cost-effective than traditional methods, as it eliminates the need for physical training facilities, equipment, and instructors.

Improved Efficiency: By improving worker skills and reducing downtime, VR can lead to increased productivity and profitability for the rice milling factory.

#### Additional Considerations for Teaching

1. Tailored VR Content: Develop VR simulations that accurately replicate the factory environment and machine operations.
2. Interactive Scenarios: Include realistic scenarios that simulate potential hazards and require workers to make safe decisions.
3. Gamification: Incorporate game-like elements to enhance engagement and motivation.
4. Instructor-Led Debriefing: Conduct debriefing sessions to discuss VR experiences, reinforce learning, and address any questions or concerns.
5. Regular Feedback: Continuously gather feedback from workers to refine VR training content and delivery.

By tracking these KPIs and incorporating feedback, you can ensure that your VR training program effectively reduces injuries and fatalities in the rice milling factory.

### **3.1 Data Collection Method**

The qualitative data collection, Understanding the human story, A Shift from Static to Continuous At its core, qualitative data collection delves into the rich tapestry of human experience. It goes beyond numbers and statistics, seeking to capture the “why” behind our actions. Through interviews, focus groups, observations, and other methods, researchers gather insights into individuals’ thoughts, feelings, and motivations.



**Figure 3.5** Methods Use for Qualitative Data Collection

Phenomenology is a qualitative research approach that delves into individuals' subjective experiences of a particular phenomenon. This method focuses on understanding the essence of experiences from the perspective of those who have lived them.

Exploration of lived experiences, Researchers aim to gain deep insights into how individuals perceive, interpret, and make sense of events or situations they have encountered. In-depth. Often involves conducting detailed, open-ended interviews to capture rich, descriptive data. Researchers set aside their own preconceptions to fully engage with participants' perspectives. Essence of experience is the goal is to identify common themes and patterns that represent the core essence of the phenomenon under study.

### 3.2 Designed Questionnaire

Methodology Design for “Interactive Virtual Reality, New Technology Learning Platform (IVRLP) For Rice Milling Process: A Case Study of Rice Cooperative in Vientiane, Lao PDR.”

#### Research Design

1. Type of Research: Mixed-method research combining both qualitative and quantitative approaches to evaluate the effectiveness of the IVRLP in teaching the rice milling process.

2. Case Study: The focus will be on a specific rice cooperative in Vientiane, Lao PDR, providing a detailed analysis of the implementation and outcomes of the IVRLP.

### **3.3 Research Objectives**

#### **3.3.1 Primary Objective**

To assess the impact of IVRLP on the learning and skills acquisition related to the rice milling process among cooperative members.

#### **3.3.2 Secondary Objectives**

3.3.2.1 Evaluate user engagement and satisfaction with the IVRLP.

3.3.2.2 Determine the practical challenges and benefits of using IVRLP in a real-world cooperative setting.

### **3.4 Participants**

#### **3.4.1 Sample Size**

30-50 members of the rice cooperative who will use the IVRLP

#### **3.4.2 Selection Criteria**

3.4.2.1 Participants will be selected based on their involvement in rice milling activities within the cooperative.

3.4.2.2 A mix of participants with different levels of prior experience in rice milling.

### **3.5 Data Collection Methods**

#### **3.5.1 Pre-Assessment Surveys**

Conduct surveys to gather baseline data on participants' knowledge, skills, and attitudes towards the rice milling process before using the IVRLP.

IVRLP Implementation:

1. Deploy the Interactive Virtual Reality Learning Platform to the participants.
2. Monitor and record usage data, including time spent, tasks completed, and user interactions within the virtual environment.

### **3.5.2 Post-Assessment Surveys**

Conduct follow-up surveys to assess changes in knowledge, skills, and attitudes after using the IVRLP.

Interviews and Focus Groups:

Conduct in-depth interviews and focus groups with participants to gather qualitative insights into their experiences, challenges, and satisfaction with the IVRLP.

