



Based on wired/wireless IoT/Artificial Intelligence technology

Development Plan for Intelligent Fire Detection and Sprinkler System for Logistics Facilities

March 2024

ROZETATECH

CHAPTER I

Development background

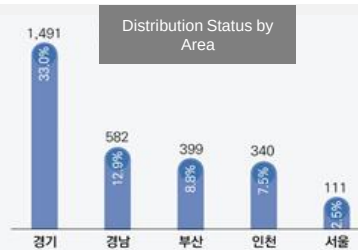
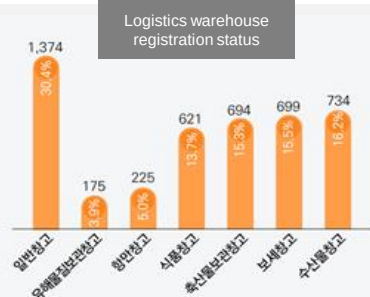


Logistics warehouse fires are continuously increasing, and those are very damaging

□ Logistics warehouses continue to increase

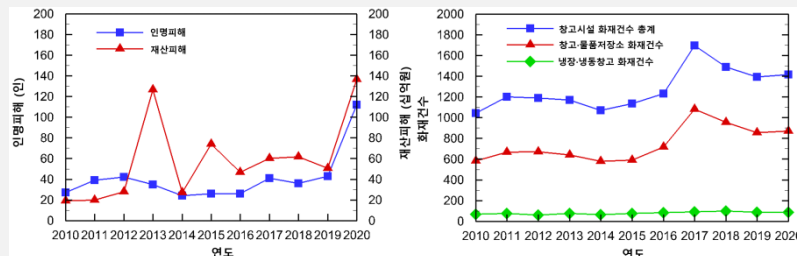
362 new registrations per annum over the past five years

	Before '15	'16	'17	'18	'19	'20
New registrations	2,711	176	304	257	342	732



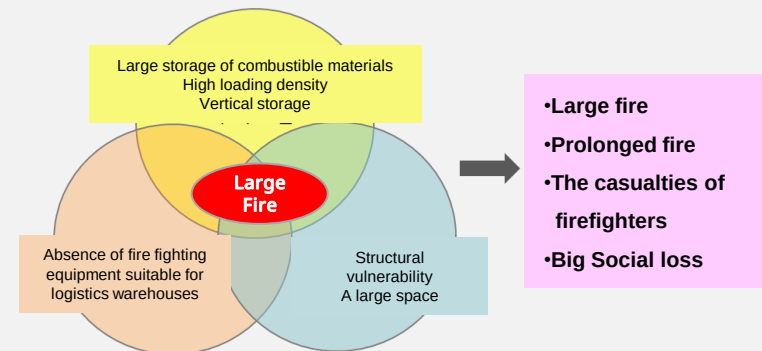
□ More than 1000 logistics warehouse fires occur every year

Dozens of lives are lost and tens of billions of won in property damage occurs every year



□ Characteristics of Fire in Logistics Warehouse

The warehouse fire turns into a large fire



□ Analysis of Fire Factors and Key Cases in Logistics Warehouse

	Analysis of Fire Causes in Warehouse (%)							
	Electric al factors	Chemical factors	Mechanical factors	Careless ness	Actual fire	Natural factors	Arson	Unkn own
'17~'18	27.1	2.9	5.5	45.4	0.5	1.6	0.8	16.2



Coupang Warehouse Fire
(2021.06.17)



Yongin Yangji Warehouse Fire
(2020.07.21)



Kimpo Warehouse Fire
(2024.02.19)

Title

Development of Intelligent Fire Detection and Sprinkler System reflecting the characteristics of Logistics Facilities

Object

Quickly detect and extinguish fires in logistics warehouses, implement an artificial intelligence-based comprehensive fire protection system

Problem

Aging of existing fire prevention facilities

Malfunction/distrust of existing fire detectors

Absence of effective fire detection solutions

Limitations of the existing wired method

Inefficient sprinkler system

Solution

Fire detection and fire suppression by improving the limitations of existing methods

Intelligent fire detection/sprinkler for logistics facilities

Intelligent multi-cognitive sensor

Differentiated sprinklers

securing golden time / early suppression

Service Support

Early detection in case of fire and transmission/initial response of related agencies and strengthening early suppression

Smart IoT-based intelligent fire detection sensor

Early suppression in case of fire by Improvement of sprinkler facilities

Early detection/prevention of abnormalities based on AI/deep learning

- Both wired & wireless communication systems
- Fire Mature stage communication guarantee

3. Technology development goals and contents

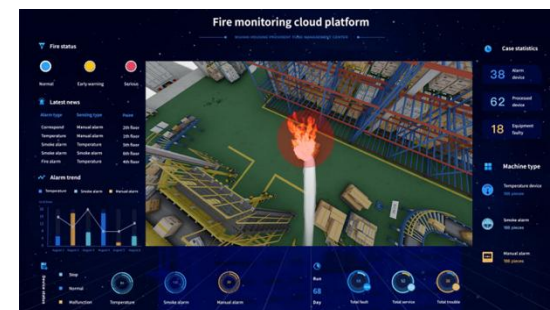
I. Development background

Technology development goals

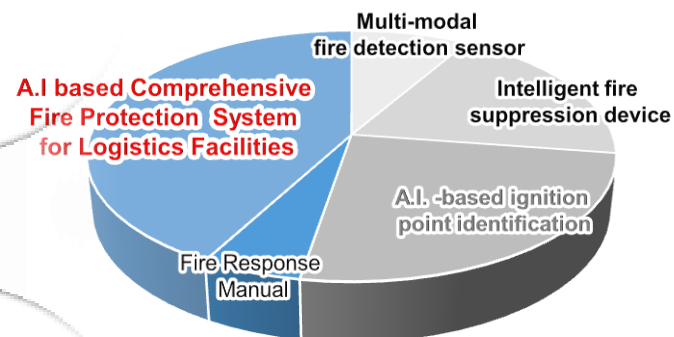
- Development of a comprehensive fire protection system for logistics facilities incorporating artificial intelligence technology
 - Need to improve performance and intelligence of existing fire detectors and sprinkler systems
- Secure technological competitiveness related to fire protection in logistics facilities / induce change
 - A.I. based intelligent fire response that can detect and extinguish fires early and suppress the spread of fires is required

Details of development: Contents

- Intelligent Fire Early Detection and Fire Extinguishing Technology reflecting the characteristics of logistics facilities
 - Multi-modal fusion sensor and early fire detection technology based on deep learning
 - IoT Complex Fire Detection Sensor (heat, smoke, temperature, humidity, CO), flame detector, CCTV image analysis
 - In the event of a fire, the operator applies the shortest safety evacuation route algorithm to escape direction indicators
- A.I. based Fire Ignition Point and Development of Fire Risk Index by Space
 - Fire ignition point identification algorithm through real-time image and time series data analysis
 - Comprehensive evaluation and management of various risk factors based on A.I. fire risk index
- Intelligent Sprinkler Equipment Technology that can control the spread of fire
 - Intelligent sprinklers or fire suppression devices
- Wired and wireless communication system technology that guarantees reliability for continuous communication even in the maturity stage due to large fire
 - Multi-modal terminals and local G/W to prevent communication disconnection of multimodal sensors
- Establishment of Fire Manual and Scenario for Logistics Facilities
 - Fire Prevention, Evacuation Optimization Manual and Facilities Improvement/ Logistics Facility Fire Scenario/Manual

