

Safety Issues in Construction Market Facing Industry 4.0

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Introduction

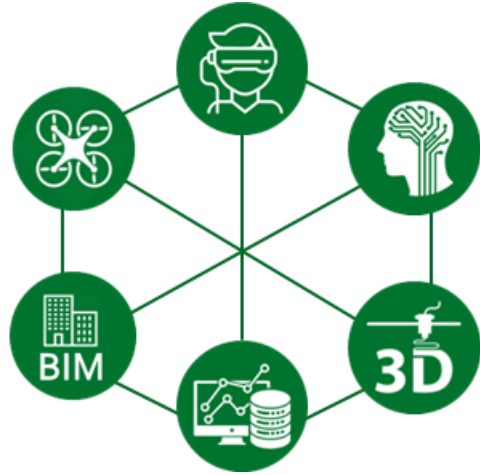
Introduction

“ Paradigm Shift to Digital Construction ”

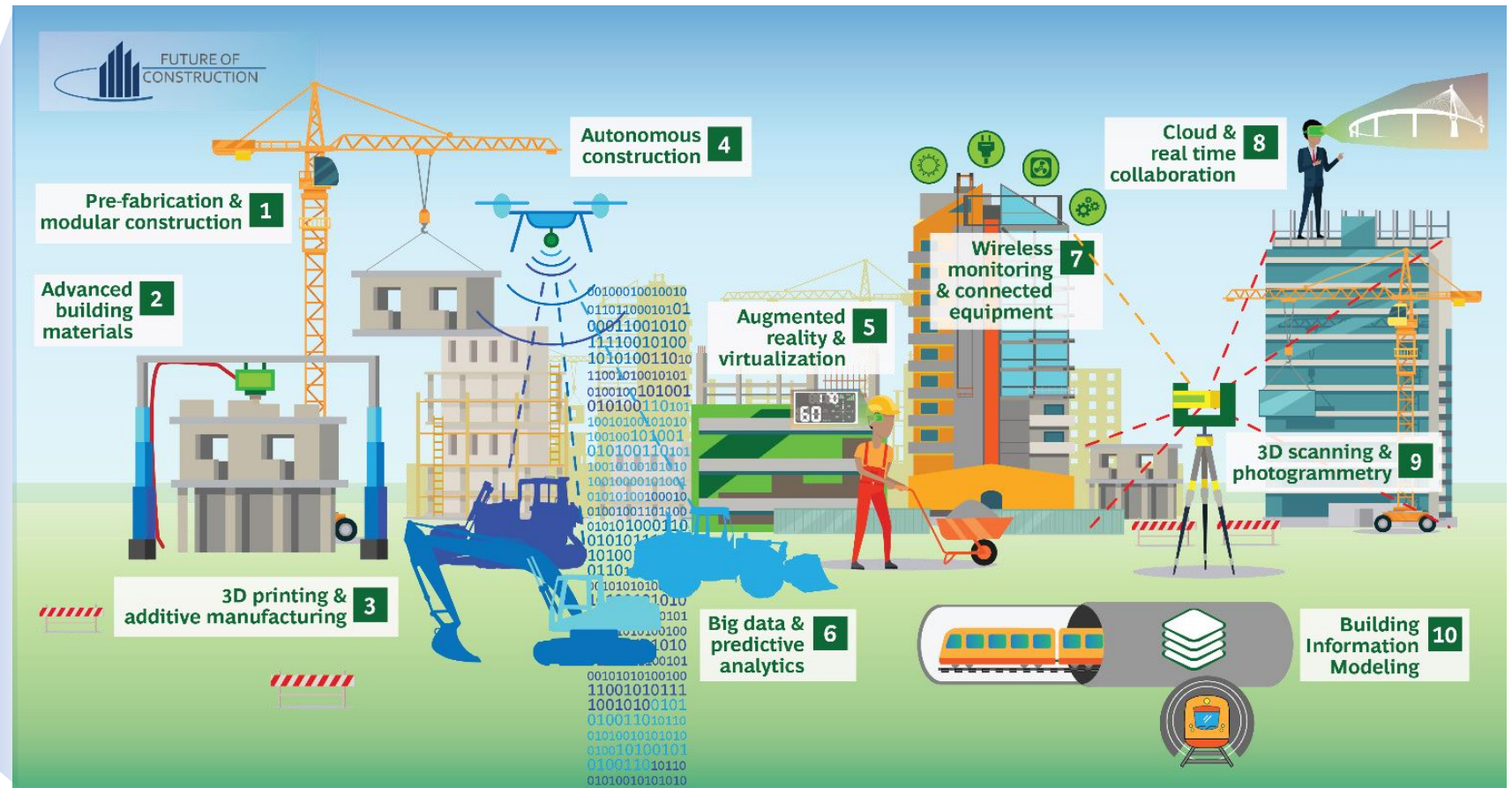
Digital technologies have transformed whole industries
it changing how infrastructure is designed, constructed, operated and maintained

Digital Construction

Smart Technologies



BIM, Drone, AR, VR, Big data, etc.



