Digital Innovation, and Competitiveness Analysis and Strategy of the Shipbuilding Industry

2023. 03. 06 ~ 10

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CHAPTER I Introduction

Introduction

➢ Characteristics of the shipyard?

- has only picture products such as drawings and photos at the shipyard's exhibition hall
- has only facility and personnel to build product as per ship-owner's request
- does not product the same ship even in case of the series orders of ships

➢ Production & Sales Strategies

Even with the same product and equipment, the operating strategies can differ:

- MTS (Make to Stock) : TV, Cars (Product Design -> Equipment Design -> Production)
- ATO (Assemble To Order) : Dell Laptop, Cars (Product design -> Equipment Design -> Production)
- ETO (Engineer to Order) : Korean Shipyard (Fixed Equipment -> Product Design -> Production)
- MTO (Make To Order) : Japanese Shipyard (Fixed Equipment -> Specification Change Design -> Production)

Introduction

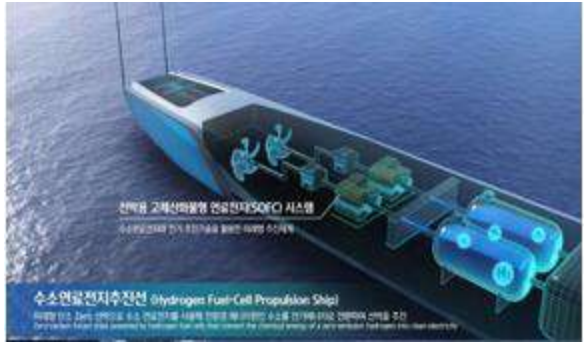
➢ Shipbuilding Industry's Products

VLCC

Large Container Ship

Very Large LNG Carrier

LNG Fueled Ship



Hydrogen Fuel Cell Propulsion Ship

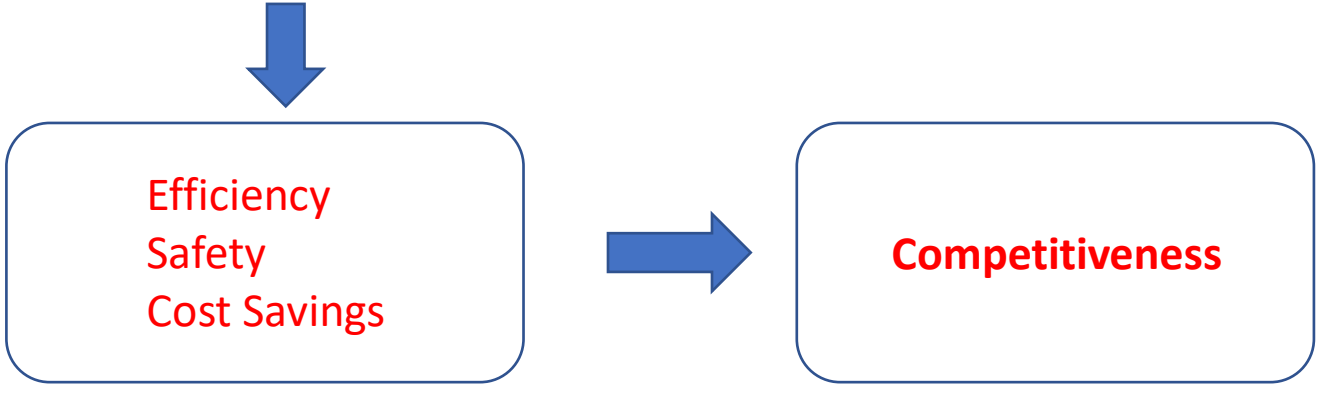
Ammonia Propulsion Ship

LH2 Carrier (Japan)

Introduction

- **What are the objectives of shipyard?**
  - Ensure that new products are designed quickly and accurately for production
  - Increase the productivity using the shipyard's equipment capacity and reduce the time required for production

- **What need for shipyard to achieve the objectives:**
  - A system that can respond flexibly to changing products → Smart Shipyard
  - Transformation to generate quick and accurate information → Digital Transformation.



CHAPTER II

Digital Innovation in Shipyards

Digital Innovation in Shipyards

➢ Digitization, Digitalization and Digital Transformation (DX)

Digitization

- The process of converting information into a digital (computer readable) format
- The digitized data is in the form of binary numbers: examples: image, sound, document processed by digital computers

Digitalization

- The use of digital technologies digitized data to improve process and provide new revenue and value-producing opportunities
- which accelerates the new digital technology and marketing such as cloud computing, machine learning, AI and IOT, etc.

Digital Transformation (DX)

- Business Transformation enabled by digitalization
- For example, introducing AI or cloud computing to enhance the customer experience.

Digital Innovation in Shipyards

➢ **Key Driving Forces of Shipbuilding Industry**
- Design capacity and Product Catalog
- Better Production Systems (Equipment, Machinery)

- Leading Products in the Market
- A System that designs/produces those Products safely, quickly and accurately

Product

Digital Transformation

System

Smart shipyard with Digital Transformation

Digital Innovation in Shipyards

➢ Working Environments in Shipyards

Accidents

Crane Accident

Fire on constructing LPG Carrier

Caught btn. Steel plates

Working Env.

Cleaning with Water

Welding

Spray p[ainting

Digital Innovation in Shipyards

➢ Evolution of Design System (as per Korean Shipbuilding Industry)

1980 (1G)

Labor Power

Manual Drawing

1990 (2G)

Automation

2D CAD

2000 (3G)

Integration

2.5D CAD

2010 (4G)

Smart Shipyard

3D CAD

2020 (5G)

Digital Transformation

DT CAD

JAPAN Shipyard (2.5G)

China Shipyard (Moving From 4G to 5G) (CCS, NACKS)

KOREA Shipyard (Advanced 3G, Moving to 5G w/o 4G)

EU, US 조선소 (Renovation with 5G) (Ecoprodigi)

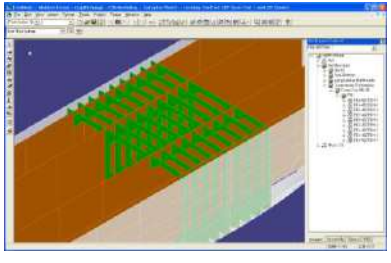
Digital Innovation in Shipyards

➢ Evolution of the Production System (as per Korean Shipbuilding Industry)

1980 (1G)	1990 (2G)	2000 (3G)	2010 (4G)	2020 (5G)
Labor Power	Automation	Integration	Smart Shipyard	Digital Transformation

Passion & Labor force

Innovative construction methods, IT application, automation (Skid, Mega Block, etc.)