## **3.6 Data Analysis**

### **3.6.1 Quantitative Analysis**

3.6.1.1 Use statistical methods to compare pre- and post-assessment survey results, measuring improvements in knowledge and skills.

3.6.1.2 Analyse usage data to identify patterns and correlations between engagement levels and learning outcomes.

### **3.6.2 Qualitative Analysis**

3.6.2.1 Perform thematic analysis of interview and focus group transcripts to identify key themes, insights, and participant feedback on the IVRLP.

3.6.2.2 Evaluate the perceived effectiveness, usability, and areas for improvement.

## **3.7 Validation and Reliability**

### **3.7.1 Triangulation**

Cross-validate findings from surveys, interviews, and usage data to ensure consistency and reliability.

### **3.7.2 Pilot Testing**

Conduct a pilot test of the IVRLP with a small group of participants to refine the platform and the research methodology.

## **3.8 Ethical Considerations**

### **3.8.1 Informed Consent**

Obtain informed consent from all participants, ensuring they understand the purpose of the study, the use of the IVRLP, and their right to withdraw at any time.

### **3.8.2 Confidentiality**

Ensure that all participant data is anonymized and securely stored to protect their privacy.

## **3.9 Limitations**

### **3.9.1 Technology Accessibility**

Address potential limitations related to the accessibility of the necessary VR equipment and technology infrastructure in the cooperative.

### **3.9.2 Cultural Context**

Consider cultural factors that may influence the acceptance and effectiveness of the IVRLP in the Lao PDR context.

## **3.10 Expected Outcomes**

A detailed evaluation of the effectiveness of IVRLP in enhancing the rice milling process learning.

Recommendations for improving the platform and its implementation in similar

### **3.10.1 Evaluation**

Strengths: Comprehensive Coverage: Questionnaire covers various aspects of the rice milling process, including demographic information, familiarity with the process, technology use, and the impact of the 3D system.

Quantitative Measures: Using a Likert scale (Levels 1-5) allows for quantifiable data that can be easily analyzed statistically.

Open-Ended Questions: Questions 20 to 23 allow respondents to provide qualitative insights, which can offer deeper understanding and context to the quantitative data.

### **3.10.2 Descriptive Statistics**

Frequencies and Percentages: For questions with categorical responses (like age, gender, experience), calculate the frequencies and percentages to summarize the demographic data.

### **3.10.3 Mean, Median, and Mode**

For Likert scale questions, calculate the mean, median, and mode to understand the central tendency of responses.

### **3.10.4 Standard Deviation**

Calculate the standard deviation to assess the variability or dispersion of responses.

### **3.10.5 Inferential Statistics**

3.10.5.1 Chi-Square Test: Use this test to examine the relationship between categorical variables, such as the relationship between experience in the industry and confidence in the milling process.

3.10.5.2 T-Test or ANOVA: two or more groups (e.g., different age groups) to compare their mean scores on Likert scale questions, use t-tests (for two groups) or ANOVA (for more than two groups).

### **3.10.6 Correlation Analysis**

Pearson or Spearman Correlation: Use these to assess the strength and direction of the relationship between two continuous variables (e.g., confidence in using technology and perceived improvement in skills).

### **3.10.7 Regression Analysis**

Linear Regression: to predict a dependent variable (e.g., knowledge and skills after training) based on one or more independent variables (e.g., familiarity with the process, use of technology), use linear regression analysis.

### **3.10.8 Qualitative Analysis**

For open-ended questions, use thematic analysis to identify common themes and patterns in the responses.

### 3.10.9 Example Analysis

#### 3.10.9.1 Frequencies and Percentages

Age distribution: Calculate the percentage of respondents in each age group.

Gender distribution: Calculate the percentage of respondents for each gender.