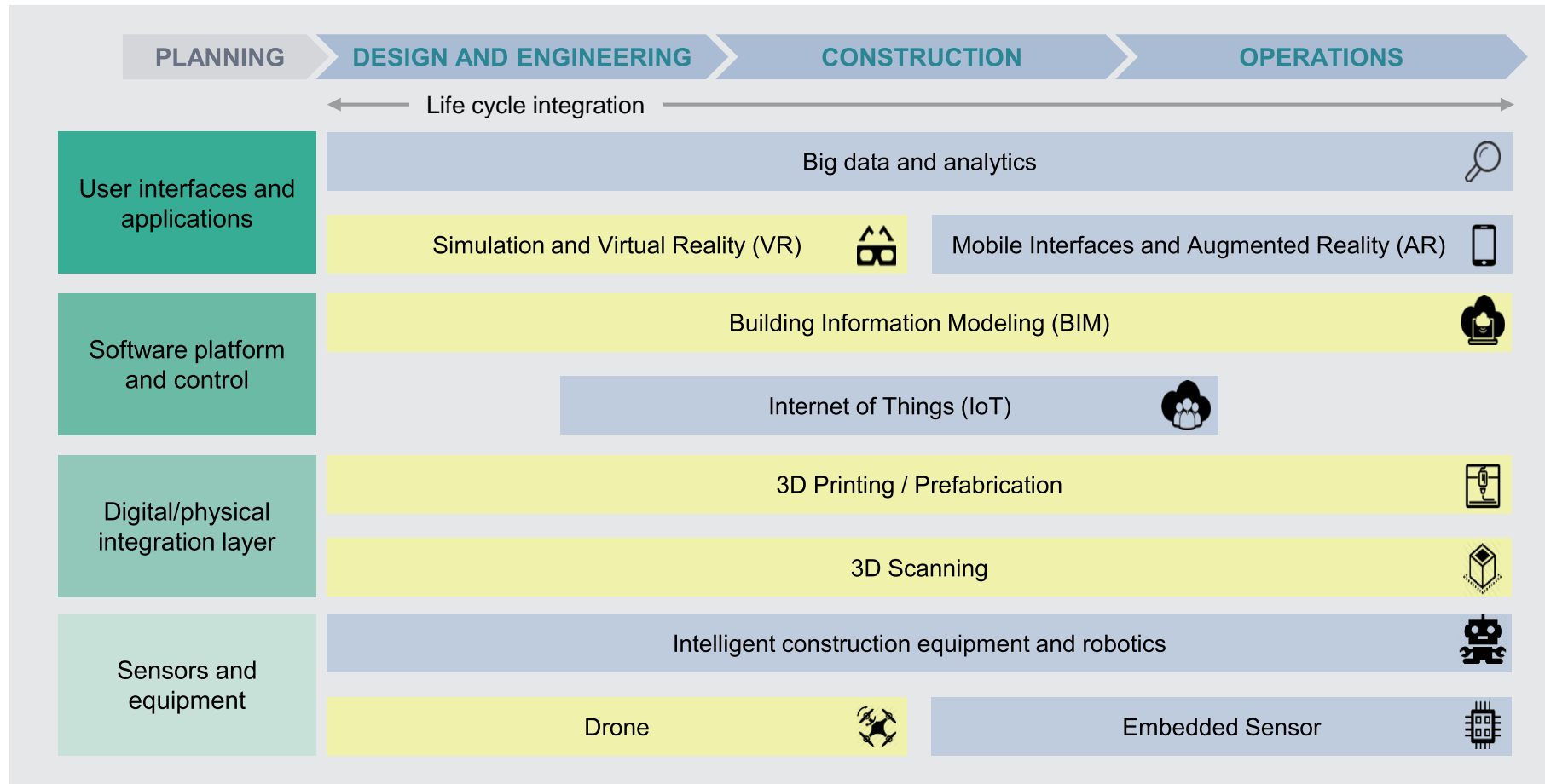
※ Source : Future of Construction, World Economic Forum, Boston Consulting Group

Introduction

“ Technology Transformation ”

Technological advances are now evolving almost all points in the construction life-cycle

Many digital technologies can be applied along the engineering and construction industry's value chain



※ Source : BCG analysis

“ The Fatal Four in Construction Site ”

The top 4 leading causes of construction fatalities

4,674 worker fatalities in private industry – 20.7% were in construction

United States

39%

FALLS

39.2% of construction deaths in the U.S. are the result of falls (OSHA, 2017).



8.2%

STRUCK-BY-OBJECT

8.2% of construction deaths in the U.S. are the result of struck-by-object accidents (OSHA, 2017).



7.3%

ELECTROCUTION

7.3% of construction deaths in the U.S. are the result of electrocution (OSHA, 2017).



5.1%

CAUGHT-IN-BETWEEN

5.1% of construction deaths in the U.S. are the result of caught-in-between accidents (OSHA, 2017).