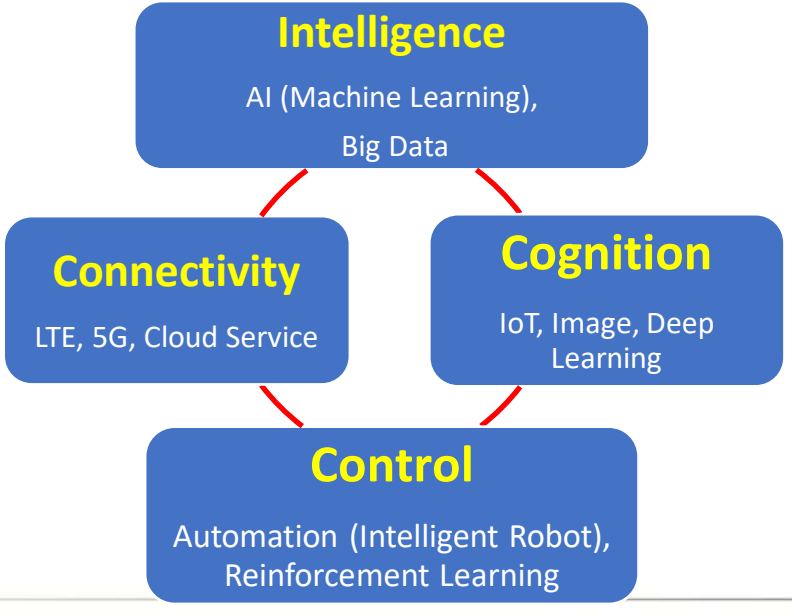


In the process of transforming into a smart shipyard

Digital Innovation in Shipyards

➢ What is Smart Shipyard?

- Smart = Four capacity (intelligence, Connectivity, Cognition and Control)
- Smart Shipyard = Transformed the current shipyard into a shipyard with intelligence, Connectivity, Cognition and Control capacity.



Smartization

Digital Innovation in Shipyards

➢ What is DX in Shipyard?

- which makes the smart shipyard to operate Information, speed, accuracy, planning, efficiency, quality, collaboration.

✓ Plan operation and monitor risks
ex) PHM Twin, Ship Twin, Equipment Twin, Process Twin

✓ Ensure that all information flows accurately
ex) DX of Design Information (Metaverse CAD)

✓ Share quality information with ship owners and classification societies

✓ Ensure accurate supply and movement of materials
ex) DX of design information and logistics Process

✓ Aim for efficiency in equipment and processes

✓ Share information with equipment and block contractors
ex) Metaverse CAD connected service, Cloud Service (share 3D design and quality information)

Digital Innovation in Shipyards

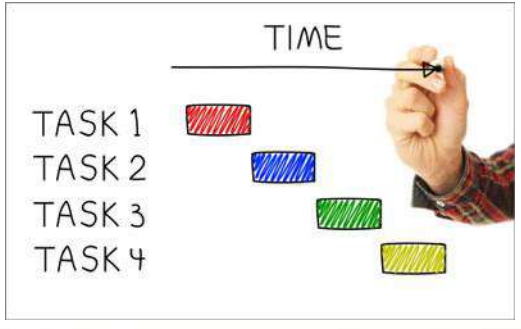
➢ What are the targets to DX in Shipyard?

Everything operating and moving within a shipyard

- ✓ How can we accurately and quickly represent the product?
- ✓ How can we plan the process accurately to direct resources?
- ✓ How can we improve resources to ensure that parts and processes are completed quickly and accurately?

Information (CAD, BOM, WOP, WSD, Master Plan, Execution Plan etc.)

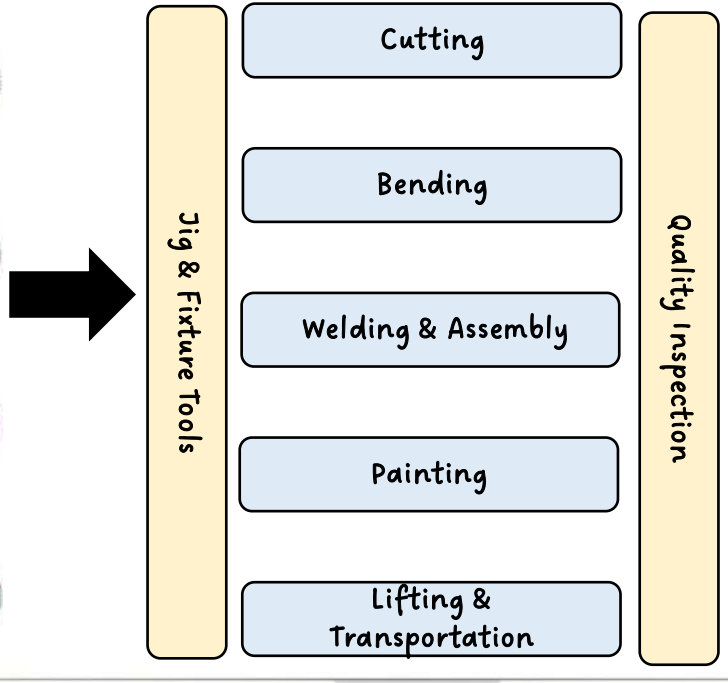
Product	Resource	Process	Time & Plan



Digital Innovation in Shipyards

➢ What are the targets to DX for Production Process in Shipyard?

- ✓ Seven-Up = 5 (Cutting, Bending, Welding & Assembly, Painting, Lifting & Transportation) + 2 (Jig & Fixture tools, Quality Inspection)
- ✓ Smartization & DX = How to improve Seven-Up



DX

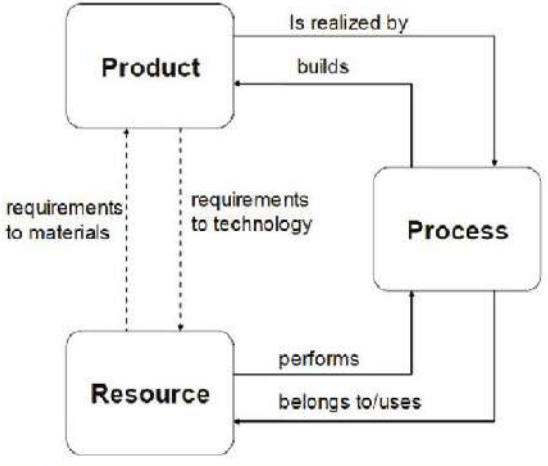
Digital Innovation in Shipyards

➢ What about DX in Design (Data)?