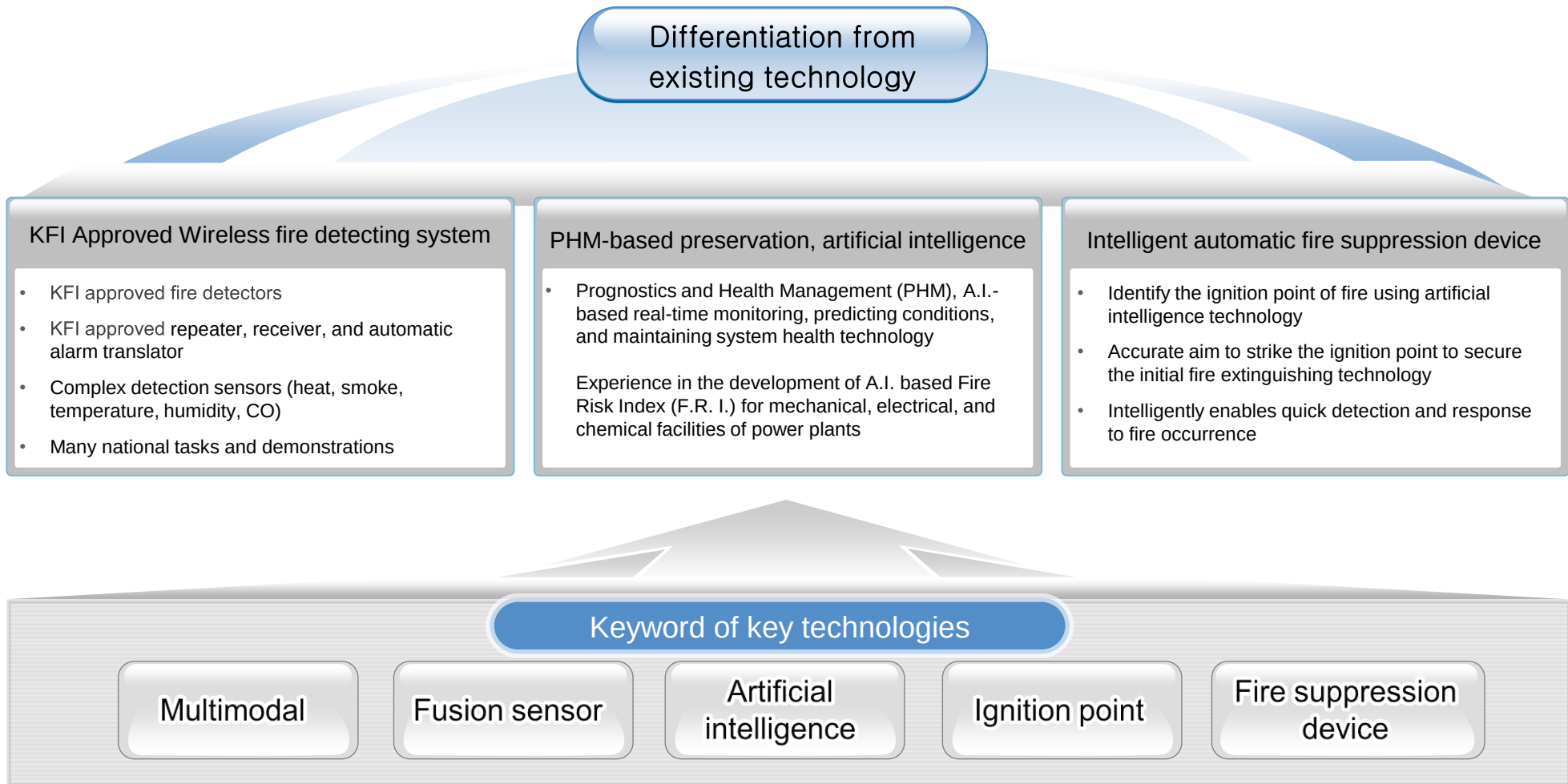


Details of development



Fire Response and Integrated Disaster Prevention System R&D
(Multiple Cognitive Sensors, Sprinklers, Artificial Intelligence)





CHAPTER II

Technology development goals and contents



Integrated monitoring platform for intelligent fire detection and fire suppression devices in logistics facilities (draft)



A.I. Multi-Modal Convergence Sensor

- Development of AIoT Multi-modal convergence sensor and Identifying the ignition point
- Development of combined wired and wireless fire detection sensors (heat, smoke, temperature, humidity, CO)
- Development of Fire Risk Index by Building and Space

Automatic fire suppression system

- Fire ignition positioning and automatic aiming function
- Intelligent automatic fire suppression devices

Integrated Fire Protection System based on Fire Risk Index

- Development of Fire Risk Index by Space of Logistics Facilities
- Control Monitoring Based on Space Safety Assessment Tool
- Early fire detection and integrated fire protection enhancement

Development of Fire Protection Multimodal Convergence Sensor and Automatic Pressure System for Logistics Facilities

Technology development goals

- **Development of early fire detection technology based on IoT multi-modal convergence sensor**
 - Development of multi-modal fusion sensor and early fire detection technology based on deep learning
 - Development of multi-modal sensor complex terminal and local gateway prototypes
- **Development of artificial intelligence ultra-low delay fire detection, prediction, and 3D fire origin identification technology**
 - Real-time image and time series data analysis to identify ignition point in 3D space
 - Development of integrated monitoring and control system for Intelligent fire response system based on artificial intelligence
- **Development of Intelligent Automatic Fire Suppression Device**
 - Development of an intelligent automatic fire suppression device and control system capable of controlling the spread of fire
 - Development of a large capacity automatic fire suppression device for fire suppression and fire penetration
- **Development of wired and wireless communication systems that can communicate continuously even in the maturity stage of fire**
 - Development of both wired and wireless communication system technology that guarantees reliability for continuous communication even in the maturity stage due to large fire
 - Development of complex terminals and local gateways to prevent communication disconnection

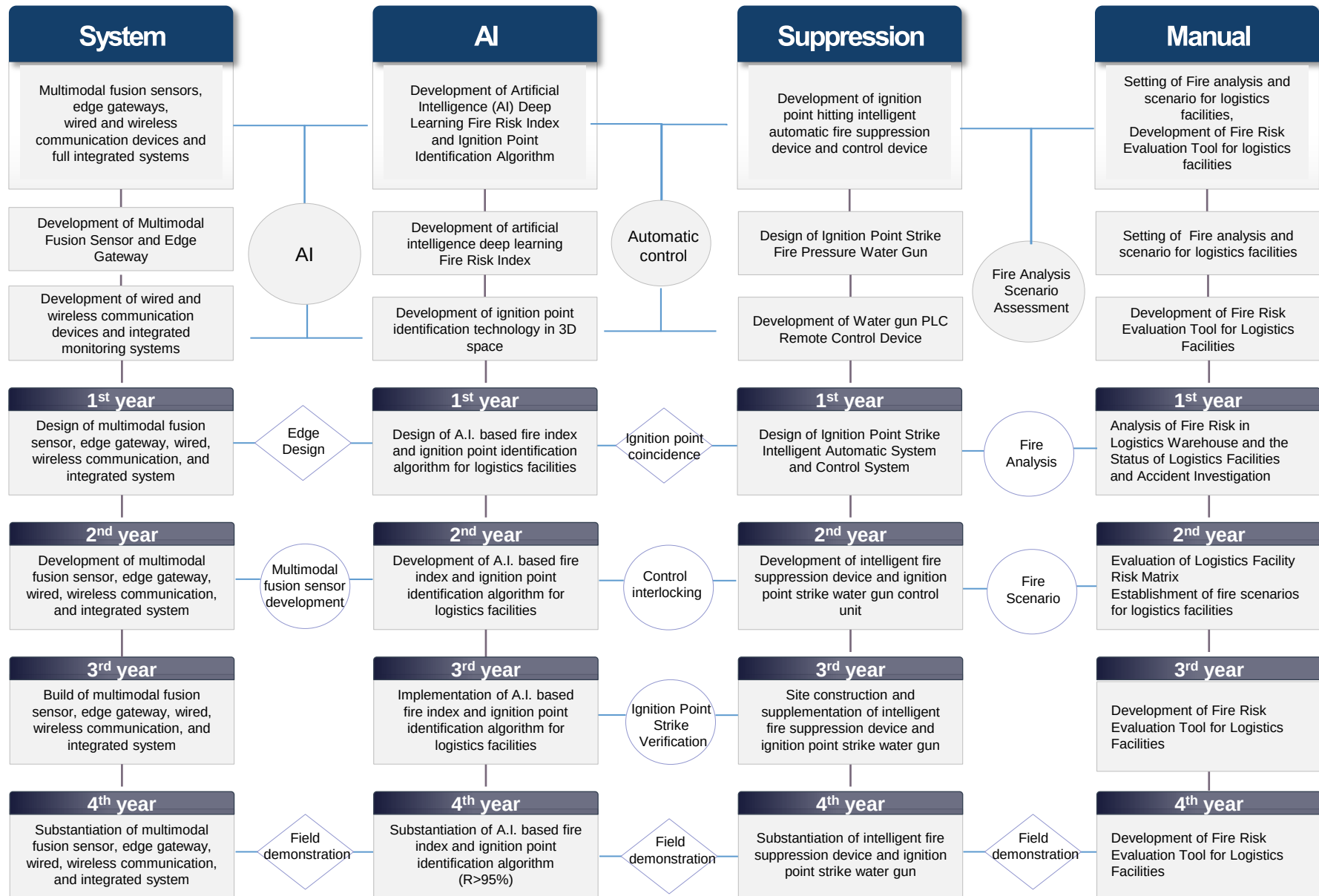
Configuration of multimodal fusion sensors and automatic suppression devices (example)