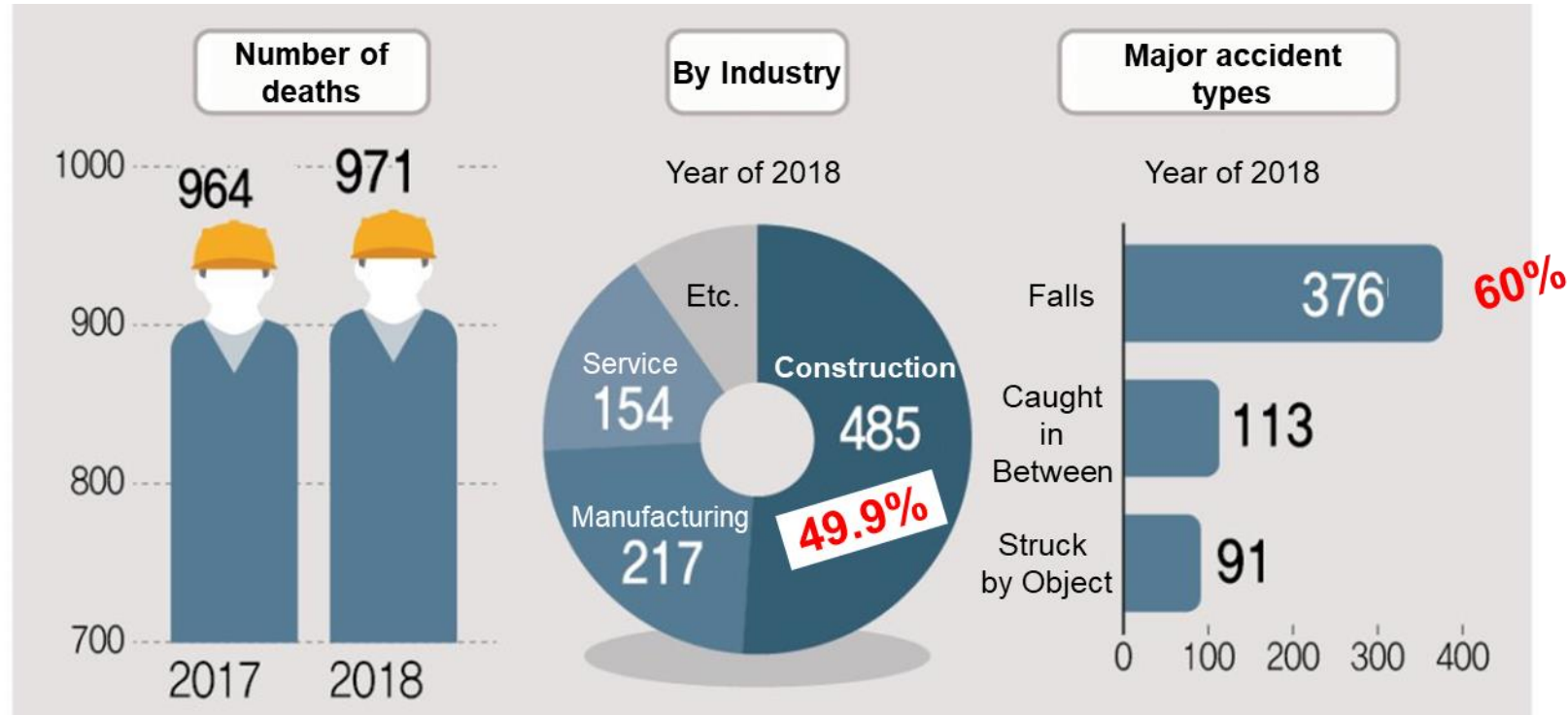


“ Domestic Industrial Accident Statistics ”

Korea

Fatalities of construction industry is 49.9%

Major accident types are falls(60%), caught in between, and struck by object



Introduction

“ Key Items Related to HSE ”

Issues during under construction and after construction
(e.g. securing safety of workers, monitoring indoor air quality condition)







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During under construction

SITE SAFETY			
	Construction work in progress Parents are advised to warn children of the dangers of entering this site		Danger Demolition work in progress
	No admittance for unauthorised personnel		Use ear protectors
	This is a hard hat area		High visibility jackets must be worn
	Protective footwear must be worn		Warning Look out for overhead loads

&

After construction

INDOOR AIR QUALITY*					
		*ISO 16000/AFFSET			
		A+			
		A+	A	B	C
Airborne particles from diesel exhaust, dust, smoke and other sources	Indoor formaldehyde from building materials, furniture, cooking, and smoking	Household odors & gases from activities such as painting, cooking, and smoking	Ozone from outdoor air (ground level ozone is harmful to breathe)	Carbon Dioxide from people exhaling and cooking	
					

“ HYUNDAI E&C’s 12 Safety Golden Rules ”

A primary approach to motivate safety cultures and behaviors that must be complied by all employee of HYUNDAI E&C

HYUNDAI E&C



Pre-Risk Management

- Comply with 'Permit To Work'

Ensuring Safe Working Conditions

- Install Safety Facilities / Wear PPE
- Conduct Gas test In confined space
- Conduct Electrical safety inspection prior to work
- Prevent fire during Hot work

Interrupting Unsafe Act

- Use Designated access Only
- Do not be under Suspended load
- Maintain Safety devices on Equipment
- Do not enter Installation/Dismantling work area

Establishing Basic Discipline

- No Alcohol
- No Smoking outside designated areas
- No Over-speeding while driving /No Mobile Phone while working

