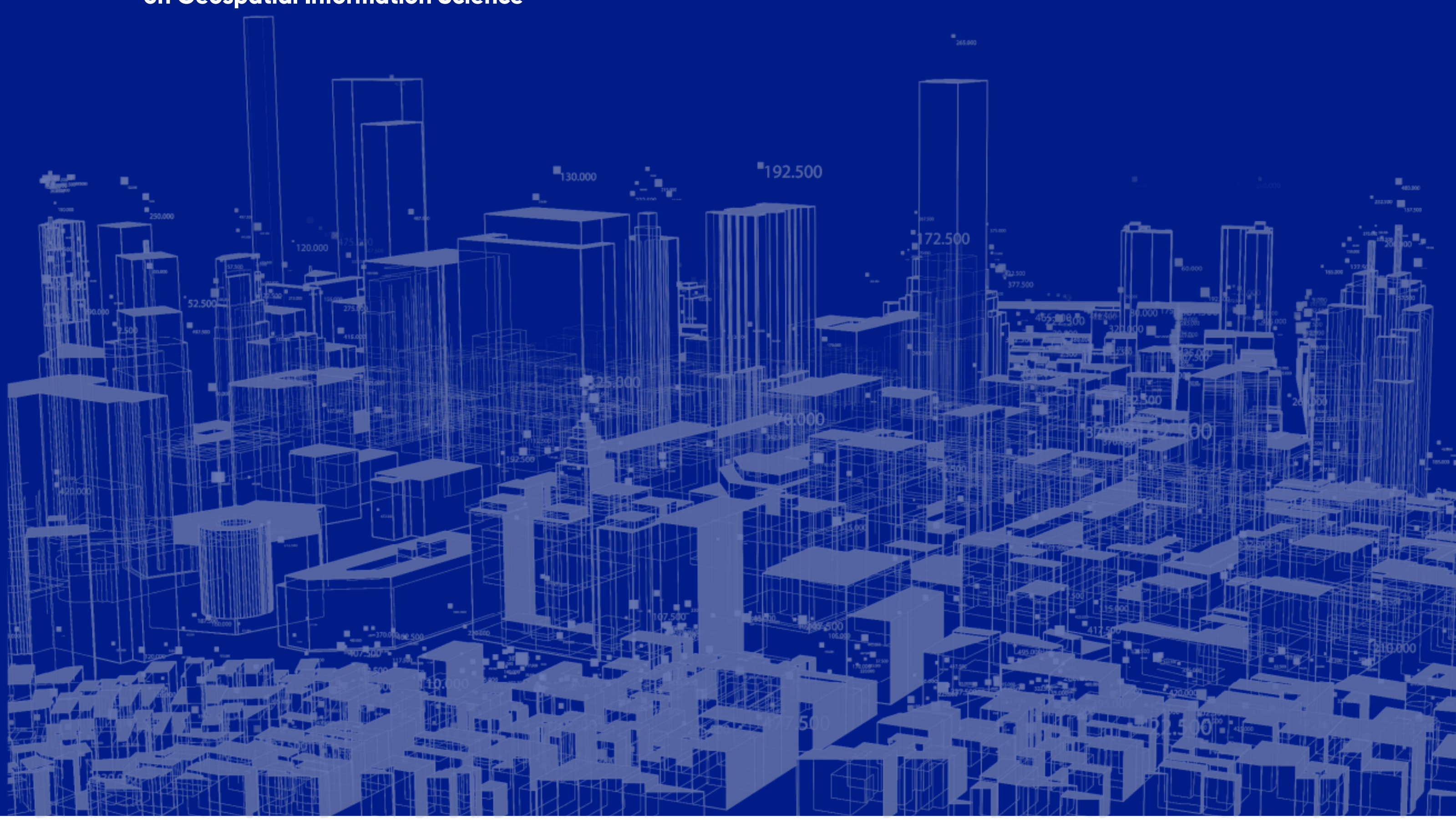
2021 ICGIS

International Conference
on Geospatial Information Science



KRIHS
Korea Research Institute for Human Settlements

Smart GEO Expo 2021
2021 스마트국토엑스포

Spatially Enabled Society with AI and Digital Twin (II)

인공지능과 디지털트윈으로 여는 공간정보 (II)

2021. 7. 22 (목) 14:00~18:00

사전등록 온라인 컨퍼런스

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2021 ICGIS

International Conference on Geospatial Information Science

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ICGIS 2021 Program

Time • 시간	Contents • 발표내용	Speaker • 발표자
14:00~14:05	Opening Remarks 개회사	Hyunsoo Kang President of Korea Research Institute for Human Settlements 강현수 국토연구원장
14:05~14:10	Congratulatory Address 축사	Soosang Kim Deputy Minister of House and Land Office, Ministry of Land, Infrastructure and Transport 김수상 국토부 주택토지실장
14:10~14:40	Keynote Speech "National Digital Twin in UK" 기조연설 "영국의 국가디지털트윈"	Mark Enzer Chair of DFTG, Center for Digital Built Britain (CDBB)
14:40~15:00	Opening Speech "Policy Directions of National Digital Twin in Korea" 개막연설 "한국의 디지털트윈 정책방향"	Hyejung Sung Korea Research Institute for Human Settlements 성혜정 국토연구원
Break Time 15:00~15:10		
Invited Talk • 초청발표		
15:10~15:30	Sharpening urban infrastructure decisions with artificial intelligence AI를 이용한 도시 인프라 구축 전략	Hoon Han Univ. of New South Wales
15:30~15:50	Smart construction with BIM and geospatial information BIM과 공간정보를 이용한 스마트 건설	Troy Rigby Trimble Asia-Pacific
15:50~16:10	Autonomous train with AI and 3D Geospatial Data 인공지능과 3차원 공간정보 기반 자율주행 기차	Gunho Sohn York Univ.
16:10~16:30	IoT and AI based Smart Building/Energy Twin Platform for Smart City 스마트시티를 위한 IoT & AI기반 스마트빌딩/에너지트윈 플랫폼	Changsoo Park Ntels 박창수 엔텔스
16:30~16:50	Urban 3D geospatial modelling for Realistic Geospatial Data 실감공간데이터를 위한 도시 3차원 지형공간 모델링	Si-yeong Lim Korea Research Institute for Human Settlements 임시영 국토연구원
Break Time 16:50~17:00		
17:00~18:00	Panel Discussion Moderator Prof. Kijoune Li (Pusan National University)/이기준 교수 (부산대학교) Panels Daejong Kim (KRIHS)/김대종 본부장 (국토연구원) Prof. Youngok Kang (Ewha Womans University)/강영옥 교수 (이화여자대학교) Honryang Im (NS Center)/임헌량 센터장(NS 센터) HeuiYoung Park(Seoul)/박희영 공간정보담당관 (서울시) Bogyeong Mun (The Electronic Times)/문보경 기자	
Closing Remarks • 폐회식		

Contents

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2021 스마트국토엑스포

Keynote Speech

National Digital Twin in UK

[영국의 국가디지털트윈]

Mark Enzer Chair of DFTG, Center for Digital Built Britain (CDBB)

NATIONAL DIGITAL TWIN PROGRAMME

Data infrastructure
for the information economy

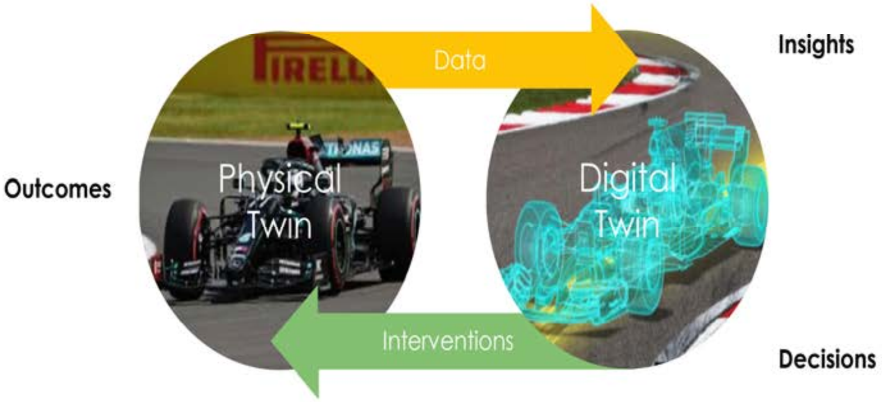
UNIVERSITY OF CAMBRIDGE
UK Research and Innovation
Department for Business, Energy & Industrial Strategy
cdbb

Running order

1. Digital twins
2. A brief step back for the bigger picture
3. The National Digital Twin

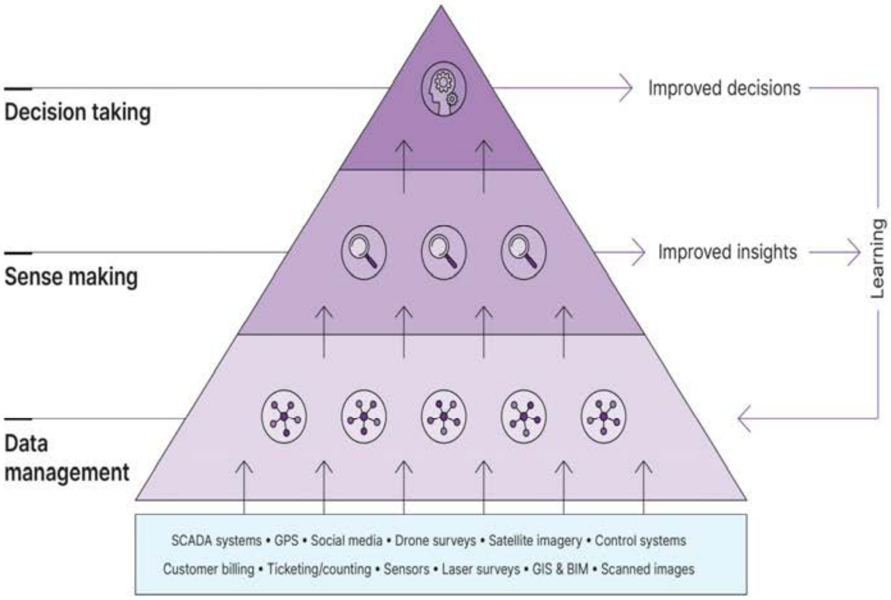
NATIONAL DIGITAL TWIN PROGRAMME

Digital twins

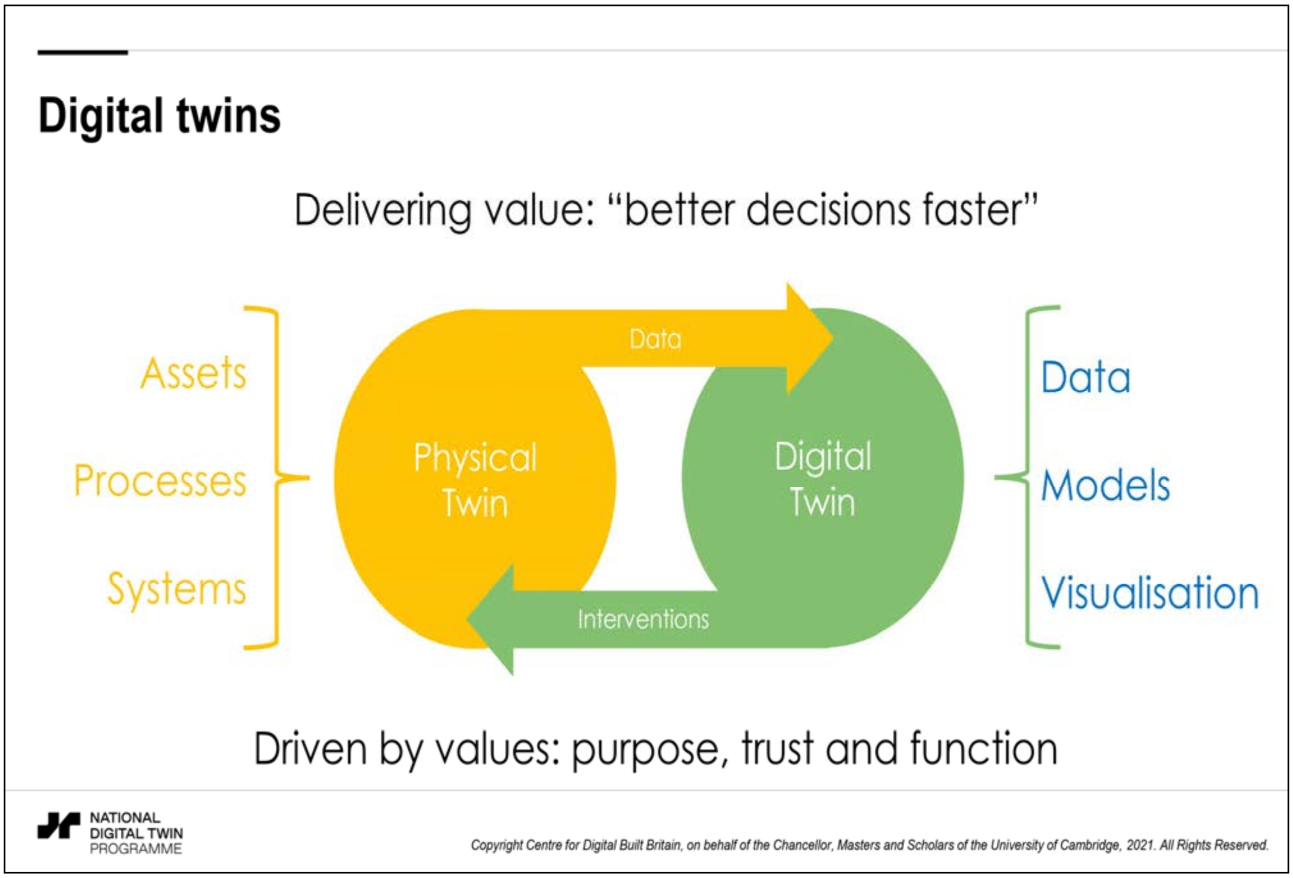


NATIONAL DIGITAL TWIN PROGRAMME

The information value chain



NATIONAL DIGITAL TWIN PROGRAMME


Digital twins
Delivering value: "better decisions faster"
Assets
Processes
Systems
Data
Physical Twin
Digital Twin
Interventions
Data
Models
Visualisation
Driven by values: purpose, trust and function
NATIONAL DIGITAL TWIN PROGRAMME
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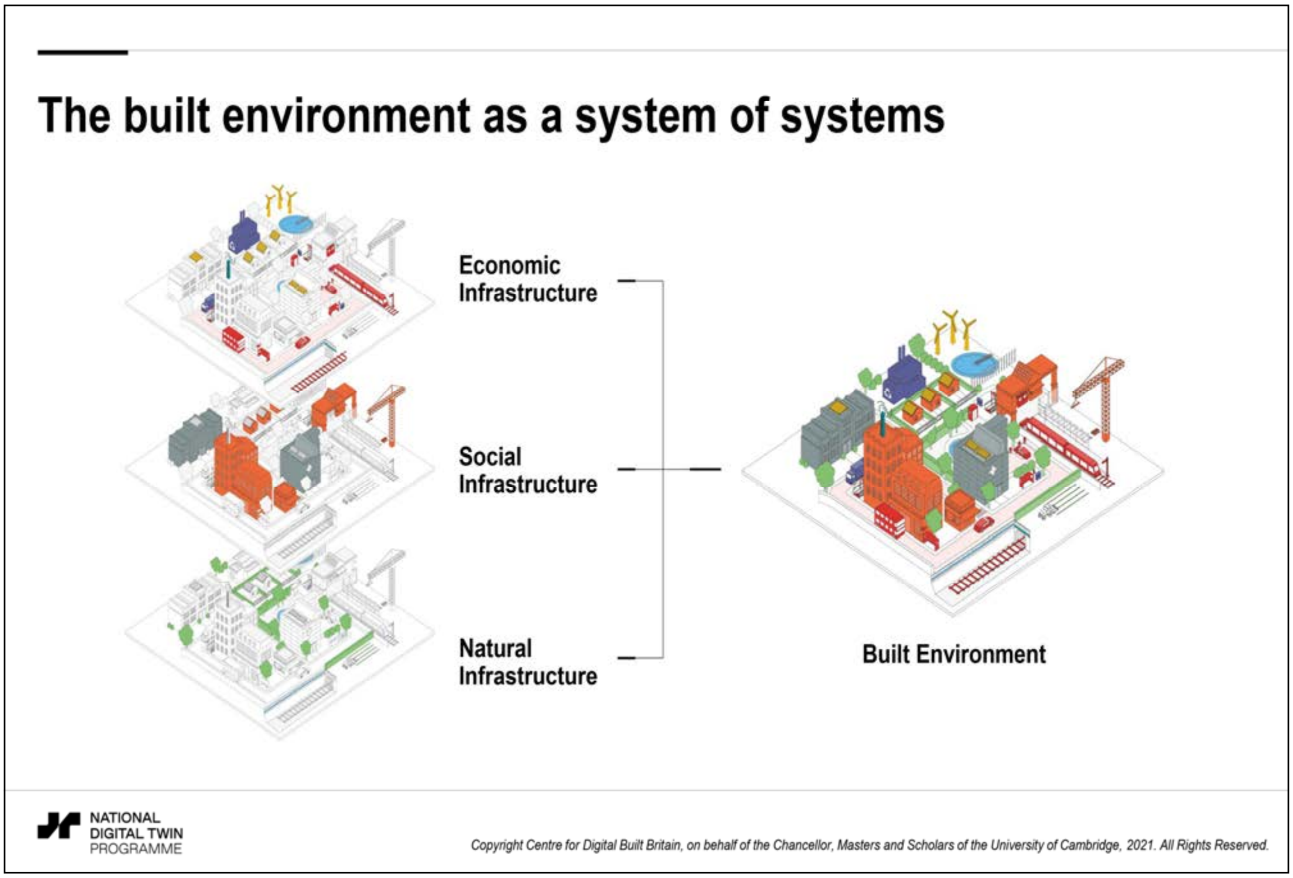
The built environment as a system of systems
Economic Infrastructure
Social Infrastructure
Natural Infrastructure
Built Environment
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Sustainable outcomes from the systems

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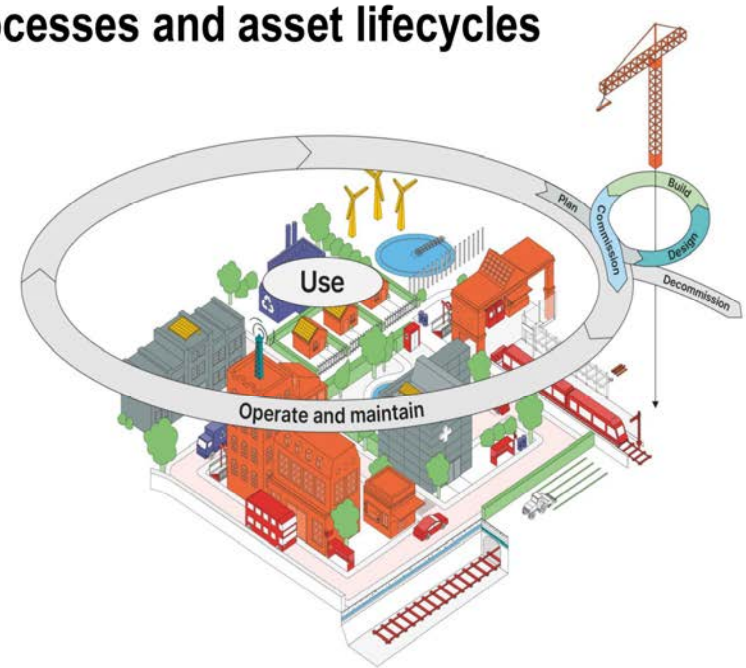
System processes and asset lifecycles



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Interventions on the system of systems

99.5% **0.5%**

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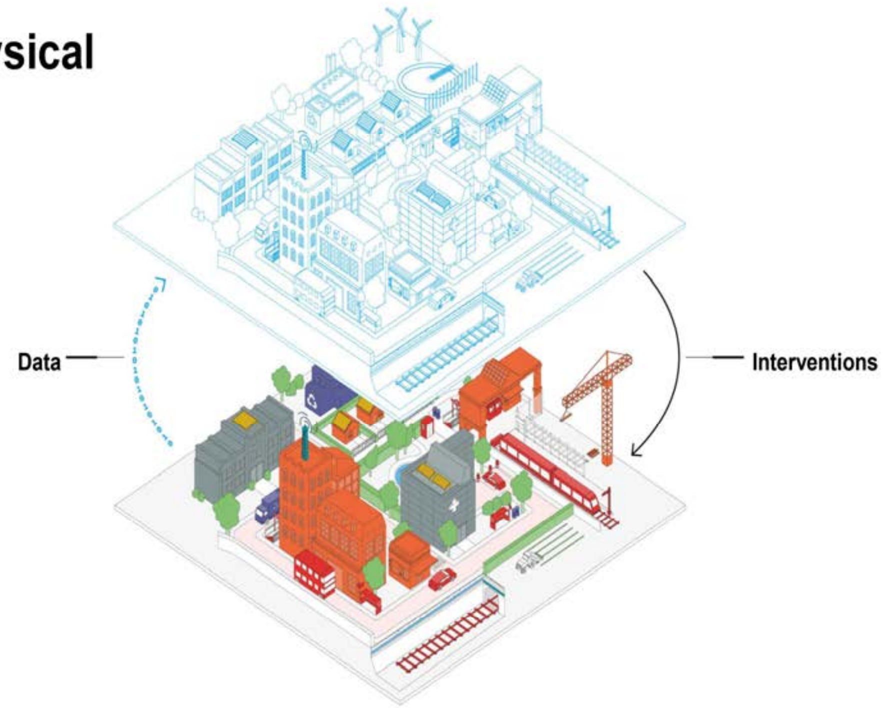
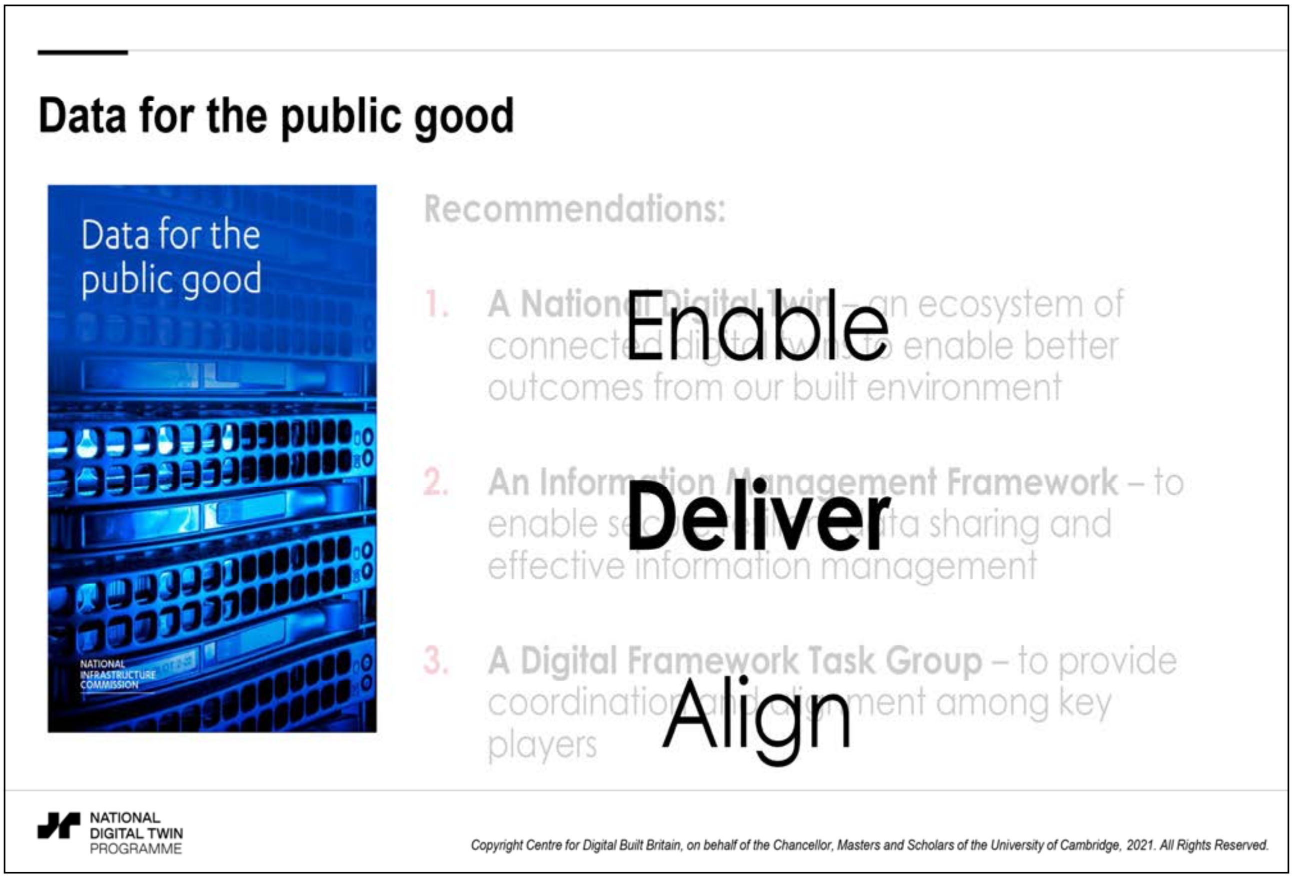
Cyber-physical system