Fire suppression devices based on intelligent convergence sensors in logistics facilities (example)

2. Promotion schedule by development topic

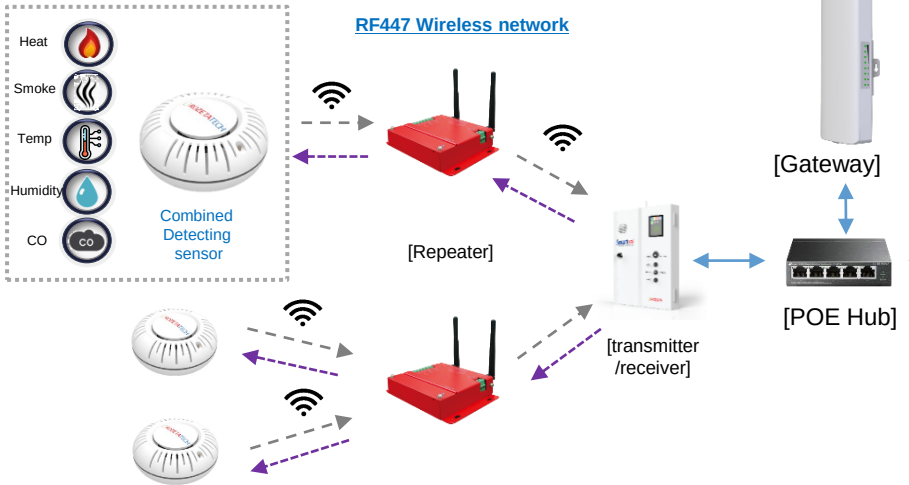
II. Technology development goals and contents



3. Implementation plan for each goal

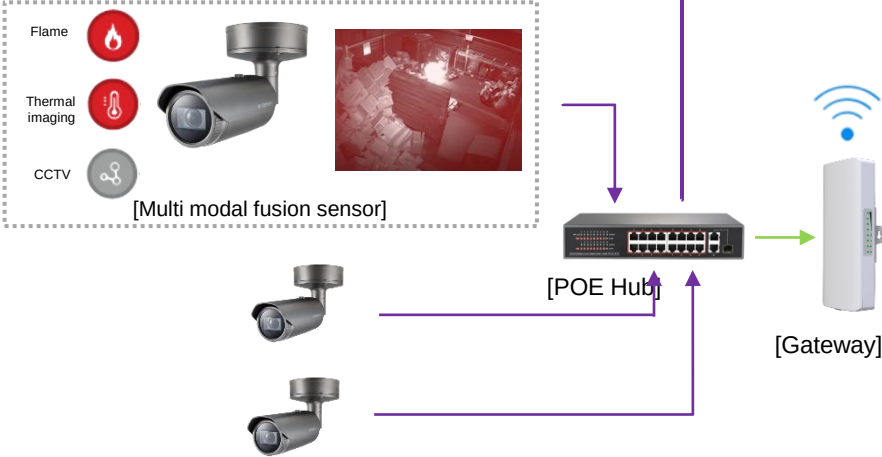
II. Technology development goals and contents

Combined fire detection sensor system



Multimodal fusion sensor system

P-to-P Structure



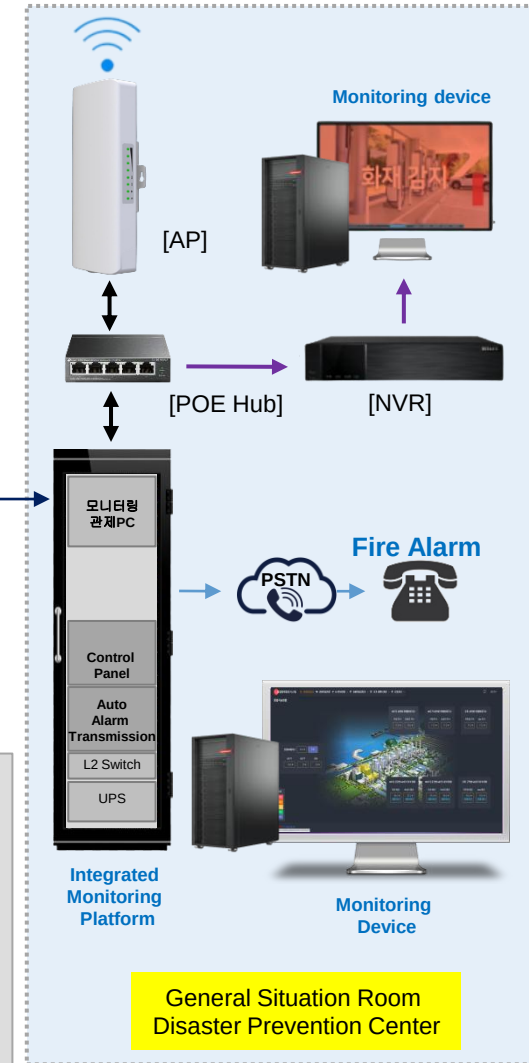
< Flame detection/
real-time image data >

[Wired Communication]

- ↔ UTP line (Combined sensor data)
- UTP line (Flame detection/ real-time image data)

[Wireless Communication]

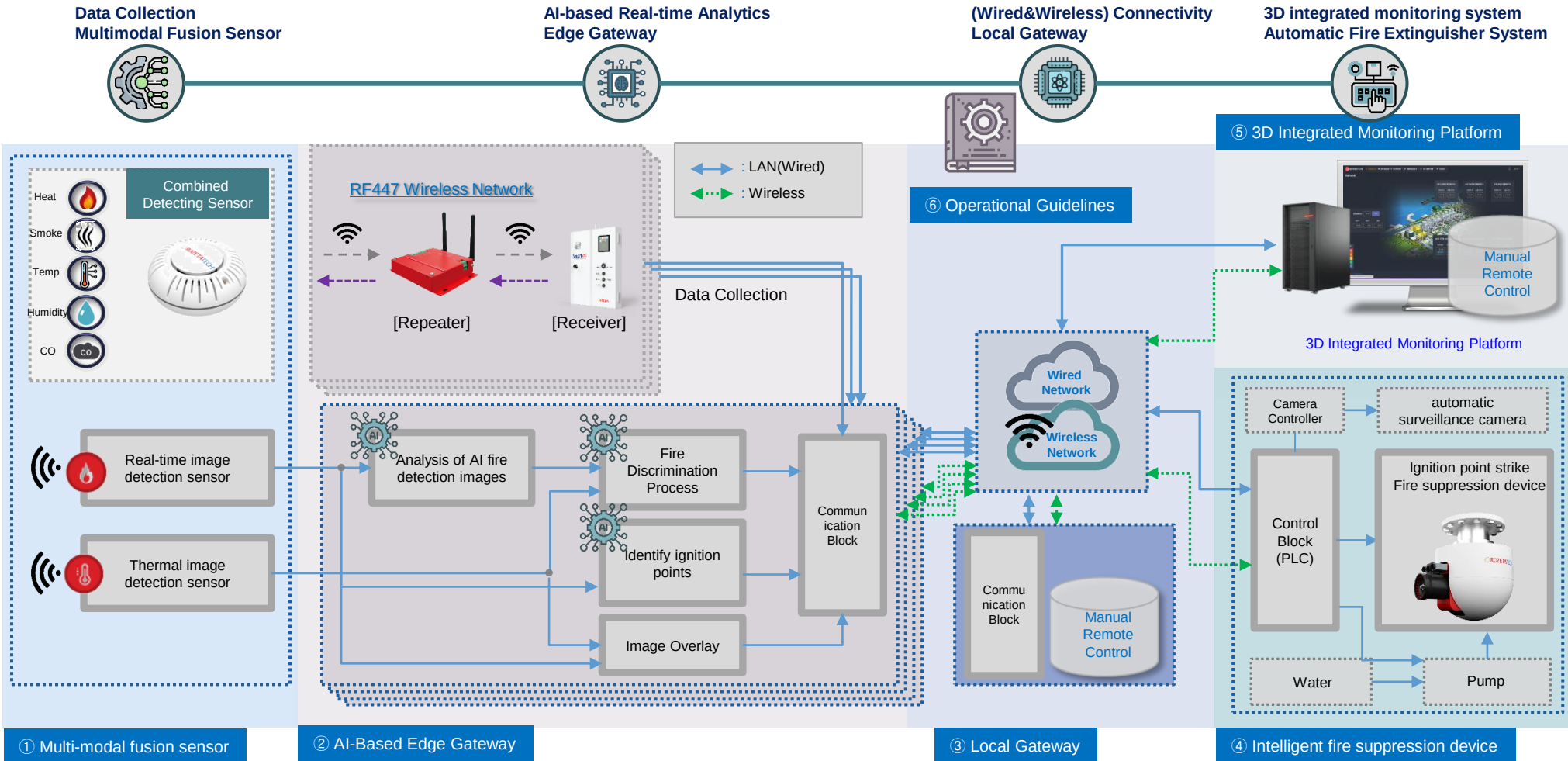
- RF447MHz
Combined sensor data
- CPE(5.8GHz)
Combined sensor data
Flame detection/ real-time image data



