International Journal of Innovative Research and Scientific Studies, 8(2) 2025, pages: 1348-1358

ISSN: 2617-6548

URL: www.ijirss.com

The impact of smart aquaculture environmental characteristics and system quality on acceptance intentions through value recognition of the fisheries industry in the era of AI

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Abstract

The global fisheries industry plays a critical role in providing essential nutrients and animal protein to humanity. However, the industry is undergoing a rapid paradigm shift due to technological advancements and demographic changes, particularly the aging population in fishing villages. This study aims to analyze how smart aquaculture environmental characteristics and system quality in the AI era influence the acceptance intention of these technologies through the recognition of the value of the fishery industry. This study employs an empirical approach to assess the impact of smart aquaculture on the fisheries sector. The research utilizes Smart PLS 4.0 for statistical analysis, drawing data from individuals engaged in or interested in the fishery industry. The study focuses on evaluating the relationship between smart aquaculture environmental characteristics, system quality, value perception of the fisheries industry, and acceptance intention of AI-driven technologies. The results indicate that the higher the impact of smart aquaculture environmental characteristics and system quality on the value perception of the fisheries industry, the stronger the acceptance intention of AI-driven technologies. This confirms that enhancing technological infrastructure and system efficiency significantly contributes to the greater adoption of smart aquaculture solutions. The study highlights the transformative role of AI-based automation and ICT convergence technology in the fisheries industry. As smart aquaculture continues to evolve, its adoption is influenced by how stakeholders perceive its value. The findings emphasize that technological advancements must be accompanied by efforts to enhance users' trust and understanding of AI-driven systems. The study provides valuable insights for policymakers, stakeholders, and industry professionals. By leveraging system quality and social influence factors, stakeholders can enhance the adoption of smart aquaculture technologies. Addressing challenges such as an aging workforce and improving fishery production efficiency through AI-driven smart systems will contribute to the long-term sustainability and competitiveness of the fisheries industry.

Keywords: Acceptance intention opportunity capture, Process improvement, Smart aquaculture environmental characteristics, Smart aquaculture system quality, Value recognition of fisheries.

DOI: 10.53894/ijirss.v8i2.5463
Funding: This work was supported by Dongwon Research Foundation in 2024. (Grant Number: 202404140001).
History: Received: 23 January 2025 / **Revised:** 25 February 2025 / **Accepted:** 3 March 2025 / **Published:** 18 March 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Institutional Review Board Statement: Not applicable.
Publisher: Innovative Research Publishing

1. Introduction

Globally, the fisheries industry is recognized as an important sector as it provides essential nutrients to mankind and serves as a food industry that supplies animal protein [1]. In addition, the current fisheries industry is facing a rapid paradigm shift. The domestic fisheries sector continues to decline in the coastal fishing industry, and the problem of depletion of fish stocks in the East Sea, the West Sea, and the South Sea persists. Fishing villages, which are the backbone of the fisheries industry, are suffering from hollowing out and intensifying aging due to the increase in urban migration of the production population. This situation acts as an obstacle to the development of the fisheries industry, which is a labor-intensive primary sector, and is a major factor in the decrease in production in conjunction with the depletion of fish stocks.

To overcome this problem, the Ministry of Oceans and Fisheries is promoting the transition to the secondary industry through the industrialization of aquaculture in the primary fisheries sector. The Ministry is striving to develop technology for smart aquaculture systems to revitalize the fishery industry. The technological development of the 4th Industrial Revolution is crucial to increasing the competitive advantage of the fisheries industry amid the continuous and long-term aging of fishing villages [2]. With the emergence of 4th Industrial Revolution technology amid the paradigm shift in the fisheries industry, a transformation is taking place within the aquaculture and fisheries sector. The development into an excellent smart farm is inevitably progressing. From remote monitoring and passive control-based services through mobile devices in the early stages, it has recently evolved into an artificial intelligence-based automation system capable of collecting and analyzing big data and optimizing production environment control and management after analysis [3].

Recently, policies related to smart aquaculture are being intensively promoted in Korea. The smart aquaculture project, initiated by the government, aims to develop and distribute advanced eco-friendly aquaculture technologies within the existing labor-intensive aquaculture system and to establish a solid aquaculture foundation. The government is promoting technology development and on-site demonstrations related to smart aquaculture in a dual manner and is currently advancing the project to increase fish capacity to revitalize smart aquaculture [4]. The 4th Industrial Revolution, anticipated through the trend of technological development, is expected to be deeper and more advanced than the previous information age. This 4th Industrial Revolution is also relevant to the fisheries industry. With the enactment and promulgation of the Growing Fisheries Promotion Act in 2001, Korea's aquaculture industry has grown significantly under the government's intensive support. However, due to the rapid growth of aquaculture in a short period, the inflow of land pollutants at fishing grounds, environmental degradation caused by self-pollution, an increase in the frequency of diseases in aquaculture products due to long-term aging, and a circulating structure of disease spread are becoming entrenched [5]. Additionally, it is inevitable that AI-based fisheries will transition to develop the aquaculture industry into an advanced country-type future industry, considering the recent megatrend in the industry as a whole and the current status of the aquaculture sector [6].