NATIONAL DIGITAL TWIN PROGRAMME


Data for the public good
Data for the public good
NATIONAL INFRASTRUCTURE COMMISSION
Recommendations:
Enable
outcomes from our built environment
Deliver
effective information management
3. A Digital Framework Task Group – to provide
players
Align
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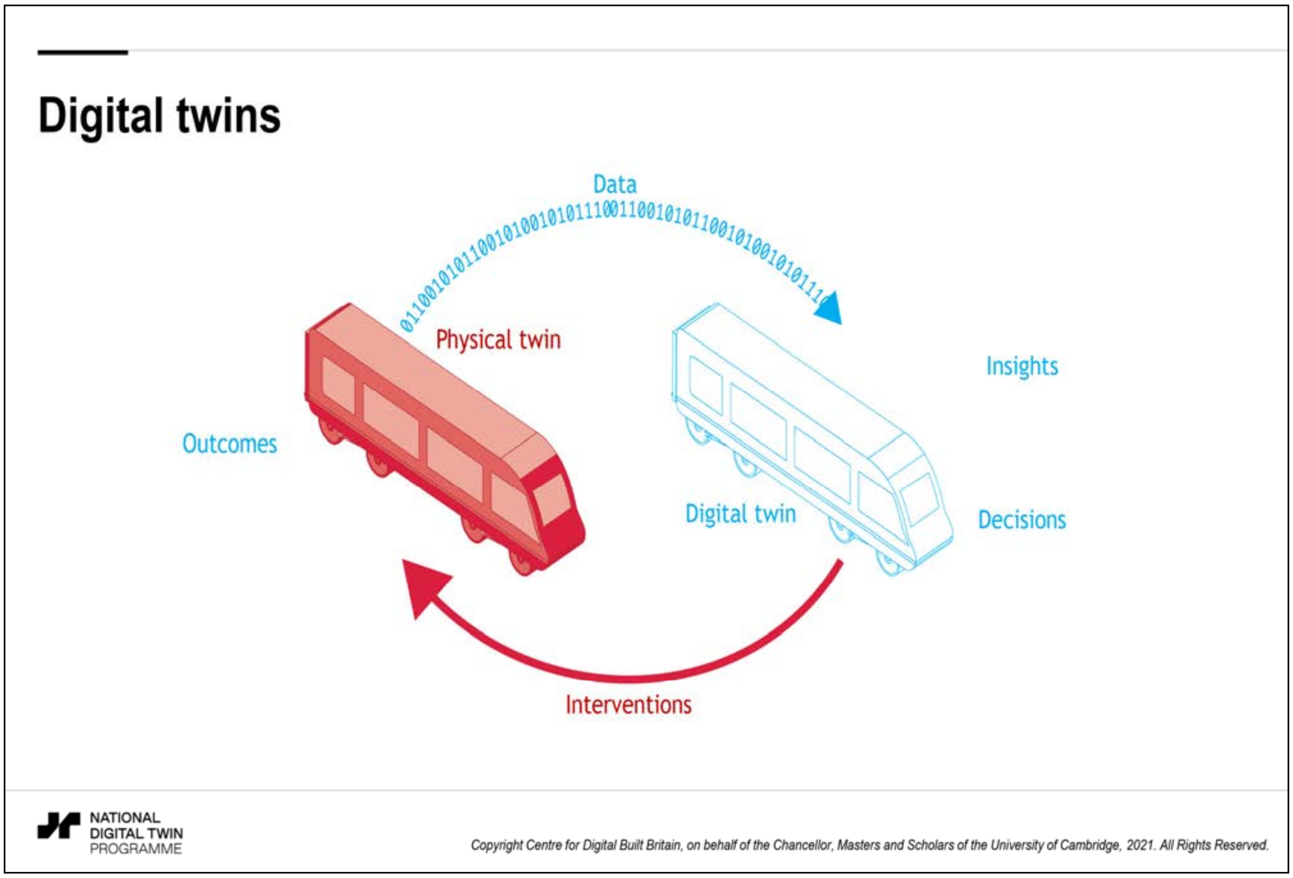
Digital twins
Data
Physical twin
Insights
Outcomes
Digital twin
Decisions
Interventions
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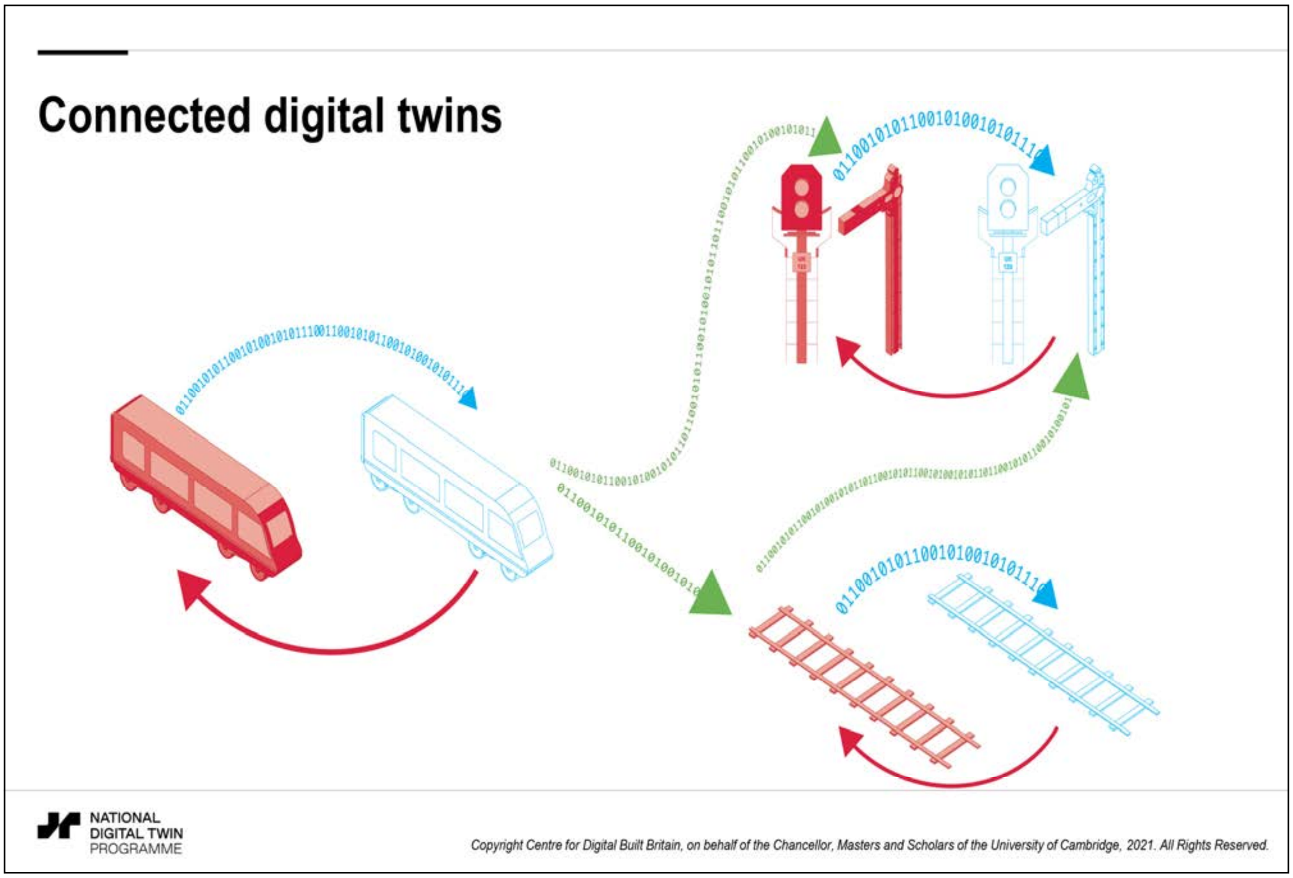
Connected digital twins
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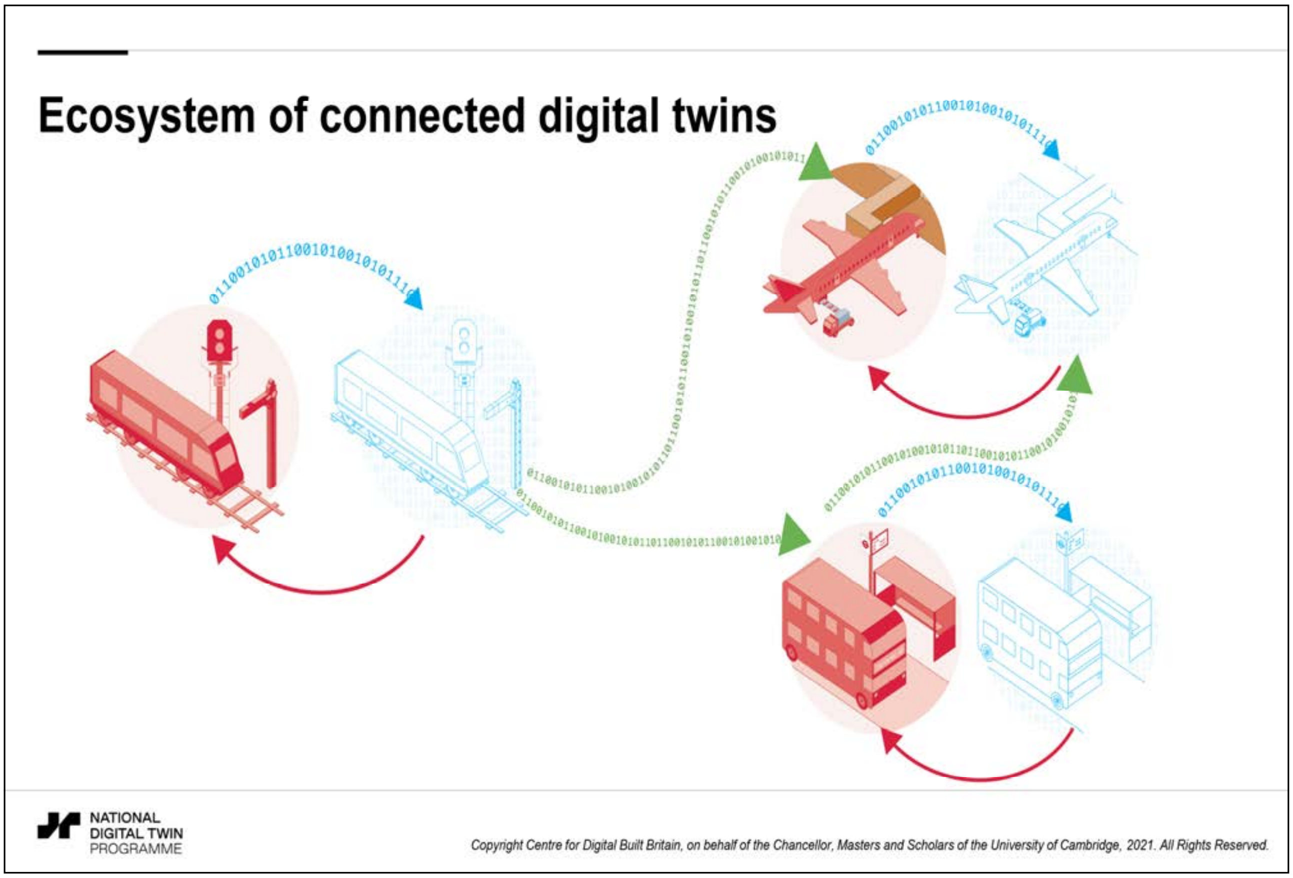
Ecosystem of connected digital twins
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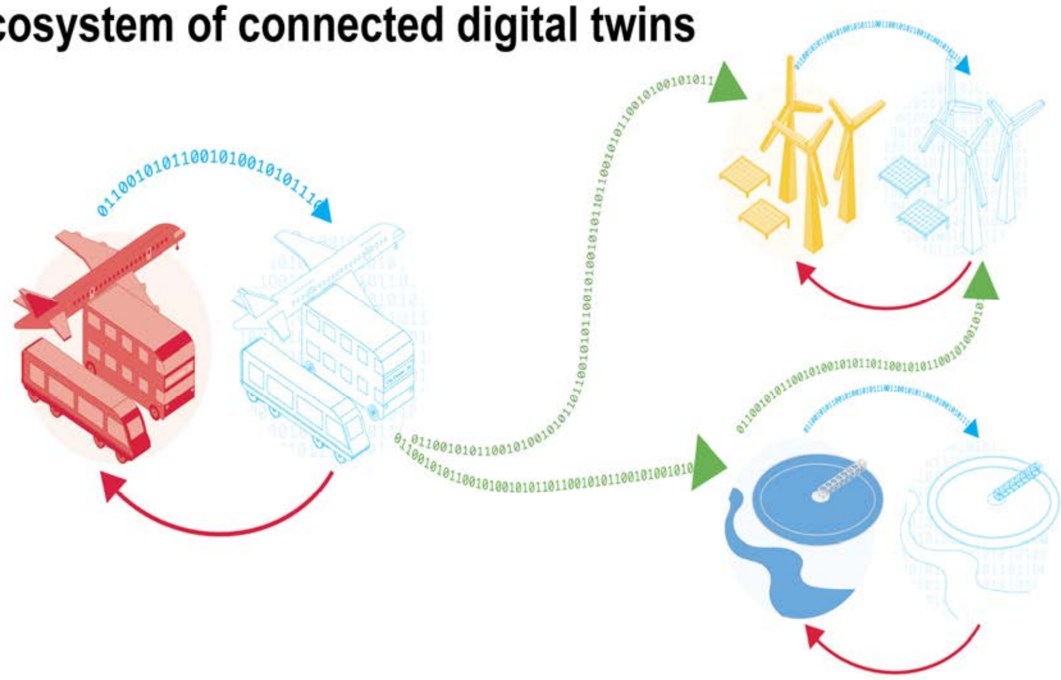
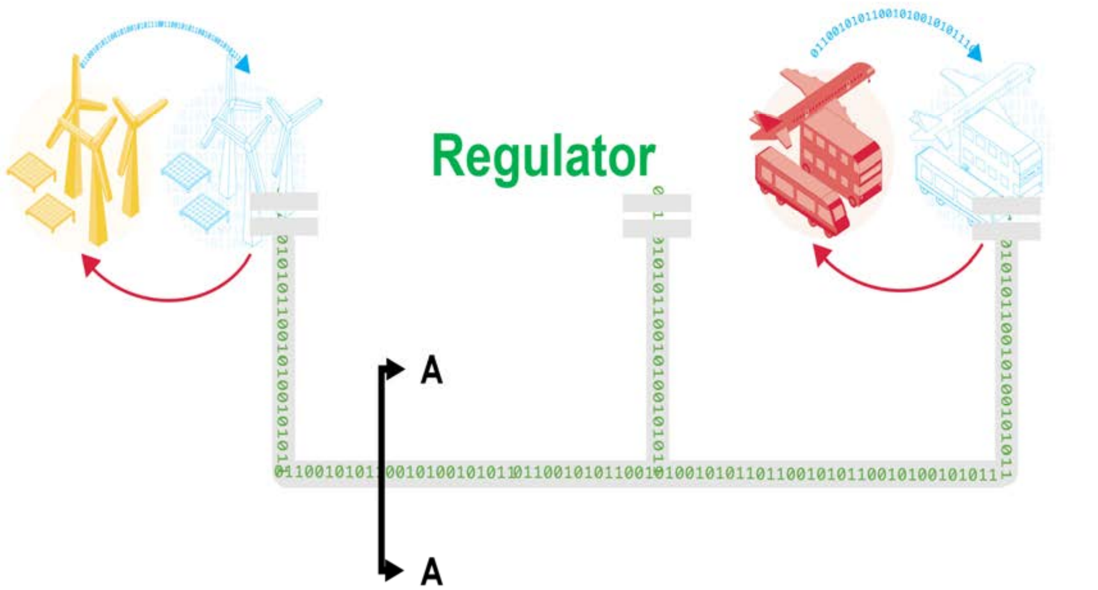
Ecosystem of connected digital twins



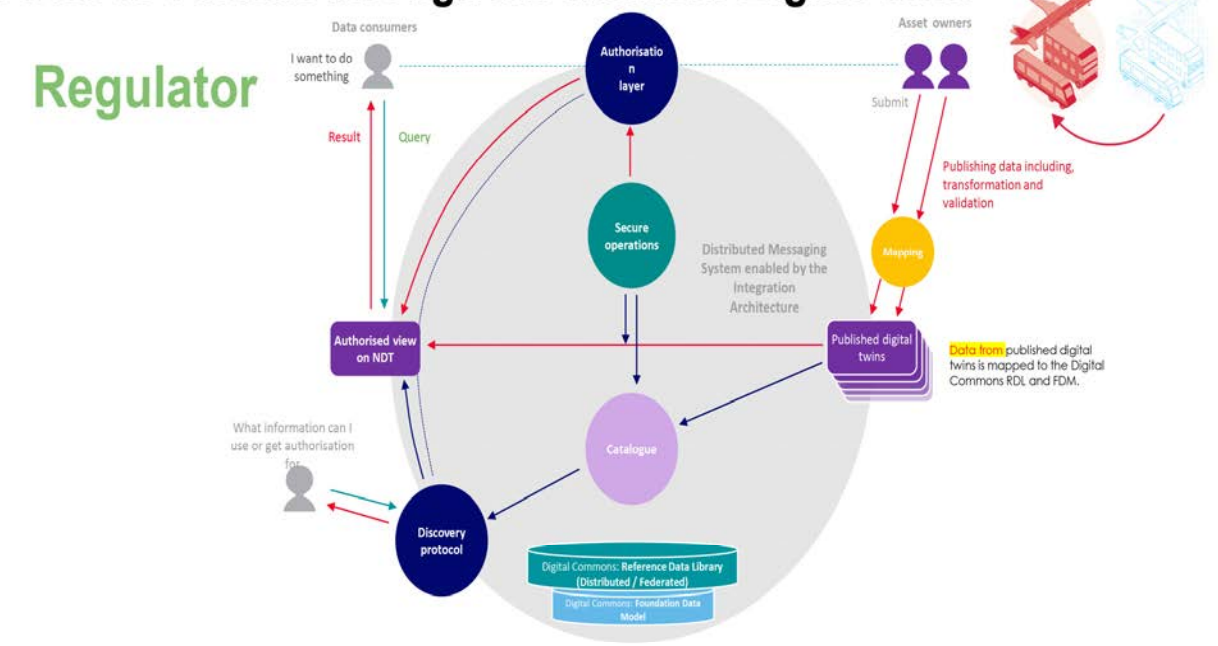
NATIONAL DIGITAL TWIN PROGRAMME

The NDT programme – a principled approach



NATIONAL DIGITAL TWIN PROGRAMME

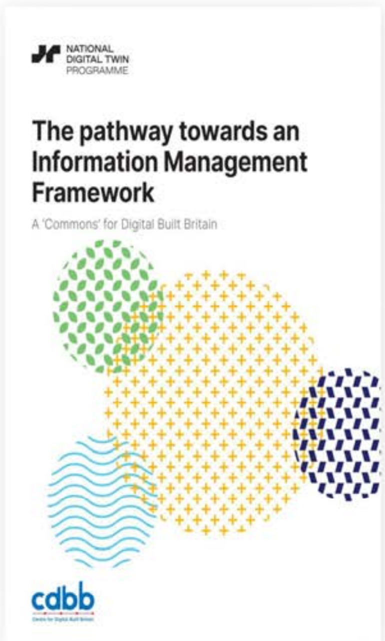
A cross-section through the National Digital Twin



NATIONAL DIGITAL TWIN PROGRAMME

The pathway towards an Information Management Framework

1. **Foundation Data Model** – a consistent, clear understanding of what constitutes the world of digital twins
2. **Reference Data Library** – the particular set of classes and the properties we will want to use to describe our digital twins
3. **Integration Architecture** – the protocols that will enable the managed sharing of data



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Benefits of the National Digital Twin

Better decisions equal better outcomes for people and society

1. Benefits to society: Improved stakeholder engagement. Better outcomes for the ultimate customers (the public – taxpayers/bill payers/fare payers/voters). Improved customer satisfaction and experience through higher-performing infrastructure and the services it provides.

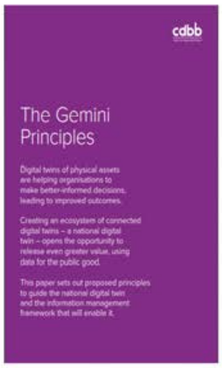
2. Benefits to the economy: Improved national productivity from higher-performing and resilient infrastructure operating as a system. Improved measurement of outcomes. Better outcomes per whole-life pound. Improved information security and thereby personnel, physical and cyber security.

3. Benefits to business: New markets, new services, new business models, new entrants. Improved business efficiency from higher-performing infrastructure. Improved delivery efficiency, benefiting the whole construction value chain – investors, owners, asset managers, contractors, consultants, suppliers. Reduced uncertainty and better risk management.

4. Benefits to the environment: Less disruption and waste. More reuse and greater resource efficiency – a key enabler of the circular economy in the built environment.

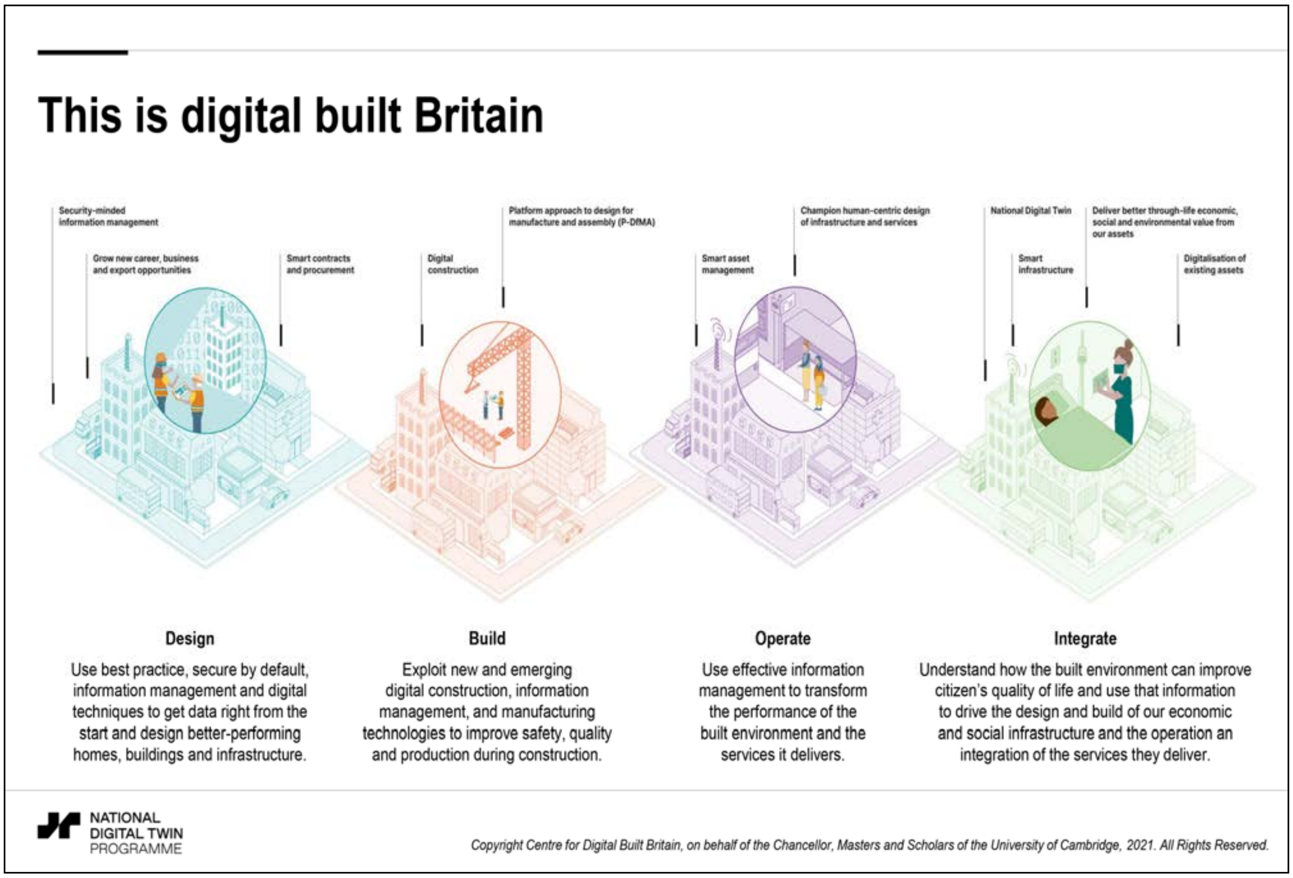
NATIONAL DIGITAL TWIN PROGRAMME

Driven by values



Purpose: Must have clear purpose	**Public good** Must be used to deliver genuine public benefit in perpetuity	**Value creation** Must enable value creation and performance improvement	**Insight** Must provide determinable insight into the built environment
Trust: Must be trustworthy	**Security** Must enable security and be secure itself	**Openness** Must be as open as possible	**Quality** Must be built on data of an appropriate quality
Function: Must function effectively	**Federation** Must be based on a standard connective environment	**Curation** Must have clear ownership, governance and regulation	**Evolution** Must be able to adapt as technology and society evolve

NATIONAL DIGITAL TWIN PROGRAMME


This is digital built Britain
Security-minded information management
Grow new career, business and export opportunities
Smart contracts and procurement
Digital construction
Platform approach to design for manufacture and assembly (P-DfMA)
Smart asset management
Champion human-centric design of infrastructure and services
National Digital Twin
Smart infrastructure
Deliver better through-life economic, social and environmental value from our assets
Digitalisation of existing assets
Design
Use best practice, secure by default, information management and digital techniques to get data right from the start and design better-performing homes, buildings and infrastructure.
Build
Exploit new and emerging digital construction, information management, and manufacturing technologies to improve safety, quality and production during construction.
Operate
Use effective information management to transform the performance of the built environment and the services it delivers.
Integrate
Understand how the built environment can improve citizen's quality of life and use that information to drive the design and build of our economic and social infrastructure and the operation an integration of the services they deliver.
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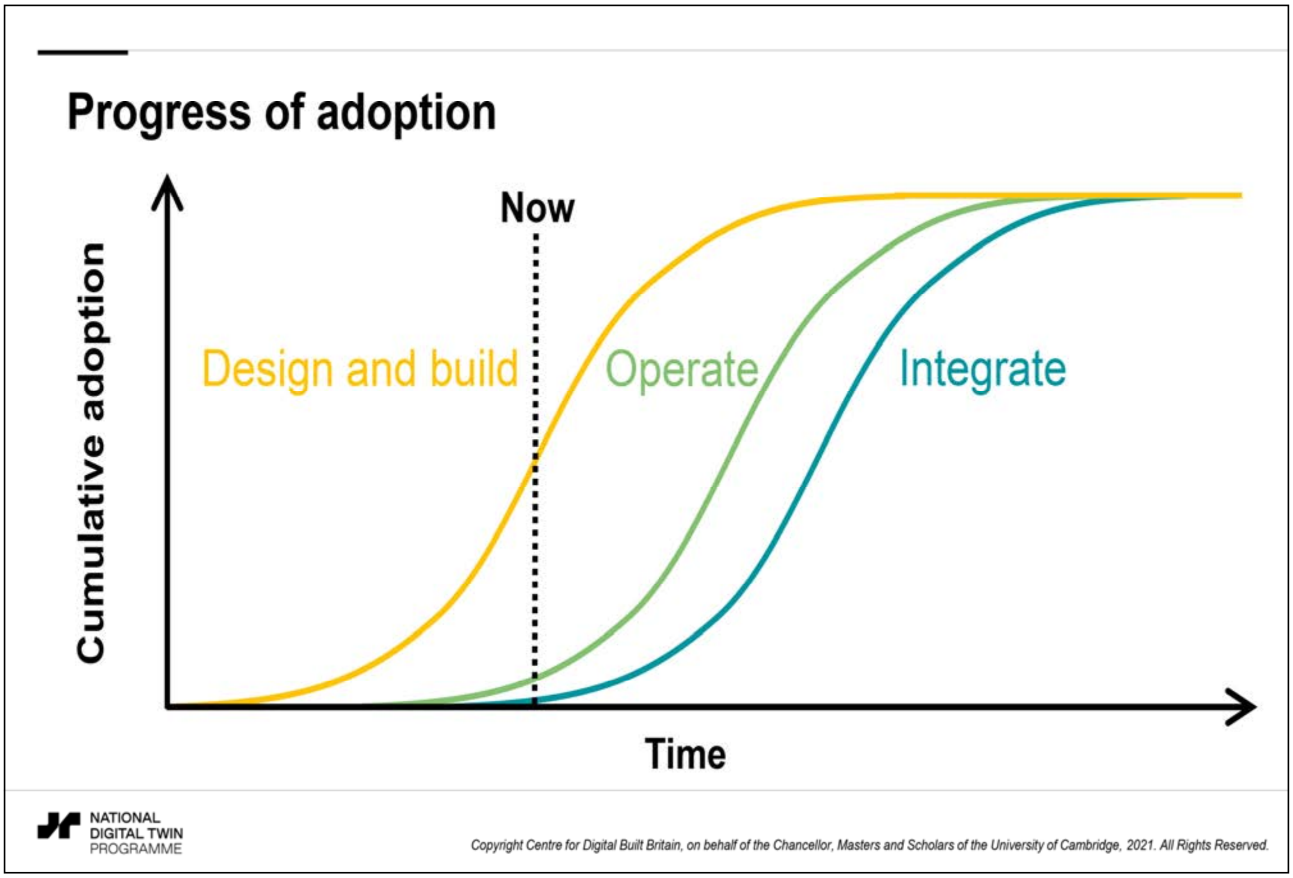
Progress of adoption
Cumulative adoption
Now
Design and build
Operate
Integrate
Time
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Thank you
Build better connections:
digitaltwinhub.co.uk
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UK Research and Innovation
Department for Business, Energy & Industrial Strategy
cdbb
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Opening Speech

Policy Directions of National Digital Twin in Korea
[한국의 디지털트윈 정책방향]

Hyejung Sung Korea Research Institute for Human Settlements


2021 ICGIS International Conference on Geospatail Information Science
Policy Directions of National Digital Twin in Korea
Hyejung Sung
hjsung@krihs.re.kr
KRIHS
Korea Research Institute for
Human Settlements


About KRIHS
KRIHS(Korea Research Institute for Human Settlements)
:: Think Tank of National Territorial Planning and Development in Korea
Research Division
– National Territorial Planning & Regional Research
– Urban Research
– Housing & Land Research
– Infrastructure Research
– Spatially enabled Society Research (Geospatial Information Research)
National Spatial Data Infrastructure, Smart City, Digital Twin, Spatial Analysis