3. Implementation plan for each goal

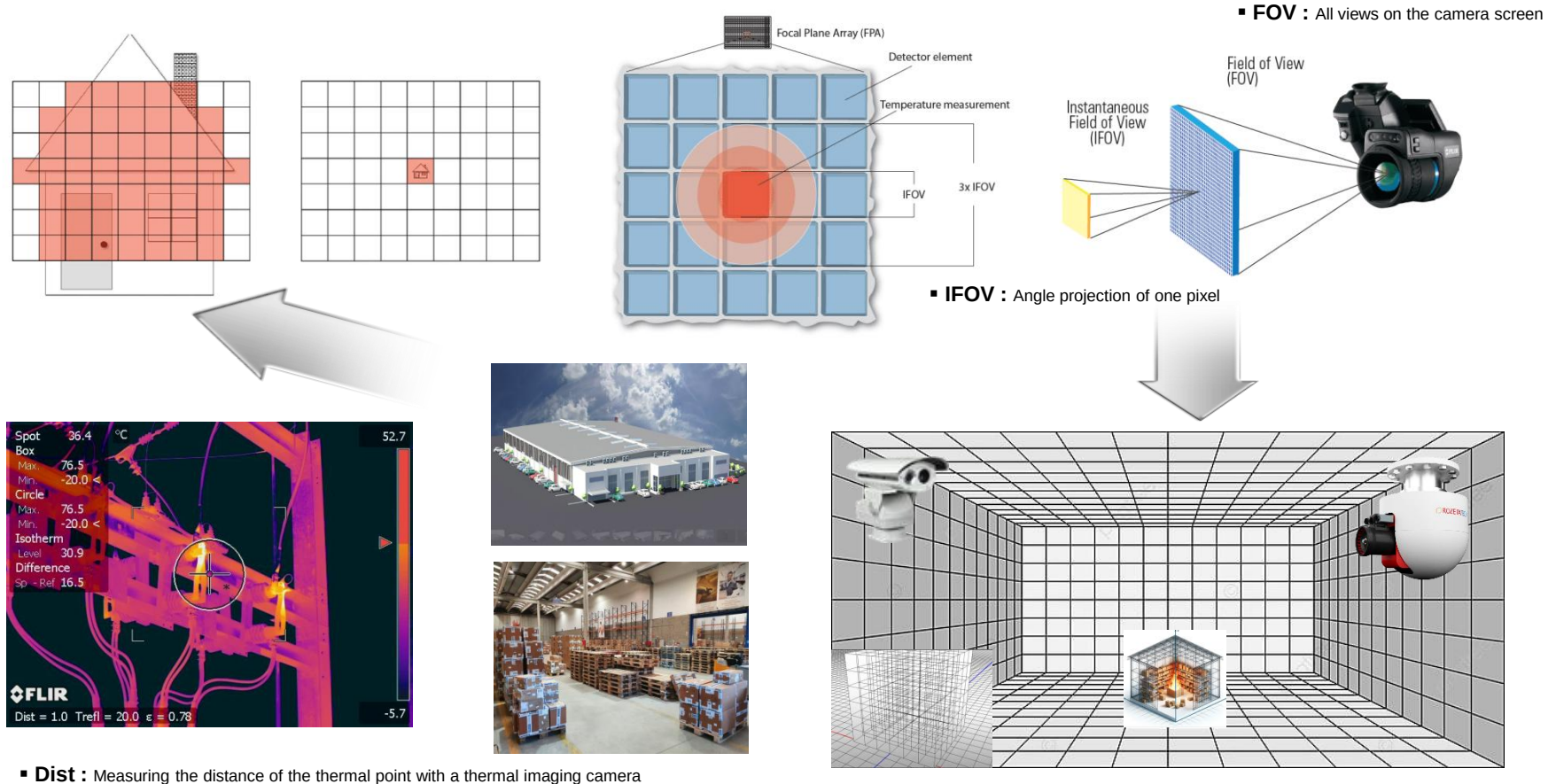
3.2 .Overall System Configuration Chart (Architecture)

Overall configuration diagram of intelligent fire detection and fire suppression system in logistics facilities



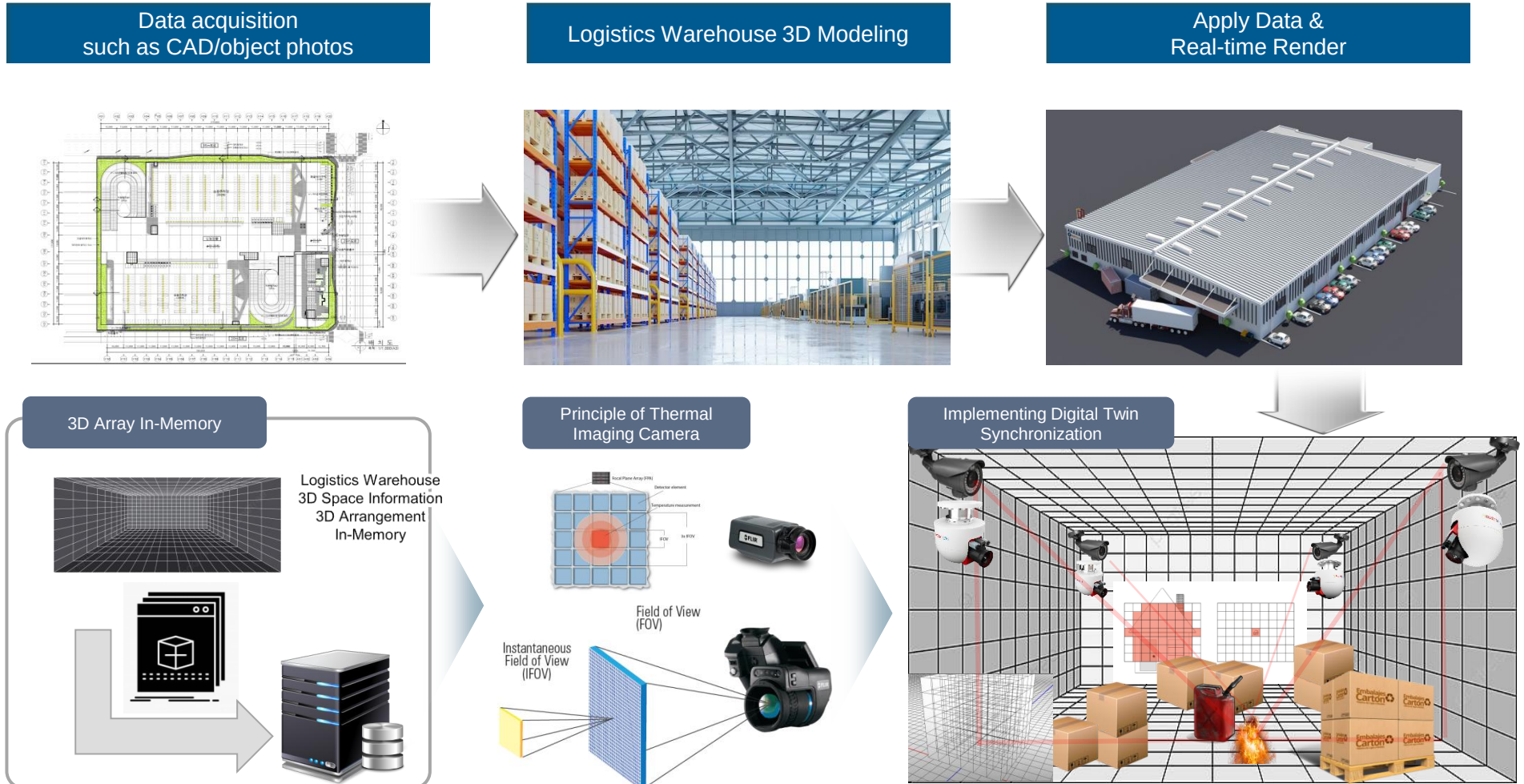
3.3. Implementation of Digital Twin for 3D Modeling of Logistics Facilities