The information age is revealing new possibilities as time and space expand. ICT technology, which is developing innovatively, will be the key to succeeding in the 4th Industrial Revolution. We will empirically study how this smart aquaculture system impacts the environment and system quality of the fisheries industry. It will be a foundational study that attempts to connect the fishery environment and the 4th Industrial Revolution. In this paradigm of environmental change, I would like to present the development direction of the fishery industry.

This study investigated the effect of smart aquaculture environmental characteristics (investment value, policy support, industrial standardization, social impact) on the value recognition (opportunity capture, process improvement) and acceptance intention of the fishery. The environmental characteristics and cysteresis of smart aquaculture were set as independent variables, and the value recognition of the fishery was established as parameters affecting acceptance intention. This is a study that empirically analyzes environmental factors for smart aquaculture systems in the fishery.

Previous studies have consistently conducted research on smart aquaculture systems. However, research results that mediate the value recognition of the fisheries industry with these smart aquaculture environmental characteristics and system quality are insufficient. In this study, we will analyze how smart aquaculture environmental characteristics and system quality affect acceptance intention in the AI era. Therefore, this study will empirically conduct an analysis of how smart aquaculture environmental characteristics and system quality affect acceptance intention by examining the characteristics provided to fisheries. Consequently, smart aquaculture environmental characteristics were classified into investment value, policy support, industrial standardization, and social impact as causal variables affecting the value recognition of the fisheries industry, while smart aquaculture system quality was classified into system availability and security. Finally, the value recognition of the fishery was adopted as a parameter affecting acceptance intention.

The study aims to analyze the characteristics of the smart aquaculture environment and system quality that affect the value recognition and acceptance intention of the fisheries industry. The subjects of this study are the general public or those interested in the fishery industry, and Smart PLS 4.0 was used for statistical analysis. This study is likely to provide differentiated services to fishermen who utilize smart aquaculture environmental characteristics and system quality in the AI era.

This study fills this gap by introducing a comprehensive framework that links environmental characteristics, system quality, and value recognition to acceptance intentions. By doing so, it addresses the lack of empirical studies that integrate these elements and highlights their implications for stakeholders in the fisheries industry.

2. Literature Review

This study is grounded in the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use influence users' intention to adopt new technologies. By extending TAM, this research incorporates environmental and system quality factors to understand their impact on value recognition and acceptance intentions in the context of smart aquaculture. While the original TAM focuses primarily on perceived ease of use and usefulness, the model has been extended over time to include additional factors that can influence technology adoption, such as social influence, trust, and environmental characteristics. In the context of smart aquaculture, this study builds on TAM by incorporating environmental characteristics (such as investment value, policy support, industrial standardization, and social impact) and system quality (including system availability and security). These additional factors are hypothesized to influence value recognition (such as opportunity capture and process improvement) and, ultimately, the acceptance intention of smart aquaculture systems in the fisheries industry.

2.1. Environmental Characteristics of Smart Aquaculture

Companies want to gain a competitive advantage in the 4th Industrial Revolution. The fisheries industry, which has a competitive advantage, can maintain its competitiveness when linked to external industries. It is said that such linkage with external industries is closely related to technologies of the 4th Industrial Revolution, such as artificial intelligence and big data. Changes in external environmental characteristics can affect the smart aquaculture system of the fisheries industry. Smart farming is known to be at the level of monitoring technology using ICT technology by consultation. Smart farming is developing into a concept that includes artificial control based on the optimal growth environment, such as the recent development of an individual adaptive feed feeder based on big data analysis and the application of water quality environment control functions to fish farms [4]. Through the analysis of this preceding study, key factors of policy, economy, society, and technology surrounding the artificial intelligence-based smart aquaculture industry were derived, and a mid-term to long-term development model of future smart farming was established accordingly. In this study, investment value, policy support, industrial standardization, and social impact were classified as smart farming environmental characteristics factors and defined as follows.

2.2. Investment Value

The economic environment analysis was based on the examination of economic indicators related to the fisheries and aquaculture industry and the overall status. The economic indicators for the overall fisheries industry are as follows.