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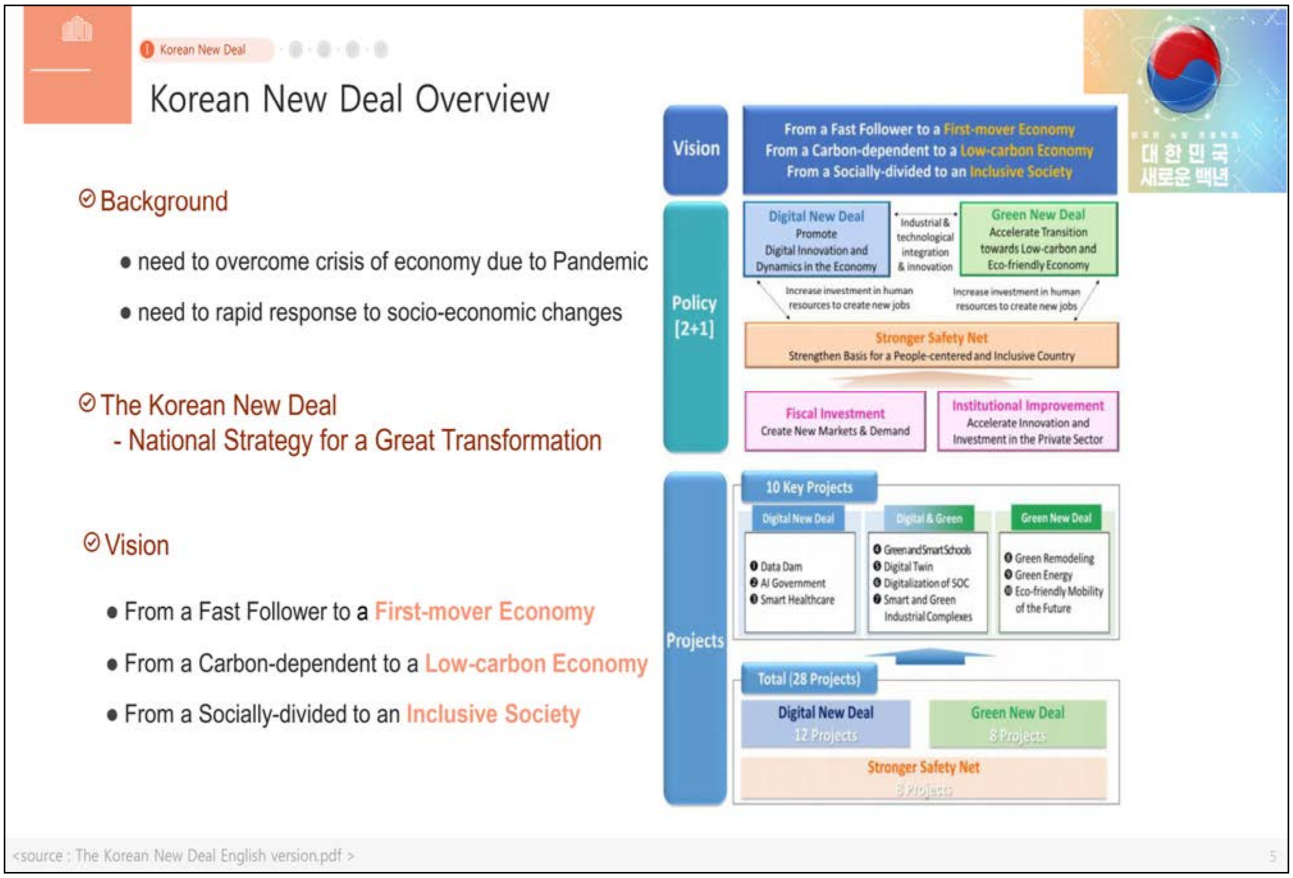
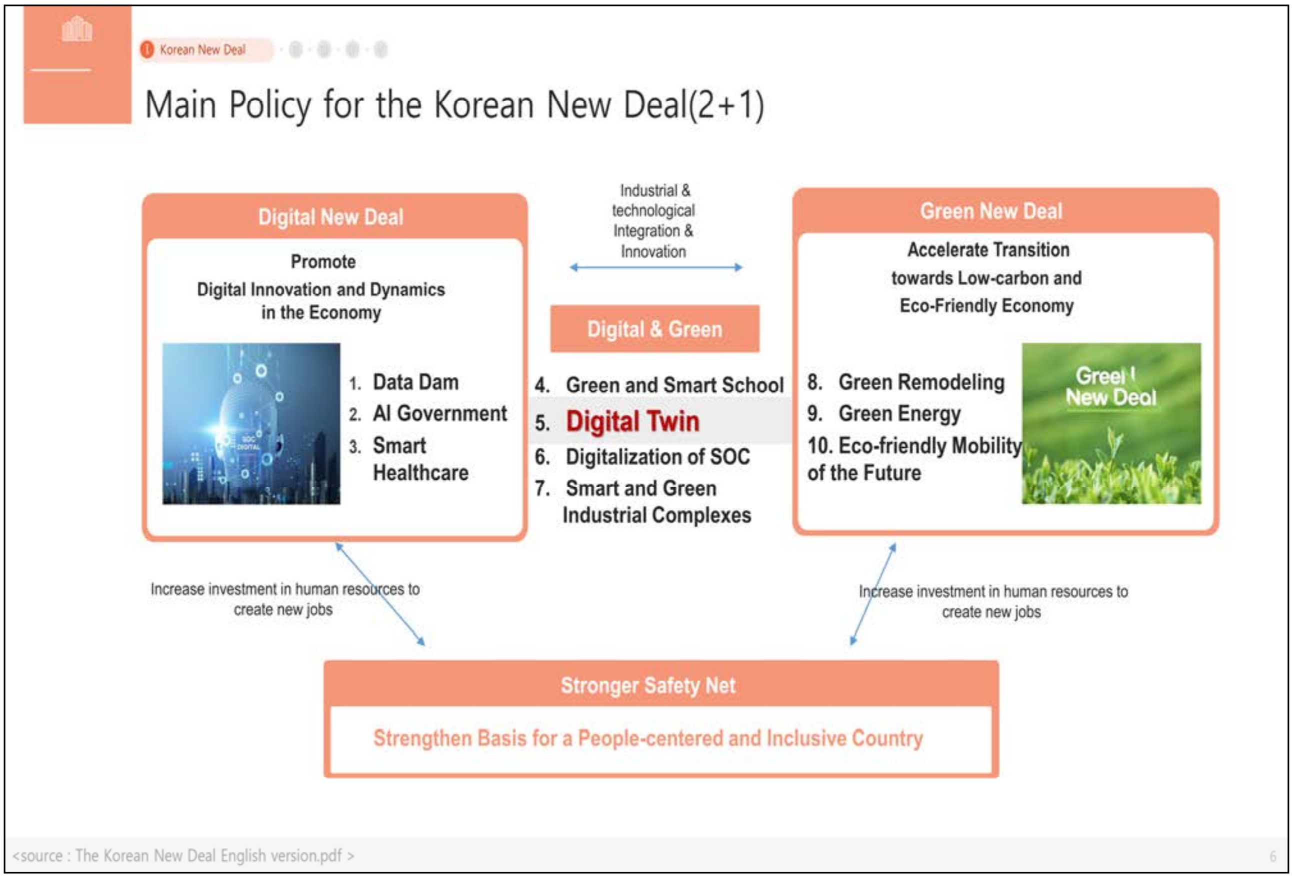
I The Korean New Deal & Digital Twin 04
II Digital Twin in Korea 09
III The Concept of 'Ecosystem of Digital Twin for Territory' 13
IV The barriers to Ecosystem of DT for Territory 19
V Direction & Principles 22


Korean New Deal
&
Digital Twin


Korean New Deal
Korean New Deal Overview
Background
need to overcome crisis of economy due to Pandemic
need to rapid response to socio-economic changes
The Korean New Deal
- National Strategy for a Great Transformation
Vision
From a Fast Follower to a First-mover Economy
From a Carbon-dependent to a Low-carbon Economy
From a Socially-divided to an Inclusive Society
Vision
From a Fast Follower to a First-mover Economy
From a Carbon-dependent to a Low-carbon Economy
From a Socially-divided to an Inclusive Society
Policy [2+1]
Digital New Deal
Promote
Digital Innovation and Dynamics in the Economy
Industrial & technological integration & innovation
Green New Deal
Accelerate Transition towards Low-carbon and Eco-friendly Economy
Increase investment in human resources to create new jobs
Increase investment in human resources to create new jobs
Stronger Safety Net
Strengthen Basis for a People-centered and Inclusive Country
Fiscal Investment
Create New Markets & Demand
Institutional Improvement
Accelerate Innovation and Investment in the Private Sector
Projects
10 Key Projects
Digital New Deal
Digital & Green
Green New Deal
Data Dam
AI Government
Smart Healthcare
Green and Smart Schools
Digital Twin
Digitalization of SOC
Smart and Green Industrial Complexes
Green Remodeling
Green Energy
Eco-friendly Mobility of the Future
Total (28 Projects)
Digital New Deal
12 Projects
Green New Deal
8 Projects
Stronger Safety Net
8 Projects
대한민국
새로운 백년
<source : The Korean New Deal English version.pdf >
5


Korean New Deal
Main Policy for the Korean New Deal(2+1)
Digital New Deal
Promote
Digital Innovation and Dynamics
in the Economy
1. Data Dam
2. AI Government
3. Smart Healthcare
Industrial & technological Integration & Innovation
Digital & Green
4. Green and Smart School
5. Digital Twin
6. Digitalization of SOC
7. Smart and Green Industrial Complexes
Green New Deal
Accelerate Transition
towards Low-carbon and
Eco-Friendly Economy
8. Green Remodeling
9. Green Energy
10. Eco-friendly Mobility of the Future
Increase investment in human resources to create new jobs
Increase investment in human resources to create new jobs
Stronger Safety Net
Strengthen Basis for a People-centered and Inclusive Country
<source : The Korean New Deal English version.pdf >
6

Korean New Deal

Digital Twin Project in the Korean New Deal

Digital twin (a digital replica of an object that can be used for the analysis and prediction of the future through simulation) will be made for roads, underground spaces, harbors and dams to lay the foundation for new industries such as drones and self-driving vehicles, and to allow for the safe management of land and facilities.

Policy Target Timeline:

	2020	2022	2025
High-definition road mapping	For all national expressways	For all national roads	For local roads with more than 4 lanes
Management system on old underground utility-pipe conduit	on 10 km	on 30 km	on 130 km

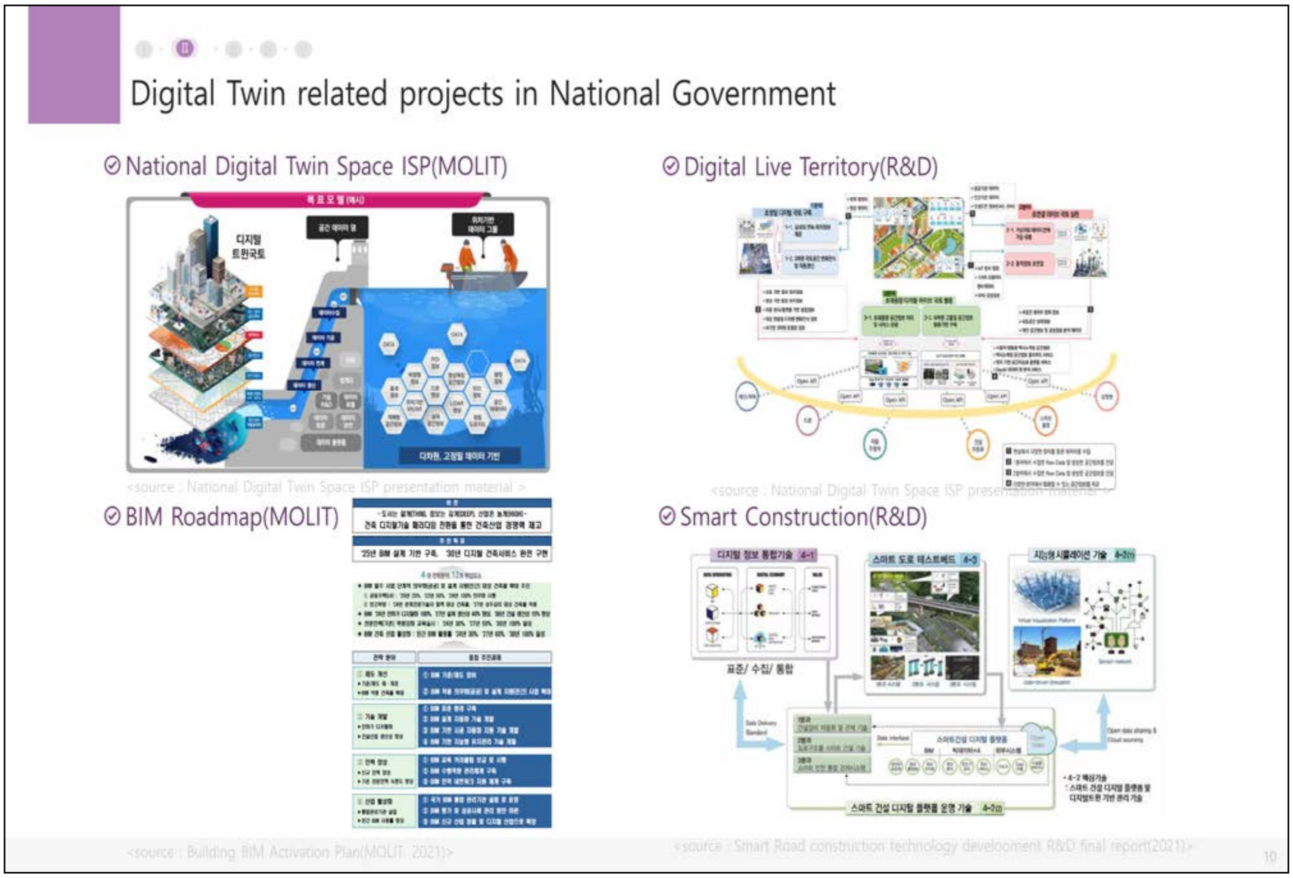
Key Investments and System Reforms:

- Invest 0.5 trillion won from the treasury by 2022 and create 5,000 new jobs
- Invest 1.8 trillion won (including 1.5 trillion won from the treasury) by 2025 and create 16,000 new jobs

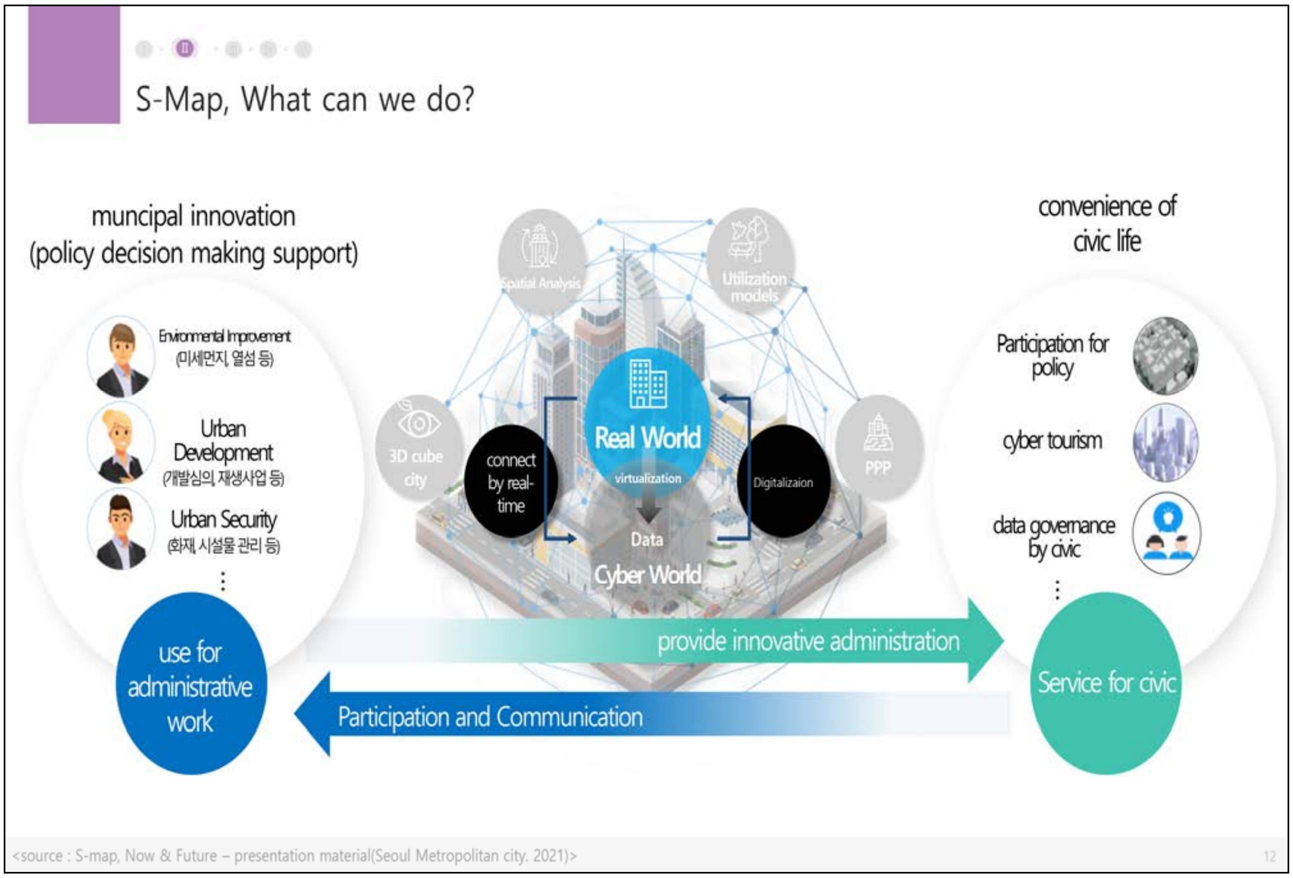
<source : The Korean New Deal English version.pdf >

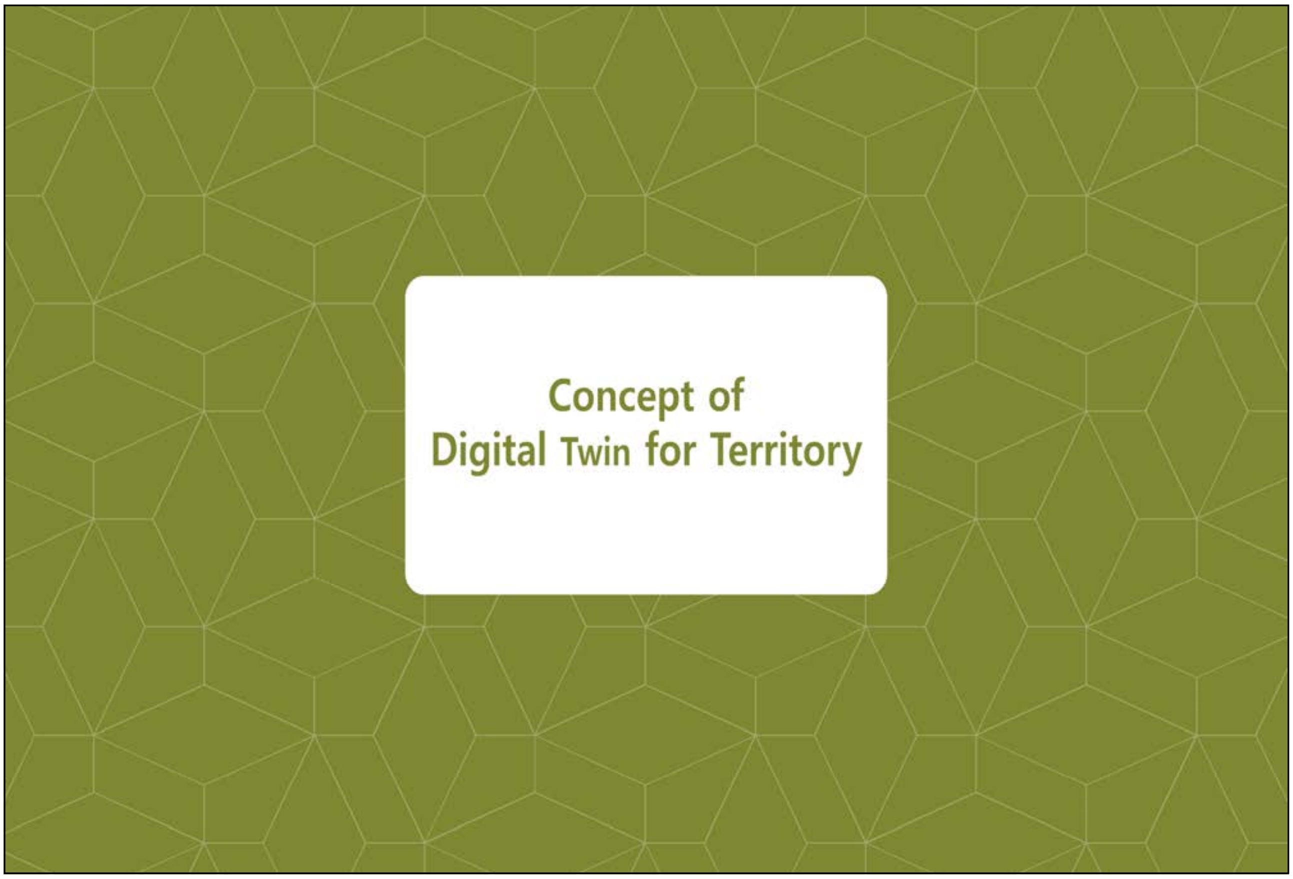
<source : 한국판뉴딜2.0발표자료.pdf >

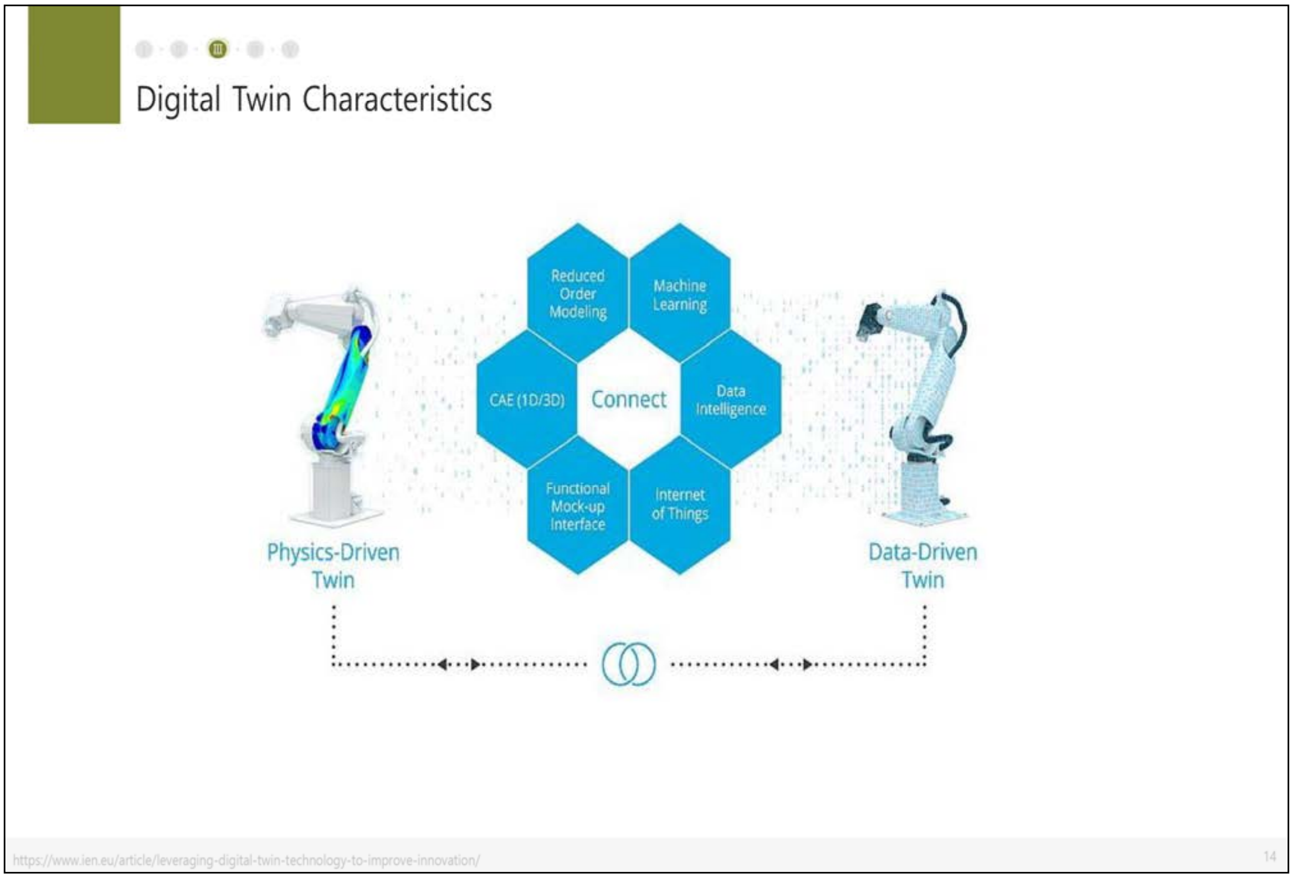

Digital Twin in Korea

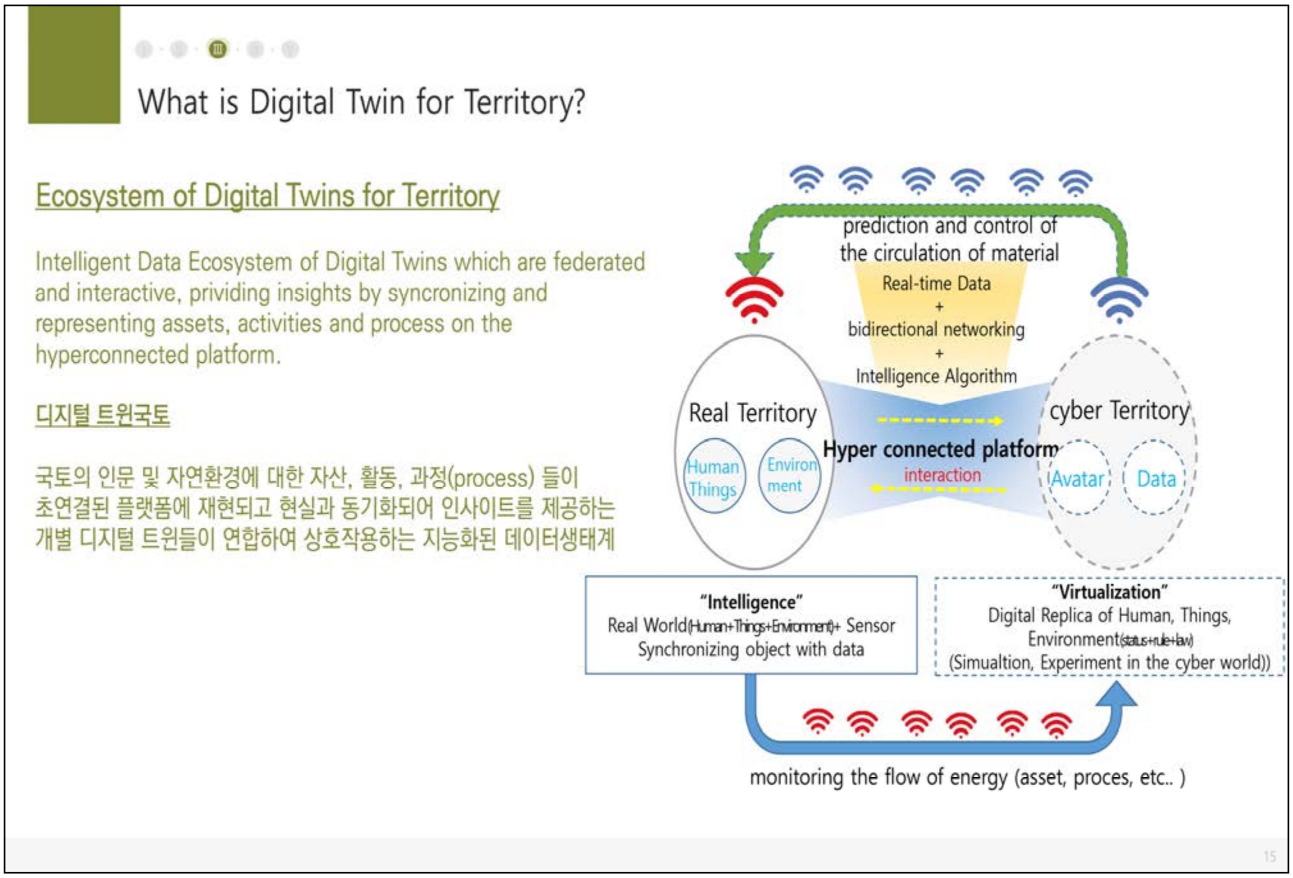

Digital Twin related projects in National Government
National Digital Twin Space ISP(MOLIT)
<source : National Digital Twin Space ISP presentation material >
Digital Live Territory(R&D)
BIM Roadmap(MOLIT)
<source : Building BIM Activation Plan(MOLIT, 2021)>
Smart Construction(R&D)
<source : Smart Road construction technology development R&D final report(2021)>
10

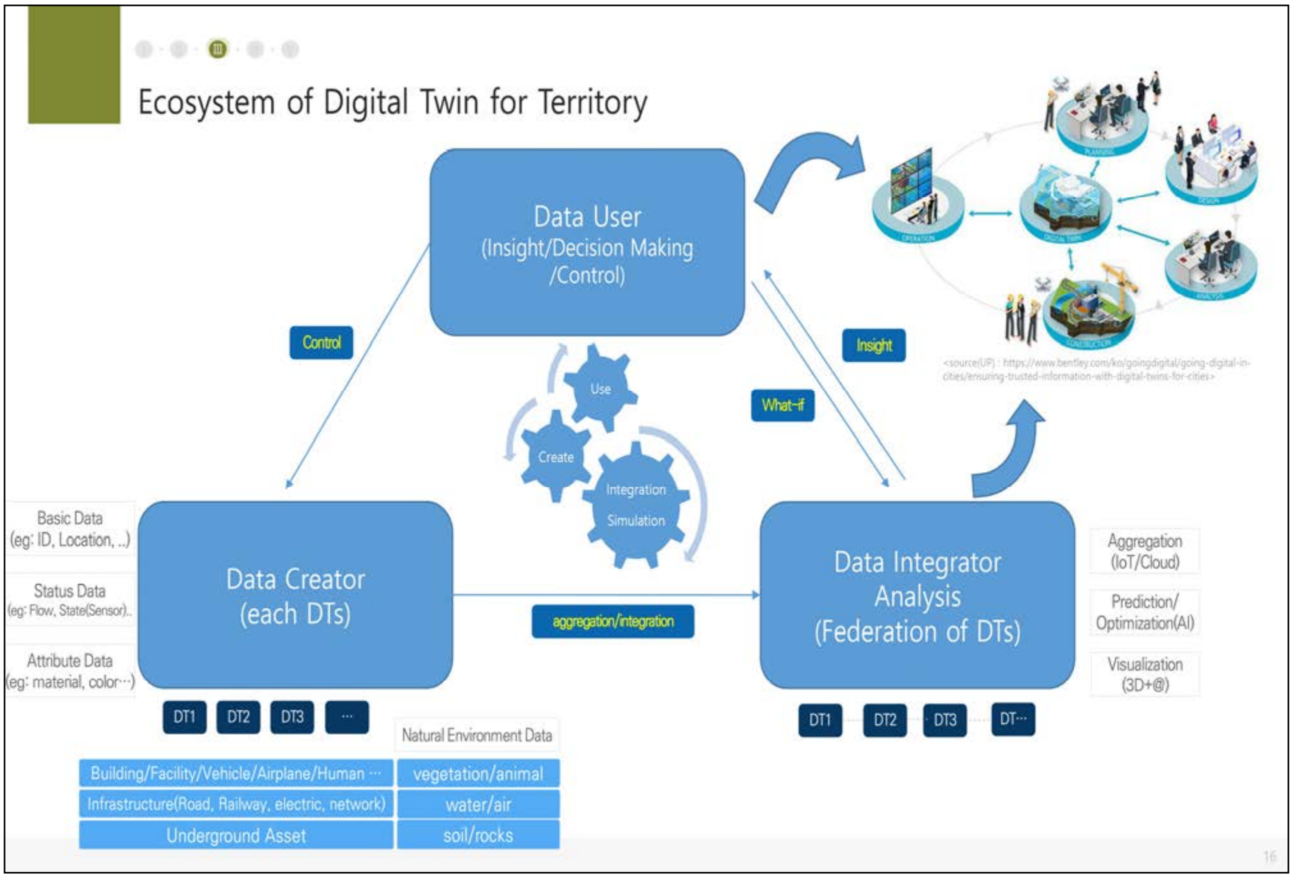

Digital Twin City project by Local Governement
Seoul Metropolitan city – Virtual Seoul (S-Map)
POI
• VR 거리뷰, 전지적서울시점, 문화재, 드론영상 등
3D Geospatial Data
• 연도별 3D건물/시설물 모델
3D Indoor Data
• 공공건축물, 지하철, 지하상가 등
Builiding & Land
• 부동산종합정보
• 교통량/사고공사, 실시간 CCTV
2D Geospatial Data
• 연도별 정사영상/ 네이버 지도
• 서울시 보유 행정 및 공간 데이터 (행정경계, 지하철정보, 도로명주소 등)
Underground facility
• 전기, 가스, 상하수도 등 6대 지하시설물
Terrain
• 수치표고모델(DEM)
• 수치표면모델(DSM)
1부 팬데믹 시티
KBS
서울시 도시건축센터 스마트회의실
<source : S-map, Now & Future – presentation material(Seoul Metropolitan city. 2021)>
11