Implementation of 3D modeling digital twins for logistics facilities and configuration of thermal camera distance measurement match (draft)



3.3. Implementation of Digital Twin for 3D Modeling of Logistics Facilities

Implementation of Digital Twin Visualization and Synchronization with Multimodal Convergence Sensor and 3D Modeling in Logistics Facilities



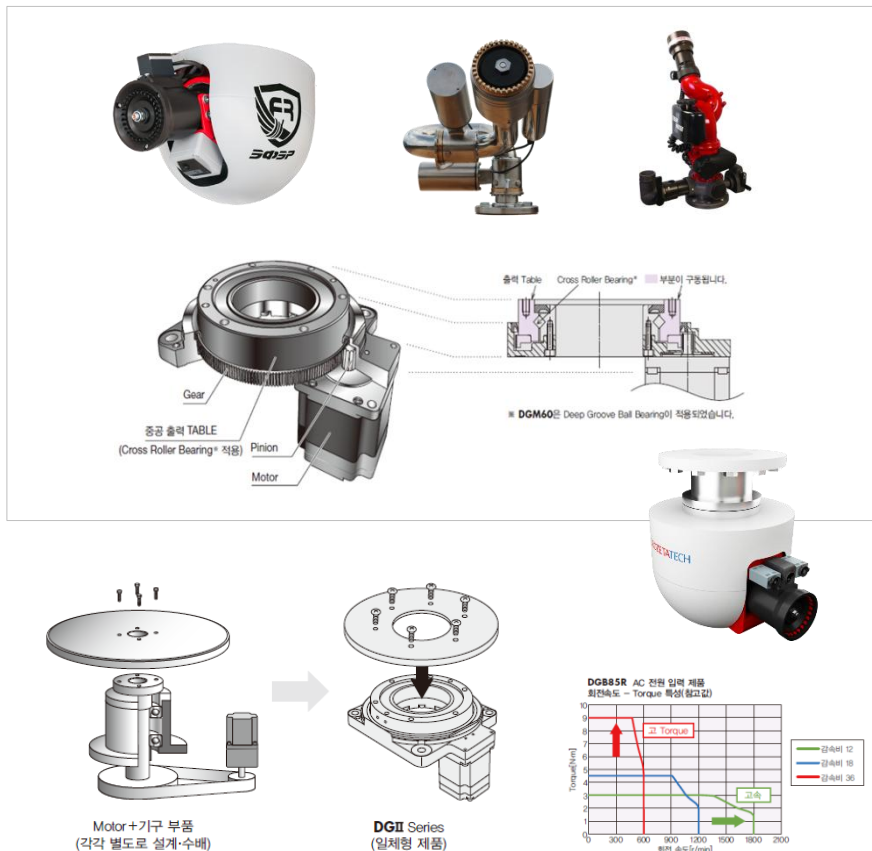
3. Implementation plan for each goal

II. Technology development goals and contents

3.4 Fire Extinguisher Development » Fire Point Strike Fire Extinguisher Development

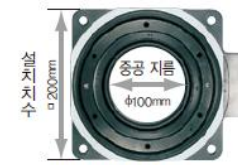
Design and Development of Automatic System for Fire extinguisher that can hit ignition points

Fire Extinguisher Structure and Major Parts



Filling equipment and motor design

liquid-piped filling equipment

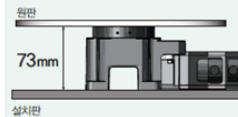


예: DGM200R의 경우

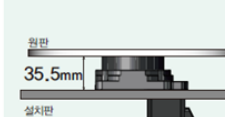
형번	설치치수 mm	중공 지름 mm
DGM60	60	φ28
DGI85R	85	φ33
DGI130R	130	φ62
DGM200R	200	φ100



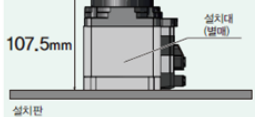
·설치판의 높이를 낮추고자 할 때
·설치판 하부를 효율적으로 사용하고자 할 때
▶ Motor 가로 방향



·설치판의 높이를 낮추고자 할 때
▶ Motor 세로 방향



·설치판 하부를 효율적으로 사용하고자 할 때
▶ Motor 세로 방향 (설치대 있음)



3.4 Fire Extinguisher Development » Fire Point Strike Fire Extinguisher Development

Development of an instrument for fire extinguisher capable of striking the ignition point

The fire suppression device developed to suppress the fire early by aiming and hitting the ignition point of the fire can prevent the spread of the fire and minimize fire damage through a quick response.



< Example of a Water Gun
with an actuator >



< Mobile Water Gun Emergency
Fire Extinguishing Device >

- Development of Biaxial (up and down, left and right) Rotating Mechanism
- Development of the shape of an automatic fire suppression system suitable for the characteristics of the logistics warehouse
- Development of Opening and Closing Function(Piping Window) of Fire Suppression Device
- Installation and Performance Test of the Demonstration Test Bed
- Presenting guidelines for each type of fire
- Interlocking

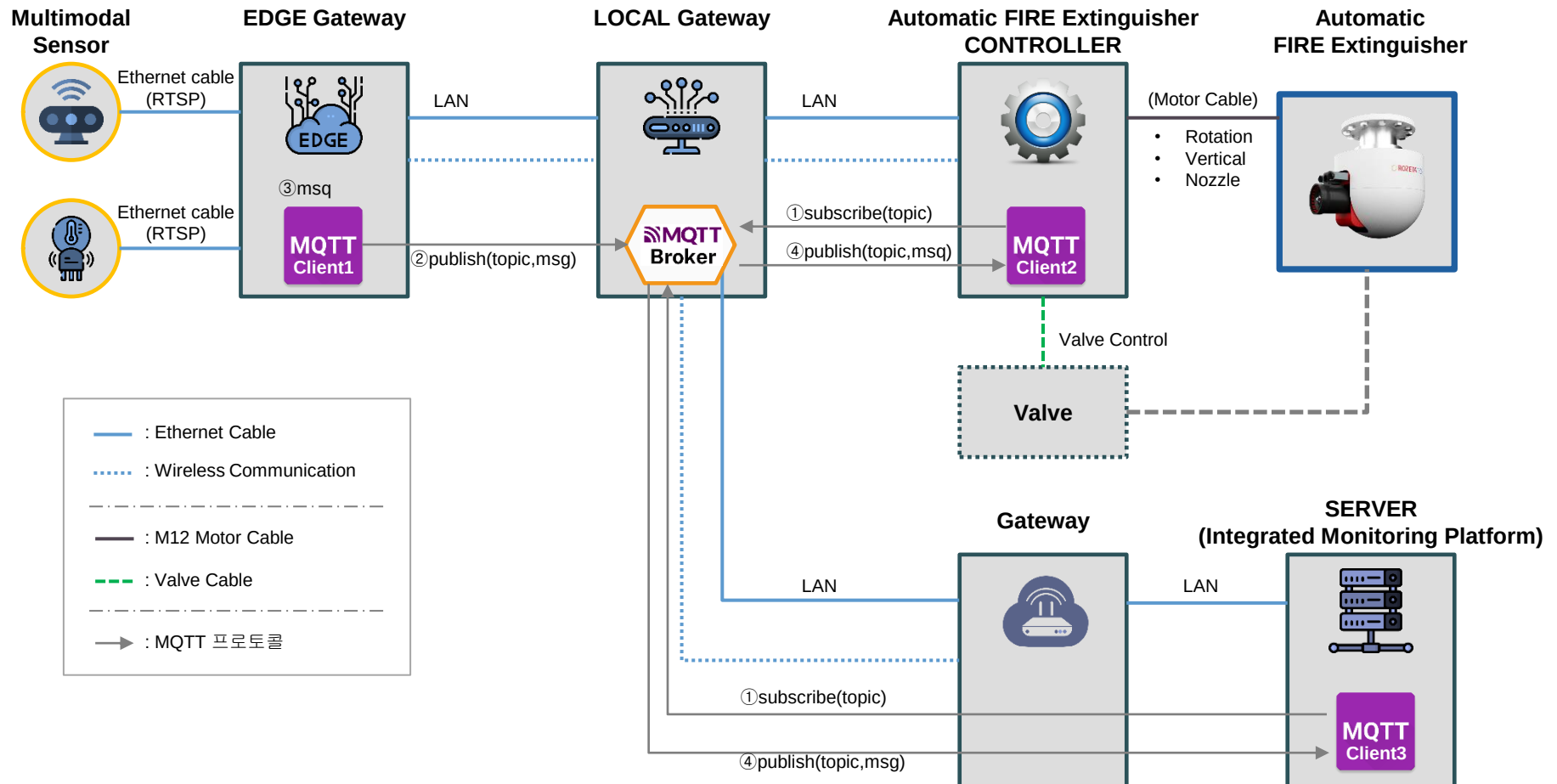


< example of a rotating mechanism >

3.4 Fire Extinguisher Development » Fire Point Strike Fire Extinguisher Development

Real-time information sharing method between Fire Extinguisher Control System and Edge Gateway