Table 1.
Fisheries economic indicators.

Category	Index	Reference Year
Total Sales of Fisheries Industry	67.2 trillion KRW	2017
Domestic Fisheries Production Value	8.6 trillion KRW	
Overseas Fisheries Imports Value	5.2 trillion KRW	
Import Ratio vs. Production Value	40.8%	
Domestic Fisheries Production Volume	3.76 million tons	
Overseas Fisheries Import Volume	1.48 million tons	
Domestic Aquaculture Production Volume	2.31 million tons	
Domestic Fisheries Production Volume	1.45 million tons	
Annual Fish Consumption per Capita	58.4 kg	2013~2015
Global Rank for Fish Consumption per Capita	1st	

The annual domestic fishery consumption per capita is 58.4 kg, ranking first worldwide. It is also rapidly increasing globally, and as Korea's external competitiveness rises and the economy grows, the proportion of overseas imports to domestic fishery production reached 40.8% in 2017, which is considered a hindrance to national fisheries independence. On the other hand, experts explain that it is an industry with high growth potential along with the crisis as the import scale of the domestic fisheries market grows, and they analyze that import should be replaced by dramatically increasing domestic production through long-term industrial promotion policies.

2.3. Policy Support

The policies of major aquaculture countries worldwide have mainly promoted initiatives to increase aquaculture products, scale aquaculture, protect ecosystems, and support reconstruction and environmental protection. To induce scale-up, efforts are being made to expand aquaculture production facilities and areas, as well as to standardize aquaculture facilities and methods. Policies for fostering a sustainable aquaculture industry are being expanded by managing aquaculture wastewater to prevent secondary damage caused by the protection of fishery resources and the development of eco-friendly production technology [1]. Key considerations in analyzing the policy environment can be divided into related laws and government policies, including private support projects. The Fisheries Act aims to comprehensively utilize the water surface to increase the productivity of fishery resources and promote fishery development and democratization of the fishery. The Aquaculture Industry Development Act was enacted in August 2019 to overcome the limitations of the existing fisheries law.

2.4. Industrial Standardization

Before looking at industrial standardization, the difference between the initial smart aquaculture system and the current smart aquaculture system model analysis, the analysis of core technologies, and the latest trends related to smart aquaculture systems, as well as the technical aspects related to smart aquaculture systems, are important factors. In the future, it should be developed into an intelligent service implementation based on data analysis and learning. Accordingly, the smart technologies required for artificial intelligence-based smart aquaculture systems should be defined [3]. The marine fisheries smartization strategy announced by the Ministry of Oceans and Fisheries in 2019 proposes a countermeasure to the problems of the existing smart aquaculture system and aims to develop into a system based on the latest analysis technology, such as artificial intelligence and digital twin, rather than the simple automation concept of the past. In addition, the current smart aquaculture system is emerging with problems of quality, cost, and compatibility among companies due to the absence of standard guides, such as industrial standards and national standards.

2.5. Social Influence

Social impact is the degree to which others perceive that they believe in using the new system. According to social impact theory, individual perceptions are likely to be remarkably influenced by the information and behavioral opinions of others. The stronger the degree to which a consumer believes that important people such as family members, neighbors, and friends around him should use it, the higher the intention to accept it will be affected [7]. The analysis of the current status of fishing villages, which are the basis of the fisheries and aquaculture industries, and the efforts of the state and local governments to analyze problems and overcome problems, should be examined. It is the rise of hollowing out and aging fishing villages. Similar to rural areas where rapid hollowing and aging are progressing, fishing villages are also experiencing serious hollowing-out problems, and fishing communities are rapidly aging. Although the domestic population is decreasing not only in fishing villages but also in the entire country, fishing villages are progressing at a faster pace, which is also related to the infrastructure of the fishing industry [8]. The fisheries industry is a primary industry in which the experience and labor of workers are concentrated and it is one of the industries with a higher accident rate than other industries. Analysis of the disaster occurrence statistics for each industry shows that as of 2015, forestry had a disaster rate of 1.18%, agriculture had a disaster rate of 0.9%, construction had a disaster rate of 0.72%, and manufacturing had a disaster rate of 0.58% still, fishing had a rate of 5.56% which was significantly higher than that of other industries. Smart technologies are further promoted and integrated throughout the fisheries and aquaculture industries as the 6th industrialization of fishing villages with a complex structure encompassing the 1st to 3rd industries progresses along with the spread of the 4th industrial revolution. Through this smartization, structural issues and fundamental problems of fishing communities should be solved, and the foundation for developing the aquaculture industry should be laid [3].