S-Map, What can we do?
muncipal innovation
(policy decision making support)
Environmental Improvement
(미세먼지, 열섬 등)
Urban Development
(개발심의, 재생사업 등)
Urban Security
(화재, 시설물 관리 등)
use for administrative work
Spatial Analysis
Utilization models
3D cube city
connect by real-time
Real World
virtualization
Data
Cyber World
Digitalizaion
PPP
convenience of civic life
Participation for policy
cyber tourism
data governance by civic
Service for civic
provide innovative administration
Participation and Communication
<source : S-map, Now & Future – presentation material(Seoul Metropolitan city. 2021)>
12

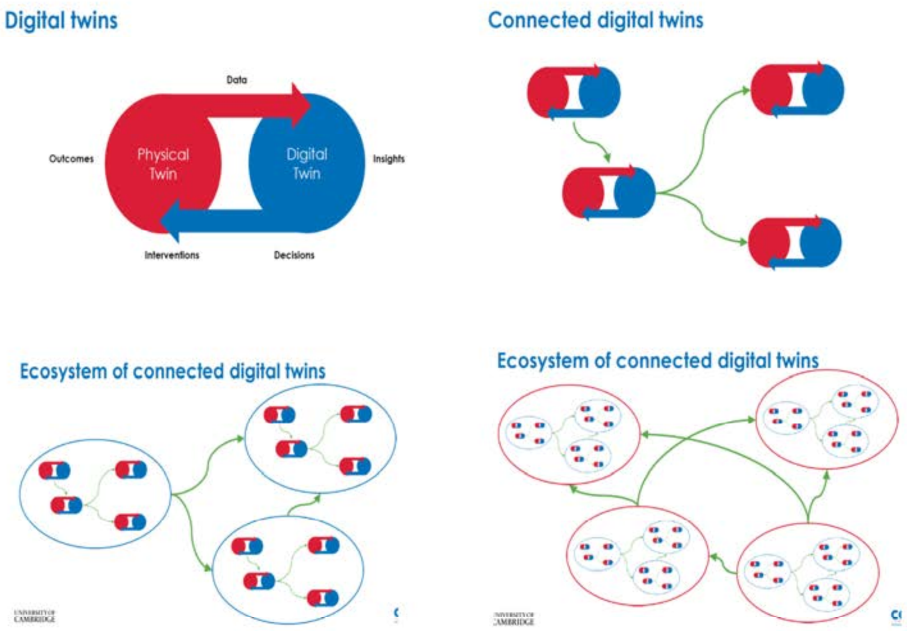

Concept of
Digital Twin for Territory


Digital Twin Characteristics
Reduced Order Modeling
Machine Learning
CAE (1D/3D)
Connect
Data Intelligence
Functional Mock-up Interface
Internet of Things
Physics-Driven Twin
Data-Driven Twin
https://www.ien.eu/article/leveraging-digital-twin-technology-to-improve-innovation/
14


What is Digital Twin for Territory?
Ecosystem of Digital Twins for Territory
Intelligent Data Ecosystem of Digital Twins which are federated and interactive, prividing insights by syncronizing and representing assets, activities and process on the hyperconnected platform.
디지털 트윈국토
국토의 인문 및 자연환경에 대한 자산, 활동, 과정(process) 들이 초연결된 플랫폼에 재현되고 현실과 동기화되어 인사이트를 제공하는 개별 디지털 트윈들이 연합하여 상호작용하는 지능화된 데이터생태계
prediction and control of the circulation of material
Real-time Data
+
bidirectional networking
+
Intelligence Algorithm
Real Territory
Human Things
Environ ment
Hyper connected platform
interaction
cyber Territory
Avatar
Data
"Intelligence"
Real World(Human+Things+Environment)+ Sensor
Synchronizing object with data
"Virtualization"
Digital Replica of Human, Things, Environment(status+rule+law)
(Simualtion, Experiment in the cyber world))
monitoring the flow of energy (asset, proces, etc..)
15


Ecosystem of Digital Twin for Territory
Data User
(Insight/Decision Making /Control)
Control
Insight
What-if
Use
Create
Integration
Simulation
Basic Data
(eg: ID, Location, ..)
Status Data
(eg: Flow, State(Sensor)..
Attribute Data
(eg: material, color···)
Data Creator
(each DTs)
aggregation/integration
Data Integrator
Analysis
(Federation of DTs)
Aggregation
(IoT/Cloud)
Prediction/
Optimization(AI)
Visualization
(3D+@)
DT1
DT2
DT3
···
Natural Environment Data
Building/Facility/Vehicle/Airplane/Human ···
Infrastructure(Road, Railway, electric, network)
Underground Asset
vegetation/animal
water/air
soil/rocks
DT1
DT2
DT3
DT···
16

Ecosystem of Digital Twins(CDBB)



<source: The National Dgital Twin. University of Cambridge & CDBB. 2018. >

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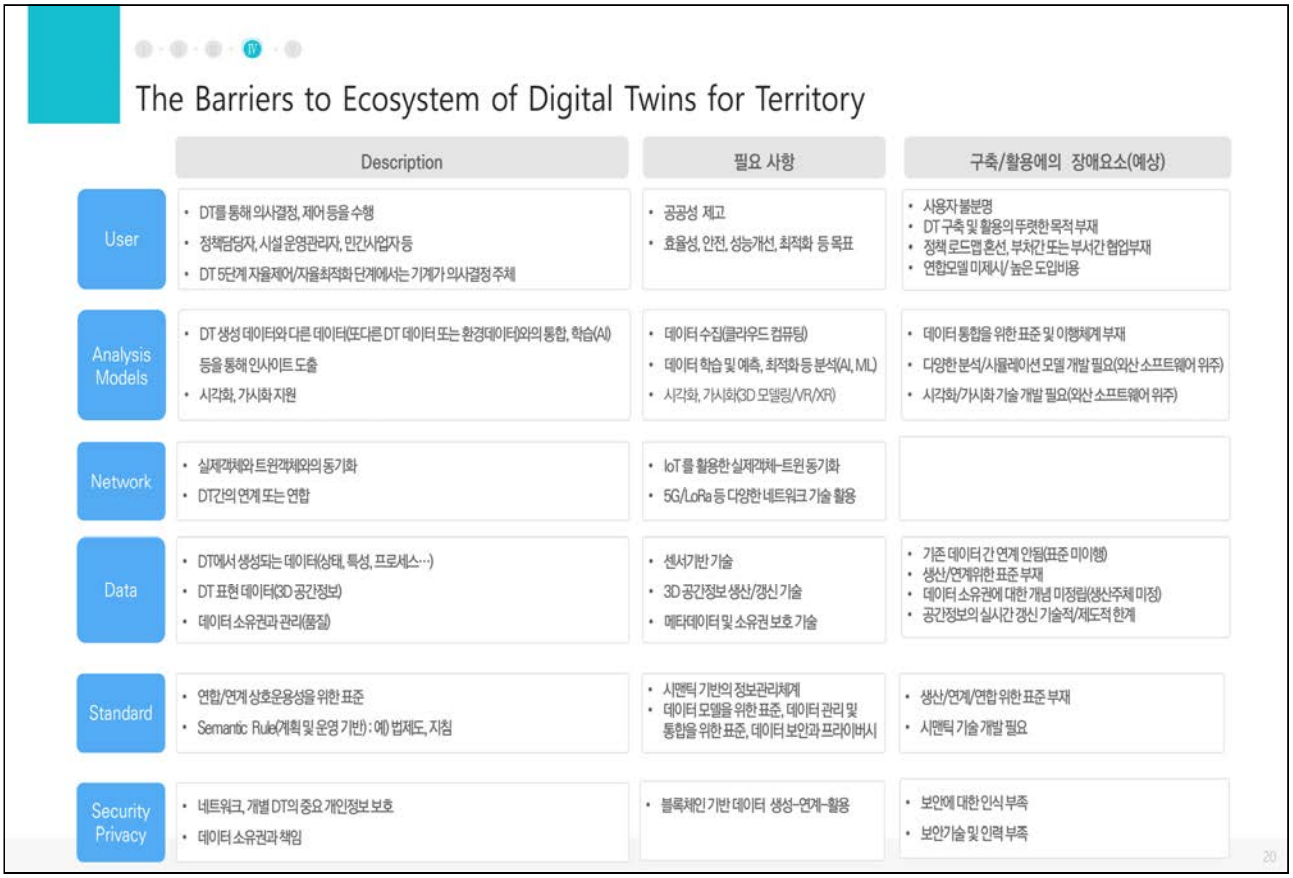
Maturity of DigitalTwin for Territory

Maturity		Define	Description
1. Copy		Capture 2D/3D model generation	현실객체의 물리적 특성을 실감형 디지털 객체로 모사 디지털 트윈국토 데이터기반 조성 실감형 모델 확보
2. Monitoring		Connect with real object (eg: IoT, Sensors)	네트워크를 통해 현실객체와 디지털객체가 연결되고 모니터링이 가능
3. Optimization		Data Integration Analysis/Simulation/Optimization	연계할 타 분야/기관/기기 들의 데이터를 통합하고 분석모델 및 시뮬레이션 모델들을 활용하여 사용자가 원하는 예측/최적화
4. Syschronization		Bidirectional(Real <-> Digital) Data Integration And Interaction	현실 상태 제어 (디지털에서 물리적 제어)
5. Federation		Federated and interacting ecosystem of digital twins	디지털 트윈 간 연계 및 연합/최적화
6. Autonomous operation		Autonomous operation	초연결 융합플랫폼의 자율운영 및 지능형국토 완성

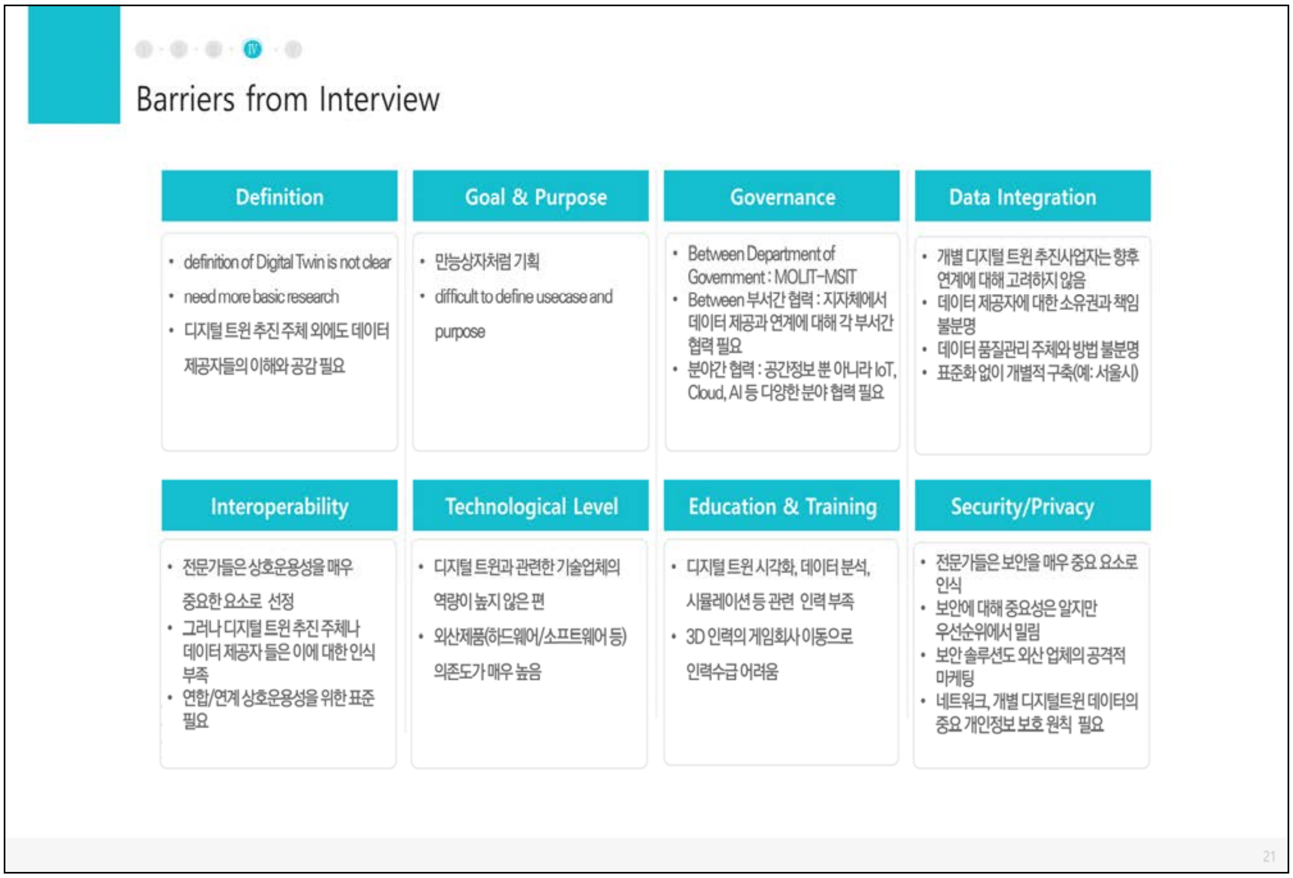
18

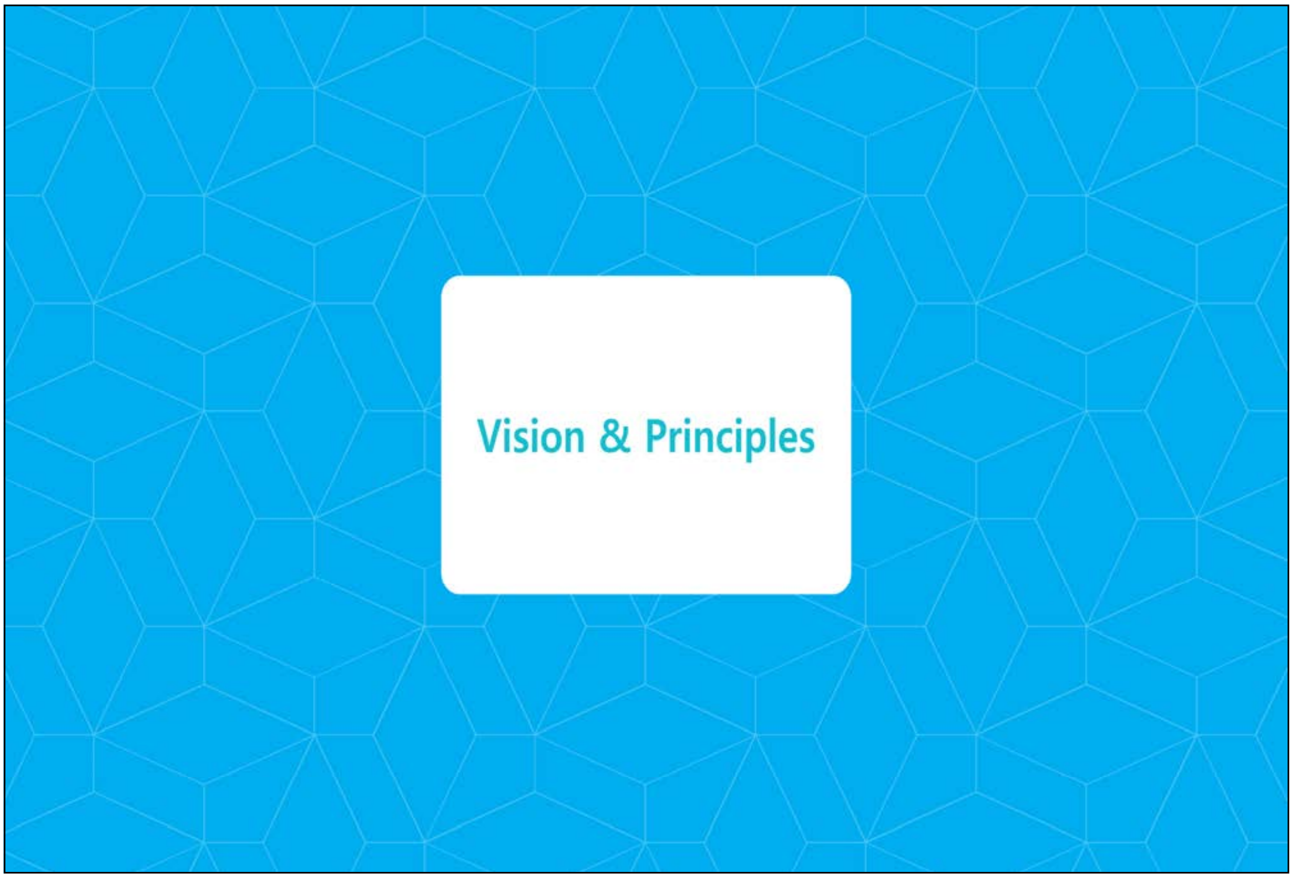


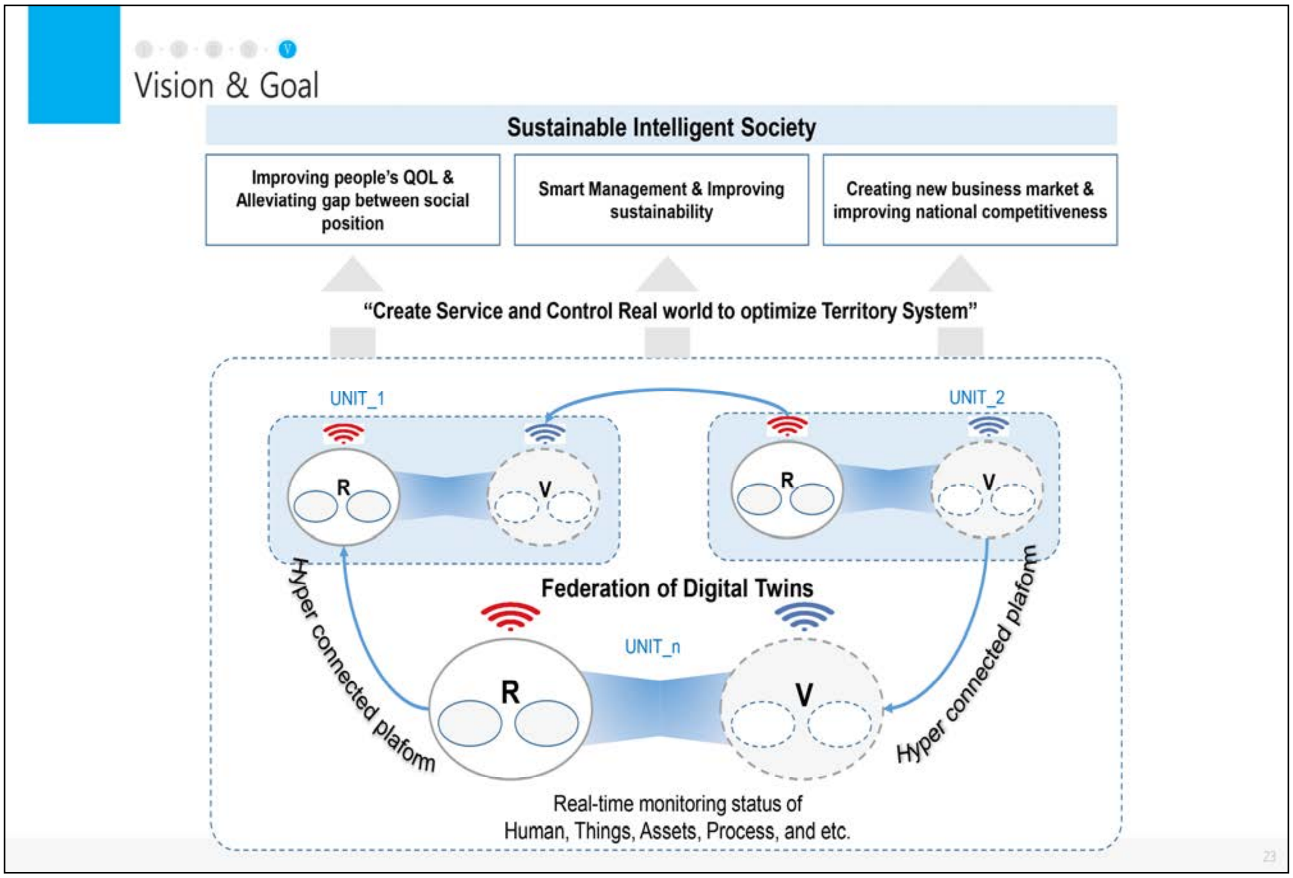
The Barriers to Ecosystem of Digital Twins for Territory

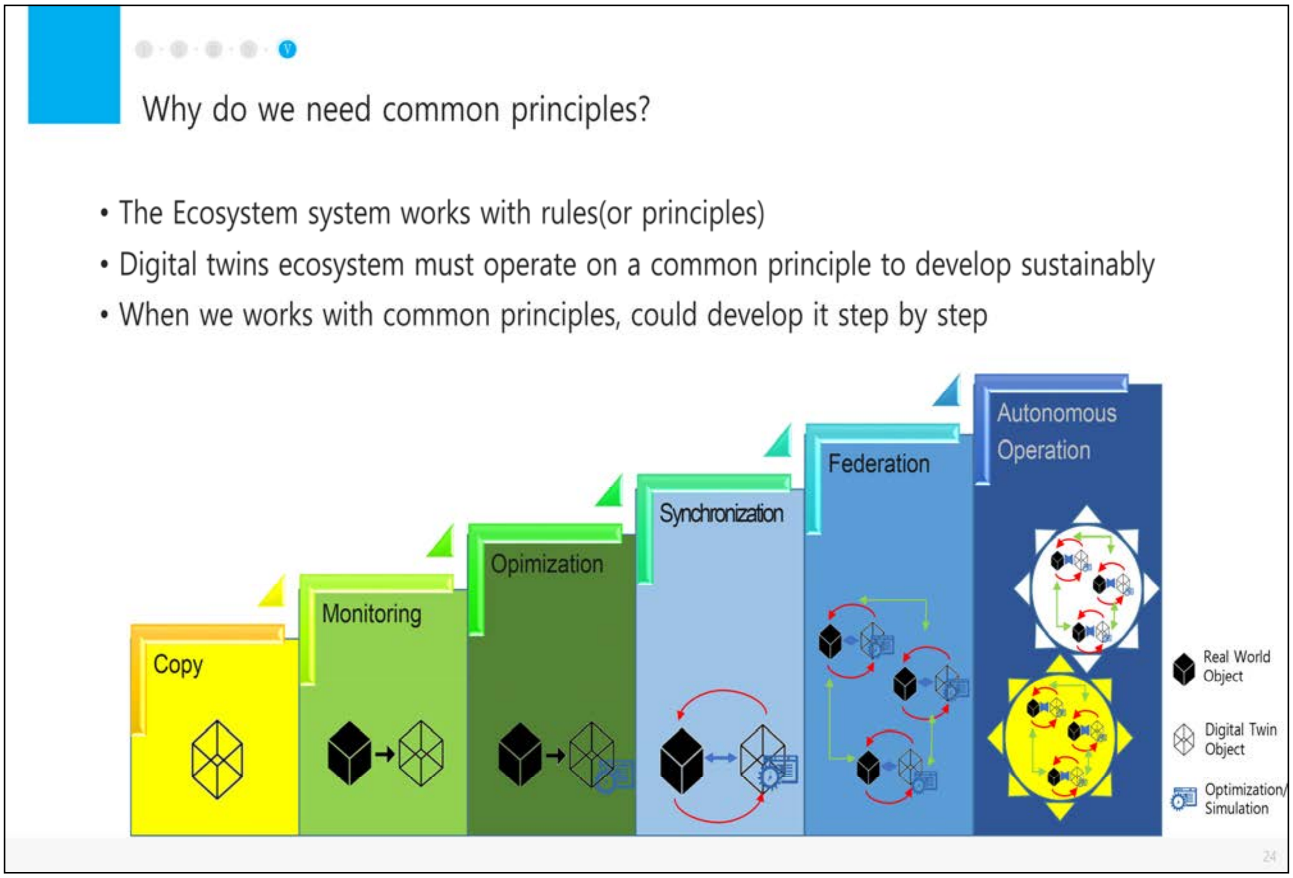
	Description	필요 사항	구축/활용에의 장애요소(예상)
User	• DT를 통해 의사결정, 제어 등을 수행 • 정책담당자, 시설 운영관리자, 민간사업자 등 • DT 5단계 자율제어/자율최적화 단계에서는 기계가 의사결정 주체	• 공공성 제고 • 효율성, 안전, 성능개선, 최적화 등 목표	• 사용자 불분명 • DT 구축 및 활용의 뚜렷한 목적 부재 • 정책 로드맵 혼선, 부처간 또는 부서간 협업부재 • 연합모델 미제시/ 높은 도입비용
Analysis Models	• DT 생성 데이터와 다른 데이터(또다른 DT 데이터 또는 환경데이터)와의 통합, 학습(AI) 등을 통해 인사이트 도출 • 시각화, 가시화 지원	• 데이터 수집(클라우드 컴퓨팅) • 데이터 학습 및 예측, 최적화 등 분석(AI, ML) • 시각화, 가시화(3D 모델링/VR/XR)	• 데이터 통합을 위한 표준 및 이행체계 부재 • 다양한 분석/시뮬레이션 모델 개발 필요(외산 소프트웨어 위주) • 시각화/가시화 기술 개발 필요(외산 소프트웨어 위주)
Network	• 실제객체와 트윈객체와의 동기화 • DT간의 연계 또는 연합	• IoT 를 활용한 실제객체-트윈 동기화 • 5G/LoRa 등 다양한 네트워크 기술 활용	
Data	• DT에서 생성되는 데이터(상태, 특성, 프로세스…) • DT 표현 데이터(3D 공간정보) • 데이터 소유권과 관리(품질)	• 센서기반 기술 • 3D 공간정보 생산/갱신 기술 • 메타데이터 및 소유권 보호 기술	• 기존 데이터 간 연계 안됨(표준 미이행) • 생산/연계위한 표준 부재 • 데이터 소유권에 대한 개념 미정립(생산주체 미정) • 공간정보의 실시간 갱신 기술적/제도적 한계
Standard	• 연합/연계 상호운용성을 위한 표준 • Semantic Rule(계획 및 운영 기반) : 예) 법제도, 지침	• 시맨틱 기반의 정보관리체계 • 데이터 모델을 위한 표준, 데이터 관리 및 통합을 위한 표준, 데이터 보안과 프라이버시	• 생산/연계/연합 위한 표준 부재 • 시맨틱 기술 개발 필요
Security Privacy	• 네트워크, 개별 DT의 중요 개인정보 보호 • 데이터 소유권과 책임	• 블록체인 기반 데이터 생성-연계-활용	• 보안에 대한 인식 부족 • 보안기술 및 인력 부족

