STRATEGIES FOR APPLYING DIGITAL TECHNOLOGY TO IMPROVE THE SAFETY MANAGEMENT OF DANGEROUS GOODS IN THE PORTS

Workshop on promoting the safety management of Dangerous Goods in the port areas in the Asia Pacific Region

1 December 2022

Kerri Ahn, ESCAP Consultant

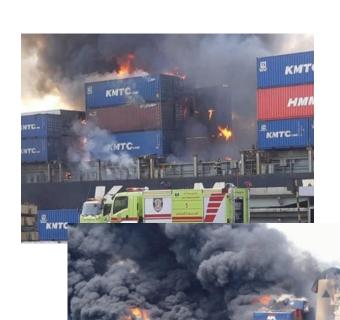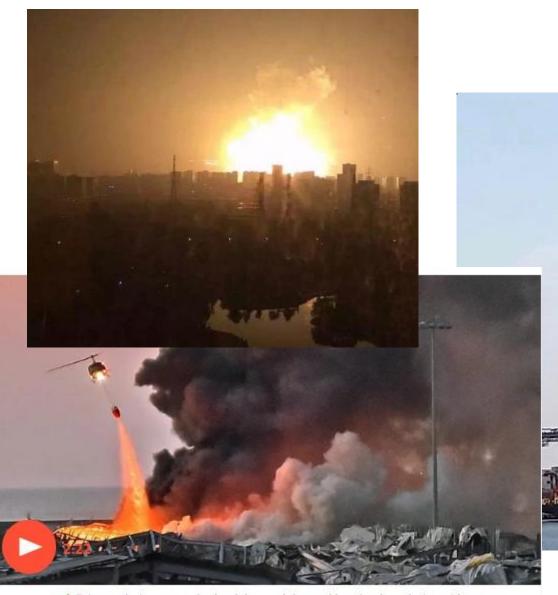# CONTENTS

I. Background

⚪ **Trend**

- Increase in volume of dangerous cargo and types of dangerous cargo

- management body of dangerous goods is dispersed and not systematic => When an accident occurs, it is difficult to solve the problem

  - Existence of relevant laws per Government agencies

  - Different agencies in charge of each hazardous substance

  - Different management bodies for each port operation

  - Not easy to grasp the situation due to poor information

- Need for safety management to prevent accidents such as fire or explosion of dangerous goods

  - Mass disasters such as Hulk   (scrapped ship) and inability to operate the accident port

  - Causing human/material damage due to negligent management

  - Dangerous goods containers must be reported as dangerous goods declaration -> If false or not reported, screening and inspection must be required

I. Background

Accidents regarding DG

Beirut explosion: scores dead and thousands hurt as blast rips through city – video report

II. Status of DG in ports

○ **DG in ports**

- Keep container or bulk cargo in yard

- Container within vessel

  - sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs

- **Sustainable development in ports**

  - **Introducing regulations on various pollutants such as IMO 2020, the sustainability of the port is being recognized as the competitiveness of the port**

  - **Indeed, sustainable development has been set up as one of the main goals in most countries' ports**

II. Case Study of DG

○ **IMO**

- IMDG (International Maritime Dangerous Goods) Code

  - covers all aspects of the packing, labelling, storage, and safety of dangerous goods while they are in the process of being transported

  - an extension of Chapter VII of the Convention for Safety of Life at Seas (SOLAS)

  - a part of the provision of the Convention for Prevention of Marine Pollution (MARPOL)

  - covers all items that are transported. It describes in detail the packing to be followed for each item, their container transport, storage, segregation, and stowage

II. Case Study of DG

○ IMO

- Types of DG classified by IMDG

  - Class 1 Explosives

  - Class 2 Gases that are compressed, liquefied or dissolved under pressure

  - Class 3 Flammable liquids

  - Class 4 Flammable solids that may be spontaneously combustible or those which emit flammable gas