New Technologies on Construction Sites

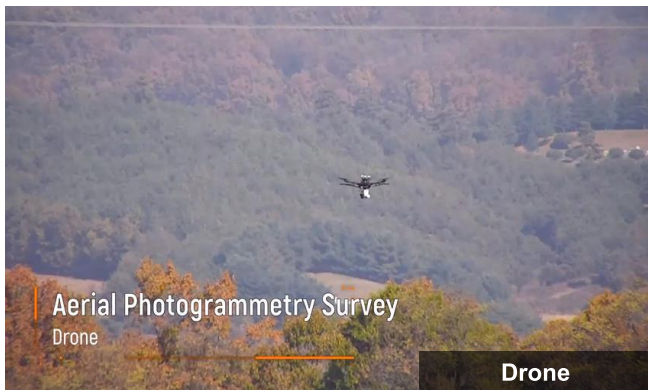
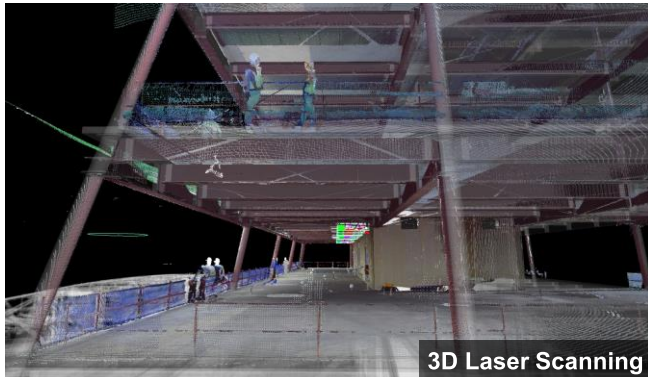
New Technologies on Construction Sites

“ Bring Digital Construction to All Stages ”

Value chain : Planning → Design → Construction → O&M(Safety control included)

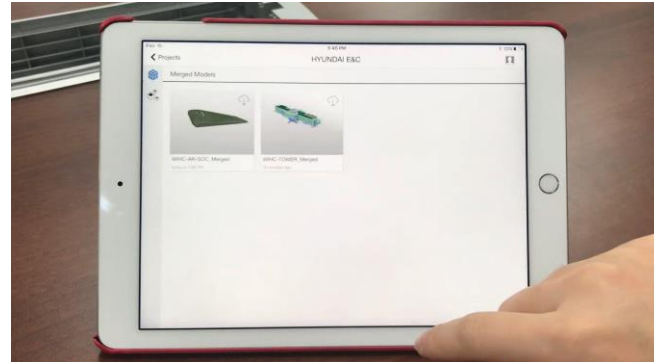
Drone + 3D Scanning

- Monitor site & construction progress



Smart Site Management

- Mobile Platform for Collaboration



- 360 Camera for Site Monitoring



IoT* Safety Control Management

- IoT-based real-time data gathering & monitoring system



Location Tracking of workers 	Toxic Gas Emission Detection 	Excavator-worker Collision Prevention
T/C Collision Prevention 	Wind Speed Detection 	ERSS Failure Detection

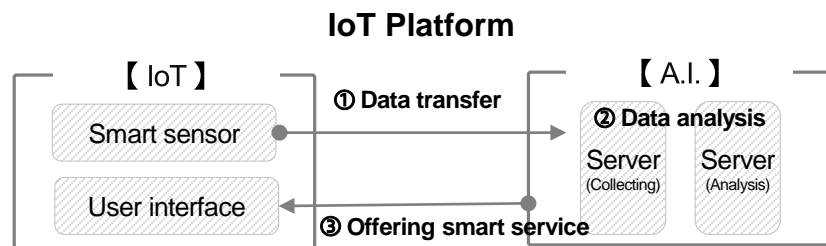
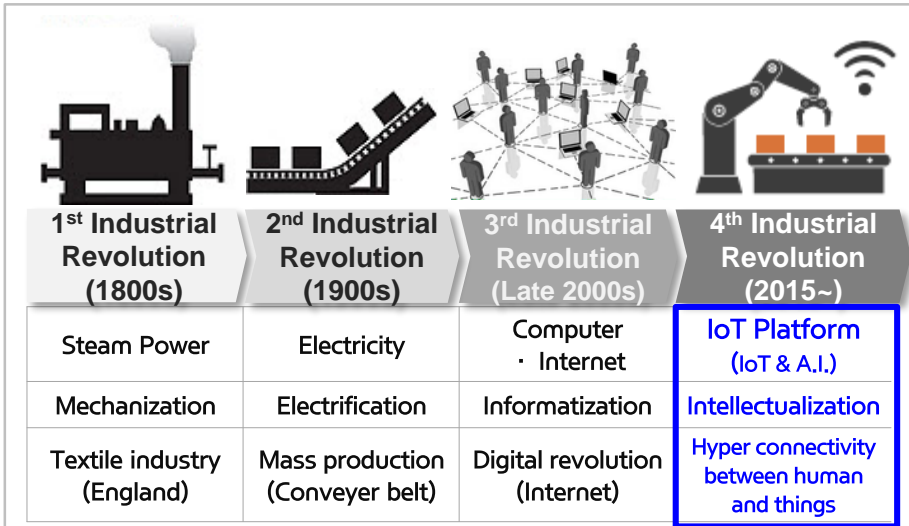
*IoT : Internet of Things