2.6. Smart Aquaculture System Quality

This study classified system availability and system security as elements of smart aquaculture system quality. Since the availability of a system directly affects the business, it is one of the non-functional elements that attracts the most attention from users and management. The system must always be available, which means the degree to which there is no problem performing the function. Otherwise, it should provide an alternative function. System availability is mainly dependent on system backup and recovery. In the event of a defect, the system must be backed up and restored within the appropriate time [9]. It is also considered necessary to have evolved security technology that can eliminate threats such as illegal access blocking and system shutdown by external hackers, which have recently emerged as the biggest problem of smart convergence systems, such as artificial intelligence service implementation technology and digital technology, and increase the availability and security of the system. Water quality management is the most important part of fisheries farming. Smart fisheries farming is an AI (Artificial Intelligence)-based water quality management system that combines data, resources, and related smart aquaculture technologies received from water environment sensors. It automatically controls water temperature, salt, dissolved oxygen, and hydrogen ion concentration to reduce effort and cost for aquaculture production [10]. System security is a quality characteristic that artificial intelligence-based smart aquaculture systems protect from external intrusion, and optimized production data are derived through analysis based on artificial intelligence technology. Advanced security technology is a system to secure confidentiality, integrity, and availability of each layer and protect personal information due to the nature of a system built based on the IoT infrastructure. It is a technology that implements enhanced authentication and secure communication, encryption storage, and server duplexing [3]. As smart aquaculture systems become more advanced and scaled, the system section is subdivided, and accordingly, security vulnerabilities become a greater threat.

2.7. Value Recognition of Fisheries Industry

In this study, the value recognition factors of the fisheries industry were classified into opportunity capture and process improvement and were defined as follows. Opportunity capture means that it is important for companies to secure dynamic capabilities in order to create a sustainable competitive advantage in response to the changing environment. Companies must constantly explore technologies and markets to seize opportunities, and if they recognize opportunities based on cognitive environmental activities, they need the ability to implement opportunities that companies can immediately put into action among the perceived opportunities [11]. In the case of the fisheries industry, since stable survival is the first priority, it is most important to actively explore environmental changes and quickly capture opportunities to realize perceived opportunities.

Through systematic business process management, companies can increase organizational flexibility and secure clear visibility into what tasks occur within the organization. To achieve the goals of the fisheries industry, core processes are defined, and process improvement for continuous maintenance and management is the beginning of process management. The process is defined as a series of value-added tasks linked together to convert one or more inputs into product or service outputs and as an activity performed according to a series of steps to create specific results [12].

In this study, two variables, opportunity capture and process improvement, were defined as the main variables that determine acceptance intention.

2.8. Acceptance Intention

Acceptance intention was defined as an important factor in the behavior that occurs before consumers accept new innovative technologies, and it is said that it is the degree to which they want to use them continuously and long-term and recommend them to their neighbors. In addition, it is the degree of intention to learn and practice specific actions. The acceptance intention that the fisheries official intends to use continuously directly affects the use and can be a determinant of the consumer's immediate action [13]. In addition, it means the acceptance intention or plan that is had within a certain period [14]. Therefore, in this study, acceptance intention was defined as the degree of willingness to accept and use the services experienced by consumers in the future or to recommend them to others.

3. Research Method

This study aims to analyze the effect of smart aquaculture environment characteristics and system characteristics in the AI era on acceptance intention through value recognition of the fishery. Based on previous studies, investment value, policy support, industrial standardization, and social impact were set as independent variables of smart aquaculture environmental characteristics. System availability and system security were set as independent variables of smart aquaculture system quality. Opportunity capture and process improvement were set as parameters for recognizing the value of the fishery industry. Acceptance intention was set as a dependent variable.

3.1. Research Design

Smart PLS 4.0 was chosen for its ability to handle small to medium-sized data samples while providing robust results for complex models. Its capability to assess both reflective and formative constructs makes it ideal for this study's structural equation modeling.

3.2. Research Model

This study aims to analyze the effect of smart aquaculture's environmental characteristics and system quality in the AI era on acceptance intention through value recognition of the fisheries industry.