  - Class 5 Oxidizing agents or organic peroxides

  - Class 6 Toxic or infectious materials

  - Class 7 Radioactive materials

  - Class 8 Corrosive materials

  - Class 9 Other dangerous and non-classified materials

II. Case Study of DG

○ **IMO**

- Types of DG classified by IMDG

  - Shipper name and address

  - Consignee name and address

  - Vessel name

  - Vessel Voyage number

  - Container number

  - Name and description of each dangerous good

  - The technical name of each dangerous good

  - Quantity

  - UN number (United Nations number)

  - Hazard Class

  - Packaging group – type and make

II. Case Study of DG

◯ IMO

- Misdeclaration of DGD

  - Misdeclaration or failure to declare certain dangerous goods is a serious offence

  - Incorrect or incomplete Dangerous Goods Declarations can lead to accidents that may cost human lives and loss to cargo or equipment

  - It may be an accidental omission, but some shippers do this on purpose to avoid certain charges or to transport banned substances

  - Customs and port authorities, as well as shipping lines, impose heavy fines on shippers for misdeclaration of dangerous goods or attempting to transport them without declaring

II. Case Study of DG

⚪ **IPCSA**

- ■ PCS

  - An electronic platform which connects the multiple systems operated by a variety of organisations that make up a sea port or airport community

  - A modular system with functionality designed to provide all the various sectors and players within a port community environment with the tools specific to them, thus delivering a tightly integrated system

  - Developed for port users by port users, a PCS encompasses exports, imports, transshipments, consolidations, hazardous cargo and maritime statistics reporting

  - Key features

    - ✓ Easy, fast and efficient EDI-based information exchange, re-use and centralisation, available 24/7/365.
    - ✓ Customs declarations
    - ✓ Electronic handling of all information regarding import and export of containerised, general and bulk cargo
    - ✓ Status information and control, tracking and tracing through the whole logistics chain
    - ✓ **Processing of dangerous goods.**
    - ✓ Processing of maritime and other statistics

II. Case Study of DG

○ **EPCSA**

- PCS

  - A neutral and open electronic platform enabling intelligent and secure information exchange between public and private stakeholders in order to improve the competitive position of the seaport communities

  - Optimizes, manages and automates logistics-efficient processes through a single submission of data, connecting transport and logistics chains.

  - Electronic communication in ports between the private transport operators, the private hinterland, the importers and exporters, the port authorities, Customs and other authorities

  - Typical Services

    - ✓ information exchange between transport operators in the port and for hinterland connections, the port users, Customs, port and other authorities,

    - ✓ electronic exchange of Customs declarations and Customs responses, and cargo releases between private parties and Customs,

    - ✓ electronic handling of all information regarding import and export of containerized, general and bulk cargo for the port community,

    - ✓ status information and control, tracking and tracing goods through the whole logistics chain, and

    - ✓ processing declarations of dangerous goods with the responsible authorities.

II. Case Study: digitalizing the logistics sector

○ **China**

- the interim operational requirements by Shanghai International Port Group (SIPG)

  - Apply this requirements to containers of imported hazardous chemicals listed on the Catalog of Hazardous Chemicals (2015) but are not subject to the International Maritime Dangerous Goods (IMDG) Code.

  - Starting on July 1, 2022, consignees and their appointed agents must submit the Identification and Classification Report for Hazardous Chemicals issued by a qualified third-party institution by email and the filled Dangerous Goods Declaration Form 24 hours prior to arrival

  - The operation terminal will synthesize relevant information, classify the specific cargo into the category of dangerous goods with the most similar hazard properties, take corresponding safety precautions, provide corresponding port operations and stockpiling services, and bill the service fee according to the standards of the corresponding category

II. Case Study: digitalizing the logistics sector

○ **China**

- the interim operational requirements by Shanghai International Port Group (SIPG)

  - mandatory information

    - ✓ Ship and port information – shipper, ship's name and voyage number, port of loading, and port of destination

    - ✓ Cargo information – proper shipping name, UN number, CAS number, hazard class, packing group and quantity