- ✓ DX of Data must be done simultaneously with DX of production process
- ✓ CAD and process/time planning information must be and connected and consistent
- ✓ The right parts should be arrived at the right time in smart shipyard.

(The information about the DX-ed parts must be communicated to the production process via planning systems or supply chain systems)

- ✓ The DX of the parts should be accurately and quickly represented in CAD, through the use of models and a bill of materials (BOM)

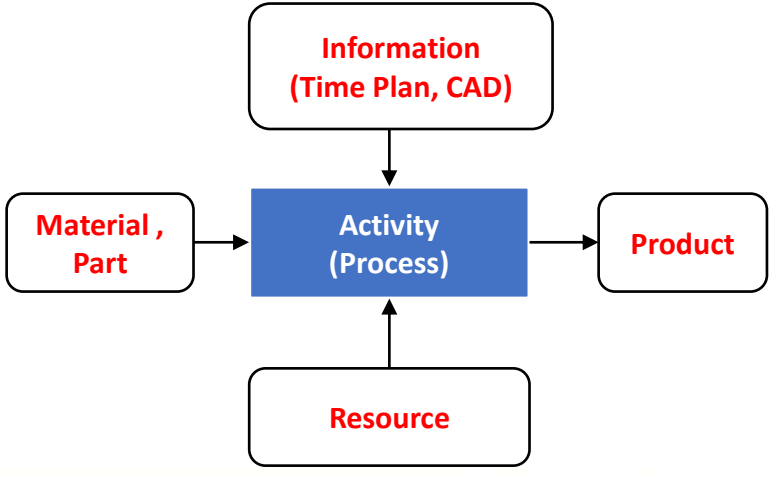


Digital Innovation in Shipyards

➢ Design, Process, Procedure, Inspection, and Planning Information must be connected and communicated

✓ BOM, CAD, 3D Geometry, Inspection, Plan, Prediction (Forecasting), etc.

- Examples
  - 3D shape information for operating a welding robot
  - Data collected by sensors
  - Drawings and associated textual information for thousands of parts
  - Information for purchased items and their part number designation



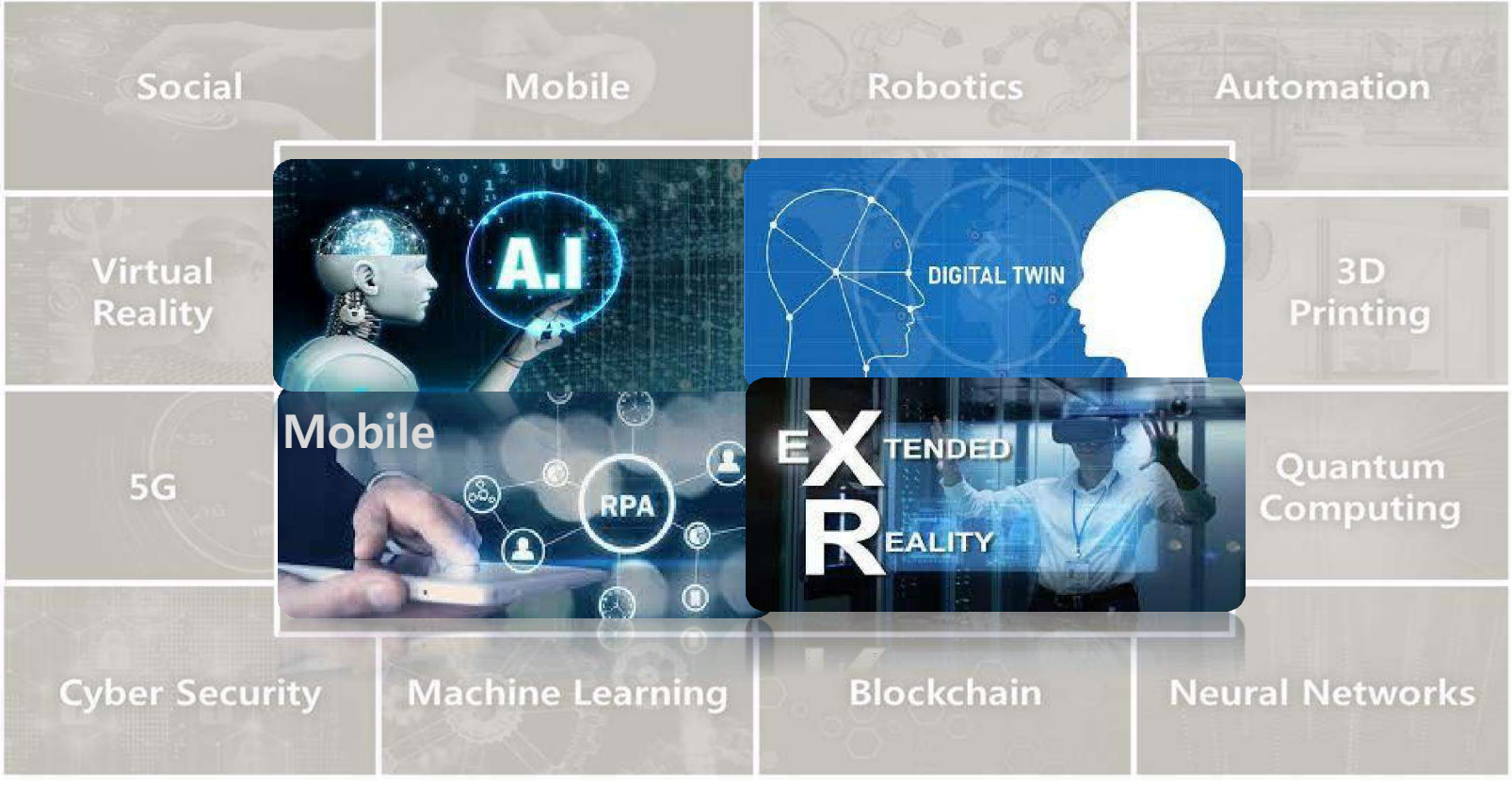
DX delivers the Information & Data required by Product, Process, Resource, and Time (Plan) to the Smart Factory quickly and accurately

SW systems (CAD, PLM, BOM, APS, ERP, SCM etc.) should to be improved to perform these tasks.