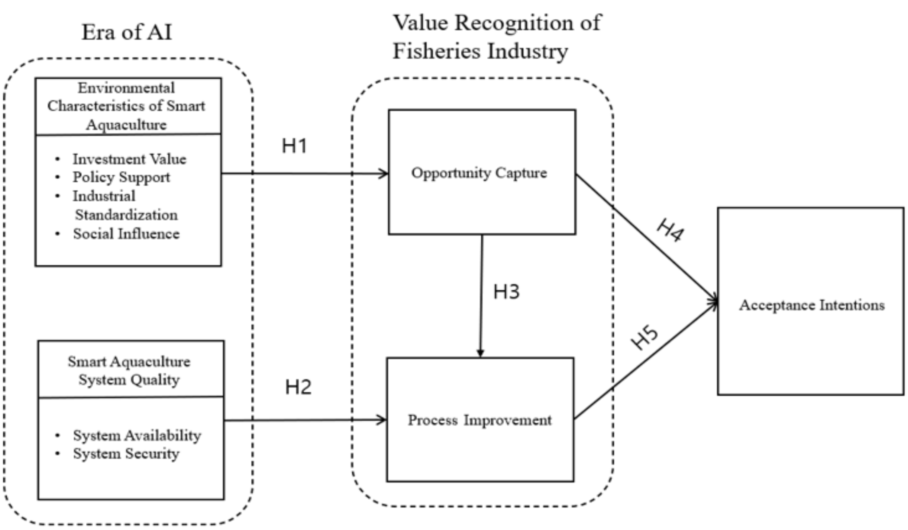

Figure 1.
Research model.

In general, in domestic and international studies, the environmental characteristics of smart aquaculture are classified into investment value, policy support, industrial standardization, and social impact [3]. Recognition methods to raise awareness of the value of the fisheries industry were divided into opportunity capture and process improvement [2]. Based on previous studies, the following model was established. The research model of this study is shown in Figure 1.

3.3. Research Hypothesis

In the AI era, smart aquaculture environmental characteristics and system quality have been developed in various ways through information technology during the 4th industrial revolution. Depending on the field of the 4th industrial revolution, these can be classified into various environmental characteristics and system quality. Various factors are classified and presented for each researcher, and in general, environmental characteristics in domestic and international studies are classified into investment value, policy support, industrial standardization, and social impact. Recognition methods to raise awareness of the value of the fisheries industry are divided into opportunity capture and process improvement. Recognition of the value of the fisheries industry affects the improvement of acceptance intention. Based on previous studies, the following hypothesis was established.

Hypothesis H1 Smart aquaculture environmental characteristics will have a significant impact on opportunity capture.
Hypothesis H1-1 The investment value will have a significant impact on opportunity capture.
Hypothesis H1-2 Policy support will have a significant impact on opportunity capture.
Hypothesis H1-3 Industrial standardization will have a significant impact on opportunity capture.
Hypothesis H1-4 Social impact will have a significant impact on opportunity capture.
Hypothesis H2 Smart aquaculture system quality will have a significant impact on process improvement.
Hypothesis H2-1 System availability will have a significant impact on process improvement.
Hypothesis H2-2 System security will have a significant impact on process improvement.
Hypothesis H3 Opportunity capture will have a significant impact on process improvement.
Hypothesis H4 Opportunity capture will have a significant effect on acceptance intention.
Hypothesis H5 Process improvement will have a significant effect on acceptance intention.

The Operational Definition of Variables

We conducted an online survey to obtain a randomized general sample. We used the survey for research purposes. Therefore, after the end of the study, we agreed to destroy all personal information. The questionnaire comprised six independent variables, two parameters, and one dependent variable. The demographic questionnaire consisted of seven questions. The online survey (Naver Survey) was conducted for one month, from September 20 to October 20, 2023, and a total of 285 copies were used for the analysis. Concentrated validity, discriminant validity, and hypothesis verification were performed using the structural equation package Smart PLS 4.0. Through the structural model, we derived the study model's inter-variable path coefficient, t-statistics, and determinant (R^2) results. Table 2 shows the operational definitions of variables used in this study.

Table 2.
The operational definition of constructs.

Variable	Operational Definition	Reference
Investment Value	- The investment costs of smart aquaculture systems are reasonable. - It is worth investing in if excellent performance occurs. - It is worth investing in if it provides a variety of high-quality smart aquaculture services based on artificial intelligence.	Ma, et al. [1]; Kim [2] and Choi [3]
Policy Support	- There should be a legal system to support the spread of smart aquaculture systems. - The environment in which the smart aquaculture system can be introduced should be sufficiently supported. - It would be nice to have a preferential tax policy or government subsidies when investing in the system.	Ma, et al. [1]; Kim [2] and Choi [3]
Industrial Standardization	- Standardization of smart aquaculture systems will help improve quality. - The standardization of the system will increase the return on investment. - I think that standardization will improve the recognition of the value of the fisheries industry.	Choi [3]; Bang [7] and Jun and Kim [8]
Social Influence	- I will use it if my close friends around me recommend it. - The smart aquaculture system should be used by others. - It helps people around them use smart aquaculture systems.	Bang [7]; Jun and Kim [8] and Park and An [13]
System Availability	- Smart aquaculture systems will be able to manage environmental information anywhere. - The smart aquaculture system is stable, so it will always be available. - Smart aquaculture systems will be solved quickly even if errors occur.	Jeong and Joo [9]; Kwon and Kim [10] An [14] and Kwon [15]
System Security	- The smart form system can be reliably accessed by authenticated users. - The smart form system safely protects the personal information used.	Jeong and Joo [9];