    - ✓ Form of transport – packaged, bulk, intermedia bulk, or tank

    - ✓ Port operation type – loading/unloading, lighterage, or storage

    - ✓ Relevant documents and container number

    - ✓ Safety precautions

II. Case Study: digitalizing the logistics sector

○ **USA**

- Logistics Security Regulation

Regulations	Descriptions
CSI	• Container Security Initiative • Since March 2002 controlled by CBP • Consignment screening by national targeting center of CBP • Sometimes, validation and inspection of the importing container by CSI staffs
C-TPAT	• Customs-Trade Partnership Against • Terrorism • Since 2002, controlled by CBP • Included to SAFE port act in 2006
24 hours rule	• Submit manifest to CBP before 24 hours arrival
10+2 Rule (ISF)	• Importer Security Filing and Additional Carrier Requirements • Since 2010, only for sea transportation
100% Screening	• Secure Freight Initiative, based on SAFE Port Act

II. Case Study: digitalizing the logistics sector

○ **Korea**

- Safety management

  - Containers with dangerous goods must be stored in a well-ventilated place without moisture depending on the characteristics of the cargo

  - Should be maintaining a certain distance between dangerous goods

- System construction in 2020

  - Dangerous Goods Container Identification System that is suspected not to be declaring

  - When dangerous goods are brought into the port of Korea, it is a system that compares the dangerous goods information required to be reported to the Ministry of Ocean and Fisheries and the import customs clearance cargo information reported to the Korea Customs Service. So, if it is suspected of being an undeclared dangerous goods container, this system automatically identifies it.

- CIP (Container Inspection Program)

  - Check whether the dangerous goods transporter complies with IMO regulation (IMDG Code) and Korean national laws and regulations

III. Safety management of DG in Ports

Logistics 4.0

Logistics 1.0 (20th Century ~)

Mechanization of transportation

- High speed and large capacity of land transportation by truck or rail
- Ship's operational stability improvement by the spread of steamships / aircraft

Logistics 2.0 (from 60's ~)

Automation of Cargo Handling

- Partially mechanized on cargo handling work in warehouses by practical application of logistics equipment
- Mechanization of port cargo handling due to the spread of container ships

Logistics 3.0 (from 60's ~)

Systematization of logistics management

- Automation and efficiency of logistics management with the widespread use of IT system such as WMS, TMS
- Digitalization of work process with the infrastructure systems

Logistics 4.0

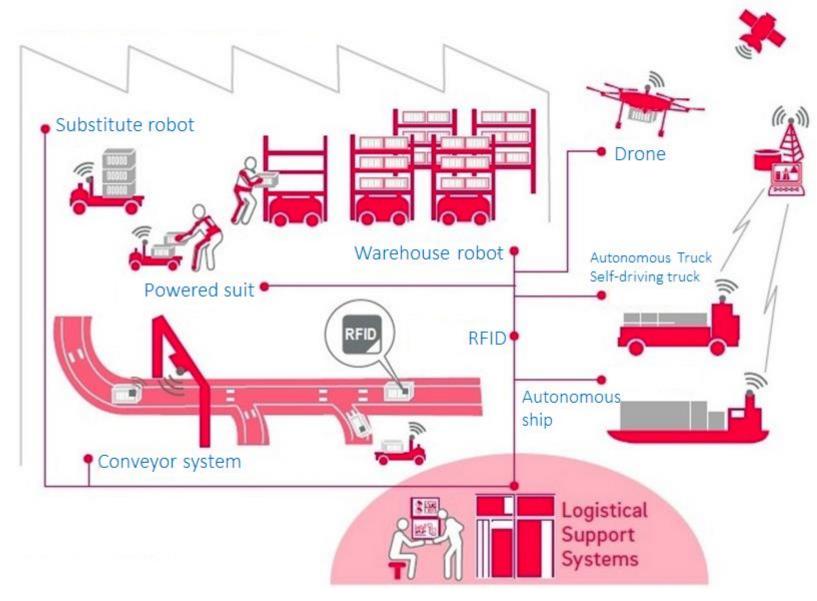### Labor saving and standardization through the evolution of IoT