New Technologies on Construction Sites

“ HIoS : Hyundai IoT Safety System ”

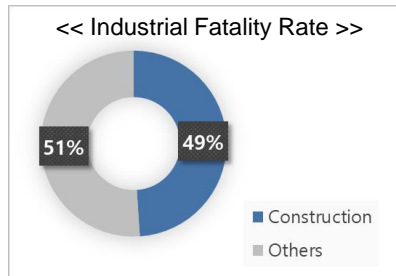
Offering smart services to enhance user convenience based on IoT
Improving the safety of construction site by using IoT platform

4th Industrial Revolution



IoT Technology in Safety

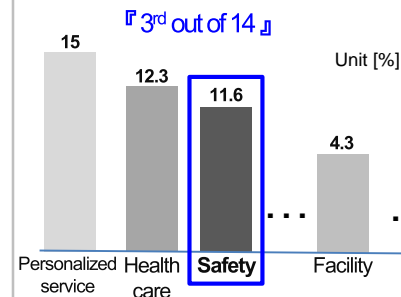
1 Industrial Accident in Construction Site



- 1st in fatality rate
- Construction accident in increase
- ✓ Many safety risk factors on site
- ✓ Installing heavy construction equipment

Source : Korea Ministry of Employment and Labor (2018)

2 Applying IoT Platform to Safety Management



정부, 2022년까지 건설현장 사망자 반으로



“Gov. planned to reduce fatality in half by 2022”

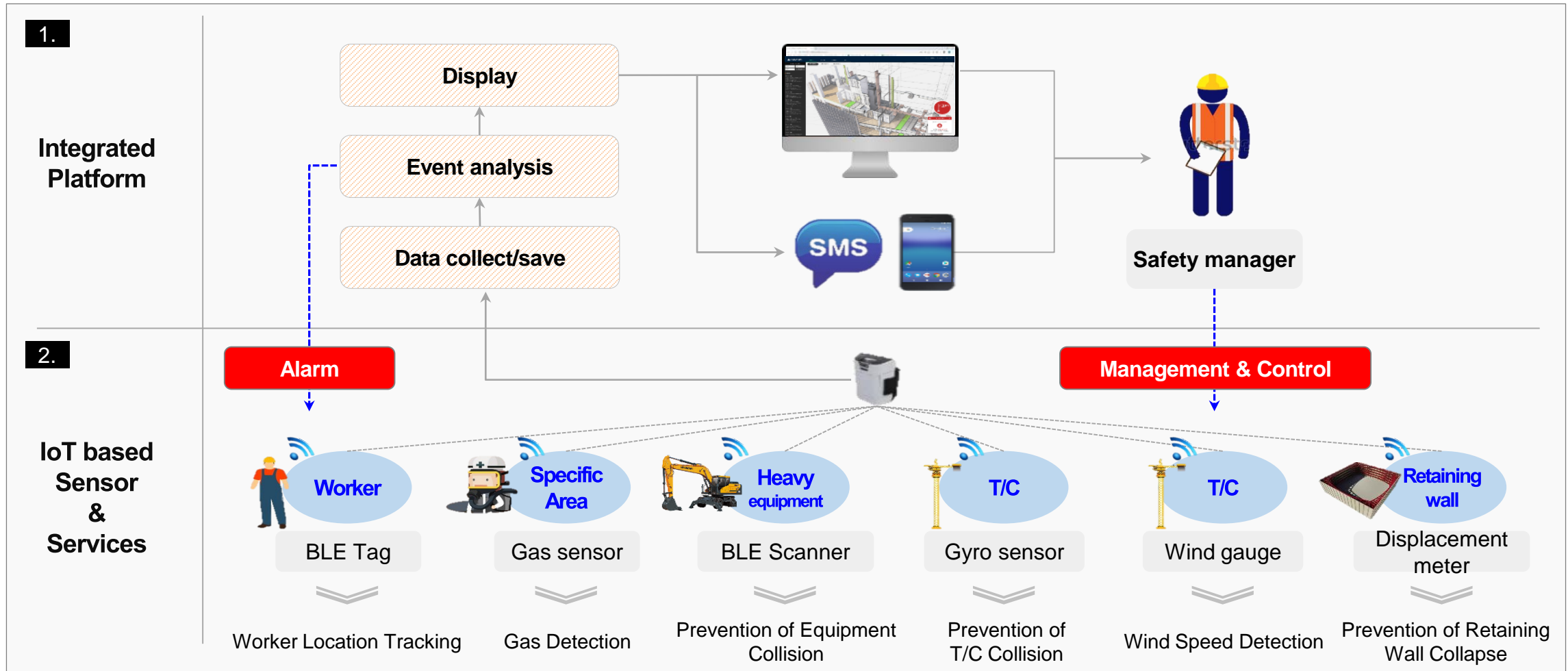
- Applying IoT in construction industry
- Long-term road map of safety management

Citation : 2016, Korea Ministry of Science, ICT and Future Planning

New Technologies on Construction Sites

“ HIoS : Hyundai IoT Safety System ”

IoT based safety management system with 6 services
web & mobile app versions are available



New Technologies on Construction Sites

“ HloS : Hyundai IoT Safety System ”