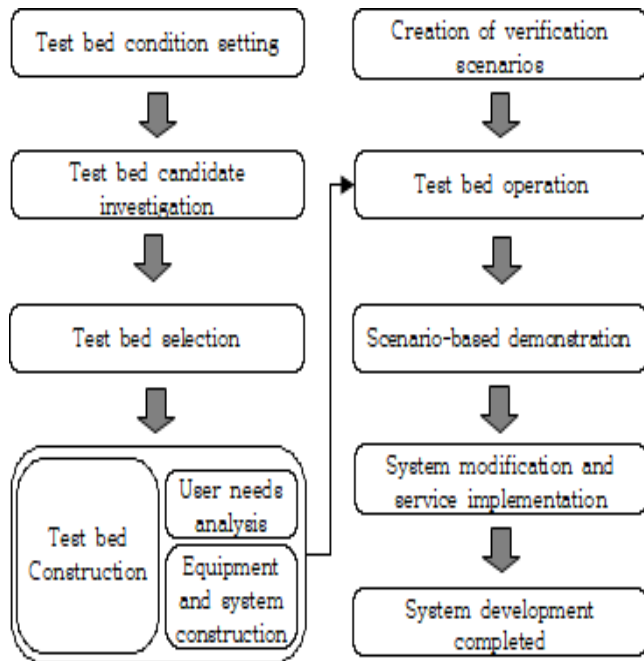
Using MQTT, the optimal IoT messaging protocol that can be used even in low-power and low-bandwidth environments



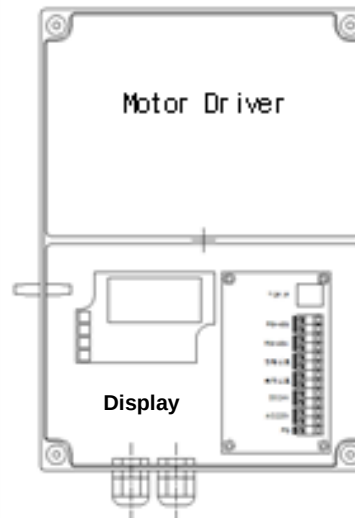
3.4 Fire Extinguisher Development » Fire Point Strike Fire Extinguisher Development

Development of a control unit for fire extinguisher capable of striking ignition point

A rapid response system can be established by developing a control unit for precise control of a fire suppression device capable of aiming and hitting the ignition point of the fire

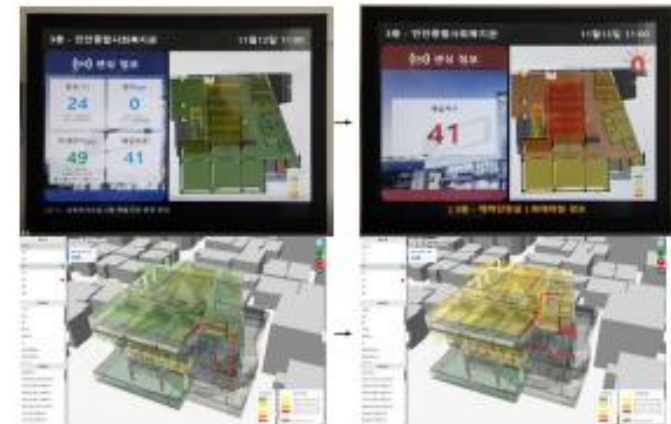


< Testbed design procedure diagram >



< Motor driver, Display >

- Development of Fire Control Unit
- Define and design communication protocols with sensing
- Drive motor and motor driver design
- PCB and control unit design
- Sensor unit and motor driver performance test
- Performance improvement and optimization control/motor driver, PCB test and supplementation
- Interlocking



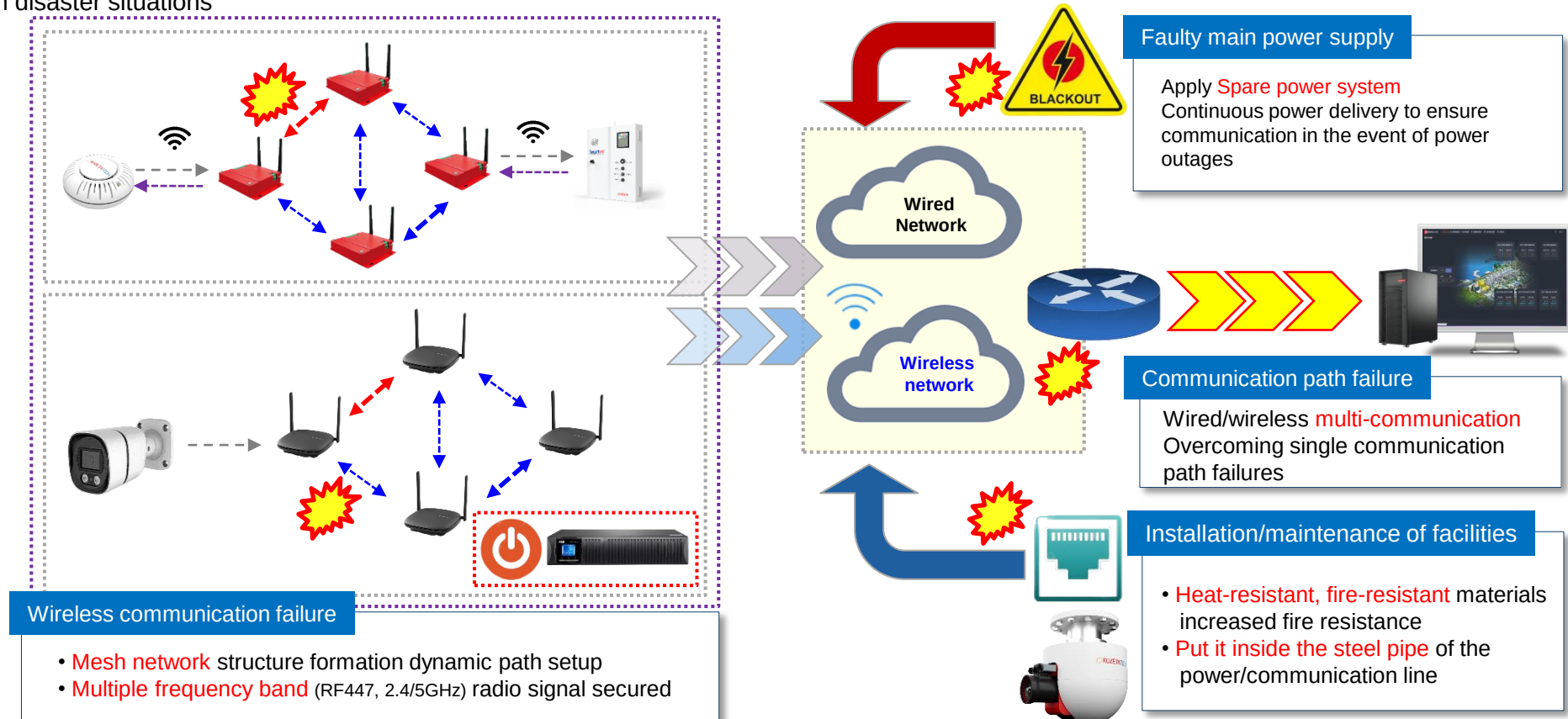
< Field Test Validation >

3. Implementation plan for each goal

3.5 Development of wired and wireless communication systems » Capable of continuous communication in the maturity stage of large fire

A reliable wired and wireless communication system that enables continuous communication even in the maturity stage of a large fire