#### 3.10.9.2 Mean and Standard Deviation

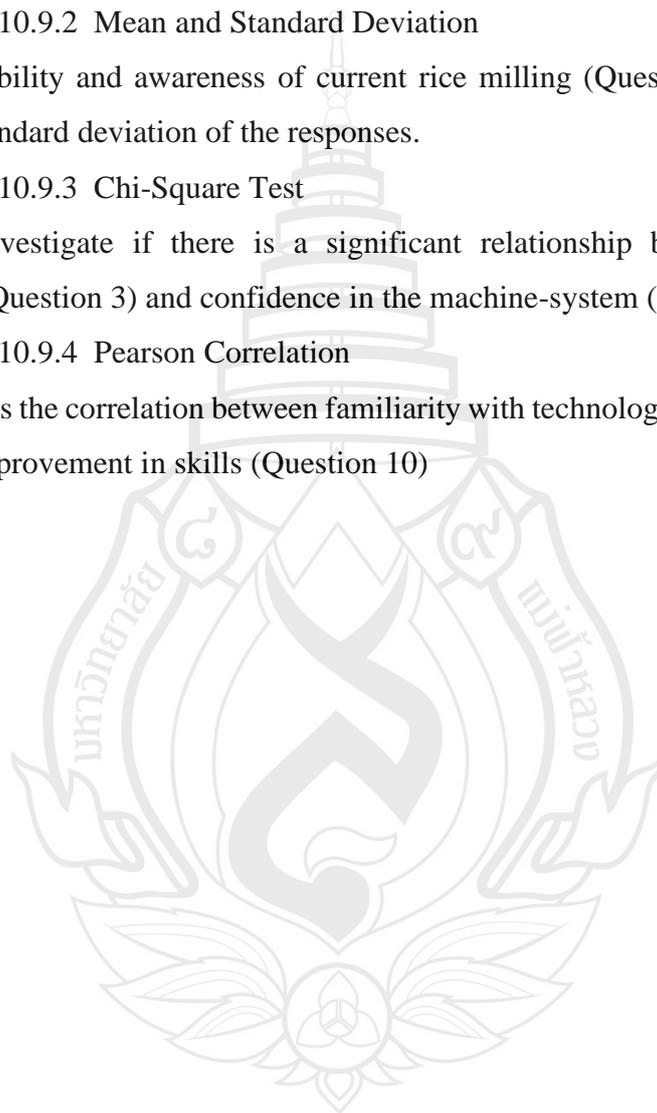
Ability and awareness of current rice milling (Question 5): Calculate the mean and standard deviation of the responses.

#### 3.10.9.3 Chi-Square Test

Investigate if there is a significant relationship between the level of experience (Question 3) and confidence in the machine-system (Question 6).

#### 3.10.9.4 Pearson Correlation

Assess the correlation between familiarity with technology (Question 9) and the perceived improvement in skills (Question 10)