- Labor saving with warehouse robots and automated driving
- Standardization by connecting logistics functions throughout the supply chain
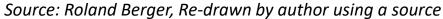
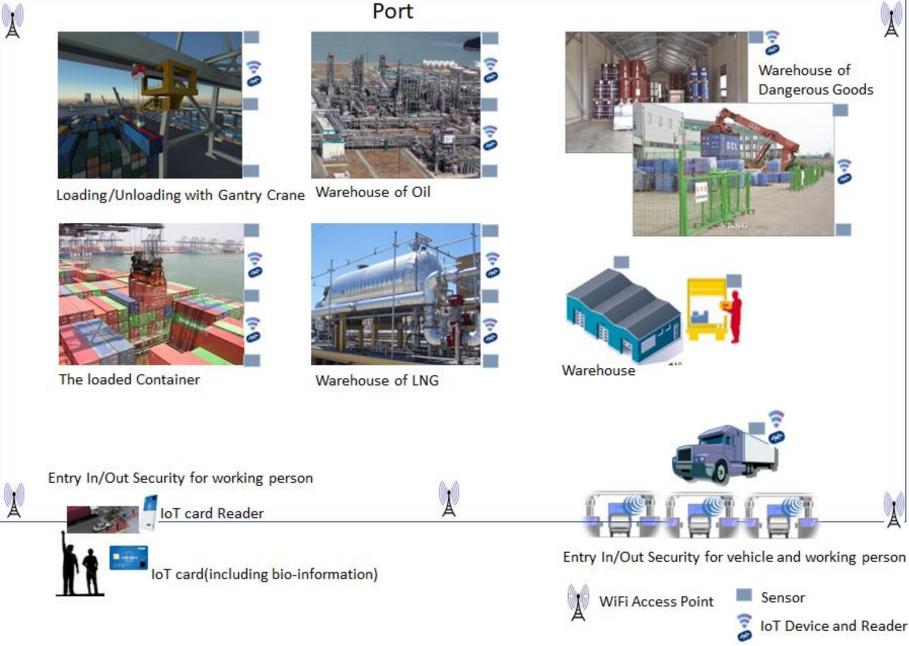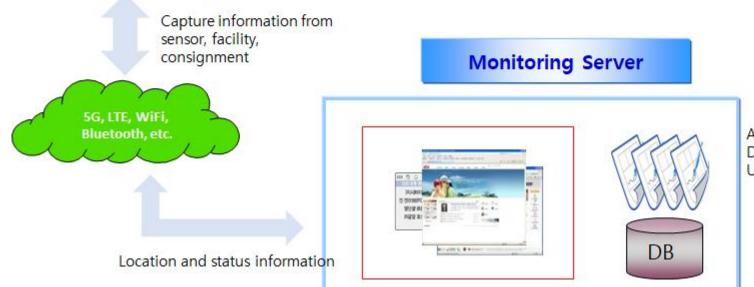*Source: Roland Berger, Re-drawn by author using a source*

III. Safety management of DG in Ports

○ **Logistics 4.0**

Source: Roland Berger, Re-drawn by author using a source

III. Safety management of DG in Ports

Capturing

Port

Loading/Unloading with Gantry Crane

Warehouse of Oil

Warehouse of Dangerous Goods

The loaded Container

Warehouse of LNG

Warehouse

Entry In/Out Security for working person

IoT card Reader

IoT card(including bio-information)

Entry In/Out Security for vehicle and working person

WiFi Access Point   Sensor

IoT Device and Reader

III. Safety management of DG in Ports

Risk monitoring
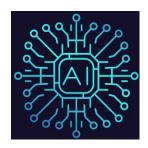
IV. The Required technologies for digitalization

Technologies (ex) for a smart port

- Use a logical way of thinking, learning and judging, like humans, on a computer
- Accumulated experience and a learning-based prediction model
- The best route navigation and recommendations.

- Decision-making support system based on a predictive model of behavior
- Port facility management with drones.

- A machine that replaces or supports human work
- Exoskeletons turn workers into human robots in order to reduce the work burden and promote safety
- Performs facility maintenance, defect status check, and underwater work etc., on behalf of workers.

- Robotics port, Unmanned transport robot
- Exoskeleton robot for workers
- Underwater construction robot

- Extract of valuable data
- Predicts behavior and pattern

- Analysis of ship operation efficiency
- Analysis of autonomous ships
- Disaster prevention and vessel safety operation

- An intelligent infrastructure and service technology for exchanging and communicating information
- Collection of information in real time from IoT sensors of containers, cargo, equipment, ships, trucks, roads etc.