The wired/wireless complex communication system aims to increase communication reliability by utilizing multiple communication paths and to improve stability by minimizing the impact of a single point of failure. It also works effectively in environments where single communication is difficult, strengthens fire response capabilities in various environments, and facilitates real-time data collection and sharing to enable rapid decision-making in disaster situations



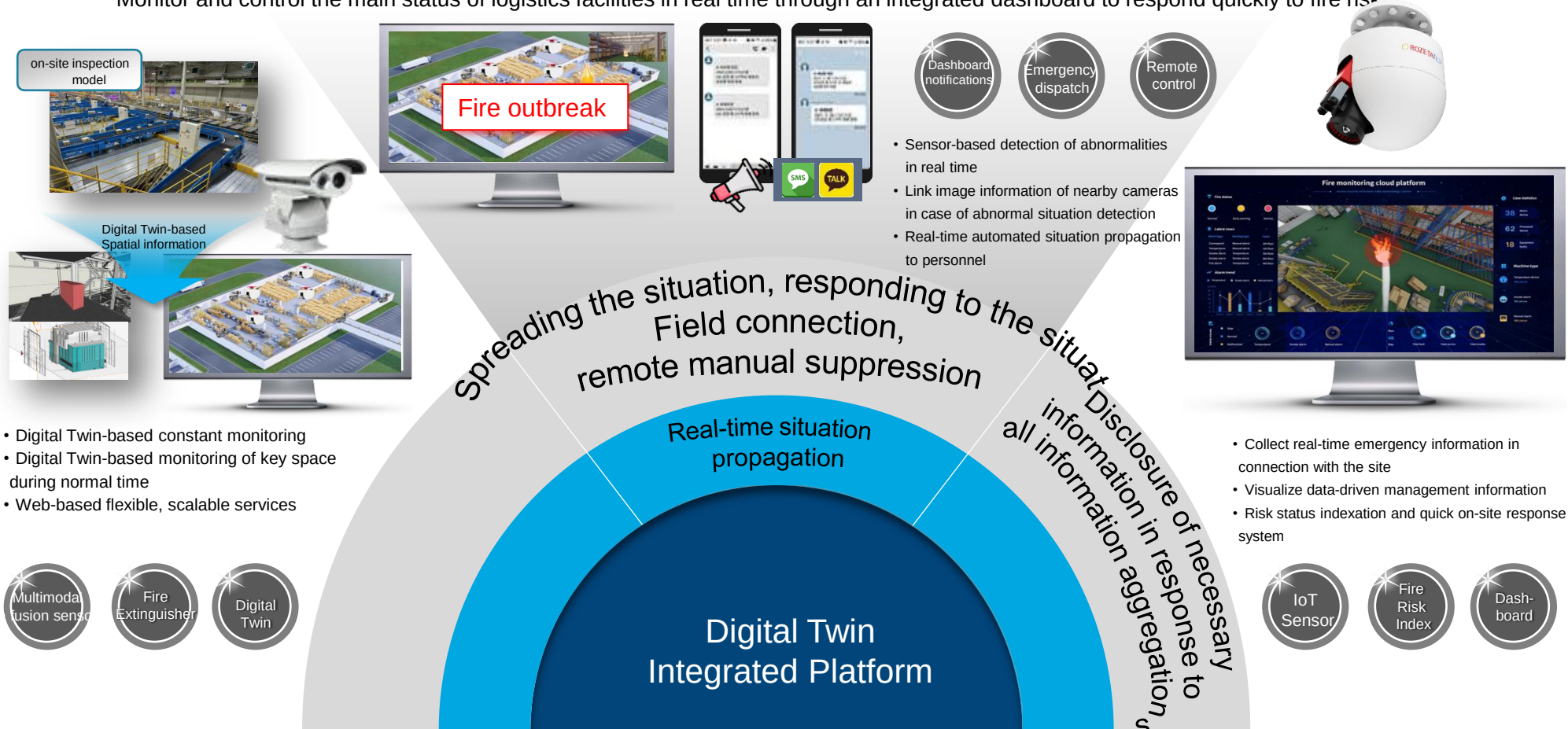
3. Implementation plan for each goal

II. Technology development goals and contents

3.6 Development of Integrated Platform for Logistics Facilities » Development of Data-Based Digital Twin Platform

Development of a digital twin integrated platform for ultra-low delay fire prediction, detection, and optimal response based on deep learning

Real-time interworking with multi-modal convergence sensors and intelligent fire suppression devices based on digital twins.
Monitor and control the main status of logistics facilities in real time through an integrated dashboard to respond quickly to fire risks



3. Implementation plan for each goal

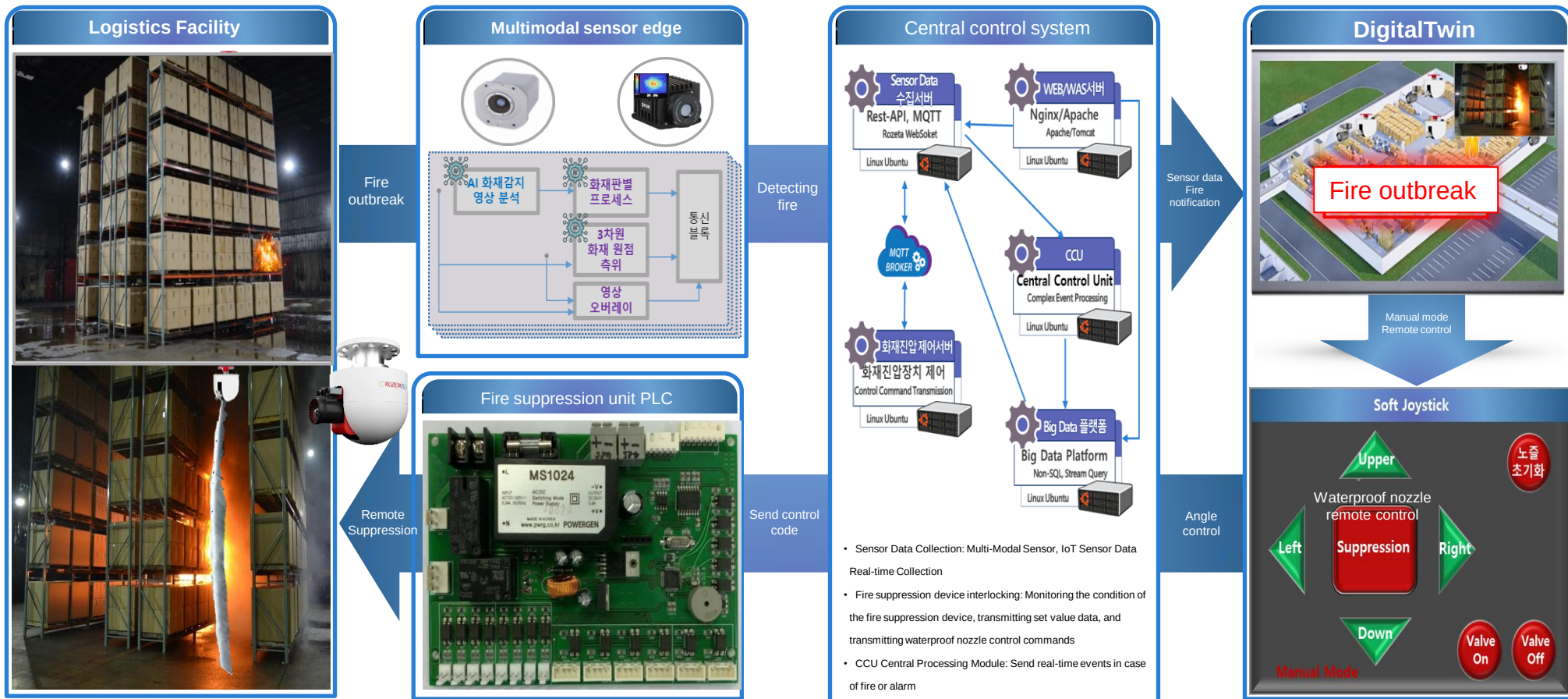
II. Technology development goals and contents

3.6 Development of Integrated Platform for Logistics Facilities »

Development of Data-Based Digital Twin Platform

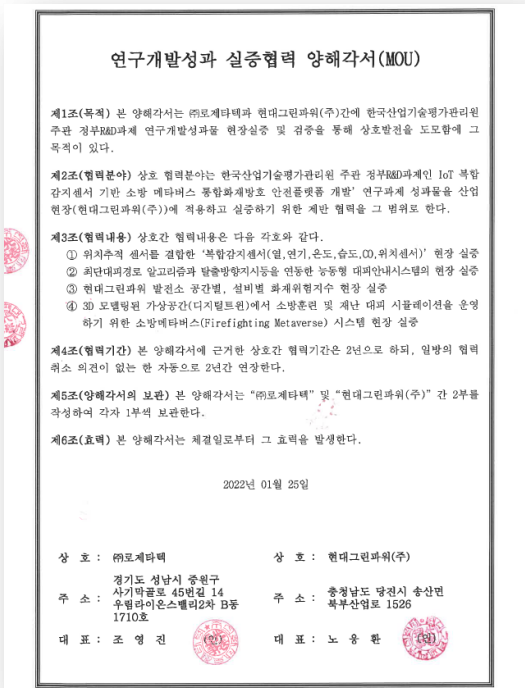
Method of Interworking and Control of Fire Suppression Devices based on Digital Twin Integrated Platform (Draft)

The multi-modal sensor-based automatic fire suppression system operates automatically by default, but provides manual remote control function on digital twins through manual mode setting.