CHAPTER III

Applicable DX Technology in Shipyards

Applicable DX Technology in Shipyards

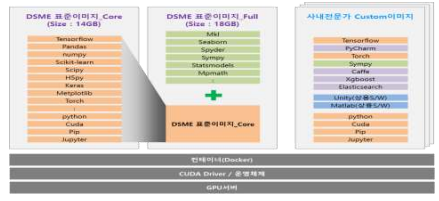


Applicable DX Technology in Shipyards

- It will be possible to implant DX technology into Smart Shipyard
- Remarkable successes in the fields of AI, Digital Twin, Mobile/RPA and VR/XR

AI

- AI and Data Analysis Platform
- Chatbot System for Work Support management
- Temperature and Humidity control inside Cargo hold



Digital Twin

- Smartyard monitoring and Control System
- Smart Commissioning remote control
- Intelligent Safety and environment monitoring

Mobile / RPA

- Mobile based quality inspection
- Work Improvement via RPA (Robotic Process Automation)
- Smartwork for Outfitting

VR/AR/XR

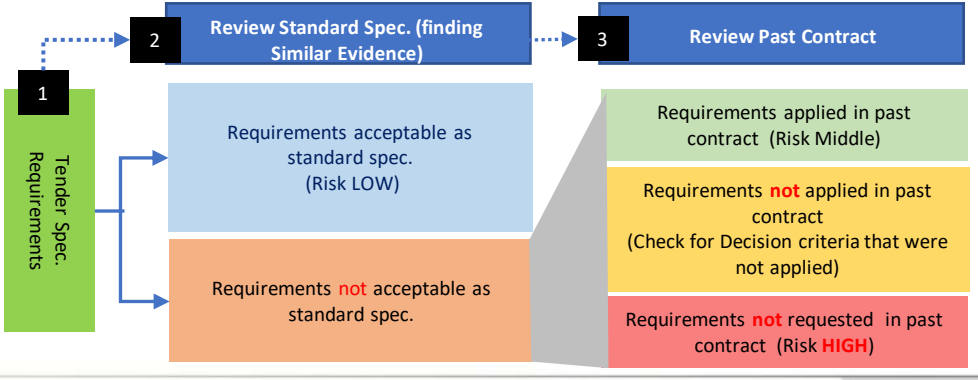
- Crew Training System with VR
- Welding/Painting Training with VR
- VR based quality inspection

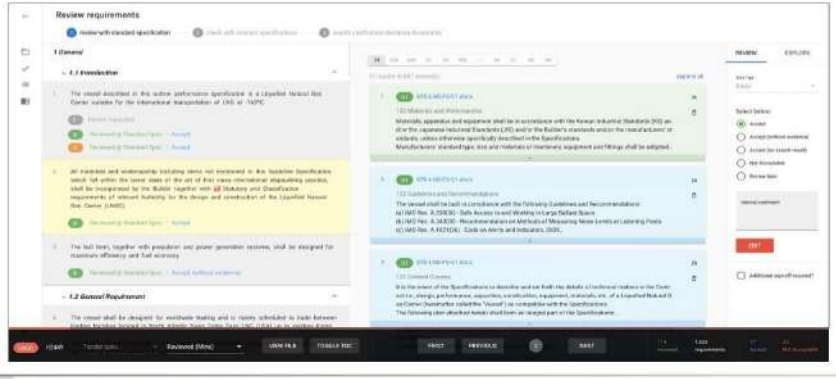
Applicable DX Technology in Shipyards

(1) Artificial Intelligence (AI) : Technical Document Review

- Establishment of solutions for efficient communication related to sales and ship construction
- Aims for data-based risk management and automation through AI technology rather than judgment based on work experience

Quick and Accurate Reasoning	It quickly and accurately presents data based on judgment to aid in deciding whether to accept the requirements during the review of technical documents	Automation
Recommendation based on Past Docs.	Recommendation of past review contents based on the review data accumulated in the system to minimize review work	Risk Management Work Efficiency





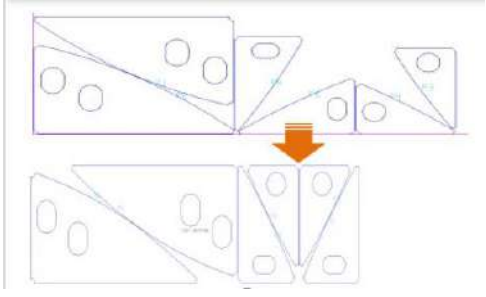
Applicable DX Technology in Shipyards

(1) Artificial Intelligence (AI) : CAD

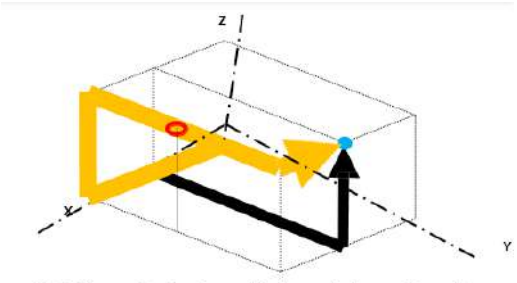
- Incorporation of AI technology into design automation

AI based Design Automation

AI Nesting



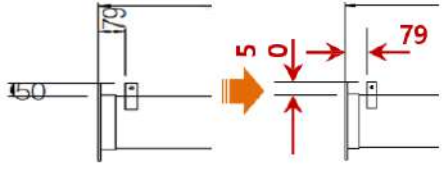
AI based PIPE AUTO-ROUTING



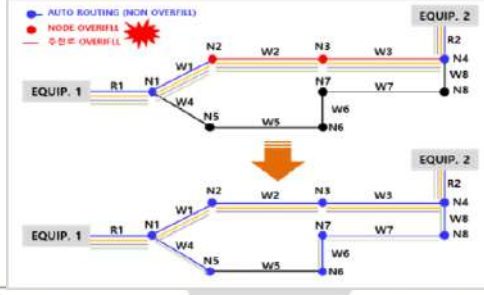
JPS (JumpPointSearch) based Auto Routing