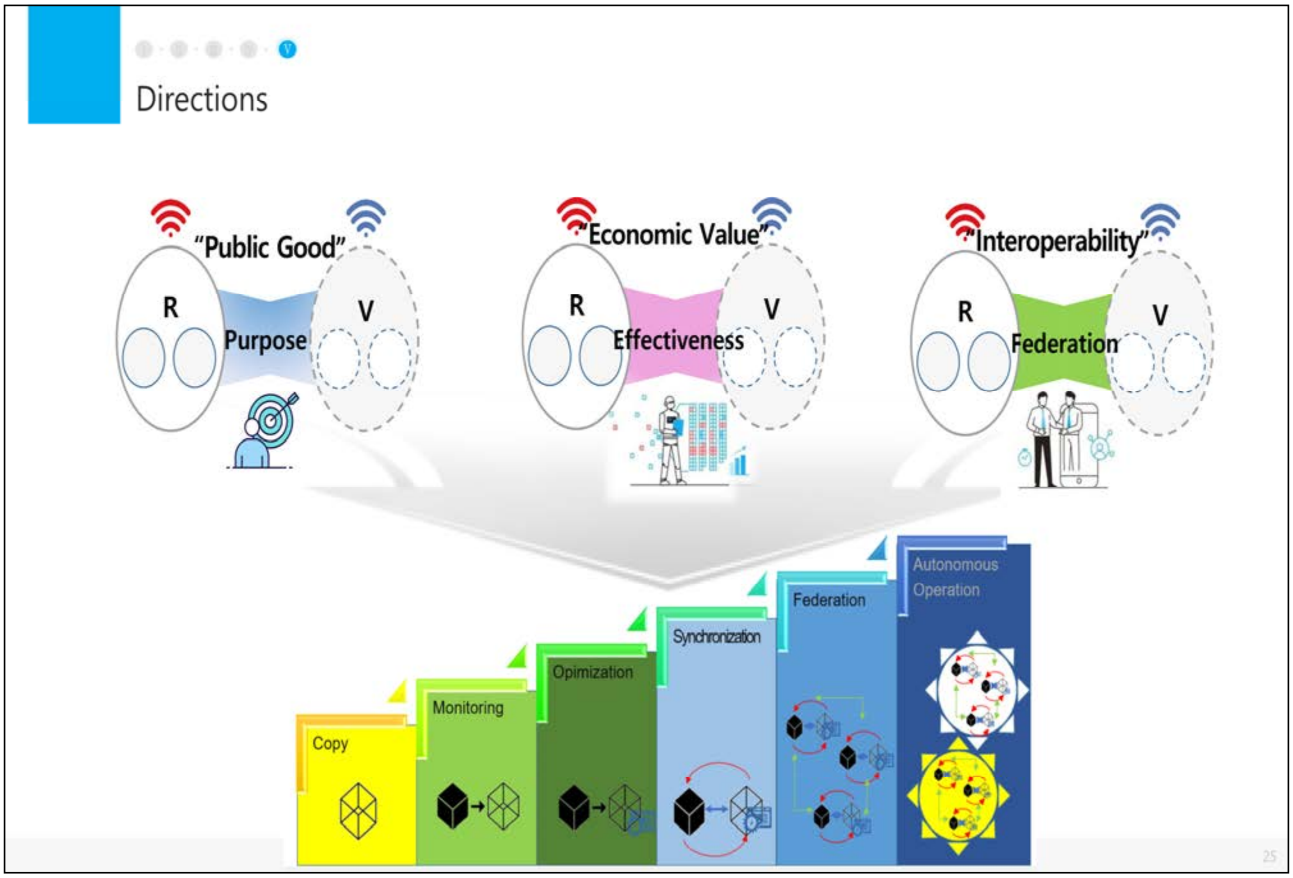
20

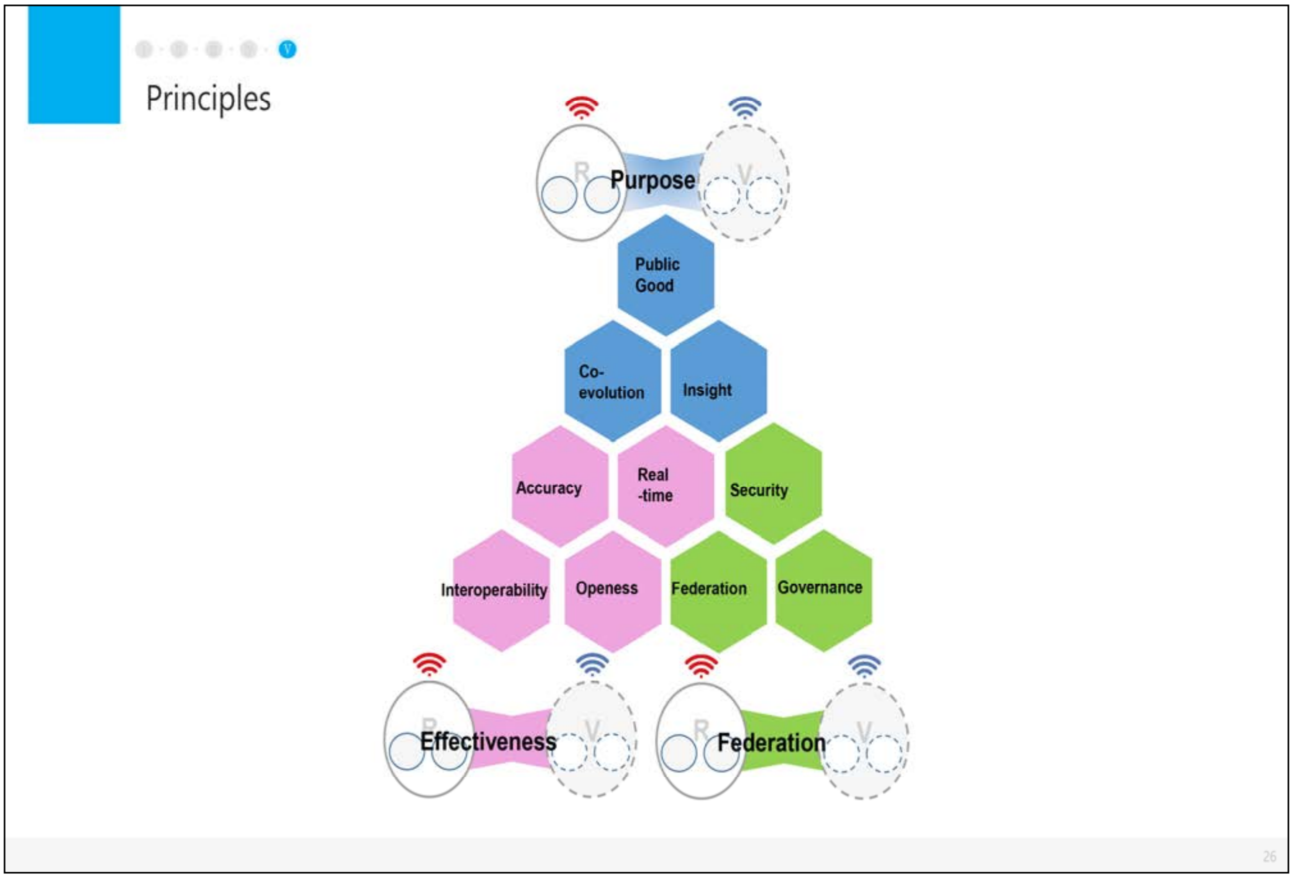

Barriers from Interview
Definition
• definition of Digital Twin is not clear
• need more basic research
• 디지털 트윈 추진 주체 외에도 데이터 제공자들의 이해와 공감 필요
Goal & Purpose
• 만능상자처럼 기획
• difficult to define usecase and purpose
Governance
• Between Department of Government : MOLIT–MSIT
• Between 부서간 협력 : 지자체에서 데이터 제공과 연계에 대해 각 부서간 협력 필요
• 분야간 협력 : 공간정보 뿐 아니라 IoT, Cloud, AI 등 다양한 분야 협력 필요
Data Integration
• 개별 디지털 트윈 추진사업자는 향후 연계에 대해 고려하지 않음
• 데이터 제공자에 대한 소유권과 책임 불분명
• 데이터 품질관리 주체와 방법 불분명
• 표준화 없이 개별적 구축(예: 서울시)
Interoperability
• 전문가들은 상호운용성을 매우 중요한 요소로 선정
• 그러나 디지털 트윈 추진 주체나 데이터 제공자 들은 이에 대한 인식 부족
• 연합/연계 상호운용성을 위한 표준 필요
Technological Level
• 디지털 트윈과 관련한 기술업체의 역량이 높지 않은 편
• 외산제품(하드웨어/소프트웨어 등) 의존도가 매우 높음
Education & Training
• 디지털 트윈 시각화, 데이터 분석, 시뮬레이션 등 관련 인력 부족
• 3D 인력의 게임회사 이동으로 인력수급 어려움
Security/Privacy
• 전문가들은 보안을 매우 중요 요소로 인식
• 보안에 대해 중요성은 알지만 우선순위에서 밀림
• 보안 솔루션도 외산 업체의 공격적 마케팅
• 네트워크, 개별 디지털트윈 데이터의 중요 개인정보 보호 원칙 필요
21

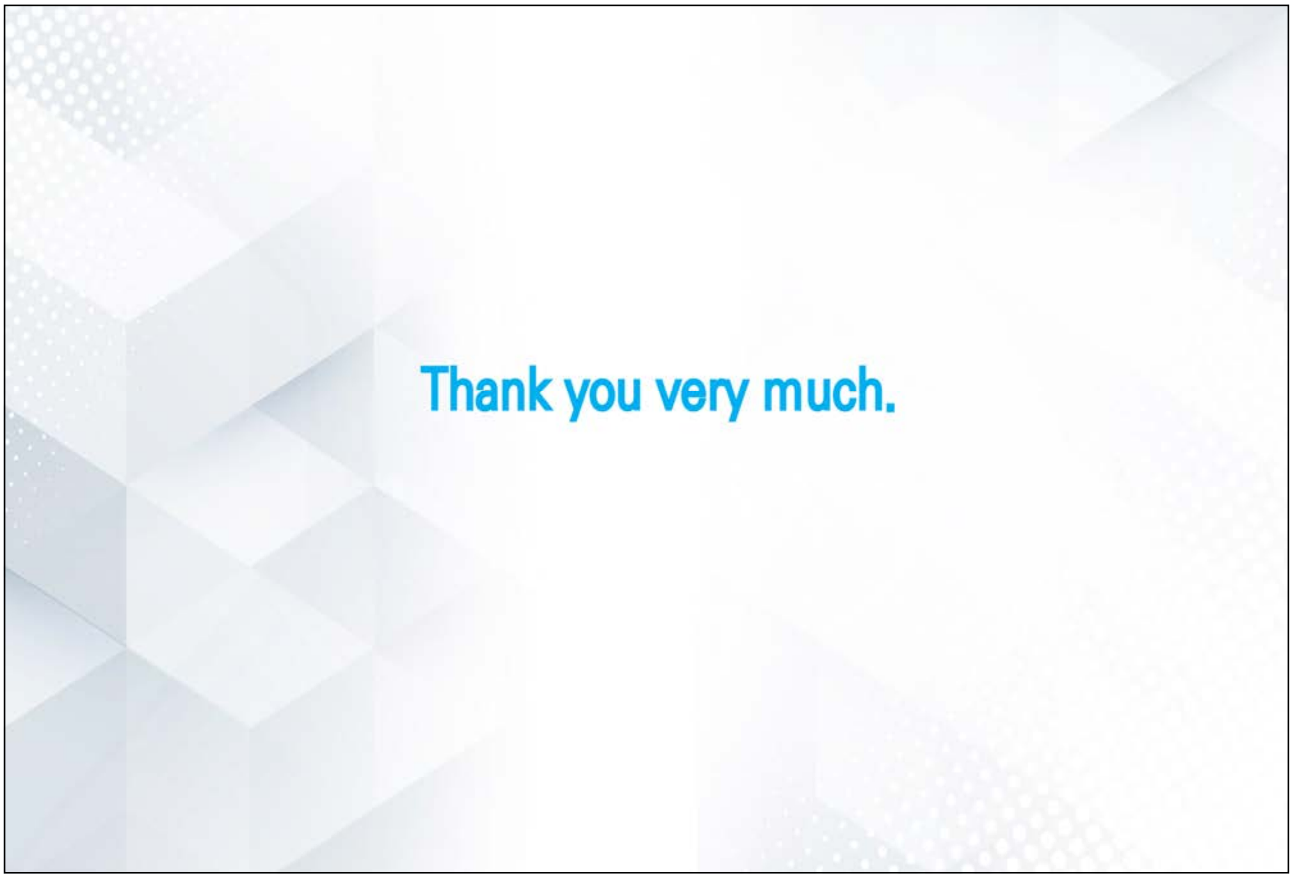

Vision & Principles


Vision & Goal
Sustainable Intelligent Society
Improving people's QOL & Alleviating gap between social position
Smart Management & Improving sustainability
Creating new business market & improving national competitiveness
"Create Service and Control Real world to optimize Territory System"
UNIT_1
UNIT_2
R
V
Federation of Digital Twins
UNIT_n
Hyper connected plafom
Hyper connected plaform
Real-time monitoring status of
Human, Things, Assets, Process, and etc.


Why do we need common principles?
• The Ecosystem system works with rules(or principles)
• Digital twins ecosystem must operate on a common principle to develop sustainably
• When we works with common principles, could develop it step by step
Copy
Monitoring
Opimization
Synchronization
Federation
Autonomous Operation
Real World Object
Digital Twin Object
Optimization/ Simulation


Directions
"Public Good"
R
V
Purpose
"Economic Value"
R
V
Effectiveness
"Interoperability"
R
V
Federation
Copy
Monitoring
Opimization
Synchronization
Federation
Autonomous
Operation


Principles
Purpose
R
V
Public
Good
Co-
evolution
Insight
Accuracy
Real
-time
Security
Interoperability
Openess
Federation
Governance
Effectiveness
Federation


Thank you very much.

2021 ICGIS
International Conference
on Geospatial Information Science

Smart GEO Expo 2021
2021 스마트국토엑스포

Sharpening urban infrastructure decisions with artificial intelligence

[AI를 이용한 도시 인프라 구축 전략]

Hoon Han Univ. of New South Wales

UNSW SYDNEY

Sharpening urban infrastructure decisions with artificial intelligence

HOON HAN
ASSOC. PROFESSOR OF CITY PLANNING
ASSOC. DIRECTOR- CITY FUTURES RESEARCH CENTRE
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2021 International Conference on GIS, Seoul, South Korea
22 July 2021

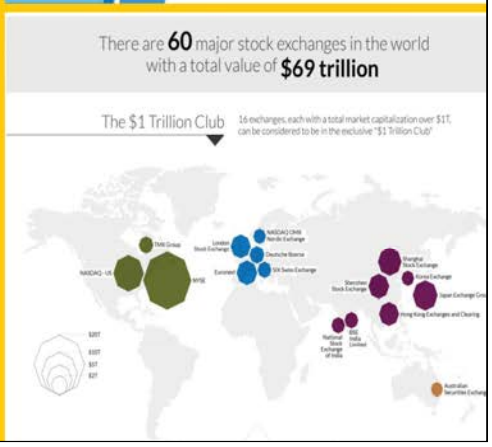
CITYFUTURES

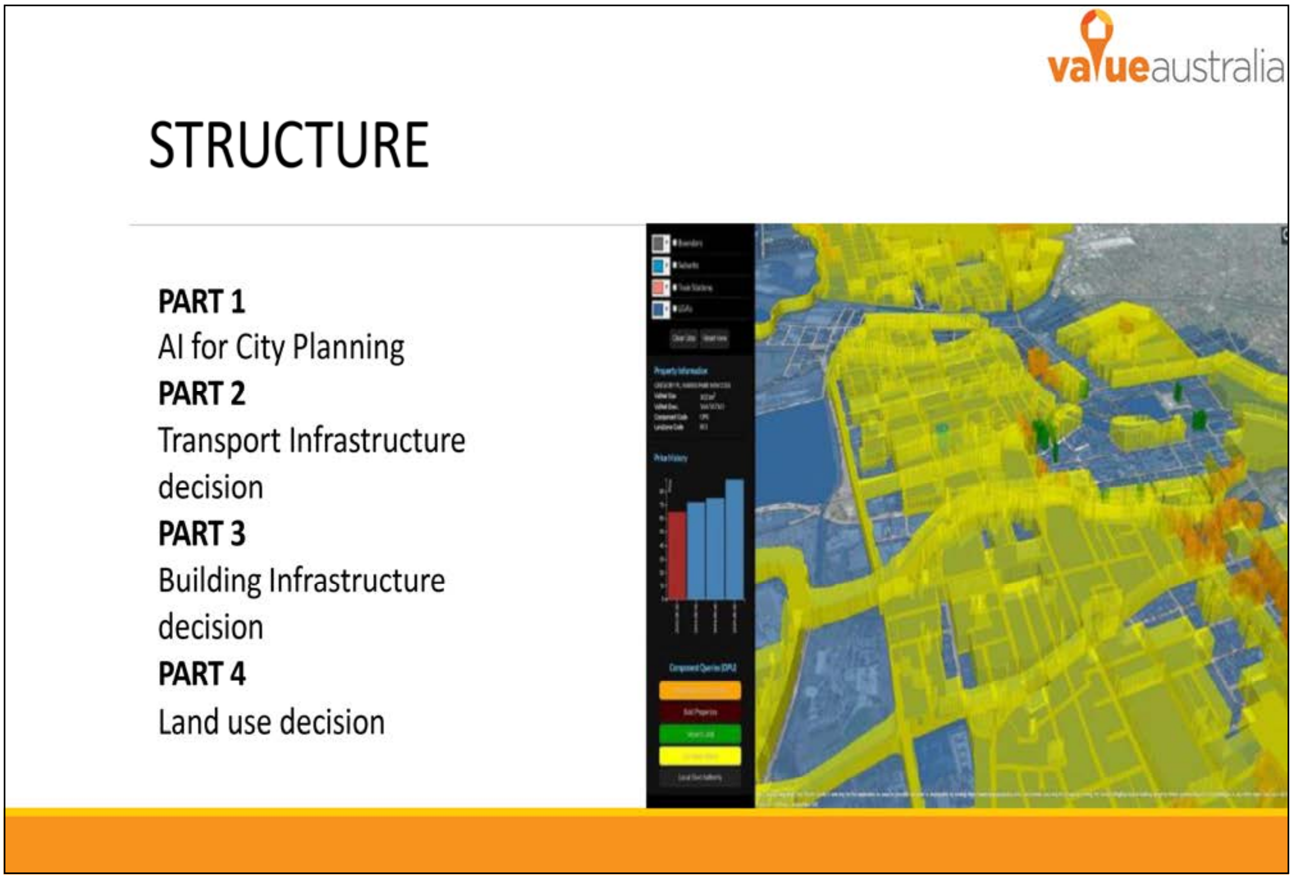
UNSW SYDNEY

Value Australia: What is value of Australia?

- Stock Market/Labor Market/Cryptocurrency Market
- SPACE MARKET = NATIONAL ASSET

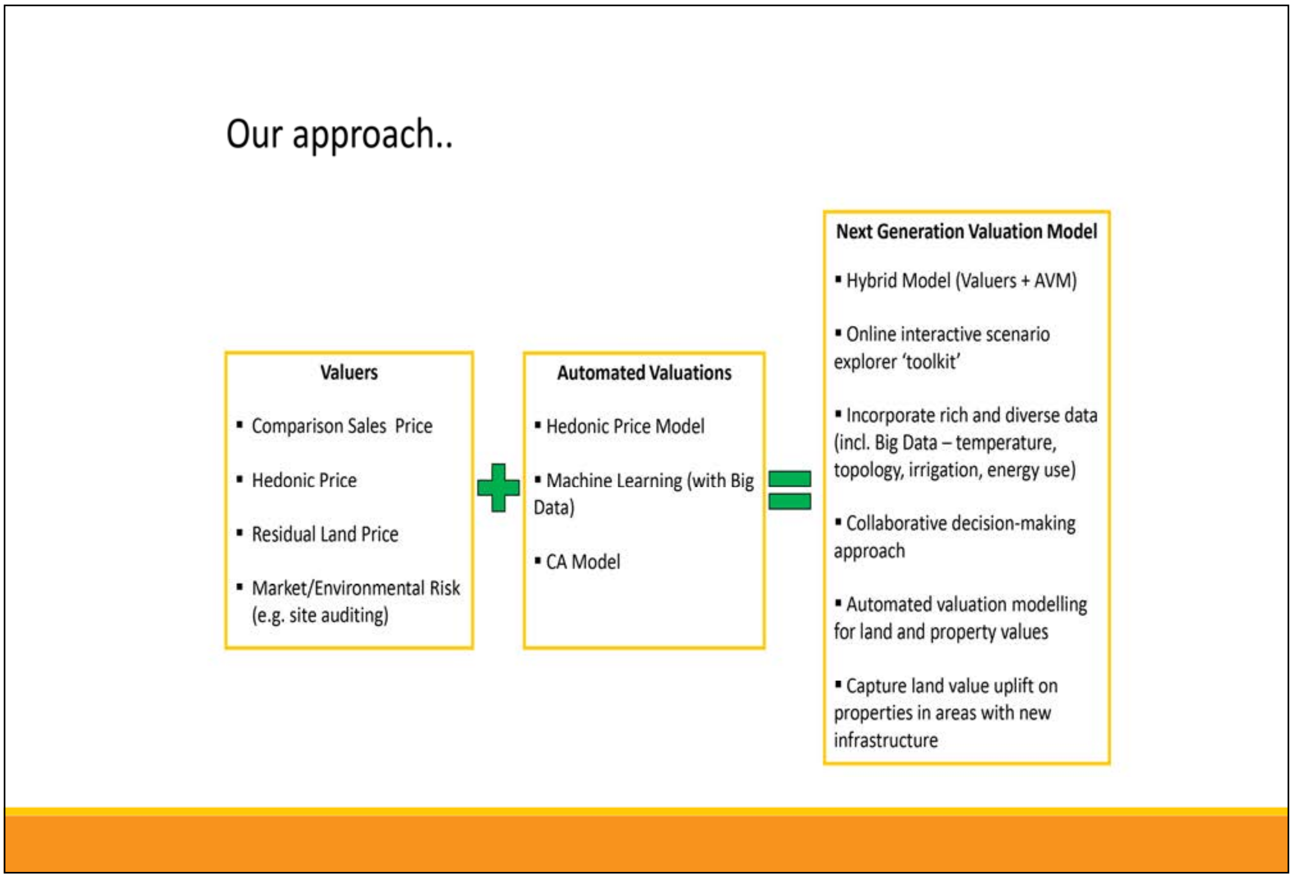
Improve space value by high-quality, sustained, accessible infrastructure



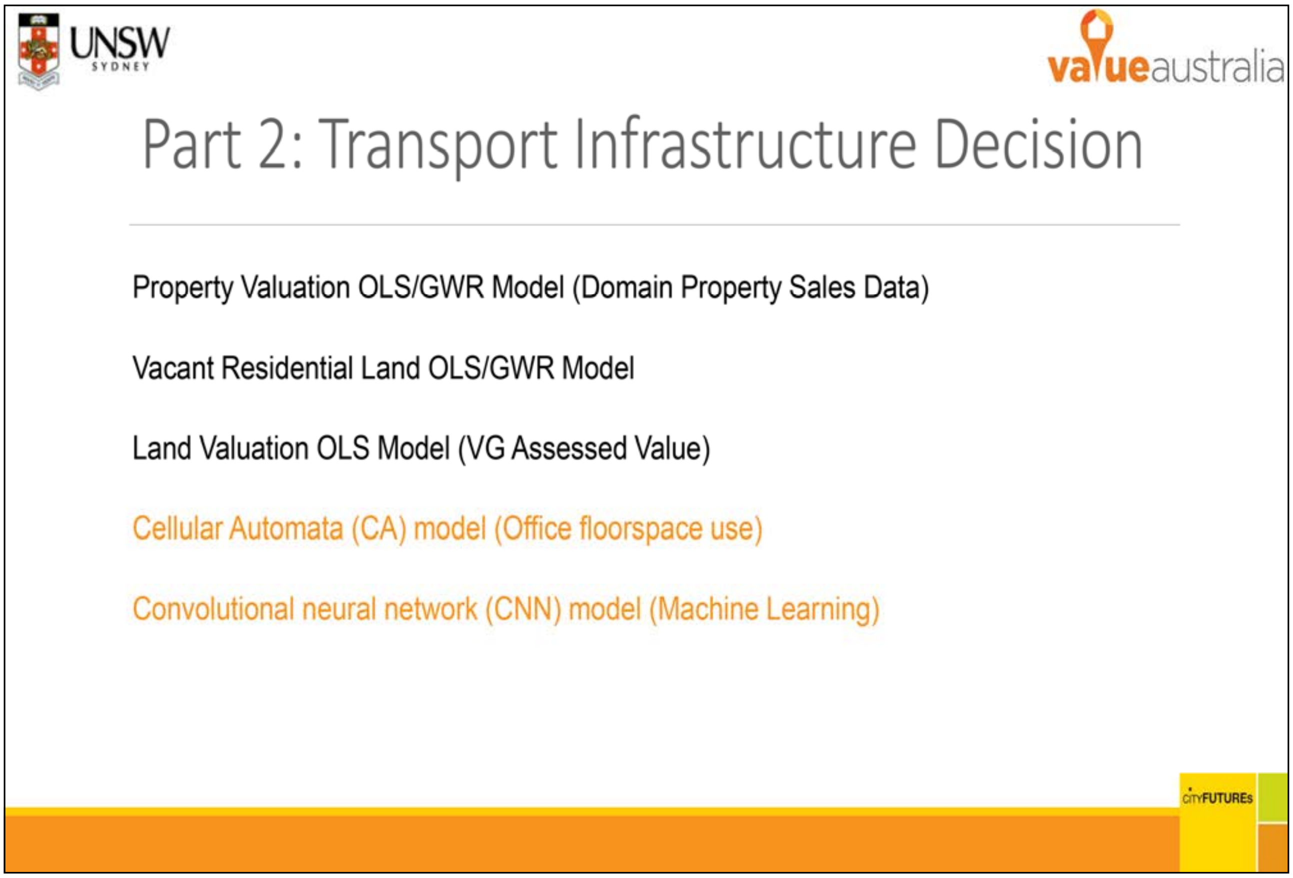

valueaustralia
STRUCTURE
PART 1
AI for City Planning
PART 2
Transport Infrastructure decision
PART 3
Building Infrastructure decision
PART 4
Land use decision


UNSW SYDNEY
valueaustralia
How to use AI for scenario planning
Sharpening our land and property decisions with artificial Intelligence
Value Australia will create scalable, efficient, secure and accurate tools that can respond to a variety of land and property types and uses across Australia, with export market potential.
The automated valuations will tackle industry identified shortcomings including:
•sub-optimal and inconsistent urban and regional planning,
•forgone tax revenues,
•disputed valuations,
•inconsistent lending and insurance risk decisions (as highlighted in the Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry), and
•the inability to easily capture land value uplift to fund infrastructure.
UNSW SYDNEY
NSW GOVERNMENT
Property NSW
crc•si
OMNILINK
LINKING PEOPLE AND INFORMATION
LIVERPOOL CITY COUNCIL
CITYFUTURES


UNSW SYDNEY
AI for Scenario Planning
Is a digital toolkit comprising a set of
frameworks and methods to support
collaborative city planning and user centred
design.
CITY FUTURES


Our approach..
Valuers
Comparison Sales Price
Hedonic Price
Residual Land Price
Market/Environmental Risk (e.g. site auditing)
Automated Valuations
Hedonic Price Model
Machine Learning (with Big Data)
CA Model
Next Generation Valuation Model
Hybrid Model (Valuers + AVM)
Online interactive scenario explorer 'toolkit'
Incorporate rich and diverse data (incl. Big Data – temperature, topology, irrigation, energy use)
Collaborative decision-making approach
Automated valuation modelling for land and property values
Capture land value uplift on properties in areas with new infrastructure


valueaustralia
Sharpening our land and property decisions with Artificial Intelligence
Sydney
Property NSW
LIVERPOOL CITY COUNCIL
FRONTIER SI
UNSW
CommonwealthBank
OMNILINK
LINKING PEOPLE AND INFORMATION


UNSW SYDNEY
valueaustralia
Part 2: Transport Infrastructure Decision
Property Valuation OLS/GWR Model (Domain Property Sales Data)
Vacant Residential Land OLS/GWR Model
Land Valuation OLS Model (VG Assessed Value)
Cellular Automata (CA) model (Office floorspace use)
Convolutional neural network (CNN) model (Machine Learning)
CITYFUTURES