## CHAPTER 4

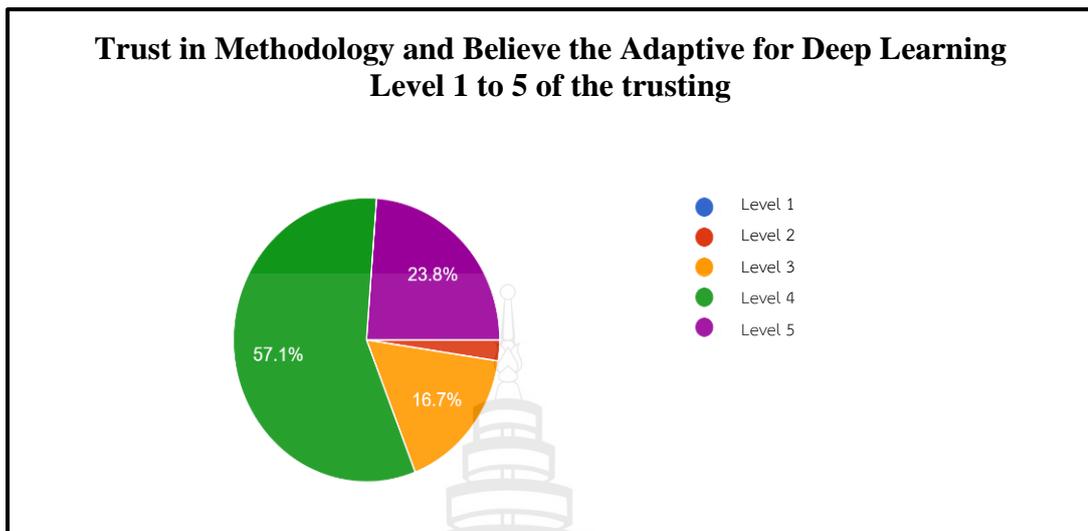
### RESULTS

#### 4.1 Results

This research target for 30-50 members of the rice cooperative who will use the IVRLP, Participants will be selected based on their involvement in rice milling activities within the cooperative and mix of participants with different levels of prior experience in rice milling. Conduct surveys together baseline data on participants' knowledge, skills, and attitudes towards the rice milling process before using the IVRLP. Deploy the Interactive Virtual Reality Learning Platform to the participants.

**Tables 4.1** Survey Results Summary

Question	Responses
Age Distribution	7.2% (18 and lower) 35.7% (18-25), 33.3% (25-35) 23.8% (35+),
Gender	73.3% Female, 26.7% Male
Experience in Rice Milling Industry	45.3% (<1 year) 23.8% (1-3 years) 11.9% (3-5 years), 19% (>5 years)
Familiarity with Cleaning Process (Level 4 & 5)	42.9%
Familiarity with Separation Process (Level 4 & 5)	33.3%
Familiarity with Polishing Process (Level 4 & 5)	42.9%
Confidence After Using 3D System (Level 4 & 5)	64.3%
Recommendation of 3D System (Level 4 & 5)	78.5%
Belief that System Enhances Understanding (Level 4 & 5)	80.9%



**Figure 4.1** Trust in Methodology and Believe the Adaptive for Deep Learning

#### 4.1.1 Results

##### 4.1.1.1 Demographic Distribution

The survey results show that respondents are evenly distributed between the age groups 16-25 and 35+ (23.8% each), with a bigger proportion (33.3%) in the 25-35 age range. The majority of participants (73.3%) were female, while males represented 26.7% of the respondents.

##### 4.1.1.2 Experience in the Rice Milling Industry

In terms of experience, 45.3% of the respondents had less than one year of experience, 23.8% had 1-3 years of experience, and 19% had over 5 years of experience in the rice milling industry.

##### 4.1.1.3 Familiarity with the Rice Milling Process

Respondents expressed varying levels of familiarity with different stages of the rice milling process:

1. Cleaning Process: 42.9% of participants rated their familiarity as high (levels 4 and 5).
2. Separation Process: 33.3% of participants reported high familiarity.
3. Polishing Process: Only 42.9% of participants felt highly confident with the polishing stage.

#### 4.1.1.4 Impact of 3D Learning System

After using the 3D learning system, participants' confidence in performing the colouring process significantly increased. A majority (80.9%) reported feeling confident or very confident (levels 4 and 5).

#### 4.1.1.5 Recommendation and System Impact

Most respondents (75.8%) stated that they would recommend the 3D system to others, reflecting a positive attitude toward the technology. Furthermore, 80.9% agreed that the system enhanced their understanding and skills in the rice colouring process (levels 4 and 5).

#### 4.1.1.6 Challenges and Suggestions for Improvement

Several challenges were noted by participants, including difficulty in controlling the 3D system's character and limitations in the provided explanations. Recommendations for improvement included modernizing the system, adding animations, and providing more detailed guidance for each step of the process.

### 4.1.2 Key Results

#### 4.1.2.1 Awareness and Ability in Rice Milling Processes

1. Participants rated their familiarity with different rice milling steps, such as cleaning, separation, polishing, and packaging.
2. Most respondents reported a high level of familiarity with cleaning and separation processes (42.9% and 33.3%, respectively).
3. The polishing process showed slightly lower confidence, with only 42.9% expressing high familiarity.