AI based Design Chatbot system

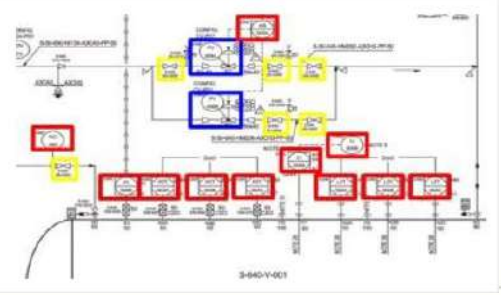
Outfitting Drawing Quality Improvement



AI based CABLE AUTO-ROUTING



P&ID Material Calculation



Applicable DX Technology in Shipyards

(1) Artificial Intelligence (AI) : Intelligent Welding Robot

- Development of Intelligent welding robot with AI & Sensor technology

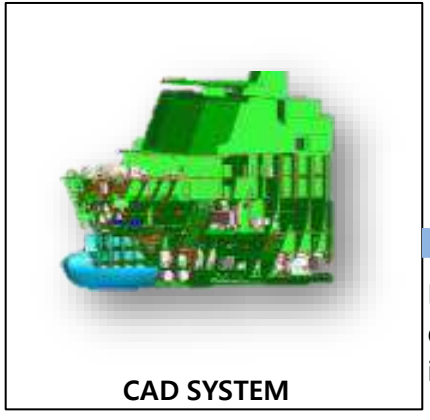
AS WAS – Manual Welding

AS IS – Robot Welding

Applicable DX Technology in Shipyards

(1) Artificial Intelligence (AI) : Bending Rolls

- Robot Processing utilizing accumulated surface machining information



Extraction of surface info

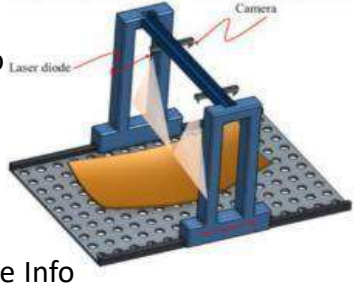
Design Info Management System

Curved surface Info. Providing service

Target surface Info

Similar surface Info

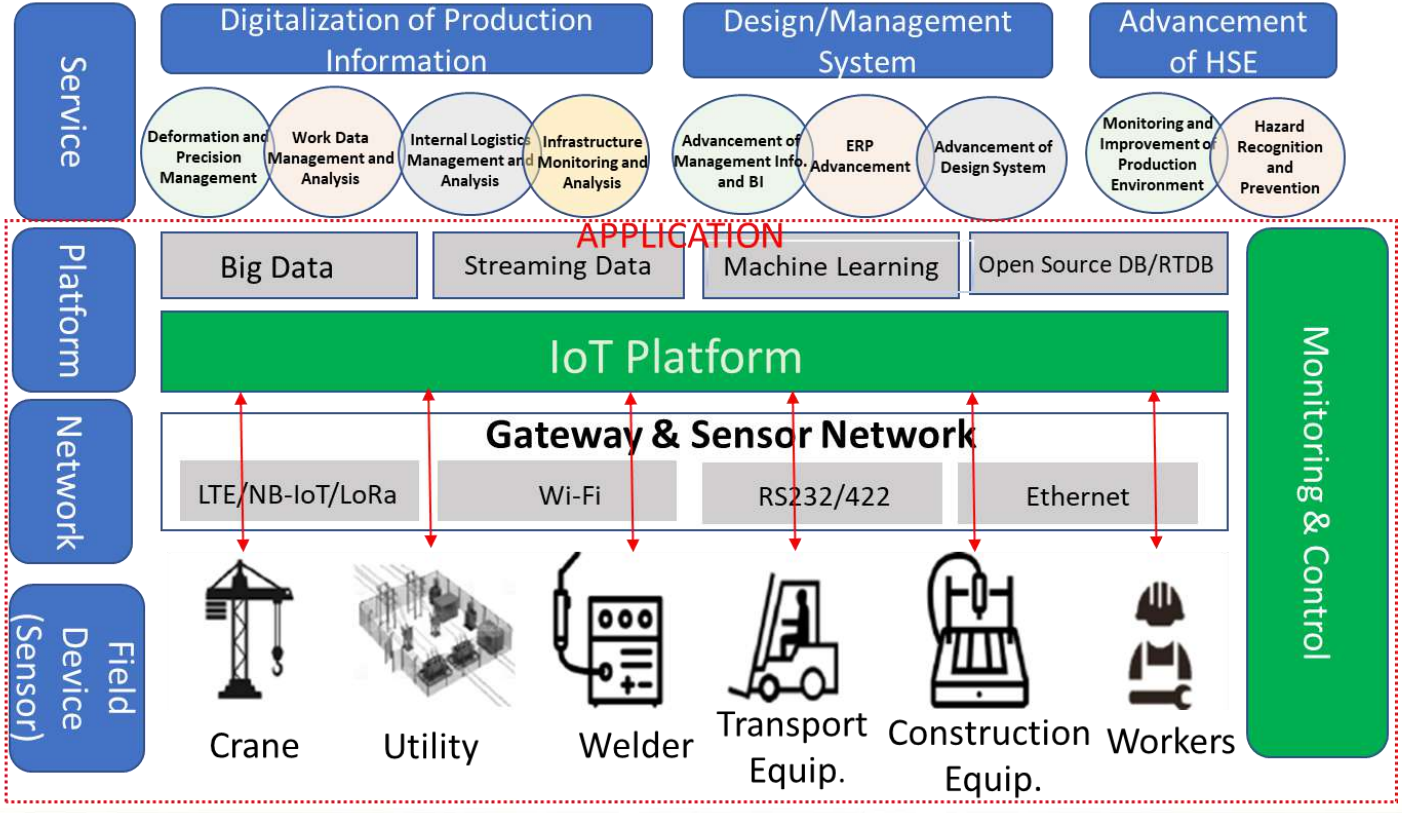
Work Performance Info



Applicable DX Technology in Shipyards

(2) Digital Twin – IoT Platform

- Utilization of IoT platform to collect, analyze, and visualize data for use in business operations



*BI : Business Intelligence

*ERP: Enterprise Resource Planning

*RTDB: Real Time DataBase

Applicable DX Technology in Shipyards

(2) Digital Twin – Construction Control Center

- Digitalized Construction Control Center utilizing Digital Twin technology
- Real-time monitoring of Ship Construction via Big Screen