Demonstration Complex - Validation of Comprehensive Fire Protection System for Stable and Effective Logistics Facilities

[MOU on cooperation for
R&D performance demonstration('24.03.03)]



구축 내용

● Construction and demonstration period

- Construction: Oct 2026 to Jan 2027 (4 months)
- Empirical test: Jan 2027 to June 2027 (6 months)

● Scope of construction

- Build multimodal fusion sensors:
 - Complex detection sensors, CCTV/thermal imaging cameras, etc
- Construction of Fire Suppression Device
 - Intelligent automatic fire suppression device
- Establishment of Digital Twin Integrated Control System

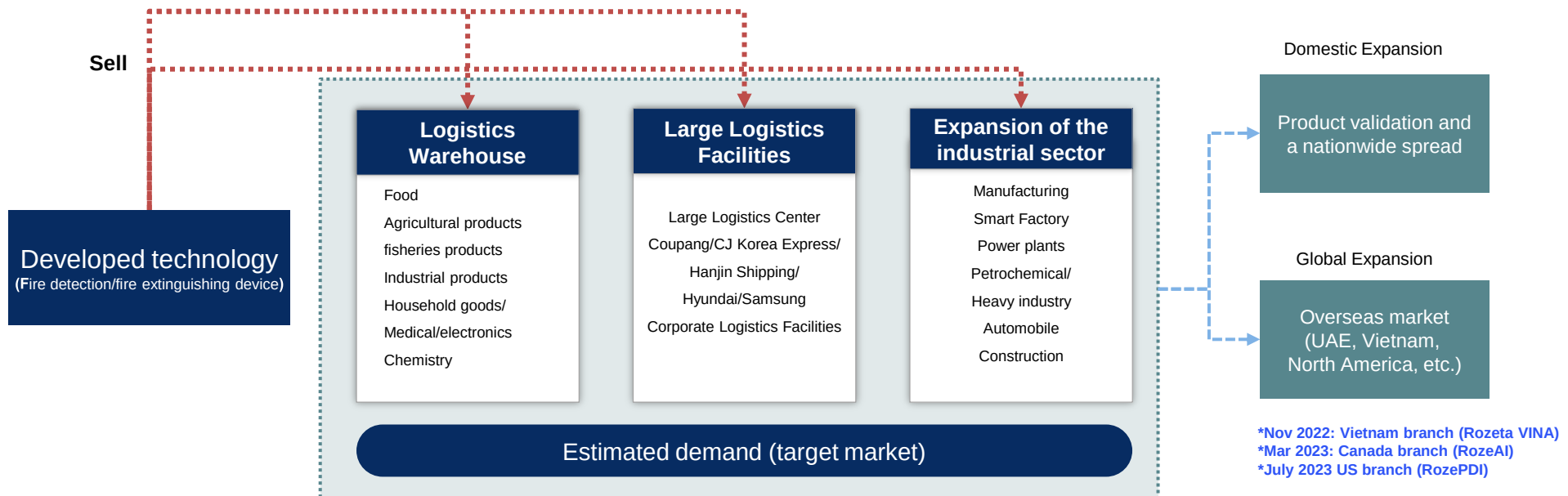
CHAPTER III

Implementation and commercialization plan

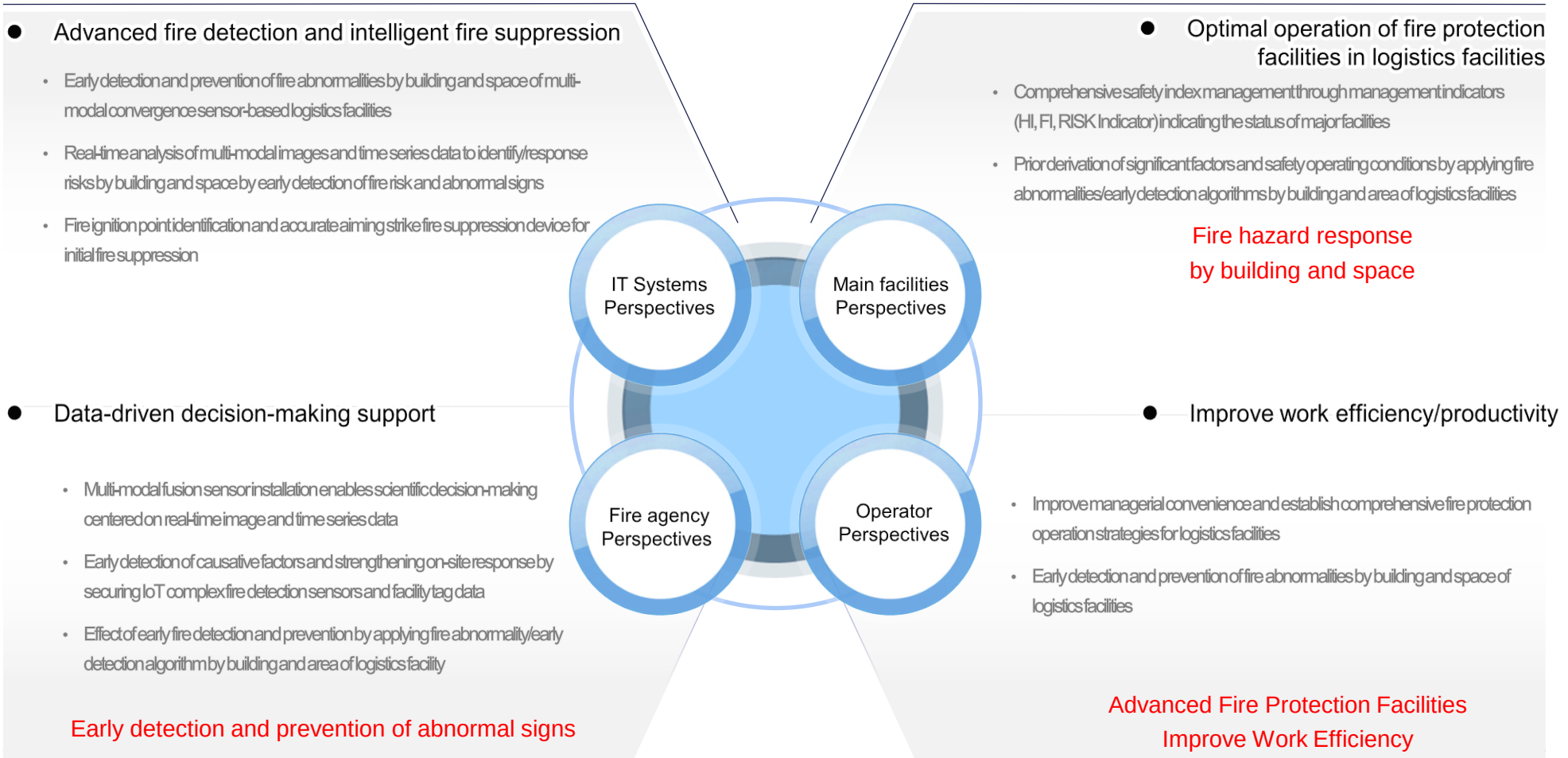


Promotion of commercialization of similar sites based on demonstration sites

- 1 Initial Prototype/Product Sales and Installation (Permit Complex Small-Success 1st)
- 2 Promote the commercialization of platform development that can be applied actively and flexibly from small logistics warehouses to large automatic warehouses
- 3 Securing the market through initial infrastructure construction through government support policy linkage plan



Expected effect of solution application



The art of reading small changes in things using IoT Technology, We are realizing.



Smart IoT, DigitalTwin, Disaster AI Platform