Variable	Operational Definition	Reference
	- The smart form system does not share personal information with other sites.	Kwon and Kim [10]; Kwon [15] and Choi and Ahn [16]
Seize the Opportunity	- The smart aquaculture system created a competitive advantage. - The smart aquaculture system has the ability to implement opportunities to select opportunities. - Smart aquaculture systems constantly explore technologies and markets to capture opportunities.	Mun and Ko [11] and Lee [12]
Process Improvement	- It is thought that new technologies of existing processes are applied and improved. - It is thought that a new technique of the existing process is applied. - The definition of various systems will help improve the process.	Mun and Ko [11] and Lee [12]
Acceptance Intention	- I have a lot of interest in smart aquaculture systems. - I will continue to use this system. - I will evaluate this system positively to those around me. - I will use this system before anything else.	Bang [7]; Park and An [13]; An [14] and Choi and Ahn [16]

4. Research Validation

4.1. Characteristics of Respondents

In order to empirically verify the research model, this study was conducted for the general public who are engaged in or interested in the fisheries industry. An online survey (Naver Survey) was conducted for a month, from September 20, 2023, to October 20, 2023. Out of a total of 300 copies, 285 copies were used for the analysis, excluding 15 copies of unfaithful responses. The basic statistical results are as follows: 64.2% of the respondents were men, and the age distribution of the respondents was 34.4% in their 30s and 27.4% in their 40s. In terms of educational background, college/university accounted for the largest percentage at 71.3%. It can be seen that the experience in the fisheries industry is mostly less than 2 years. The characteristics of the sample are summarized in Table 3.

Table 3.
Characteristics of respondents (n=285).

Characteristics		Responses	Percentage
Gender	Male	183	64.2%
	Female	102	35.8%
Age	20-29 years	15	5.3%
	30-39 years	98	34.4%
	40-49 years	78	27.4%
	50-59 years	69	24.2%
	60 years or more	25	8.8%
Education	High School	19	6.7%
	College / University	203	71.3%
	Graduate School	63	22.1%
Career	under 2 years	187	65.6%
	under 5 years	16	5.6%
	under 10 years	64	22.5%
	10 years	18	6.3%

4.2. Reliability and Internal Consistency Results

As for the measurement items, the questionnaire items used in previous studies were reorganized to fit artificial intelligence technology. All items were measured on a 7-point scale. Convergent validity, discriminant validity, and hypothesis verification were performed using the structural equation package Smart PLS 4.0. The results of convergent validity are shown in Table 4, and the discriminant validity results are shown in Table 5.

Table 4.
Reliability and internal consistency results.

Factors	Items Name	Factor Loadings	AVE	Composite Reliability	Cronbach's Alpha
Investment Value	IV1	0.853	0.754	0.902	0.837
	IV2	0.894			
	IV3	0.858			
Policy Support	PS1	0.875	0.738	0.894	0.823
	PS2	0.832			
	PS3	0.870			
Industrial Standardization	IS1	0.841	0.735	0.893	0.820
	IS2	0.906			
	IS3	0.824			
Social Influence	SI1	0.890	0.792	0.919	0.869
	SI2	0.894			
	SI3	0.886			
System Availability	SA1	0.890	0.774	0.911	0.854
	SA2	0.876			
	SA3	0.873			
System Security	SS1	0.868	0.715	0.883	0.801
	SS2	0.857			
	SS3	0.811			
Seize the Opportunity	SO1	0.907	0.810	0.927	0.882
	SO2	0.909			
	SO3	0.883			
Process Improvement	PI1	0.874	0.758	0.904	0.840
	PI2	0.843			
	PI3	0.894			
Acceptance Intention	AI1	0.820	0.727	0.914	0.875
	AI2	0.900			
	AI3	0.814			
	AI4	0.876			

Table 5.
Pearson correlations and discriminant validity.