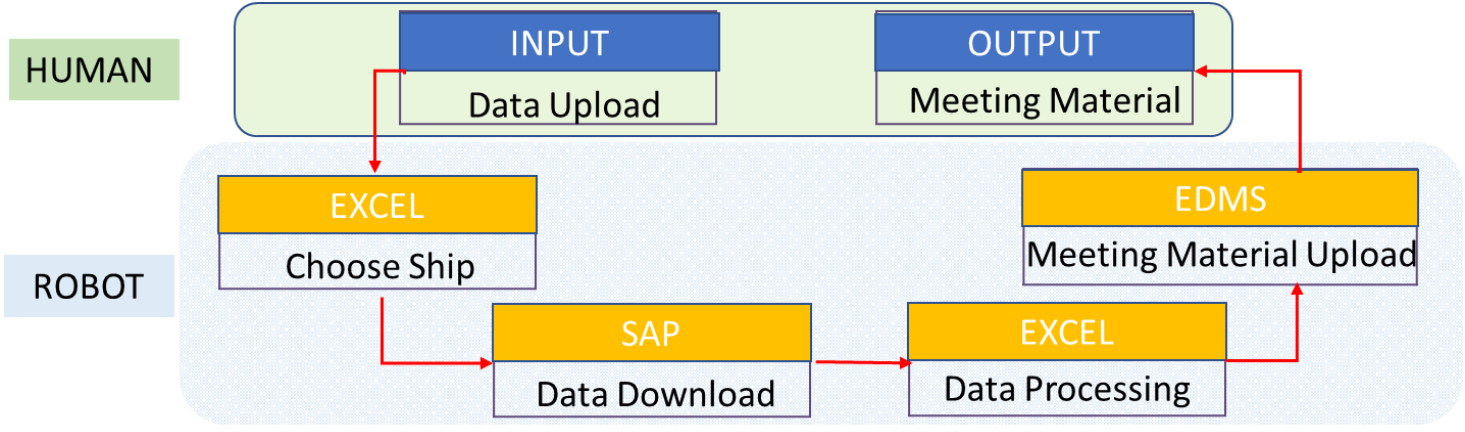
Applicable DX Technology in Shipyards

(3) Mobile/RPA – RPA based work innovation

- Application of RPA to establish smartwork environment as a work innovation tool
- Utilized RPA to use multiple data, repetitive tasks, and works outside of work hour

Example of RPA application

- Work Title: Calculation of launching progress rate of the ship and use for the meeting
- Work Hour/Period : 1h / 5 times/week



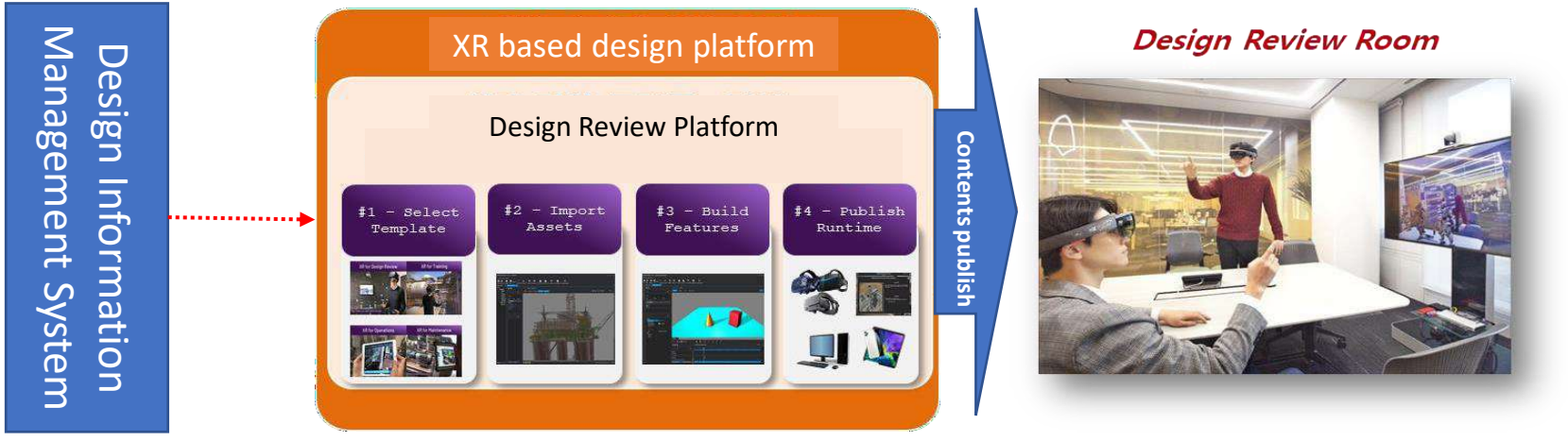
*SAP: System Applications and Products in Data Processing

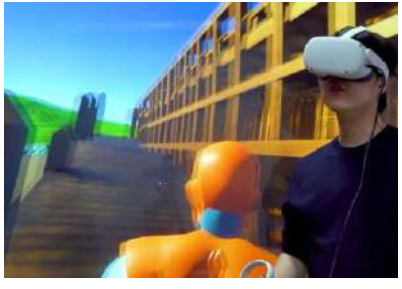
*EDMS: Electronic Document Management System

Applicable DX Technology in Shipyards

(4) Virtual/Extended Reality – VR/XR based Design Review

- Establishing VR/XR based Design Review Environment for quick and accurate design review and decision making