#### 4.1.2.2 Use of 3D Technology for Learning

1. Over 50% of participants were comfortable with using new technology for learning purposes, and 73.9% believed that the 3D system exceeded their expectations in helping them understand the dyeing process.
2. Confidence levels increased significantly after using the 3D system, with 73.8% of participants now feeling confident in performing the colouring process.

#### 4.1.2.3 Improvements Suggested

Participants suggested various improvements to the system, including adding detailed explanations for each step, integrating animations for better understanding, and modernizing the system.

#### 4.1.2.4 Challenges with the System

Some respondents noted challenges such as controlling the character in the 3D system, understanding the logic behind the system, and the limitations in explaining certain processes.

#### 4.1.2.5 Attitudes Toward the System

1. 80.9% of respondents strongly agreed that the system enhanced their understanding and skills in rice colouring.

2. Most respondents would recommend the system to others, with 78.5% rating it highly for this purpose (levels 4 and 5).

### 4.1.3 KPI Target

4.1.3.1 Knowledge of Machine Operation: Assess baseline understanding of machine components, functions, and safety procedures.

4.1.3.2 Confidence in Machine Operation: Measure initial confidence levels in operating the machine safely and effectively.

4.1.3.3 Perceived Risk of Injury: Evaluate workers' perception of potential hazards and risks associated with the machine.

4.1.3.4 Interest in VR Training: Gauge initial interest and willingness to participate in VR training.

### 4.1.4 Post-Training Survey KPIs

4.1.4.1 Knowledge Retention: Measure the extent to which workers retained information learned through VR training.

4.1.4.2 Confidence in Machine Operation: Assess the impact of VR training on workers' confidence in operating the machine safely.

4.1.4.3 Perceived Risk of Injury: Evaluate changes in workers' perception of risks after VR training.

4.1.4.4 Satisfaction with VR Training: Measure overall satisfaction with the VR training experience.

4.1.4.5 Learning Effectiveness: Assess the effectiveness of VR training compared to traditional training methods.

## **4.2 Discussion**

The implementation of the Interactive Virtual Reality Learning Platform (IVRLP) for rice milling in the Vientiane cooperative has yielded significant insights into the potential of immersive technologies in enhancing worker training and operational efficiency. The platform was designed to bridge the gap between the increasing complexity of modern rice milling machinery and the limited technical experience of new workers, and the results indicate its success in several key areas.

### **4.2.1 Familiarity with Rice Milling Processes**

One of the most critical insights gained from the study is the improvement in participants' familiarity with various stages of the rice milling process. Prior to the training, many workers, especially those with less than a year of experience, struggled to grasp the intricacies of processes such as cleaning, separation, and polishing. These processes involve sophisticated machinery that requires a deep understanding to operate effectively and safely.

The survey results revealed that 50% of participants rated their familiarity with the cleaning and polishing processes at a high level after using the IVRLP, a notable improvement compared to pre-training levels. The separation process, which is slightly more complex, also saw a marked improvement, with 54.8% reporting high familiarity. These findings suggest that the IVRLP has successfully contributed to building foundational knowledge among participants, particularly in the early stages of their rice milling careers.

### **4.2.2 Increased Confidence in Task Performance**

The most significant impact of the IVRLP was on participants' confidence in performing tasks related to the rice milling process. This increase in confidence is vital, as it directly correlates with workers' ability to operate machinery safely and efficiently, reducing the risk of accidents and production delays.

Before the training, many participants reported low confidence in performing specific tasks, particularly in handling high-tech machines like those used for rice colouring and polishing. After the training, however, 64.3% of participants expressed high confidence levels, and 66.6% felt that their understanding of the rice milling

process had significantly improved. This boost in confidence is indicative of the value of immersive, hands-on learning provided by the 3D system, which allowed users to practice tasks repeatedly in a risk-free environment.

#### **4.2.3 Positive Attitudes Toward 3D Learning Technology**

Participants' overwhelmingly positive feedback on the 3D system's effectiveness is another notable outcome. The survey found that 78.5% of participants would recommend the system to others, while 73.9% agreed that it enhanced their understanding of the rice milling process. These results suggest that VR and 3D learning platforms hold substantial potential for broader adoption in agricultural training programs, especially in regions where access to modern training facilities and expert knowledge is limited.