IoT based safety management system with 6 services
web & mobile app versions are available

HloS(Hyundai IoT Safety System) WEB & APP Service

Safety Management

- Location Tracking Control(Workers, Equipment)
- Real-time Gas Detect
- Tower Crane Collision Prevent
- Retaining Wall Collapse Prevent

Environment Management

- Automated Weather Station(Temp., humidity, etc.)
- Noise/Vibration Monitoring
- Particulate Matter Monitoring

Additional

Other sensors

- CCTV
- Fire Detector
- ⋮



Safety Control



- Tracking of workers & equipment
- Gas detection of confined space



- Retaining wall collapse prevent



- Tower Crane Collision Prevent

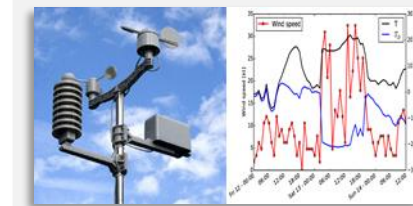


- Link with other sensors(ex. CCTV)

Environment Monitoring



- Real-time sensing data of noise / vibration / particulate matter



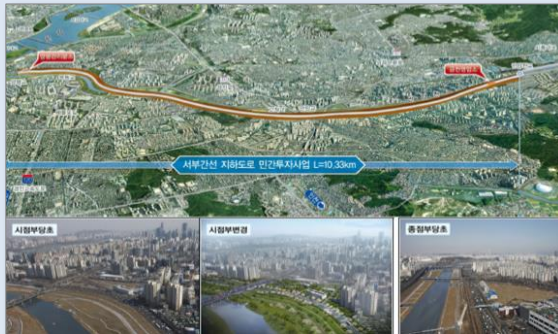
- Automated weather monitoring

New Technologies on Construction Sites

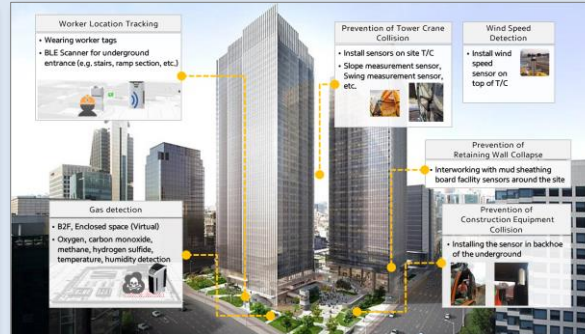
“ HloS : Hyundai IoT Safety System ”

IoT based safety management system with 6 services
web & mobile app versions are available

HloS Implemented or Suggested Site



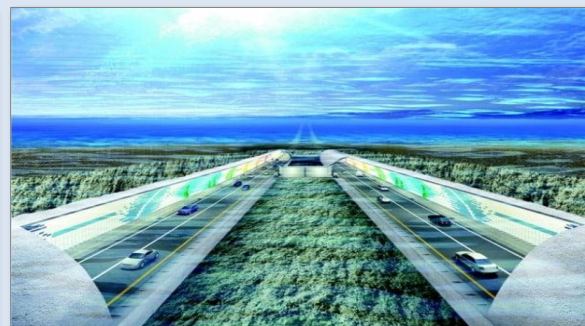
Seobu Underpass
(Tunnel)



237 Project
(Building)

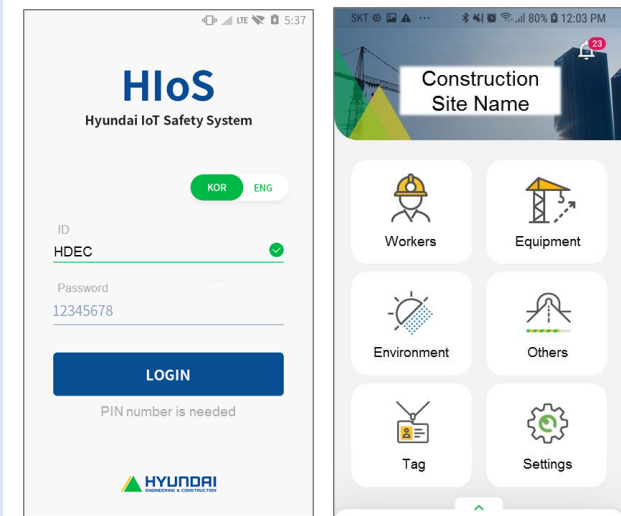


Coupang Logistic Center
(Building)



Boryeong Taean Subsea Tunnel
(Tunnel)

System Screen Example



“ Air Quality Issue : Particulate Matter ”

Korean Government announced as a “National Disasters” (2019.03)



Modeled annual mean PM2.5 for the year 2016($\mu\text{g}/\text{m}^3$) Source : <https://maps.who.int/airpollution/>

“HYUNDAI E&C’s Solution to Particulate Matter”

A total solution to particulate matter, provides customized services by making the most use of particulate matter removal technologies



Entrance cleaner(H Clean Entrance)



Indoor Children’s Forest (Hi Forest)