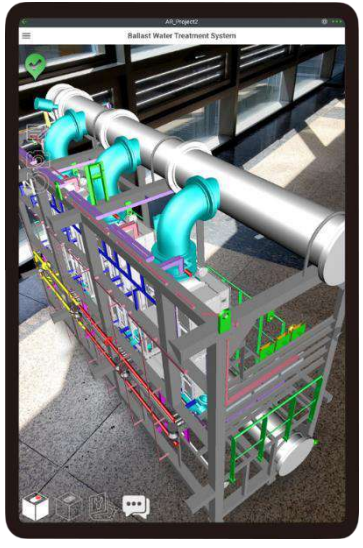




Applicable DX Technology in Shipyards

(4) Virtual/Extended Reality – Quality management AR System

- Consistency Comparison between 3-D Model based AR contents and Real Equipment

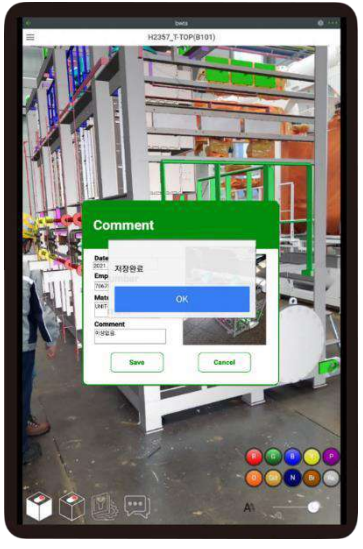


Ground Extended

3D outside View

3D Inside View

Technical Manual

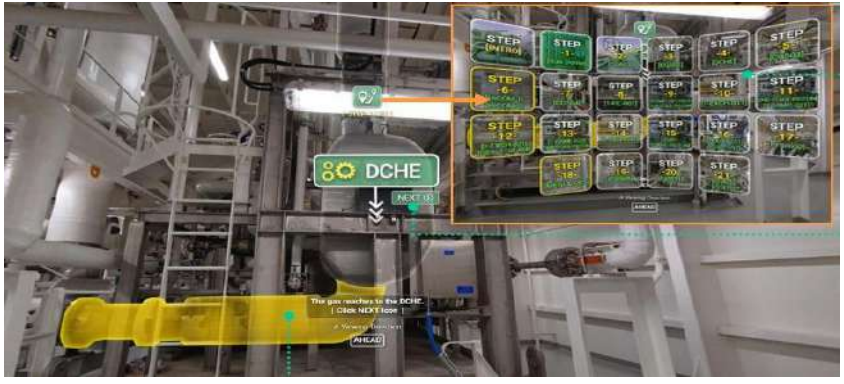


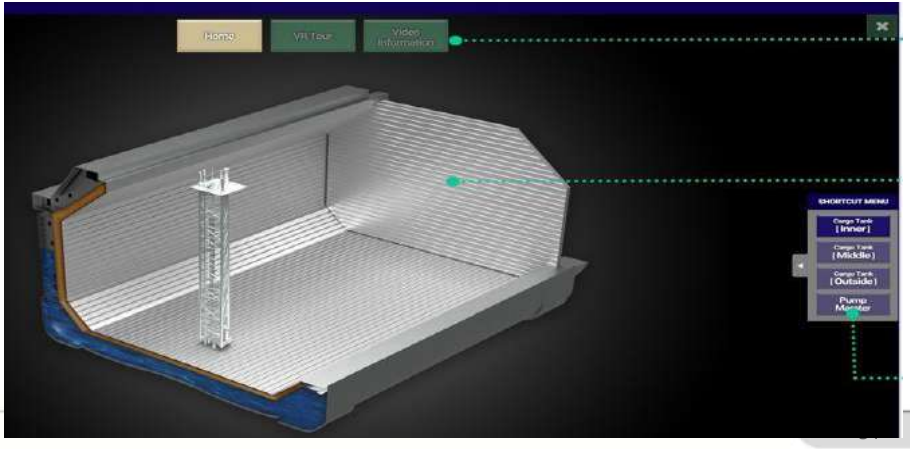
Comment Function

Applicable DX Technology in Shipyards

(4) Virtual/Extended Reality – VR based Crew Training System

- Providing Operation manual and crew training system based on VR



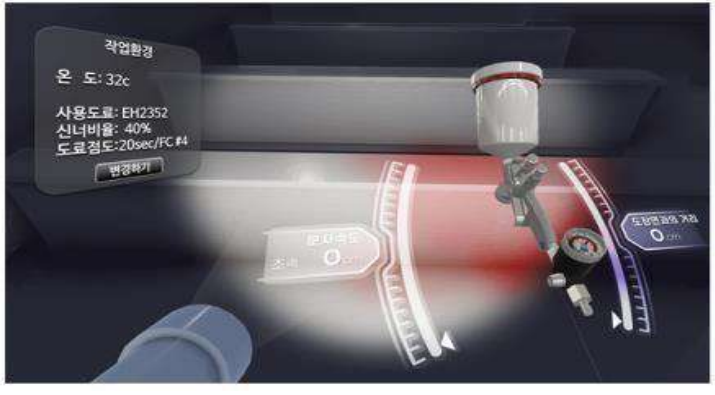


Applicable DX Technology in Shipyards

(4) Virtual/Extended Reality – VR based Painting Train

Virtual Classroom

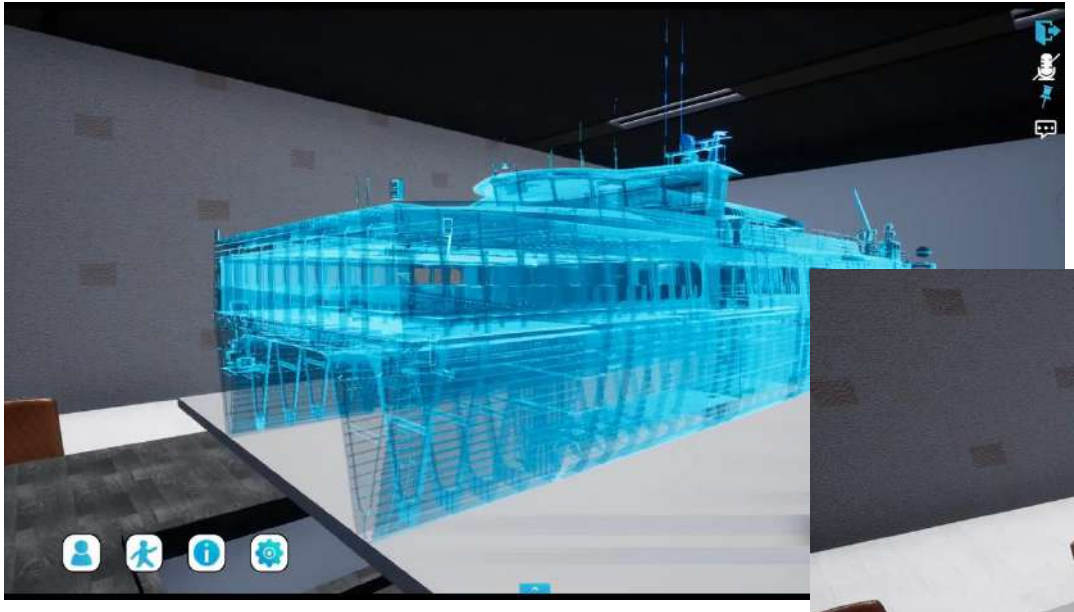
- Job training program for skilled workers
  - Theory education related to paint/painting
  - Practice training using VR contents