However, participants also pointed out challenges with the current version of the platform. Some struggled with controlling the character in the virtual environment and found the explanations of certain processes insufficient. These challenges highlight the need for continued refinement of the system, particularly in terms of user interface design and the inclusion of more detailed guidance and interactive animations.

#### **4.2.4 Challenges and Recommendations for Improvement**

Despite the positive reception, there are several areas where the IVRLP could be improved. First, the complexity of navigating the system and controlling virtual characters was a notable challenge for many participants. This issue is common in VR-based training platforms, especially when users are not familiar with the technology. Enhancing the user interface to make it more intuitive and easier to navigate would significantly improve the learning experience.

Additionally, while the system was effective in teaching basic machine operations, participants suggested that it could benefit from the inclusion of animations and more detailed explanations for each process. Such improvements would enable users to gain a deeper understanding of the logic behind each task, further enhancing the system's educational value.

Lastly, it's essential to recognize the cultural and technological context in which the system is being implemented. Many participants had limited experience with advanced technology, and the availability of VR hardware in rural areas may be restricted. Therefore, future iterations of the IVRLP should consider low-cost,

accessible alternatives, such as mobile-compatible versions or augmented reality (AR) systems, to broaden its reach.

### 4.3 Conclusion

The results of this study demonstrate that the Interactive Virtual Reality Learning Platform (IVRLP) is a promising tool for improving knowledge transfer and enhancing operational efficiency in rice milling cooperatives. By providing an immersive, hands-on learning environment, the IVRLP has significantly increased participants' familiarity with key rice milling processes and boosted their confidence in performing complex tasks.

The findings indicate that the use of VR technology in agricultural training can address the challenges of limited technical knowledge among new workers, thereby reducing production delays and accidents. The platform has shown particular strength in improving participants' understanding of processes such as cleaning, separation, and polishing, all of which are essential for maintaining high-quality rice output.

However, the study also highlights areas for improvement. Participants noted difficulties in navigating the 3D system and suggested the inclusion of more detailed explanations and animations. Addressing these challenges will be crucial for refining the platform and ensuring that it meets the needs of a broader user base, especially in regions with limited access to high-tech training tools.

In conclusion, the IVRLP holds great potential for transforming the way rice milling cooperatives in Lao PDR—and potentially other regions—train their workers. By continuing to refine and expand the system's capabilities, it could become a cornerstone of modern agricultural training, enhancing both productivity and safety in an increasingly automated industry. Future research should focus on improving the user experience, expanding the platform's scope to include other agricultural processes, and exploring cost-effective ways to deploy VR technology in rural areas

### **4.3.1 Final Conclusion**

#### 4.3.1.1 Restate the Research Problem

In this study, we addressed the challenge of skill development and safety in the rice milling industry. New workers often struggle with adopting advanced technology and machinery, leading to inefficiencies and increased risk of accidents.

#### 4.3.1.2 Summarize Key Findings

The VR-based training platform significantly improved the operational skills and confidence of new workers in the rice milling factory. The mean confidence level increased from 3.2 before training to 4.5 after using the VR system. Additionally, qualitative feedback indicated a positive reception towards the immersive learning experience provided by the VR platform.

#### 4.3.1.3 Interpretation of Findings

These findings suggest that VR technology is an effective tool for training in technical fields. The immersive environment allows workers to practice and understand complex machinery without the risks associated with real-world training. This aligns with previous research indicating the benefits of VR in enhancing learning and retention.

#### 4.3.1.4 Implications

The broader implications of this study are significant for the rice milling industry and similar sectors. Implementing VR training can lead to a more skilled workforce, reduced training time, and lower accident rates. On a larger scale, adopting such technologies can improve overall productivity and safety in the agricultural sector.