Factors	1	2	3	4	5	6	7	8	9
IV	0.868								
PS	0.360	0.859							
IS	0.402	0.413	0.858						
SI	0.431	0.480	0.492	0.890					
SA	0.307	0.420	0.452	0.454	0.880				
SS	0.432	0.458	0.356	0.439	0.399	0.846			
SO	0.534	0.403	0.422	0.616	0.317	0.471	0.900		
PI	0.440	0.523	0.516	0.541	0.628	0.605	0.547	0.871	
AI	0.449	0.598	0.504	0.663	0.491	0.639	0.654	0.686	0.853

Note: *Diagonal element shows the square root of AVE

5. Results and Discussions

5.1. Results

The structural model was verified using Smart PLS 4.0. Through the structural model, the path coefficient, t-statistics, and coefficient of determination (R^2) results were derived between the variables of the research model.

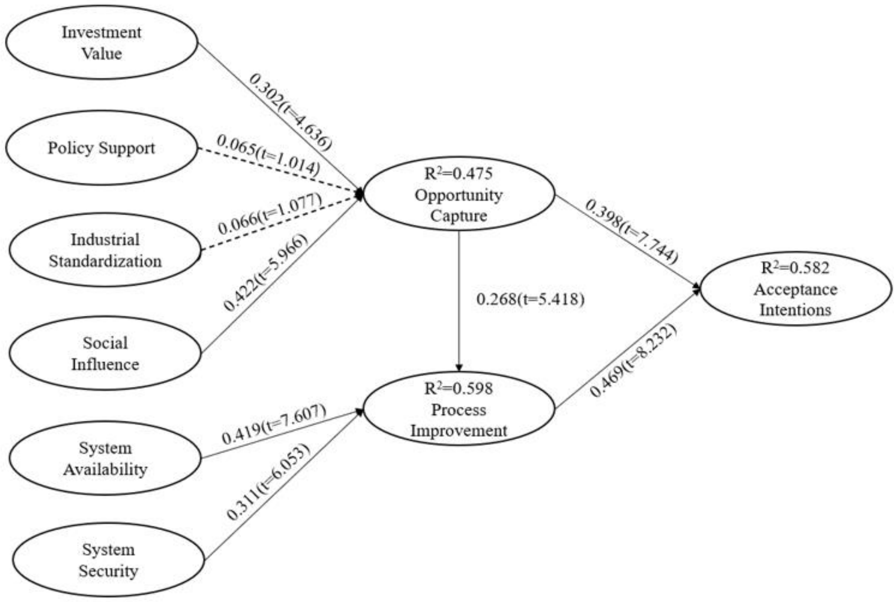

Figure 2.
Path analysis for the research model.

The results of the analysis of the research model are as follows.

First, hypothesis H1-1 was adopted. Investment value was found to have a positive significance (β=0.302, t=4.636, p<0.001) on opportunity capture. Second, hypothesis H1-2 was rejected. It was found that policy support did not have a positive significance (β=0.065, t=1.014, p<0.001) on opportunity capture. This means that policy support in the fisheries industry does not affect opportunity capture. Third, hypothesis H1-3 was rejected. It was found that industrial standardization did not have a positive significance (β=0.066, t=1.077, p<0.001). This is interpreted as industrial standardization in the fisheries industry does not affect opportunity capture. Fourth, hypothesis H1-4 was adopted. Social influence was found to have a positive significance (β=0.422, t=5.966, p<0.001) on opportunity capture. Fifth, hypothesis H2-1 was adopted. System availability was found to have a positive significance (β=0.419, t=7.607, p<0.001) on process improvement. Sixth, hypothesis H2-2 was adopted. System security was found to have a positive significance (β=0.311, t=6.503, p<0.001) on process improvement. Seventh, hypothesis H3 was adopted. Opportunity capture was found to have a positive significance (β=0.268, t=5.418, p<0.001) on process improvement. Eighth, hypothesis H4 was adopted. Opportunity capture was found to have a positive significance (β=0.398, t=7.744, p<0.001) on acceptance intention. Ninth, hypothesis H5 was adopted. Process improvement was found to have a positive significance (β=0.469, t=8.232, p<0.001) on acceptance intention.

Table 6.
Hypothesis testing of model.

Paths	Estimate	T-statistics	Hypothesis Results
H1-1: Investment Value → Opportunity Capture	0.302	4.636***	Adaption
H1-2: Policy Support → Opportunity Capture	0.065	1.014	Rejection
H1-3: Industrial Standardization → Opportunity Capture	0.066	1.077	Rejection
H1-4: Social Influence → Opportunity Capture	0.422	5.966***	Adaption
H2-1: System Availability → Process Improvement	0.419	7.607***	Adaption
H2-2: System Security → Process Improvement	0.311	6.053***	Adaption
H3: Opportunity Capture → Process Improvement	0.268	5.418***	Adaption
H4: Opportunity Capture → Acceptance Intention.	0.398	7.744***	Adaption
H5: Process Improvement → Acceptance Intention.	0.469	8.232***	Adaption

Note: *Probability level *p< 0.05, **p< 0.01, p***< 0.001.