RAISE Interface Screenshots

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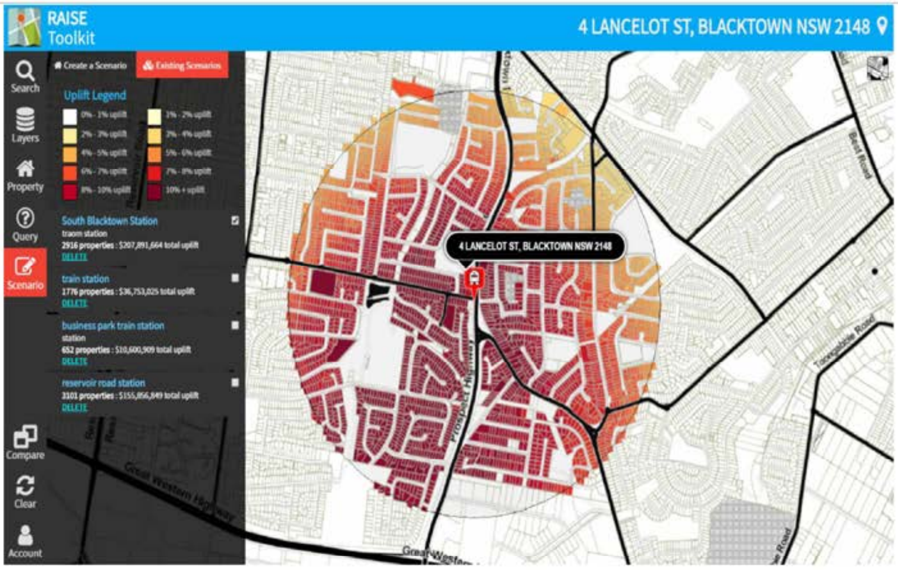
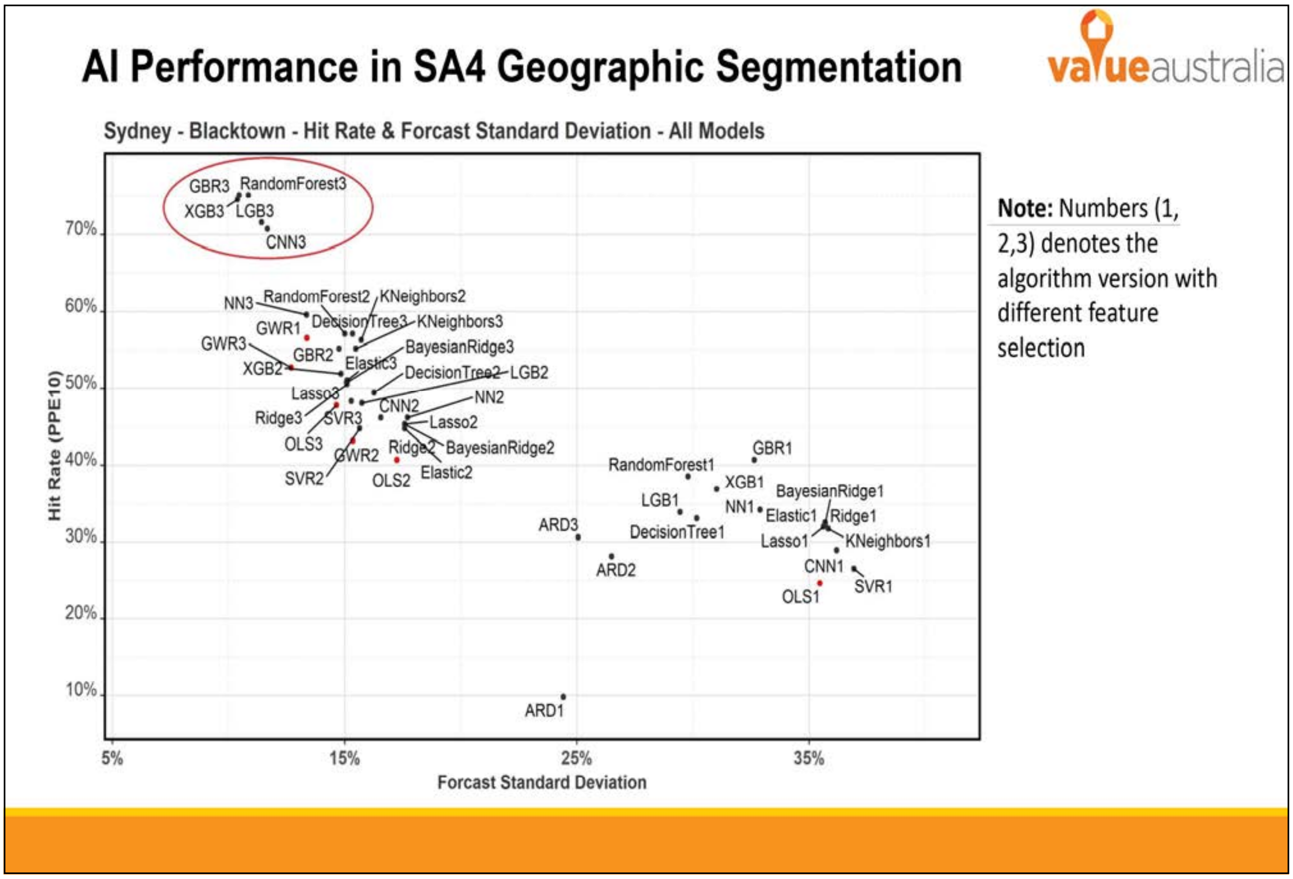
Visualising value uplift with hypothetical train station

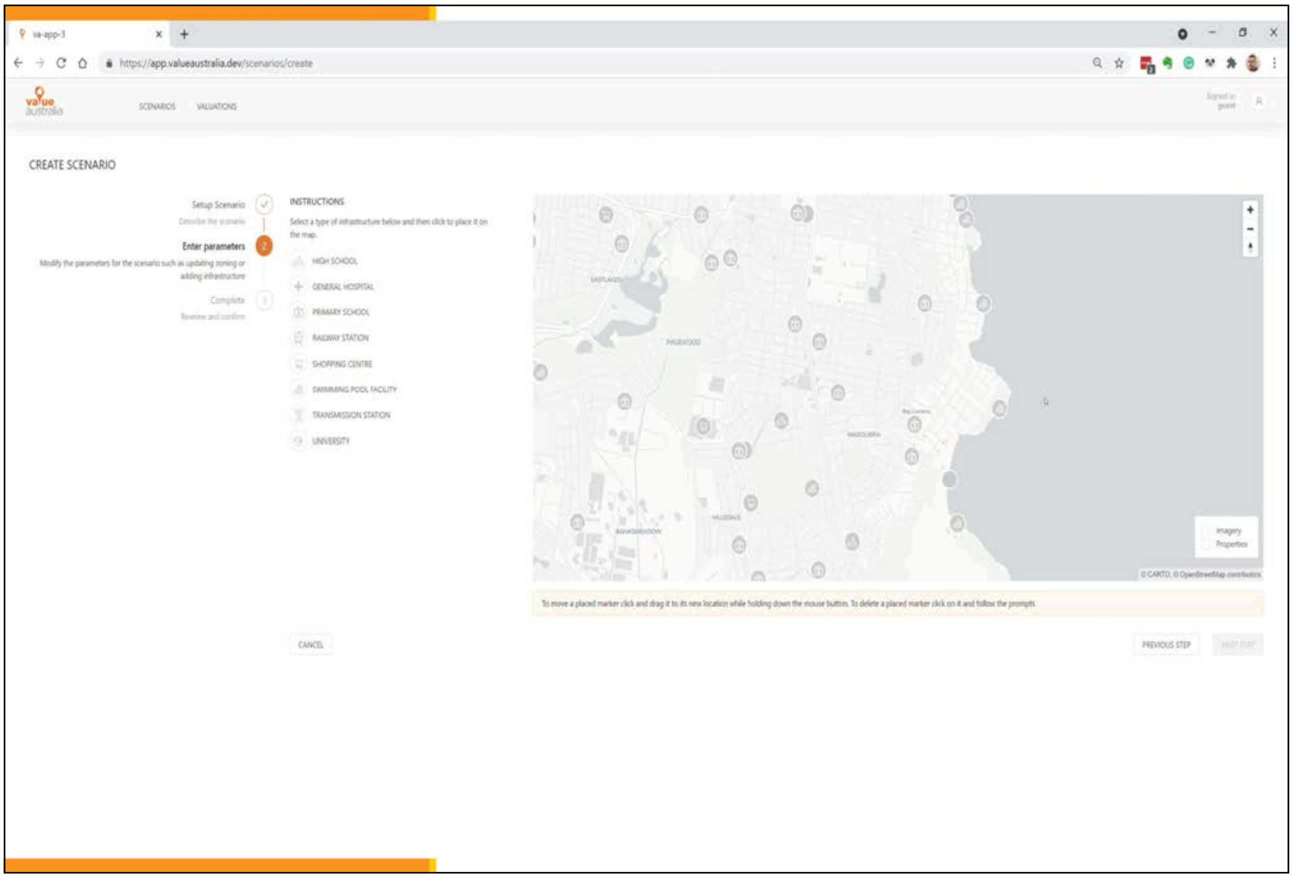


RAISE Interface Screenshots

valueaustralia

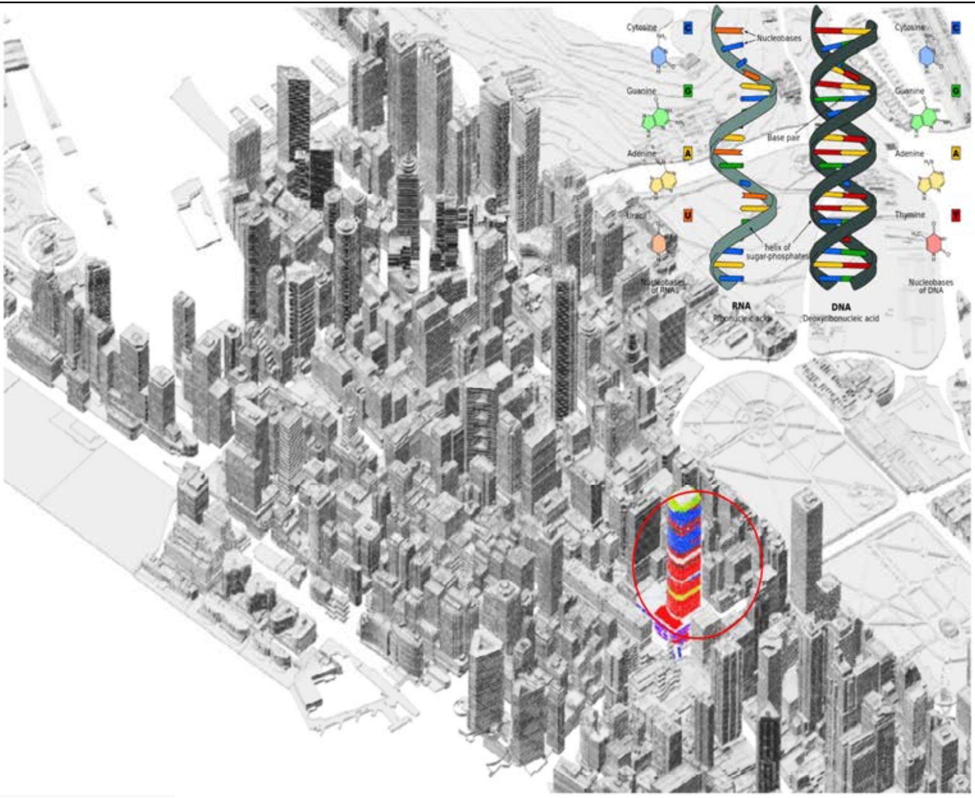
Visualising value uplift with multiple scenarios


AI Performance in SA4 Geographic Segmentation
valueaustralia
Sydney - Blacktown - Hit Rate & Forcast Standard Deviation - All Models
Hit Rate (PPE10)
70%
60%
50%
40%
30%
20%
10%
5%
15%
25%
35%
Forcast Standard Deviation
GBR3
RandomForest3
XGB3
LGB3
CNN3
NN3
RandomForest2
KNeighbors2
GWR1
DecisionTree3
KNeighbors3
GWR3
GBR2
BayesianRidge3
XGB2
Elastic3
DecisionTree2
LGB2
Lasso3
NN2
CNN2
Ridge3
SVR3
Lasso2
OLS3
GWR2
Ridge2
BayesianRidge2
SVR2
OLS2
Elastic2
RandomForest1
GBR1
XGB1
LGB1
BayesianRidge1
NN1
Elastic1
Ridge1
ARD3
DecisionTree1
Lasso1
KNeighbors1
ARD2
CNN1
SVR1
OLS1
ARD1
Note: Numbers (1, 2,3) denotes the algorithm version with different feature selection


CREATE SCENARIO
INSTRUCTIONS


valueaustralia
Part 3: Building Infrastructure Decision
Increasing office vacancies due to COVID
Increasing co-working places (e.g. hot-desk)
Decreasing retail sector
Increasing work-at-home
Vertical office space use (e.g. 3D); seamlessly changing over time
Push-and-pull patterns (e.g. coaching school, law firm, motel)


valueaustralia
Office vacancies amid COVID



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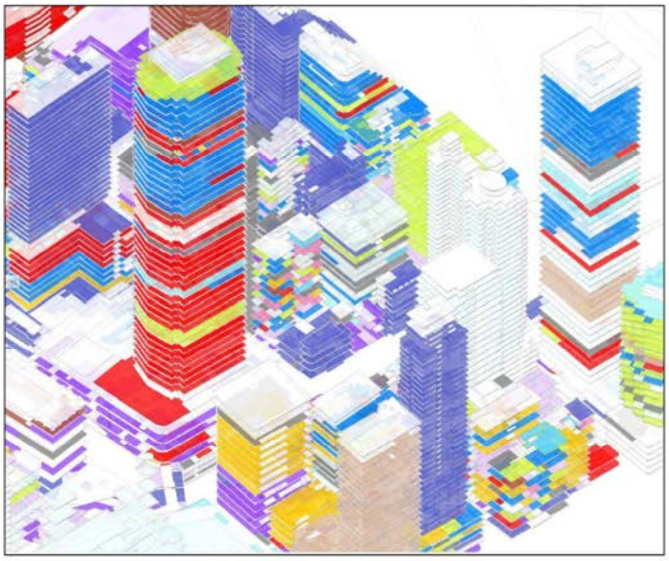
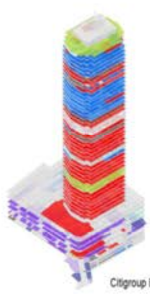
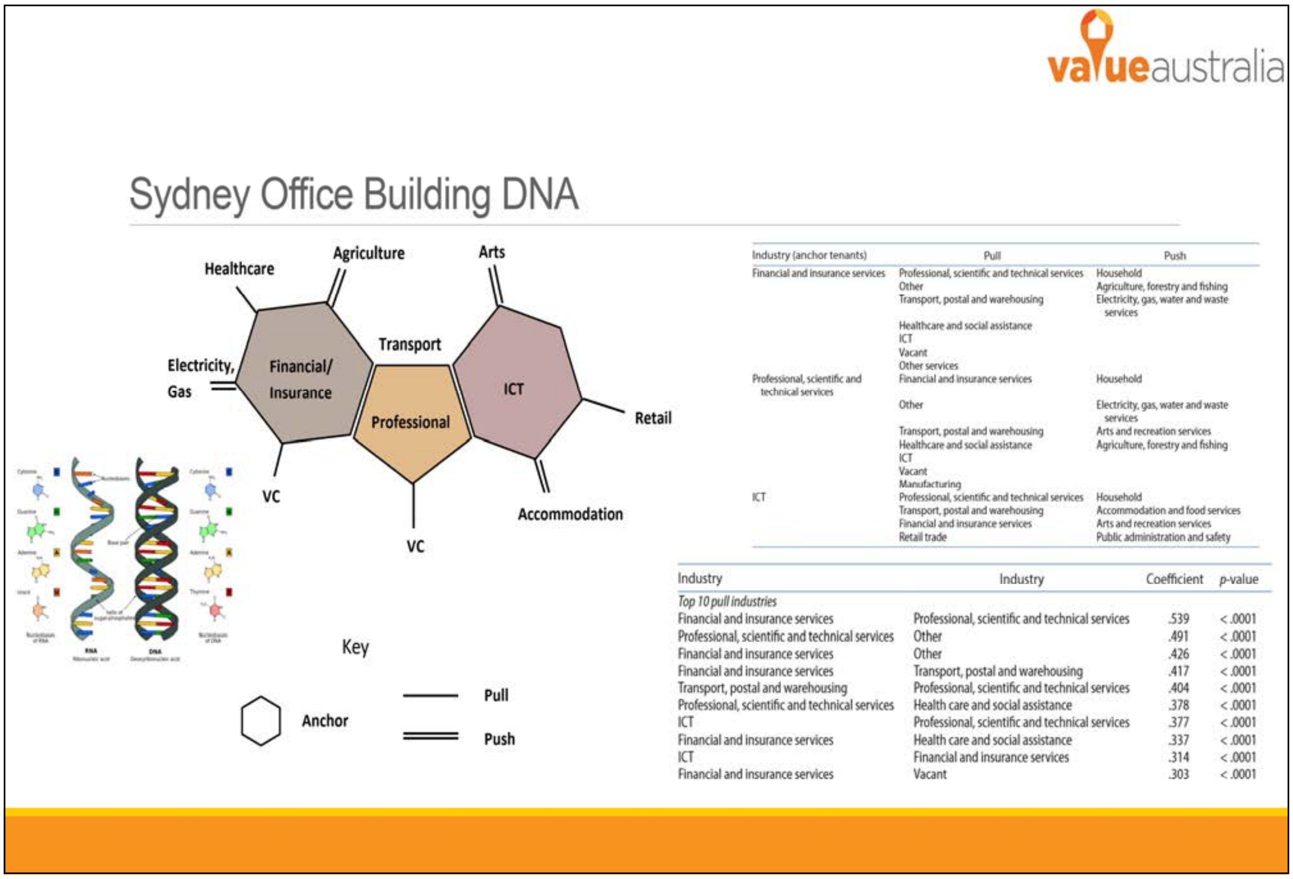
Building DNA: Vertical and Horizontal Relationship



INDUSTRY	FLOOR AREA
Education and Training	44.56579627
Mining	114.3490453
Health Care and Social Assistance	154.033653
Information Media and Telecommunications	607.174655
Arts and Recreation Services	1573.285089
Transport, Postal and Warehousing	2016.476191
Other Services	3006.767137
Accommodation and Food Services	3404.66875
Rental, Hiring and Real Estate Services	3405.278037
Vacant	3609.612517
Administrative and Support Services	5016.037234
Retail Trade	10318.15355
Professional, Scientific and Technical Services	21540.79414
Financial and Insurance Services	39641.41833
Other	74551.49831
Grand Total	169004.1923

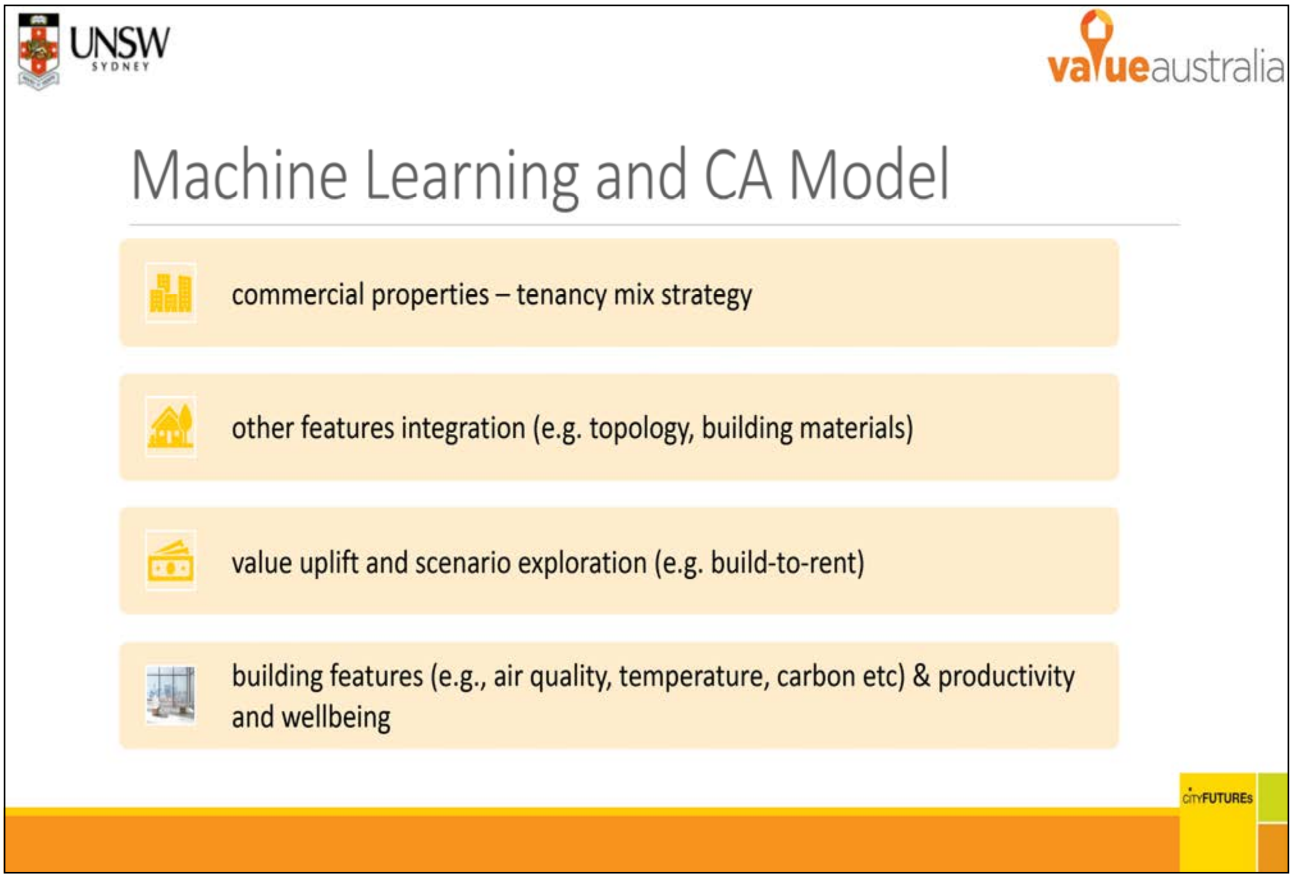


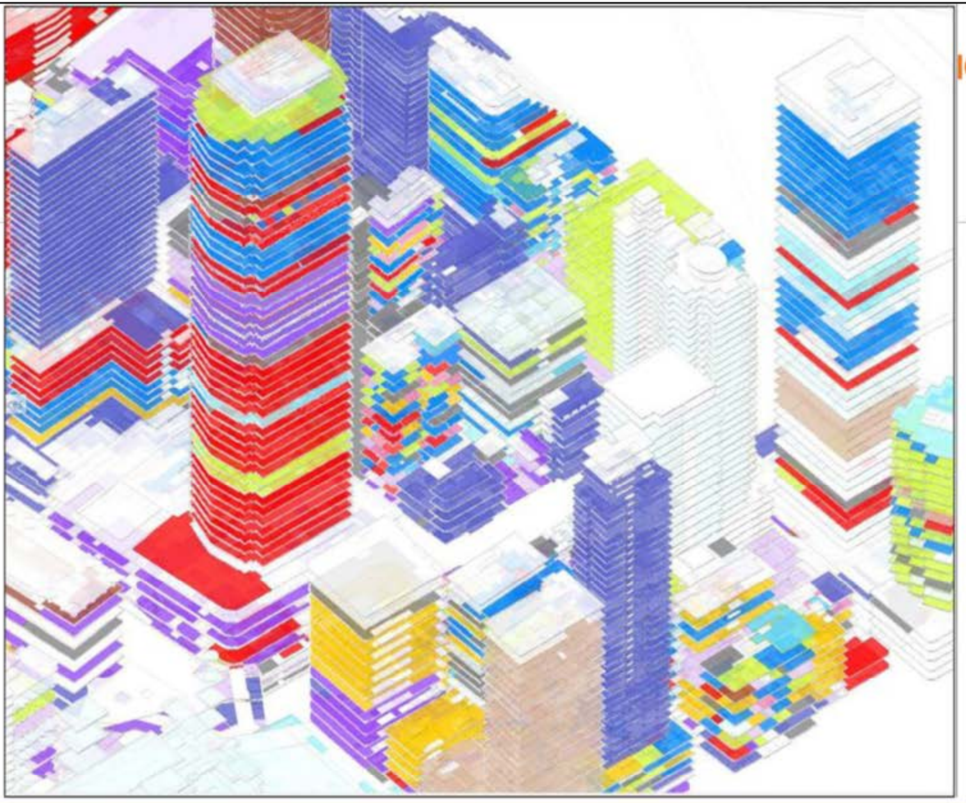
Citigroup Building



Industry (anchor tenants)	Pull	Push
Financial and insurance services	Professional, scientific and technical services Other Transport, postal and warehousing Healthcare and social assistance ICT Vacant Other services	Household Agriculture, forestry and fishing Electricity, gas, water and waste services
Professional, scientific and technical services	Financial and insurance services Other Transport, postal and warehousing Healthcare and social assistance ICT Vacant Manufacturing	Household Electricity, gas, water and waste services Arts and recreation services Agriculture, forestry and fishing
ICT	Professional, scientific and technical services Transport, postal and warehousing Financial and insurance services Retail trade	Household Accommodation and food services Arts and recreation services Public administration and safety

Industry	Industry	Coefficient	*p*-value
Top 10 pull industries			
Financial and insurance services	Professional, scientific and technical services	.539	< .0001
Professional, scientific and technical services	Other	.491	< .0001
Financial and insurance services	Other	.426	< .0001
Financial and insurance services	Transport, postal and warehousing	.417	< .0001
Transport, postal and warehousing	Professional, scientific and technical services	.404	< .0001
Professional, scientific and technical services	Health care and social assistance	.378	< .0001
ICT	Professional, scientific and technical services	.377	< .0001
Financial and insurance services	Health care and social assistance	.337	< .0001
ICT	Financial and insurance services	.314	< .0001
Financial and insurance services	Vacant	.303	< .0001

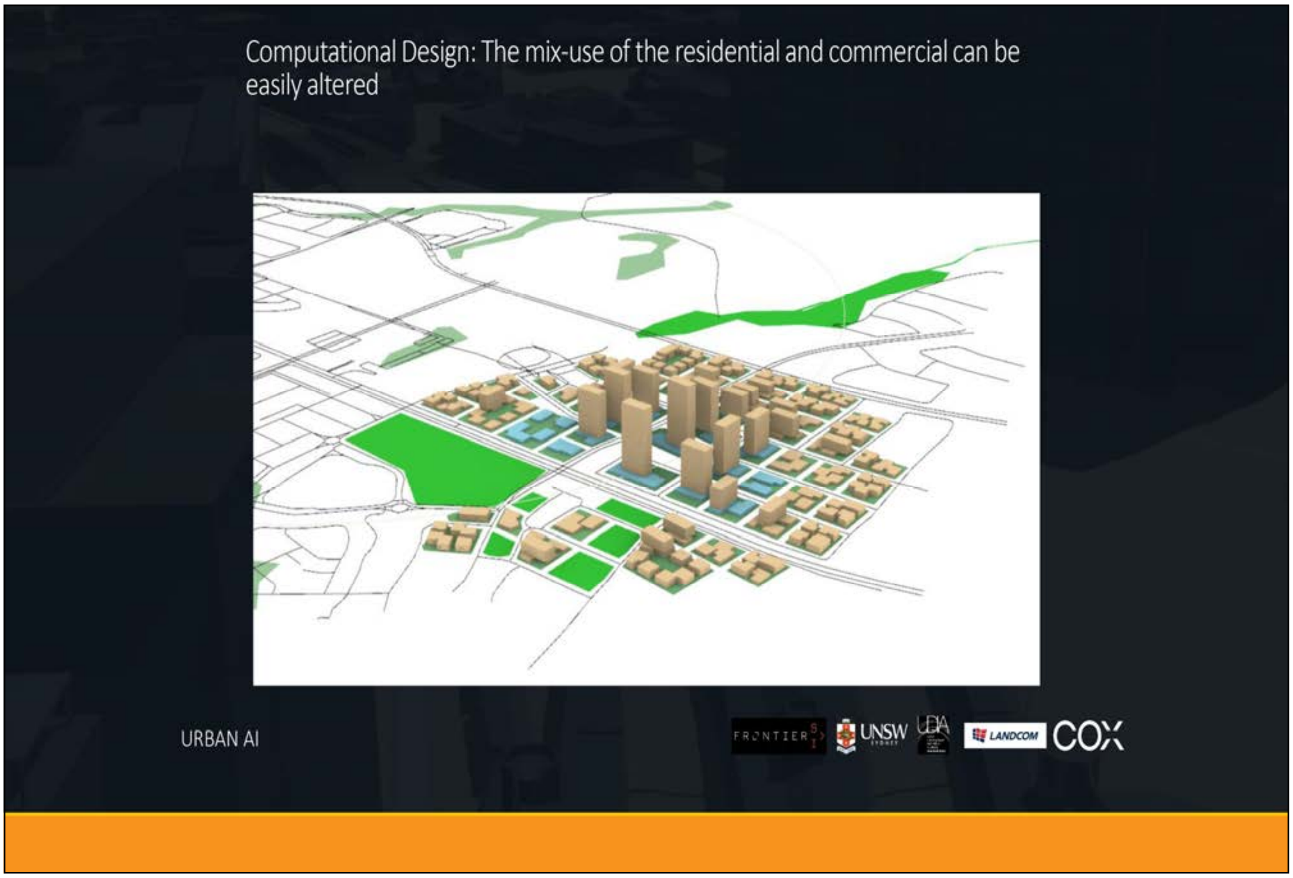




Part 4: Land Use Decision (computational urban design)