Outdoor Cooling Mist



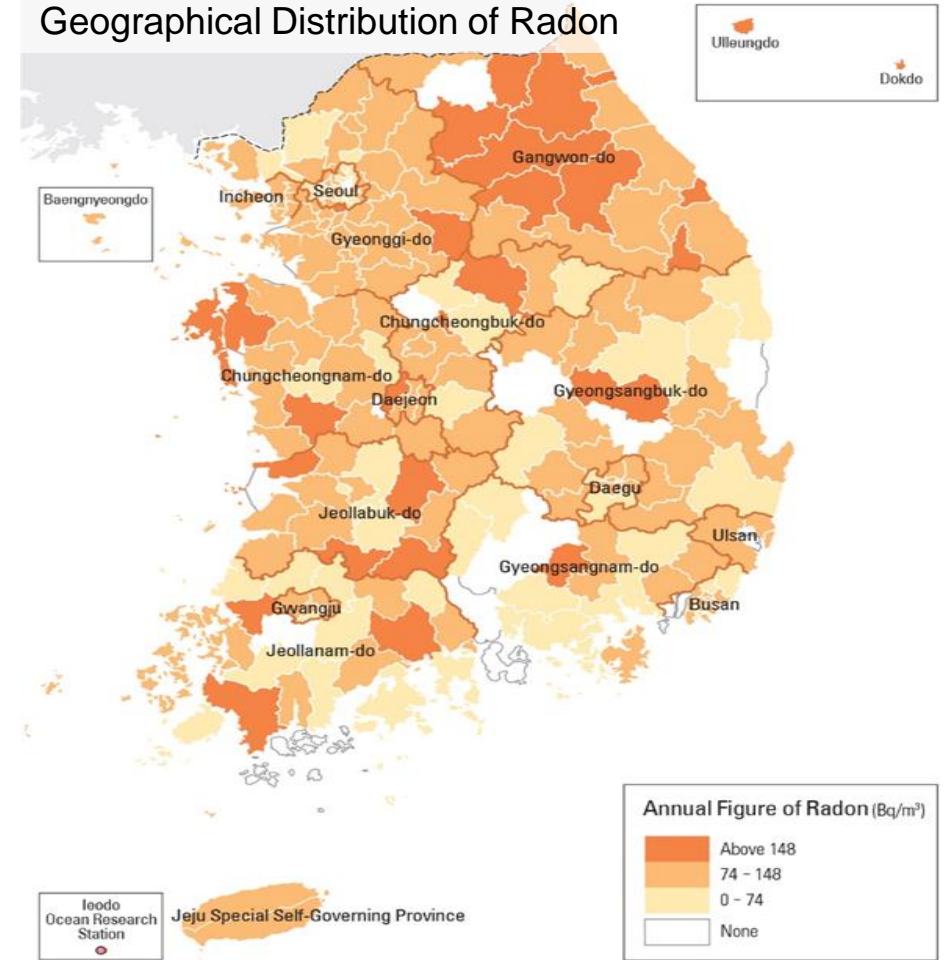
New Technologies on Construction Sites

“ Air Quality Issue : Radon ”

Radon gas from monazite used for negative ion emission in bed mattress
Known as Group 1 Carcinogens



Geographical Distribution of Radon



New Technologies on Construction Sites

“ Air Quality Issue : Volatile Organic Compounds ”

VOCs are causing Sick Building Syndrome(SBS)



Pollutant Emission Rate Test System



Precise Analysis Equipment[GCMS/HPLC]



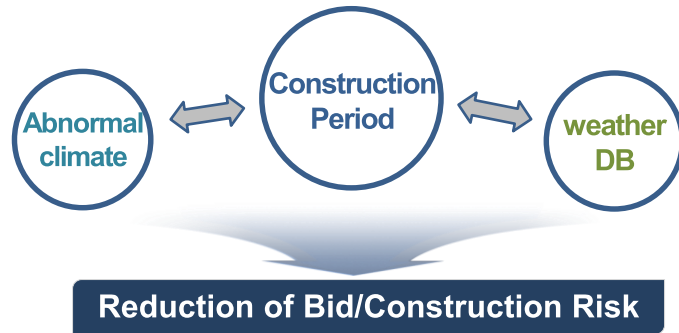
Chemical Adsorption Test System



New Technologies on Construction Sites

“ Precise Evaluation of Construction Period ”

Calculation of construction period based on the weather workability



As-is

► Simple consideration of climate conditions

Difficulty of collecting weather data

- The position of the site cannot be reflected
- Difficulty in searching and retrieving weather data

Monthly simple data analysis

- Counting simply over days per month
- Insufficient weather data processing expertise