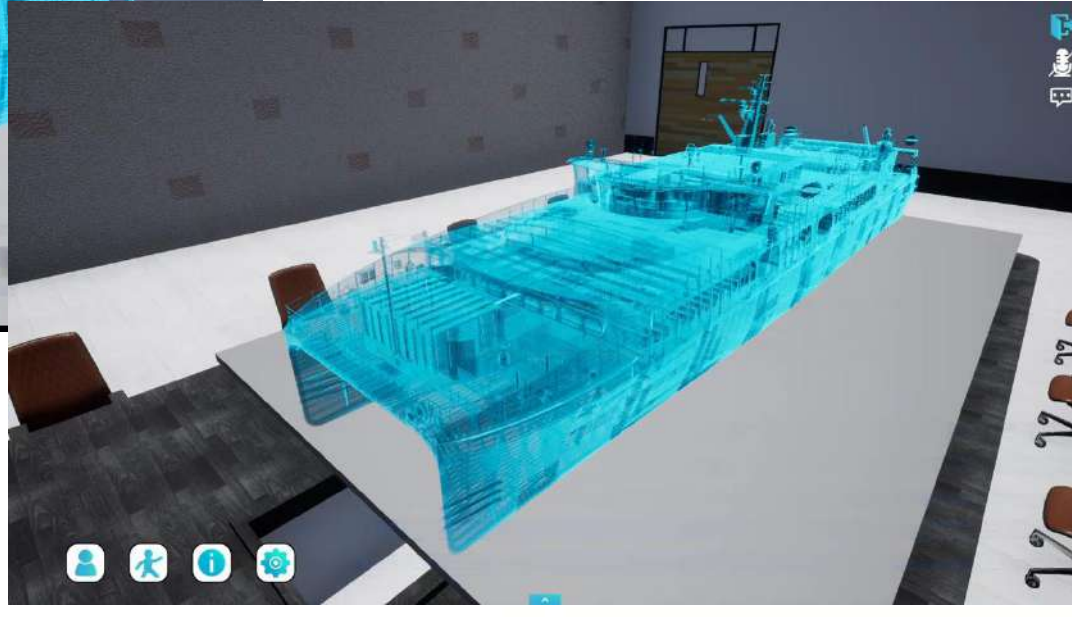
- Positive Effects
  - Skill improvement through repeated practice using VR contents
  - Experience result feedback and history management

Applicable DX Technology in Shipyards

Metaverse based Digital Twin



Remote Solution



CHAPTER IV

Competitiveness Analysis and Strategy

Competitiveness Analysis and Strategy

➢ Global trends to strengthen Competitiveness in shipyards

✓ EU SMARTYards Project

- comprises 17 partners from 9 European countries with SME shipyards and technology providers in a leading role
- improves the productivity of European small and medium sized shipyards and related subcontractors working with them by at least 20%
- develops test and validate smart technology solutions, comprising the optimum between design, equipment and work organization

Introduction of Automatic welding system replacing Manual Welding

Reduction of error through the data exchange between 3D design SW

Productivity 20% Up

Competitiveness Analysis and Strategy

➢ Global trends to strengthen Competitiveness in shipyards

✓ China

- Chinese government announced the Intelligent Ship Development Action Plan (2019 – 2021)
- Which aims to promote the integration of modern IT, AI and other innovative and high technology with shipping sector
- Which listed 7 key tasks, and one of them is "improving design and construction ability for intelligent shipping equipment and facility"
- CSSC & CSIS : Process Digitalization from design to production by 2025 => target to reduce the production cost by 50%
- SWS Shipyard : Replaced 2D drawings with 3D CAD by 80% => Efficiency improved

Competitiveness Analysis and Strategy

➢ Global trends to strengthen Competitiveness in shipyards

✓ Japan

- Ministry of Land, Infrastructure, Transport and Tourism (MLIT) decided to support R&D of innovative shipbuilding technology to improve the productivity in the shipbuilding industry (2018)
- Mitsubishi Heavy Industries (HMI): developed a management system called “M-SBIS” which integrates various functions related to shipbuilding, such as design, procurement, and production, into a single platform.
- Kawasaki Heavy Industries: developed a ship design system that uses AI to optimize ship design and reduce design time, and which includes VR to visualize and interact with designs in a 3D environment.
- Imabari Shipbuilding: developed a ship design system that uses AI and a production scheduling system that optimizes production efficiency, and also introduce the use of robotics in shipbuilding, including automated welding systems.

Competitiveness Analysis and Strategy

➢ Competitiveness Strategy in Shipbuilding Industry

- Reduce the cost: need to improve production efficiency, optimize the supply chain, adopt the new technologies which can reduce the labor and material costs
- Focus on market demands: need to adopt the market demands such as smart ships, autonomous ships, and low/zero carbon fueled ships
- Make a Difference: need to offer difference from the competitors, which can be the product differentiation such as cruise (EU), offering specialized design services to meet specific customer requirements (Japan), and cost reduction through global networks (Korea)
- Diversify business models: expand the business to offshore, repair, marine services, O&M if possible
- Invest in R&D : need to improve technological capabilities to adopt the new technologies to provide the high quality products and services

CHAPTER V

Conclusions

Conclusions

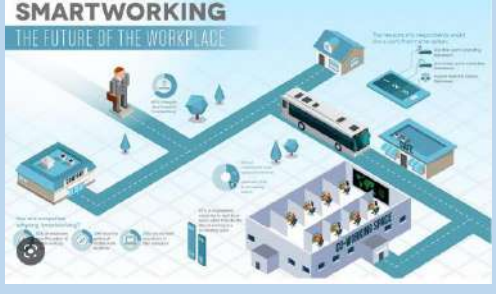
- To stay ahead in a highly competitive industry and position for long term survival, the shipbuilding industry must focus on the continuous improvement of their technologies for products and services, and innovation on their facility and systems.
- To achieve sustainable growth, the shipbuilding industry must pursue a revolutionary increase in productivity and product quality.
- Then, How?

Digital Transformation

Smart Shipyard

Smart Ship

Smart Workplace



Questions?

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