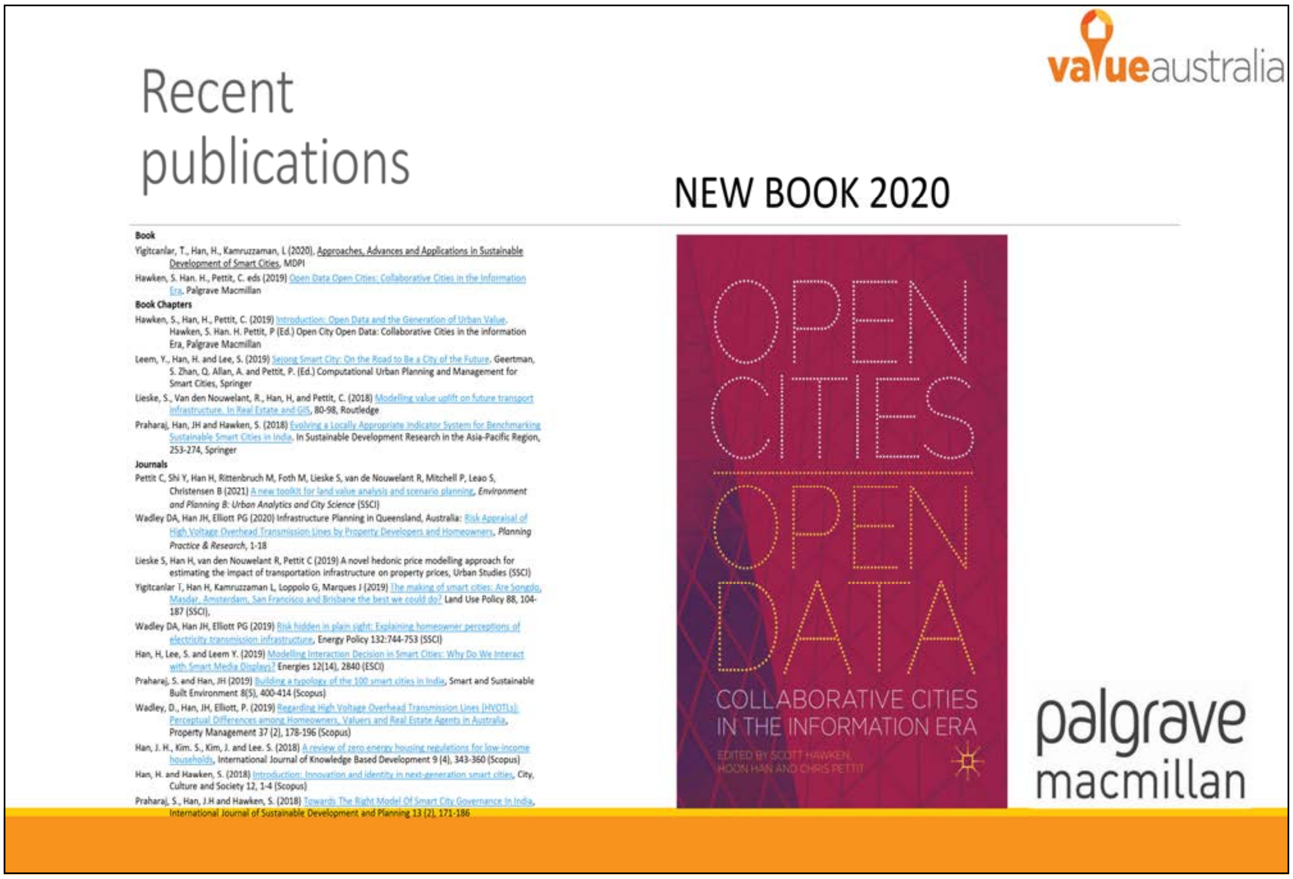
- Highest Best Use (Floorspace Ratio and Building Height)
- Minimising Traffic Congestion
- Maximising Rental Yield
- Balancing Land Use Mix (Residential + Retail + Office)


Computational Design: The land use responds to highest and best use
URBAN AI
FRONTIER
UNSW
LANDCOM
COX


Computational Design: The mix-use of the residential and commercial can be easily altered
URBAN AI
FRONTIER
UNSW
LANDCOM
COX


UNSW SYDNEY
valueaustralia
Collaborative Approach
Collaboration means the parties are working together to develop products and services that will deliver benefits for all parties involved in the collaborative effort
Partners to share investments and risks, as well as the benefits and outcomes
Maximising the overall benefits to the collaborators as a whole, rather than just maximising individual interests.
CITYFUTURES


UNSW SYDNEY
City Futures Research Centre – Partners
AHURI
Australian Government Australian Research Council
LANNOCK
ocn
NSW Data Analytics Centre
Sydney WATER
Community Housing Industry Association
NSW Property NSW
DEAKIN UNIVERSITY
FRONTIER SI
CANTERBURY BANKSTOWN
ACSL
RMIT UNIVERSITY
Urban Growth NSW
CommonwealthBank
STRATA COMMUNITY INSURANCE
The Sydney Morning Herald
Shelter
Griffith UNIVERSITY
LIVERPOOL CITY COUNCIL
PIA Planning Institute Australia
NSW Office of the Chief Scientist & Engineer
The University Of Queensland
OMNILINK
NSW Land & Housing Corporation
strata community association
PLuS ALLIANCE
Curtin University
UNIVERSITY OF WOLLONGONG AUSTRALIA
LANDCOM
AURIN
SSROC
SWIN BUR NE
Heart Foundation
LOW CARBON LIVING CRC
THE UNIVERSITY OF SYDNEY
Tenants Queensland Inc
Australian Government Department of Industry, Innovation and Science
Australian Bureau of Statistics
EY
Australian Government Department of Climate Change and Energy Efficiency
Australian Government Australian Institute of Health and Welfare
SGCH
WESTERN SYDNEY UNIVERSITY
NSW Greater Sydney Commission


valueaustralia
Recent publications
NEW BOOK 2020
Book
Yigitcanlar, T., Han, H., Kamruzzaman, L (2020). Approaches, Advances and Applications in Sustainable Development of Smart Cities, MDPI
Hawken, S. Han. H., Pettit, C. eds (2019) Open Data Open Cities: Collaborative Cities in the Information Era, Palgrave Macmillan
Book Chapters
Hawken, S., Han, H., Pettit, C. (2019) Introduction: Open Data and the Generation of Urban Value, Hawken, S. Han. H. Pettit, P (Ed.) Open City Open Data: Collaborative Cities in the information Era, Palgrave Macmillan
Leem, Y., Han, H. and Lee, S. (2019) Sejong Smart City: On the Road to Be a City of the Future, Geertman, S. Zhan, Q. Allan, A. and Pettit, P. (Ed.) Computational Urban Planning and Management for Smart Cities, Springer
Lieske, S., Van den Nouwelant, R., Han, H, and Pettit, C. (2018) Modeling value uplift on future transport infrastructure. In Real Estate and GIS, 80-98, Routledge
Praharaj, Han, JH and Hawken, S. (2018) Evolving a Locally Appropriate Indicator System for Benchmarking Sustainable Smart Cities in India. In Sustainable Development Research in the Asia-Pacific Region, 253-274, Springer
Journals
Pettit C, Shi Y, Han H, Rittenbruch M, Foth M, Lieske S, van de Nouwelant R, Mitchell P, Leao S, Christensen B (2021) A new toolkit for land value analysis and scenario planning, Environment and Planning B: Urban Analytics and City Science (SSCI)
Wadley DA, Han JH, Elliott PG (2020) Infrastructure Planning in Queensland, Australia: Risk Appraisal of High Voltage Overhead Transmission Lines by Property Developers and Homeowners, Planning Practice & Research, 1-18
Lieske S, Han H, van den Nouwelant R, Pettit C (2019) A novel hedonic price modelling approach for estimating the impact of transportation infrastructure on property prices, Urban Studies (SSCI)
Yigitcanlar T, Han H, Kamruzzaman L, Loppolo G, Marques J (2019) The making of smart cities: Are Songdo, Masdar, Amsterdam, San Francisco and Brisbane the best we could do? Land Use Policy 88, 104-187 (SSCI),
Wadley DA, Han JH, Elliott PG (2019) Risk hidden in plain sight: Explaining homeowner perceptions of electricity transmission infrastructure, Energy Policy 132:744-753 (SSCI)
Han, H, Lee, S. and Leem Y. (2019) Modelling Interaction Decision in Smart Cities: Why Do We Interact with Smart Media Displays? Energies 12(14), 2840 (ESCI)
Praharaj, S. and Han, JH (2019) Building a typology of the 100 smart cities in India, Smart and Sustainable Built Environment 8(5), 400-414 (Scopus)
Wadley, D., Han, JH, Elliott, P. (2019) Regarding High Voltage Overhead Transmission Lines (HVOTLs): Perceptual Differences among Homeowners, Valuers and Real Estate Agents in Australia, Property Management 37 (2), 178-196 (Scopus)
Han, J. H., Kim. S., Kim, J. and Lee. S. (2018) A review of zero energy housing regulations for low-income households, International Journal of Knowledge Based Development 9 (4), 343-360 (Scopus)
Han, H. and Hawken, S. (2018) Introduction: Innovation and identity in next-generation smart cities, City, Culture and Society 12, 1-4 (Scopus)
Praharaj, S., Han, J.H and Hawken, S. (2018) Towards The Right Model Of Smart City Governance In India, International Journal of Sustainable Development and Planning 13 (2), 171-186
OPEN CITIES OPEN DATA
COLLABORATIVE CITIES IN THE INFORMATION ERA
palgrave macmillan

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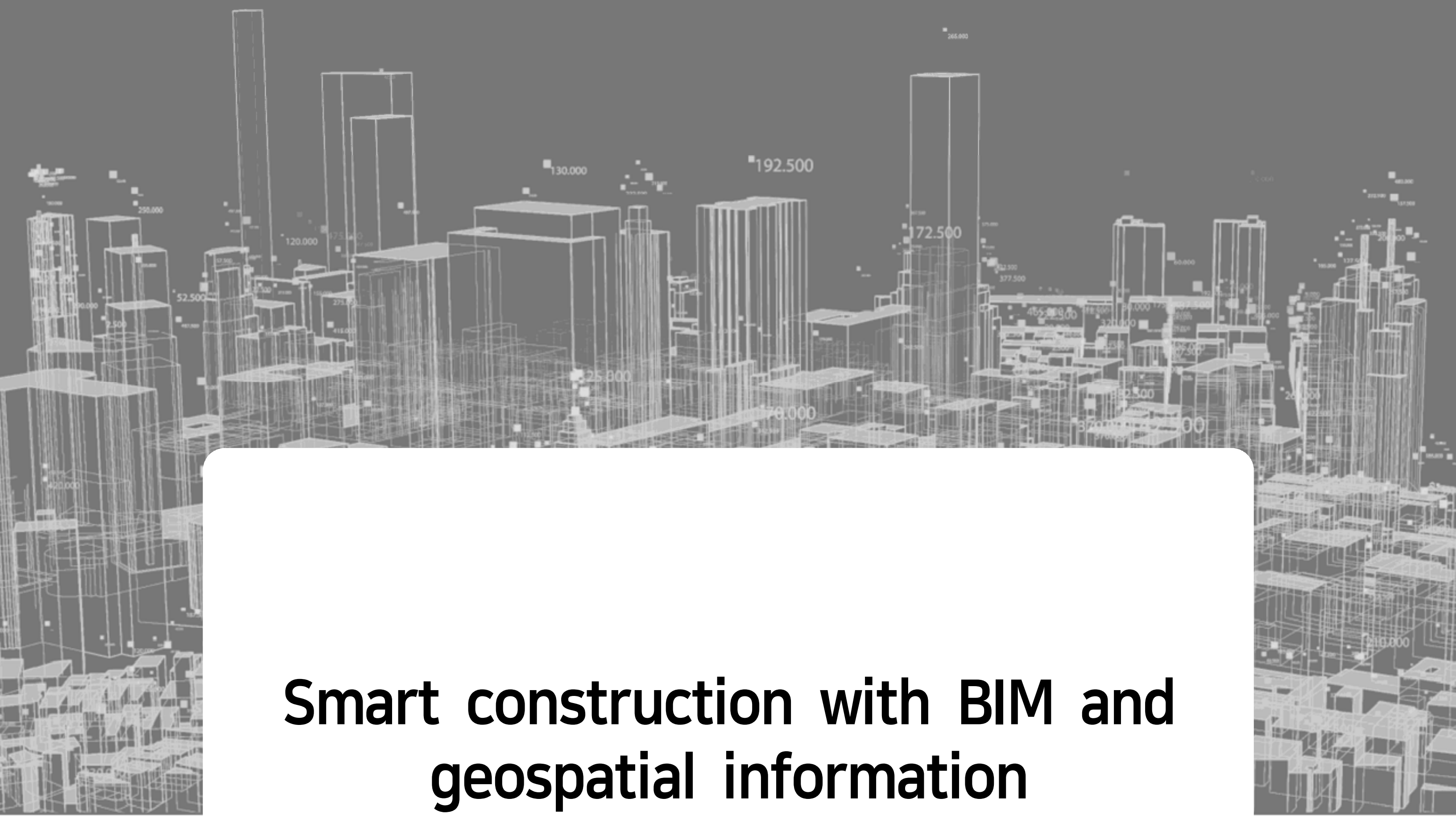

Smart construction with BIM and geospatial information

[BIM과 공간정보를 이용한 스마트 건설]

Troy Rigby Trimble Asia-Pacific


Trimble
Presented By:
Troy Rigby
Asia Pacific Director of Sales
Smart Construction with BIM and Geospatial Information
The Impact Of Digitalization On The Civil Construction Industry
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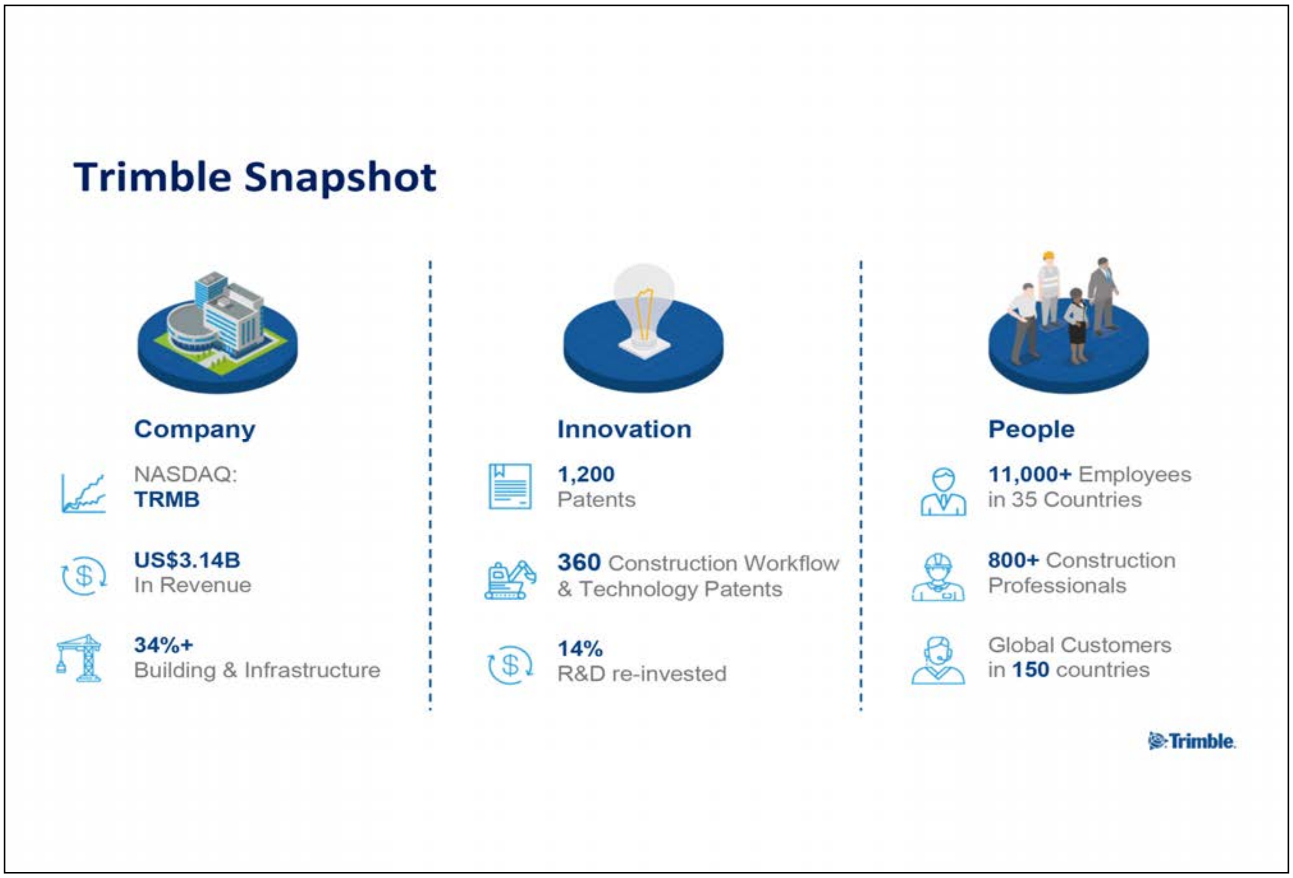

Trimble Snapshot
Company
NASDAQ: TRMB
US$3.14B In Revenue
34%+ Building & Infrastructure
Innovation
1,200 Patents
360 Construction Workflow & Technology Patents
14% R&D re-invested
People
11,000+ Employees in 35 Countries
800+ Construction Professionals
Global Customers in 150 countries
Trimble


Core Business Franchises
Our core industries are global trillion $ industries which operate in demanding environments, with technology adoption in the early phases
Agriculture
Buildings
Civil Engineering and Construction
Geospatial
Transportation and Logistics
Trimble.

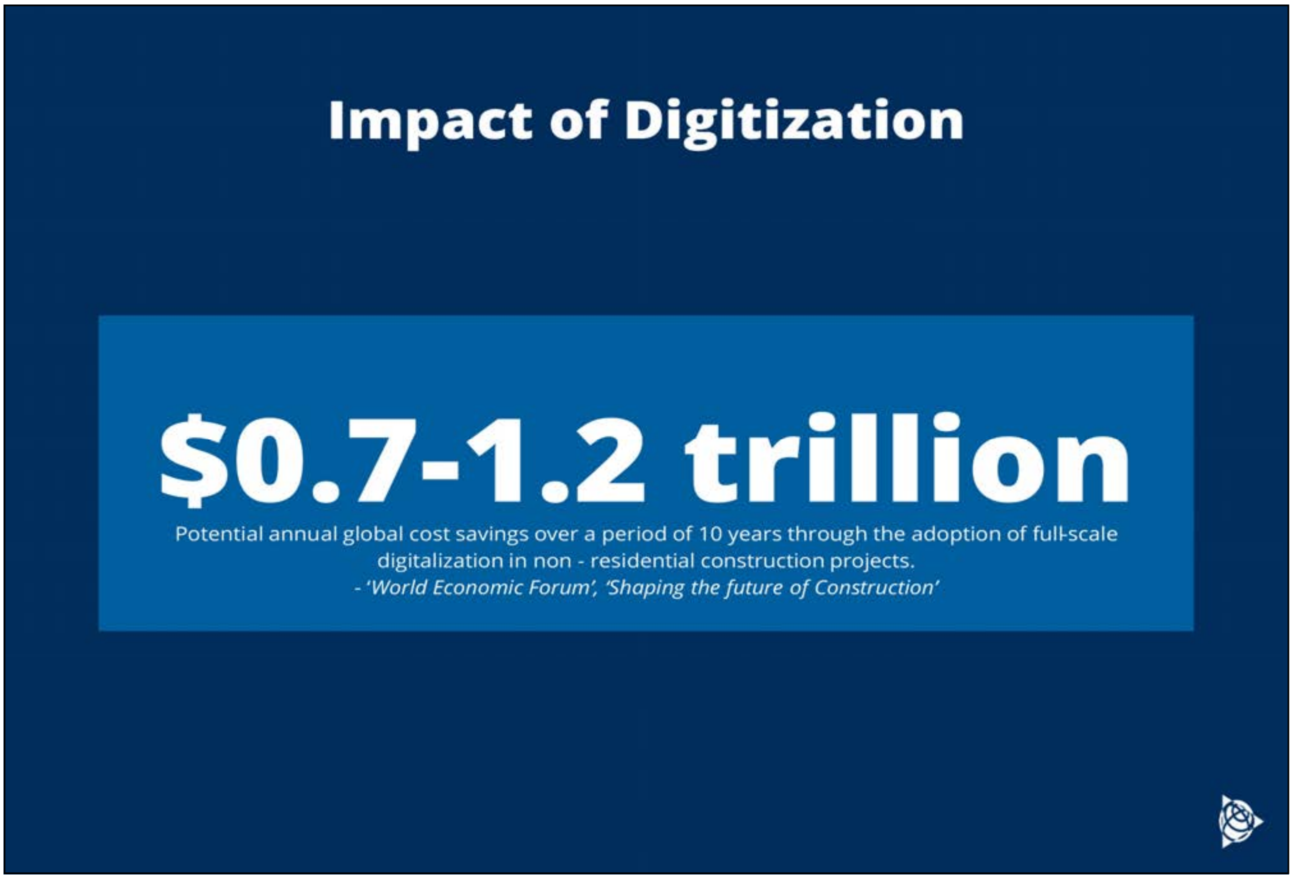

Construction is a factory
Making customised products


Construction Industry Challenges
Unique & Complex
Unstable Workforce
"In Canada, about 25% of workers whose construction jobs are terminated find their next job in sectors outside construction."
Smart Construction with BIM and geospatial information
" Global listed E&C companies have a weighted average total shareholder return of only 5% and are consistently outperformed by most S&P 500 companies."
Over-preference for Lowest Bid
"The launch of a 17km (11 mile) highway segment in Germany was delayed by six months, as one bidder raised objections to the tendering process – the lowest bid had not been chosen."
Source: World Economic Forum; The Boston Consulting Group


Construction Industry Challenges
Unique & Complex
Stakeholders with diverse goals
"Three different project owners are involved in the construction of the Berlin airport. Delays of 10 years and cost overruns of about €5 billion are expected. "
Highly Fragmented Industry
"The United States has 710,000 E&C companies; only 2% of them have more than 100 workers and 80% have just 10 workers or fewer."
Conservative Clients
"A minor problem with an innovative rapid-hardening concrete during a night shift almost brought a public road project to a halt, as the project owner lost faith in the new material."
Source: World Economic Forum; The Boston Consulting Group


Construction Industry Challenges
Despite having huge demand and scope, the construction industry has always performed inadequately. It represents 13% of the global GDP but has experienced a productivity growth of only one percent per year for the last 20 years.
Research by McKinsey


Construction Industry Challenges
Productivity in the highway, street and bridge construction sector has actually reduced between 2007 and 2019.
Source: U.S. Bureau of Labour Statistics, Office of Productivity & Technology


Impact of Digitization
$0.7-1.2 trillion
Potential annual global cost savings over a period of 10 years through the adoption of full-scale digitalization in non - residential construction projects.
- 'World Economic Forum', 'Shaping the future of Construction'


From concept to design, to build and maintain. Digital technology gives customers true visibility and real-time control of their projects.
Between Stakeholders
Owner
Capital Program Management
General Contractor
Project Management And Controls
Self Perform Contractor
Production Schedule, Work Order Management and As-built QA
In the Office
REPORTING
PROCUREMENT
JOB COST
SCHEDULING
In the Field
TABLET
INSTRUMENT
EQUIPMENT
LABOR
MATERIAL
The Right Data to the Right Person at the Right Time

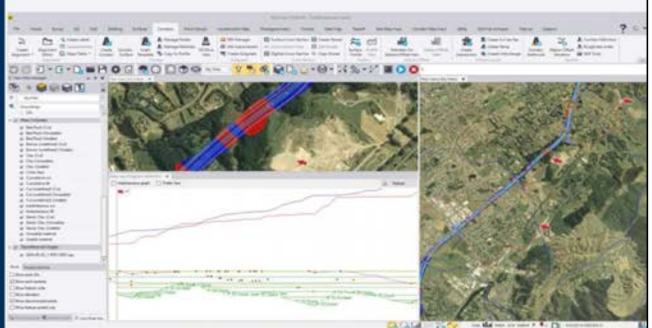

Impact of Digitalization
Continuous Operation, Rain Hail or Shine
GOODMANS


Impact of Digitalization
3D Visualization of Alignment Options

Impact of Digitalization

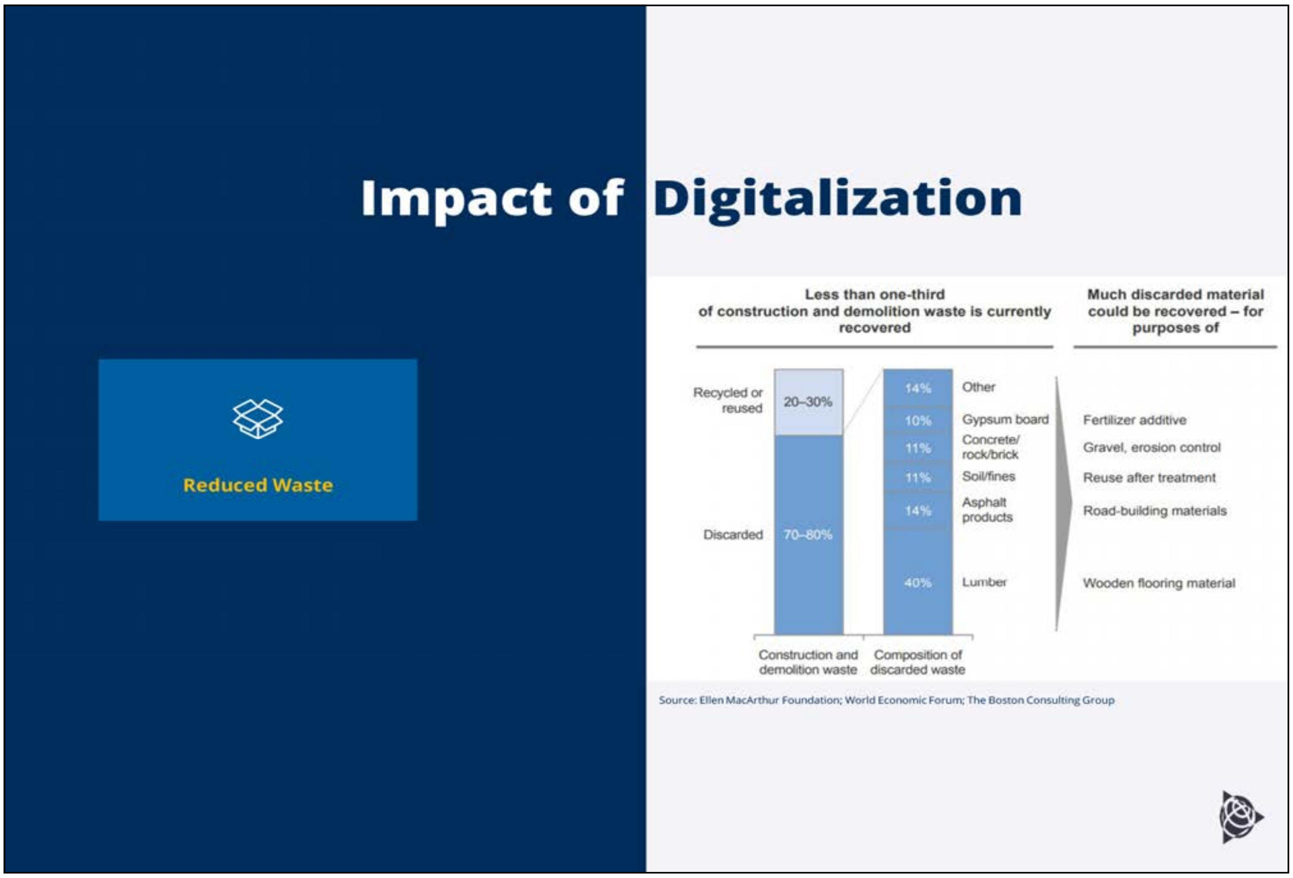
Continuous Operation, easily picking up from last operator.