To-be

► Calculate construction period according to Big Data

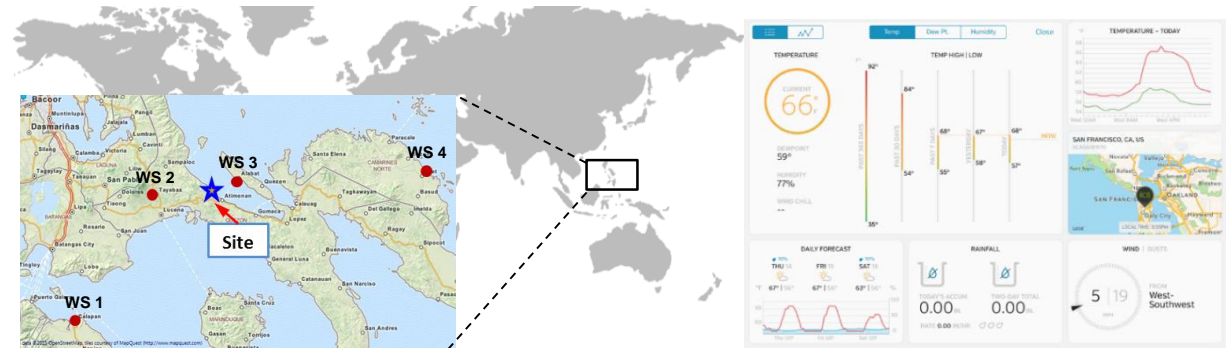
Consider site located weather data

- Apply peripheral weather station data interpolation algorithm

Weather data analysis by timeline

- Consider work in the morning / afternoon
- Ensuring reliability by applying a data processing method that applies the theory of climate analysis

Data Processing Diagram



Weather Station WS 1 Weather Station WS 2 Weather Station WS 3 Weather Station WS 4 • • •

Monthly Data Interpolation

Hourly Data Extraction
using Stochastic Generator

Sort of Weather Condition
ex) rainfall - greater than 10 mm per day

Delay Day Count
daily & hourly basis



Kuwait Al-Zour LNG

India VBSL



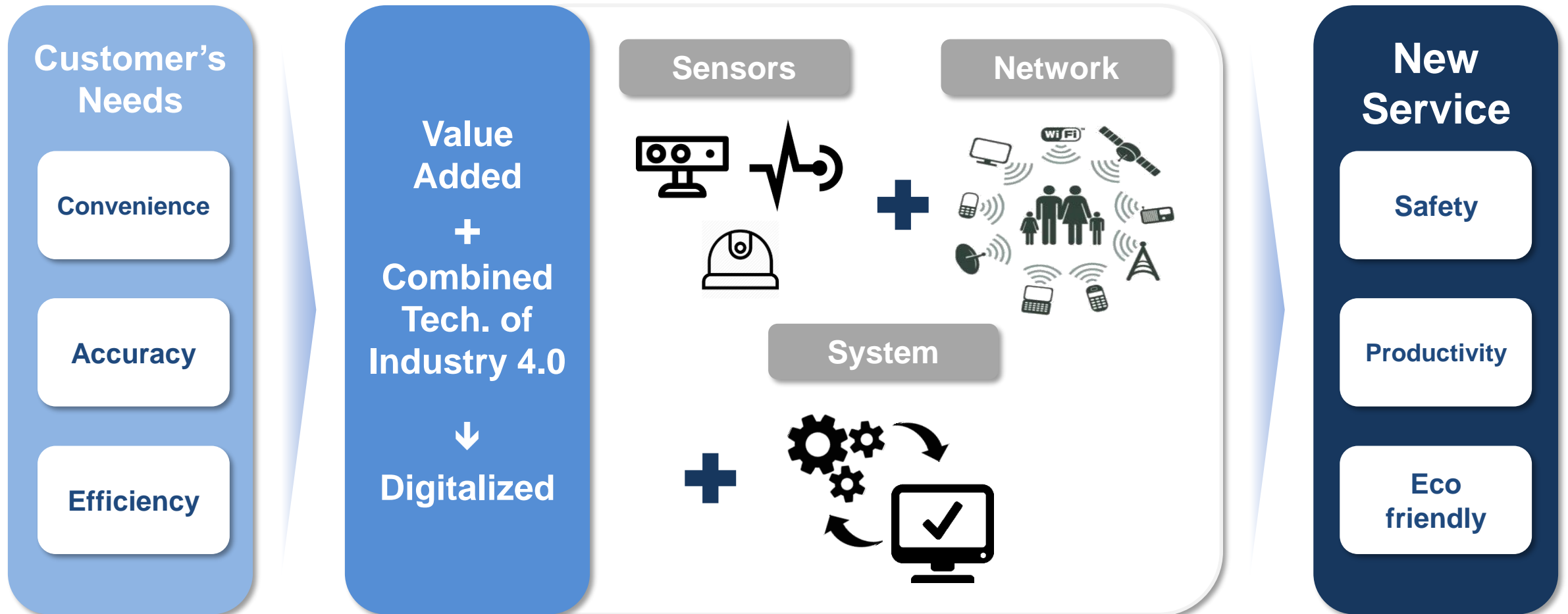
Tanzania New Selander Bridge

Conclusion

Conclusion

“ Customer First Always ”

Making new HSE services through value added technology development based on customer's needs



Conclusion

“ Out of Frame, Turning Technology into Art ”

A total solution provider which offers safe and optimal solutions
New vision beyond construction by converging with ICT technologies

Paradigm Shift 

 Bring Digital Twin to Construction

Implement New Technologies to HSE 

Digital construction
with innovation tech.



Convergence with
ICT technologies



Secure HSE
& Leading new era



Thank you

Appendix

HYUNDAI
MOTOR GROUP

53 Affiliates

280,828 Employees

Revenues USD 220 Billion

AUTOMOBILE



PARTS



CONSTRUCTION



STEEL



FINANCE & Others