- Real-time cargo flow tracking, Cargo and ship monitoring.
- Port of data-centric decision-making, Intelligent wharf wall.

- Virtualization solution implementation
- Able to improve the efficiency of all processes, from design to manufacturing and services
- Pre-verification through simulation before actual operation

- Ship life-cycle management, Facility management
- Smart ship sailing, Smart port operation management
- Container status monitoring

BLOCKCHAIN

- Prevents data fabrication& modification
- Verify transaction
- Record immutability, transparency

CLOUD COMPUTING

- Able to provide common management of resources, cost reduction and operational efficiency improvement

EDGE COMPUTING

- A method of data processing at device (system) close to the network edge where data is generated
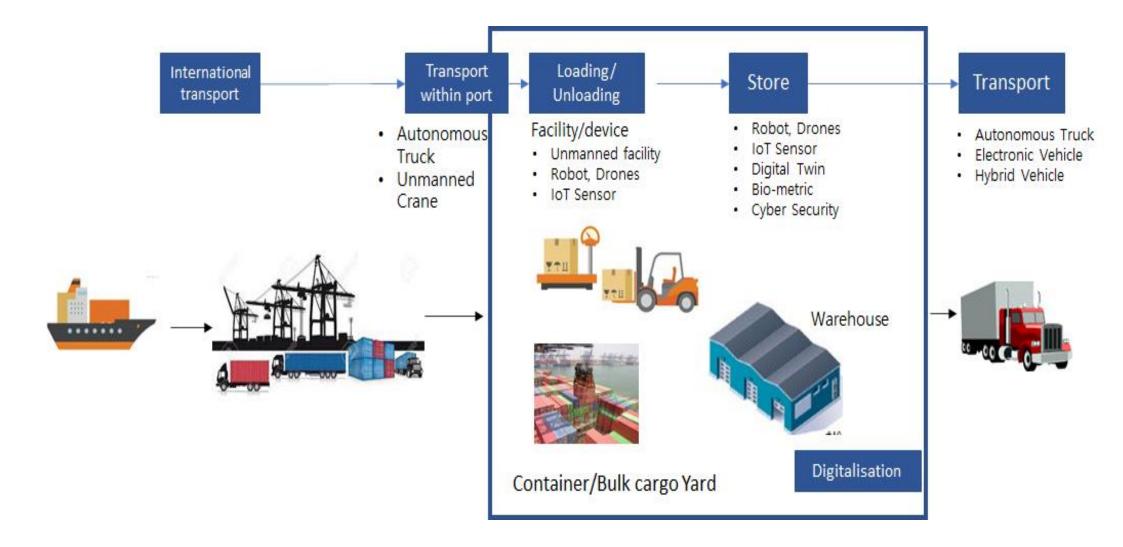

5G

- Ultra-high speed, ultra-low latency communication service

UNITED NATIONS
ESCAP

The K Consulting

V. Conclusion

Service Model

International transport	Transport within port	Loading/ Unloading	Store	Transport
	• Autonomous Truck • Unmanned Crane	**Facility/device** • Unmanned facility • Robot, Drones • IoT Sensor	• Robot, Drones • IoT Sensor • Digital Twin • Bio-metric • Cyber Security	• Autonomous Truck • Electronic Vehicle • Hybrid Vehicle

Warehouse

Container/Bulk cargo Yard

Digitalisation

V. Conclusion

Why starting toward to a smart transport and logistics using digitalization?

- **Digital transformation and globalization, information should be exchanged between cross-border countries for connectivity, interoperability, reliability, or safety, etc.**

- **Technical trend is also changing, therefore many organizations try to adopt new technology to enhance their capability**

Goal Direction Strategy	Collaboration	Digitalization with Technology	Safety Management with technology

감사합니다.

Thank you

ขอบคุณค่ะ

Contact: **Dr. Ahn, Kerri**
- The K Consulting -

Email address: ahn.kyeongrim@gmail.com