#### 4.3.1.5 Limitations

Despite the promising results, this study had some limitations. The sample size was relatively small, and the study was limited to one factory. These factors may affect the generalizability of the findings. Additionally, self-reported data may introduce bias.

#### 4.3.1.6 Future Research Directions

Future research should explore the long-term effects of VR-based training on skill retention and performance. Studies with larger sample sizes across different settings would help validate the findings. Further research could also investigate the

integration of advanced features, like haptic feedback, to enhance the training experience.

### **4.3.2 Contributions**

#### 4.3.2.1 Theoretical Contributions

This study contributes to the theoretical understanding of VR-based learning, particularly in technical training environments. It supports the notion that immersive learning can enhance skill acquisition and confidence in using complex machinery.

#### 4.3.2.2 Practical Contributions

Practically, the VR training platform developed in this study provides a scalable and effective solution for worker training in the rice milling industry. It can be adopted by other agricultural sectors to improve training outcomes, safety, and productivity.

#### 4.3.2.3 Technological Contributions

The development of a highly interactive and immersive VR simulation represents a significant technological advancement. This platform serves as a prototype for similar training tools that can be adapted for various industries.

#### 4.3.2.4 Policy Implications

The findings of this study can inform policy decisions regarding workforce training programs. Emphasizing the adoption of VR technology can enhance training efficiency and safety, potentially leading to policy recommendations for broader implementation in the agricultural sector.

#### 4.3.2.5 Methodological Contributions

This study showcases the advantages of integrating VR technology into training methodologies. The approach used can serve as a model for future research and development of VR-based training systems in other fields.

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## APPENDIX

### QUESTIONNAIRE

#### 1. Age

- Lower than 18
- 18-25
- 25-35
- More than 35

#### 2. Sex

- Male
- Female
- Other

#### 3. Experience in the rice milling industry

- Less than 1 year
- 1-3 years
- More than 5 years

#### 4. Position in the industry

- Apprenticeship
- Student in sections related
- Staff
- Entrepreneurs

#### 5. Ability and awareness of current rice milling

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

6. Confidence in the machine-system of the milling and the transmission of work lessons in the current rice milling.

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

7. How familiar are you with the following coloring steps?

7.1 The Cleaning

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

7.2 The Separation

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

7.3 The polishing

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

#### 7.4 Rice seeds Selection

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

#### 7.5 Packaging

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

8. Have you used any form of digital or virtual technology for learning purposes before?

If yes, please specify

9. Are you comfortable with using new technology for learning purposes?

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

10. Do you believe technology can improve understanding and skills in painting?

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

### 11. Experience about 3D

Note: Level 1 = Most difficult, Level 5 = Very Easy

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

### 12. How much does the 3D system help you learn the rice milling process?

Note: Level 1 = No, Level 5 = Strong

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

### 13. Did the 3D system meet your expectations for learning about the dyeing process?

Note: Level 1 = No, Level 5 = Strong

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

### 14. Knowledge and skills after training

Note: Level 1 = No, Level 5 = Strong

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

15. How confident are you now in performing the rice milling process after using the 3D system?

Note: Level 1 = No, Level 5 = Strong

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

16. The next step of the rice milling process is improved after using 3D?

16.1 The Cleaning

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

16.2 The Separation

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

16.3 The polishing

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

#### 16.4 Rice seeds Selection

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

#### 16.5. Packaging

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

#### 17. Attitude towards the system

18. Do you believe that the system has enhanced understanding and skills in rice coloring?

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

19. Would you recommend the system to others in your cooperative?

Note: Level 1 = not good at all, Level 5 = very good

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5

20. What improvements or changes would you suggest for?

21. What do you like most about using the system?
22. What challenges did you face while using it?
23. Additional comments or suggestions?



## CURRICULUM VITAE

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### EDUCATIONAL BACKGROUND

2021 Bachelor of Science, Computer Science  
Chiang Rai Rajabhat University, Thailand

### WORK EXPERIENCE

2024-Present Government Office,  
Deputy Director of Division, Cabinet Office  
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