5.2. Discussion

This study is an empirical investigation to analyze how smart aquaculture environment characteristics (investment value, policy support, industrial standardization, social impact) and smart aquaculture system quality (system availability, system security) in the AI era affect acceptance intention, which is a dependent variable, with value recognition (opportunity capture, process improvement) of the fishery as a parameter. The results of the empirical analysis on the variables selected in this study will serve as basic data to increase the competitiveness of the fisheries industry in the AI era concerning the smart aquaculture environmental characteristics and system quality. The results of this study are summarized as follows. First, it was found that the hypothetical investment value had a positive significant effect on opportunity capture. Second, it was found that the hypothetical policy support did not positively affect opportunity capture. This means that policy support in the fishery does not affect opportunity capture. The rejection of H1-2 suggests that policy support alone cannot drive opportunity capture in smart aquaculture. This may reflect a lack of practical implementation or awareness of policies among industry stakeholders. Similarly, rejecting H1-3 indicates that fragmented or inconsistent industrial standardization efforts fail to create a tangible impact on opportunity capture. Future studies should explore targeted, industry-specific frameworks to address these gaps. Third, it was found that industrial standardization did not have a positive significant effect on opportunity cap ture. This is interpreted as the fact that industrial standardization in the fishery does not affect opportunity capture. Fourth, the hypothetical social impact was found to have a positive significant effect on opportunity capture. Fifth, the availability of the hypothetical system was found to have a positive significant effect on process improvement. Sixth, the hypothesis regarding system security was found to have a positive significant effect on process improvement. Seventh, the hypothesis of opportunity capture was found to have a positive significant effect on process improvement. Eighth, the hypothesis of opportunity capture was found to have a positive significant effect on acceptance intention. Ninth, the hypothesis of process improvement was found to have a positive significant effect on acceptance intention. Through this study, it was confirmed that the value recognition of the fisheries industry has a positive effect on acceptance intention. Policymakers can leverage these findings to design initiatives that enhance community engagement, provide practical policy support, and address system inefficiencies. Industry stakeholders should prioritize investments in robust AI-based systems that optimize aquaculture production while addressing labor shortages and environmental concerns.

6. Conclusions

The implications of this study are, first, among the factors of smart aquaculture environmental characteristics, social impact, investment value, policy support, and industrial standardization, which showed high satisfaction in order. This means that social impact is recognized as the most important factor among smart aquaculture environmental characteristics. In other words, it is necessary for fisheries workers to organize social norms, values, and cultures so that the changes or influences of individuals, groups, or organizations on society can be applied in a positive direction and help the future development of the fishery with social influences consistent with the nature of the fishery. Second, it was found that system availability among the quality factors of smart aquaculture systems had a higher influence on the value perception of the fishery than the system's security. This means that consumers are satisfied when the system operates normally and can be used smoothly without problems. Third, to improve the acceptance intention, it is necessary to recognize the value of the fishery, that is, to capture opportunities or improve processes.

Through this study, smart aquaculture systems must maintain high levels of environmental characteristics that can meet the fisheries system's rapidly changing goals and improve consumers' social impact or value. Additionally, it is necessary to raise awareness of the value and acceptance intention of the fisheries industry in order to ultimately improve the availability and security of the system quality of different fisheries. In particular, detailed and accurate management plans will be needed because social impact and system availability were derived as the most important factors from the fisheries industry's value recognition perspective.

The limitation of this study is that since samples were randomly extracted from the general public who are engaged in or interested in the fisheries industry, the population may not be evenly represented, leading to biased results. In particular, this problem becomes more prominent as the sample size is smaller. Therefore, in future studies, more meaningful research results can be drawn if the research is conducted through a sample survey of the population. In addition, the independent variables of the research model were selected as investment value, policy support, industrial standardization, social impact, etc., but research analysis on various and complex areas is necessary. However, it is significant that the results of this study, which is currently developing a smart aquaculture system, provided a positive foothold in the value recognition and management of the fisheries industry. Future research should address these limitations by expanding the sample to include a more diverse and representative population. Longitudinal studies tracking technology adoption over time will provide deeper insights into the dynamic nature of acceptance intentions. Additionally, exploring the impact of advanced AI tools on sustainability and environmental outcomes in aquaculture can further enrich this field.

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