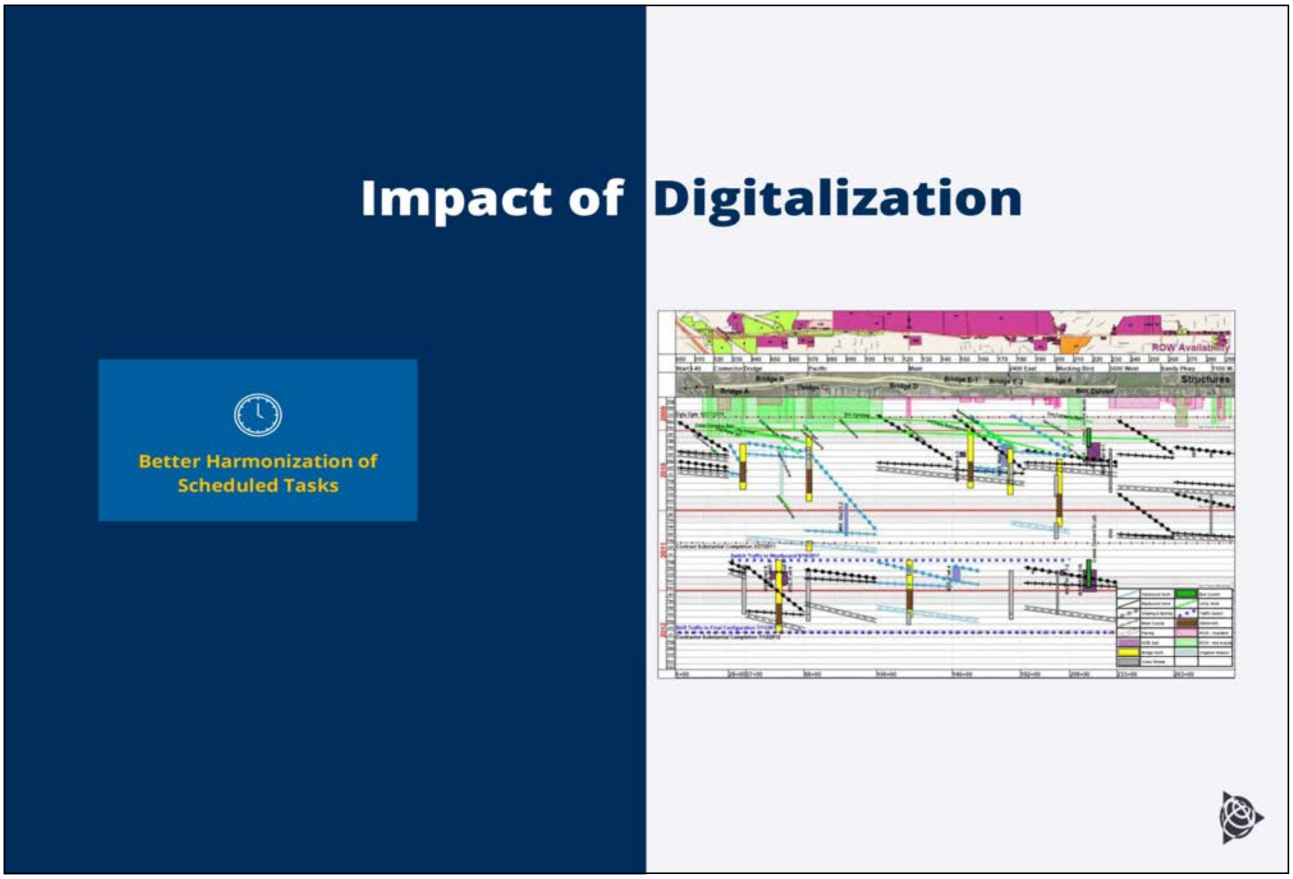
Impact of Digitalization



Estimate & Plan Earthworks With Confidence


Impact of Digitalization
Increased capabilities of workforce in shorter time.


Impact of Digitalization
Reduced Waste
Less than one-third of construction and demolition waste is currently recovered
Much discarded material could be recovered – for purposes of
Recycled or reused
20–30%
Discarded
70–80%
14%
Other
10%
Gypsum board
11%
Concrete/ rock/brick
11%
Soil/fines
14%
Asphalt products
40%
Lumber
Fertilizer additive
Gravel, erosion control
Reuse after treatment
Road-building materials
Wooden flooring material
Construction and demolition waste
Composition of discarded waste
Source: Ellen MacArthur Foundation; World Economic Forum; The Boston Consulting Group


Impact of Digitalization
Better Harmonization of Scheduled Tasks
ROW Availability
Structures

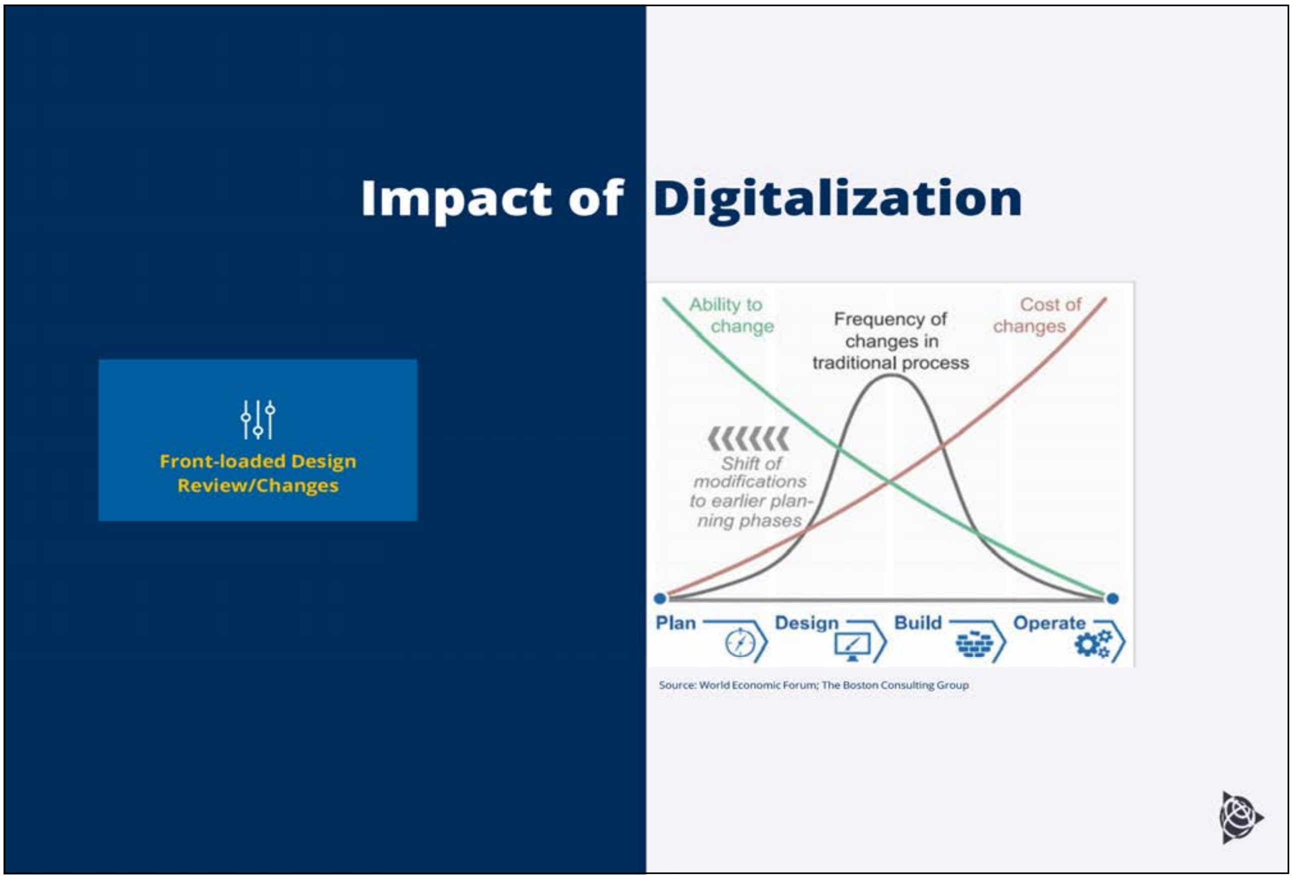

Impact of Digitalization
Improved Work Coordination and Collaboration
Trimble WorksOS
Quality Metrics


Impact of Digitalization
Track & Assign Tasks In Near Real-Time From The Office
Quadri

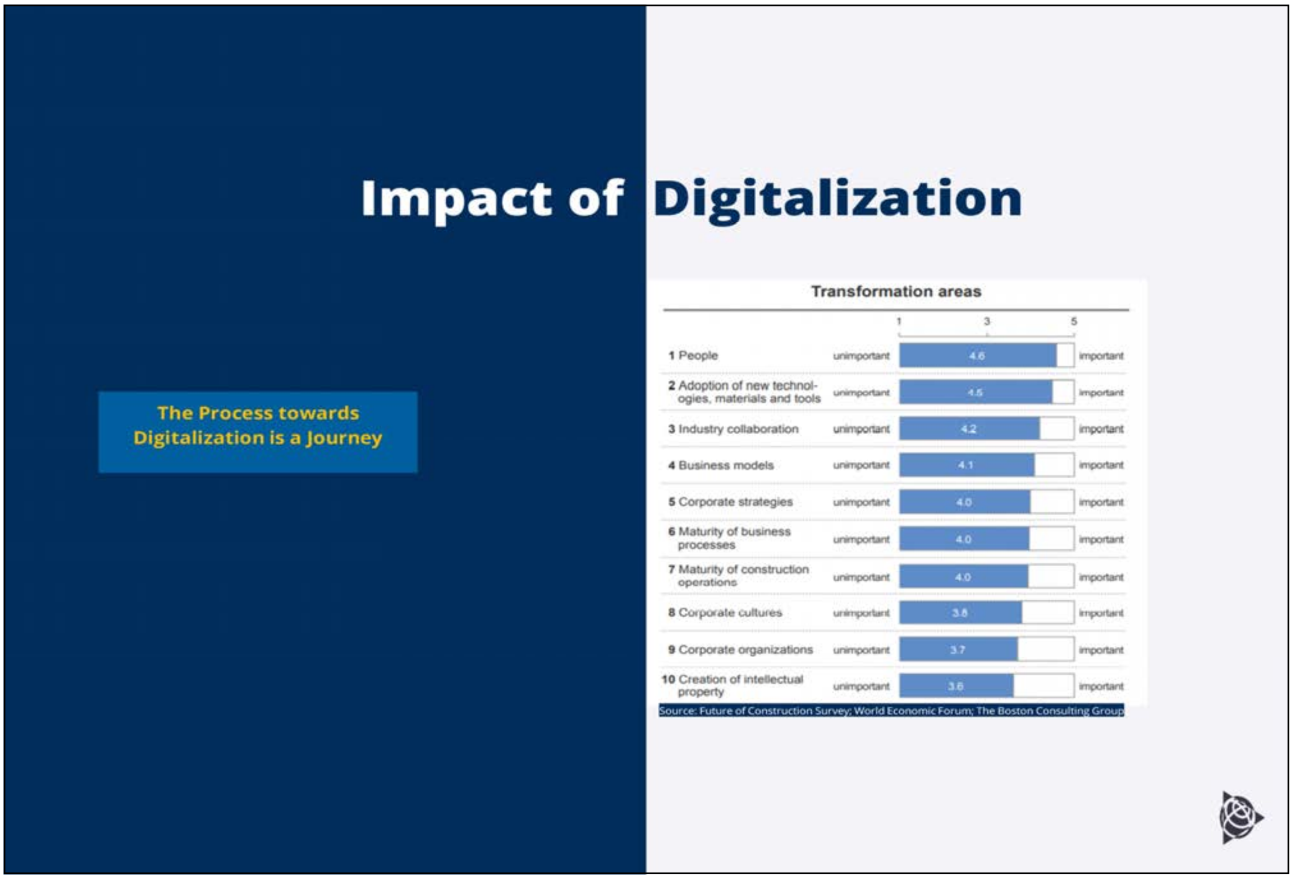

Impact of Digitalization
Better Site Review and Changes
Cross-section
Transparency


Impact of Digitalization
Alignment Cost At A Glance

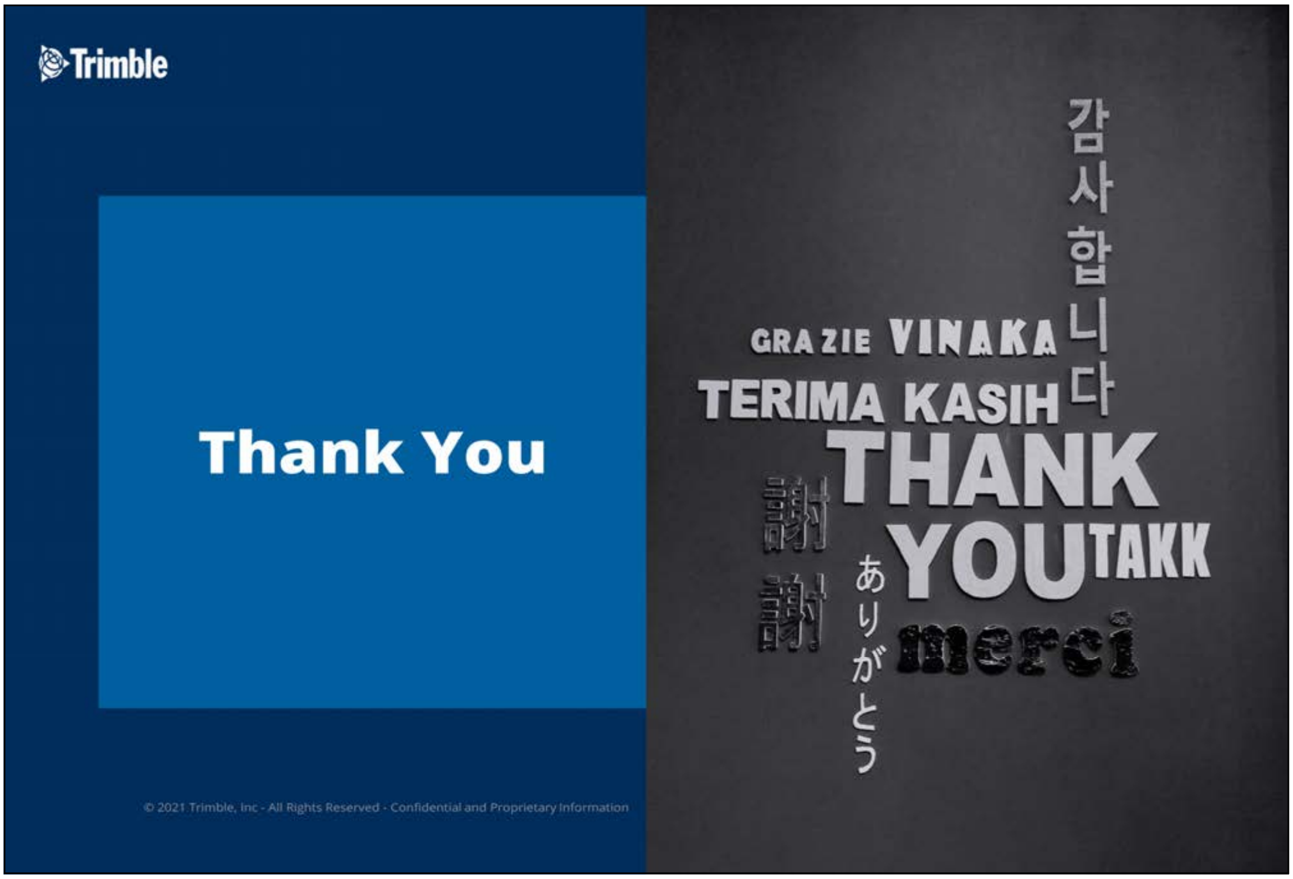

Impact of Digitalization
Just-in-Time pull of Resources


Impact of Digitalization
Front-loaded Design Review/Changes
Ability to change
Frequency of changes in traditional process
Cost of changes
Shift of modifications to earlier plan-ning phases
Plan
Design
Build
Operate
Source: World Economic Forum; The Boston Consulting Group


Impact of Digitalization
Better Alignment of Resources and Data.
Small Capital Funding Performance (Projects Below $5,000,000)
Funding Source
Budgeted
Committed
Balance


Impact of Digitalization
The Process towards
Digitalization is a Journey
Transformation areas
1
3
5
1 People
unimportant
4.6
important
2 Adoption of new technologies, materials and tools
unimportant
4.5
important
3 Industry collaboration
unimportant
4.2
important
4 Business models
unimportant
4.1
important
5 Corporate strategies
unimportant
4.0
important
6 Maturity of business processes
unimportant
4.0
important
7 Maturity of construction operations
unimportant
4.0
important
8 Corporate cultures
unimportant
3.8
important
9 Corporate organizations
unimportant
3.7
important
10 Creation of intellectual property
unimportant
3.6
important
Source: Future of Construction Survey; World Economic Forum; The Boston Consulting Group


Together we need to move the industry
From Traditional Construction
To Data Driven Construction, enabling Highly Automated
Processes
Geospatial
BIM
Project and timeline
Machines and equipment
Financial and supply
Machine Learning
Artificial Intelligence
Visualize, optimize, connect, inform and automate construction process
Constructing;
Better, Faster, Safer, Cheaper, Greener


Trimble
Thank You
© 2021 Trimble, Inc - All Rights Reserved - Confidential and Proprietary Information
감사합니다
GRAZIE VINAKA
TERIMA KASIH
THANK
YOU TAKK
謝謝
ありがとう
merci

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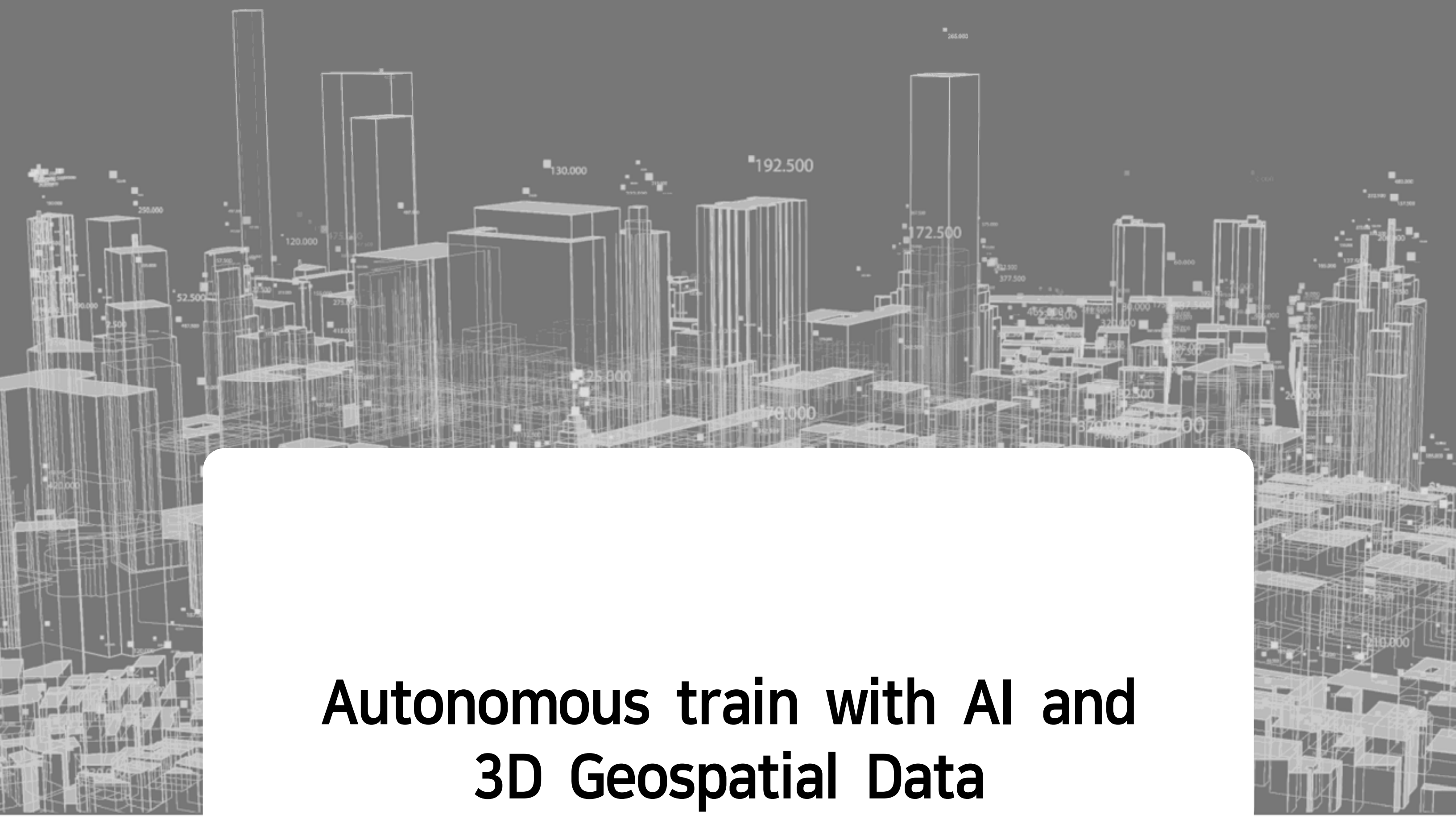


Autonomous train with AI and 3D Geospatial Data

[인공지능과 3차원 공간정보 기반 자율주행 기차]

Gunho Sohn York Univ.

2021 ICGIS (International Conference on GIS) – July 22nd, 2021, COEX Convention and Exhibition Centre, South Korea

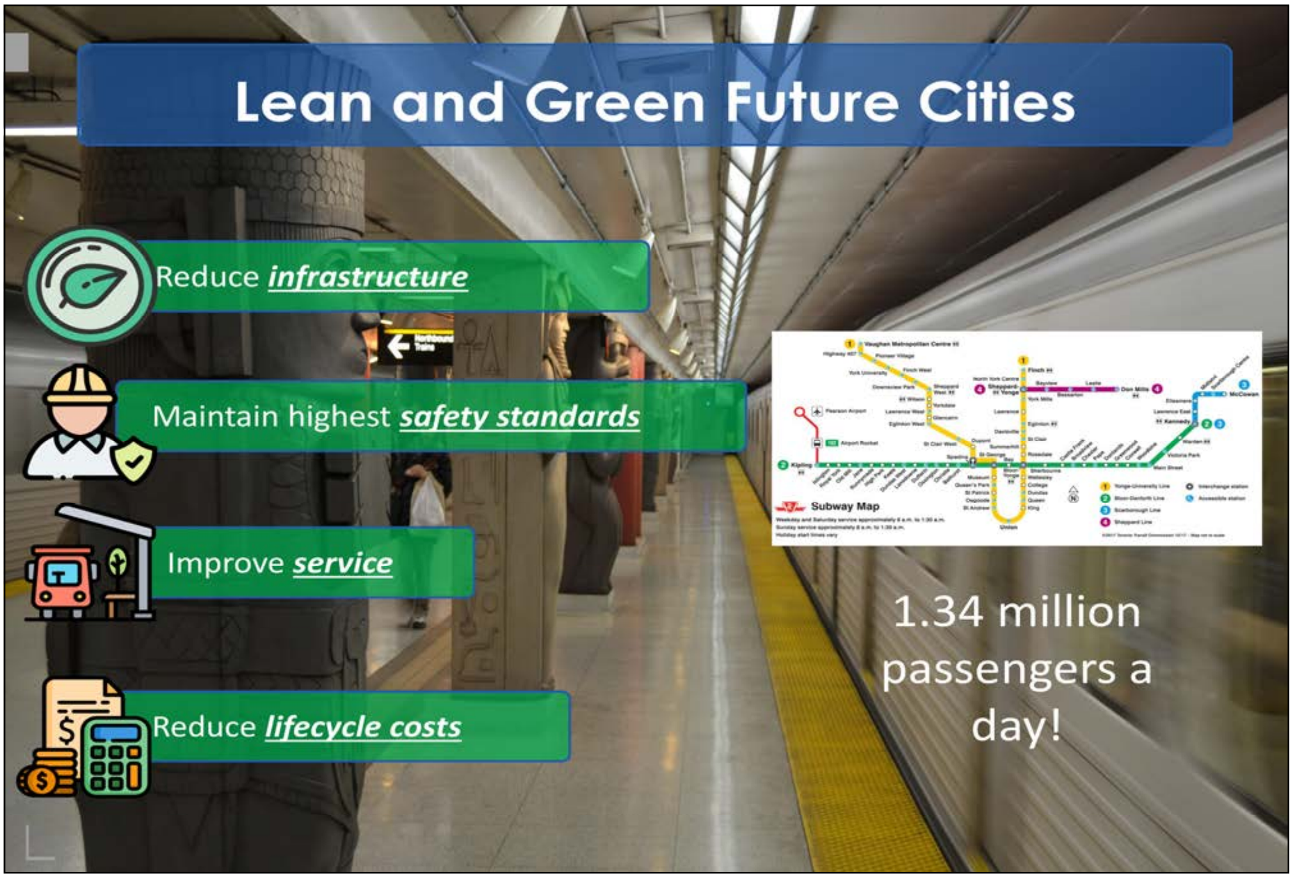
AUTONOMOUS TRAIN WITH AI AND 3D GEOSPATIAL DATA

Dr. Gunho Sohn (gsohn@yorku.ca)

Associate Professor
Department of Earth and Space Science and Engineering
Lassonde School of Engineering, York University

*Some slides of this presentation courtesy of Thales Canada (David Beach)

creative passionate rational confident ingenious



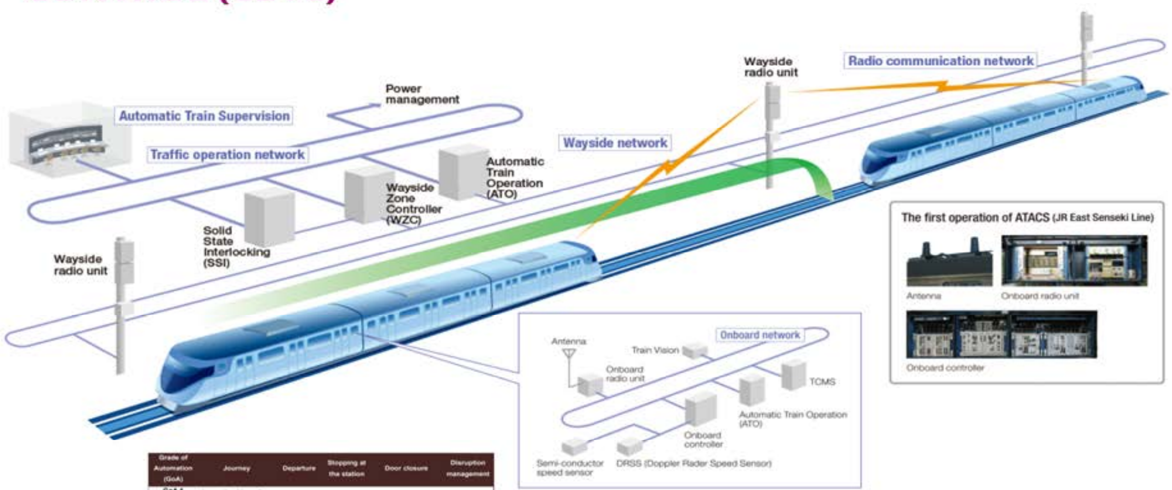
AUTONOMOUS TRAIN

The first AT in London


actual first AT, Thomas

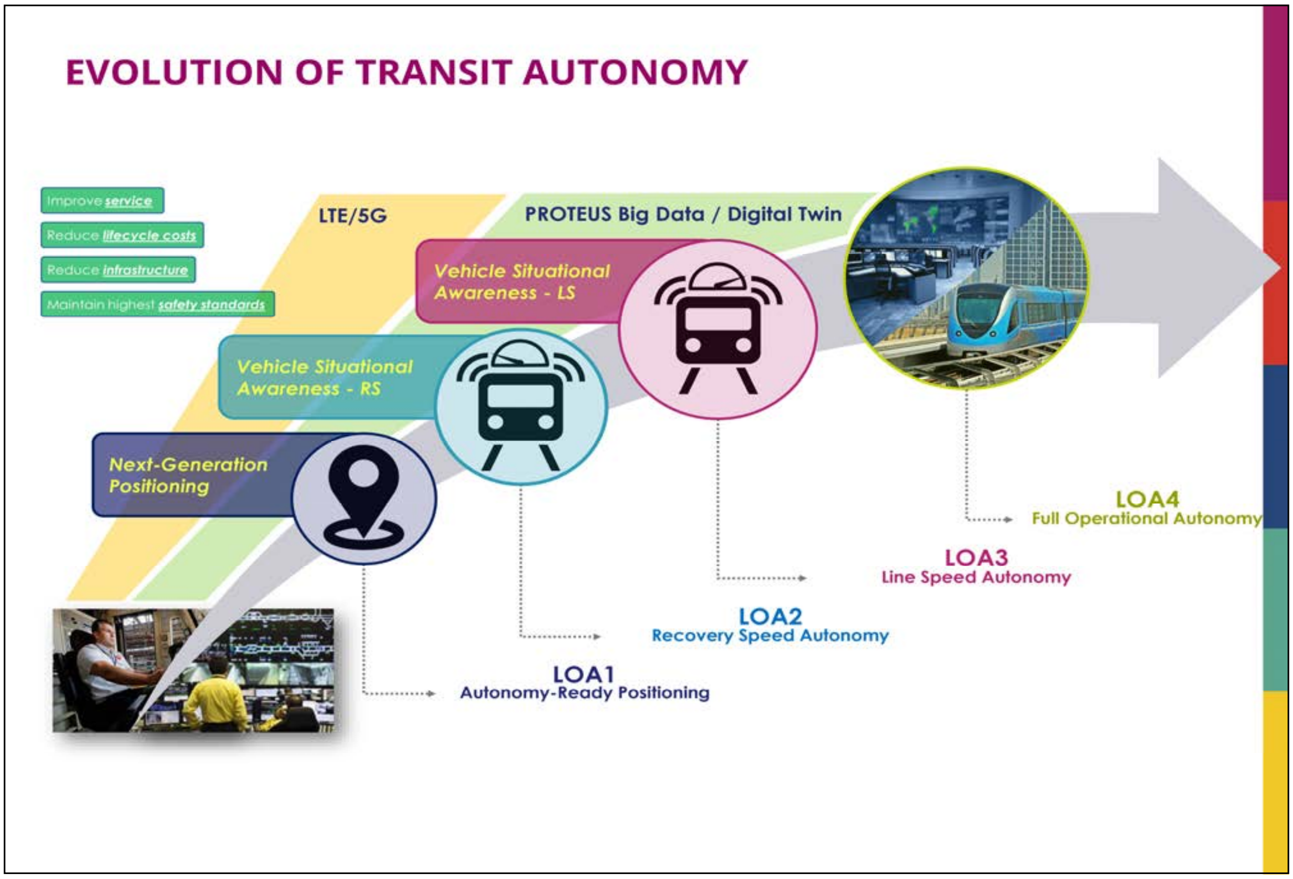
Sky-Train in Vancouver

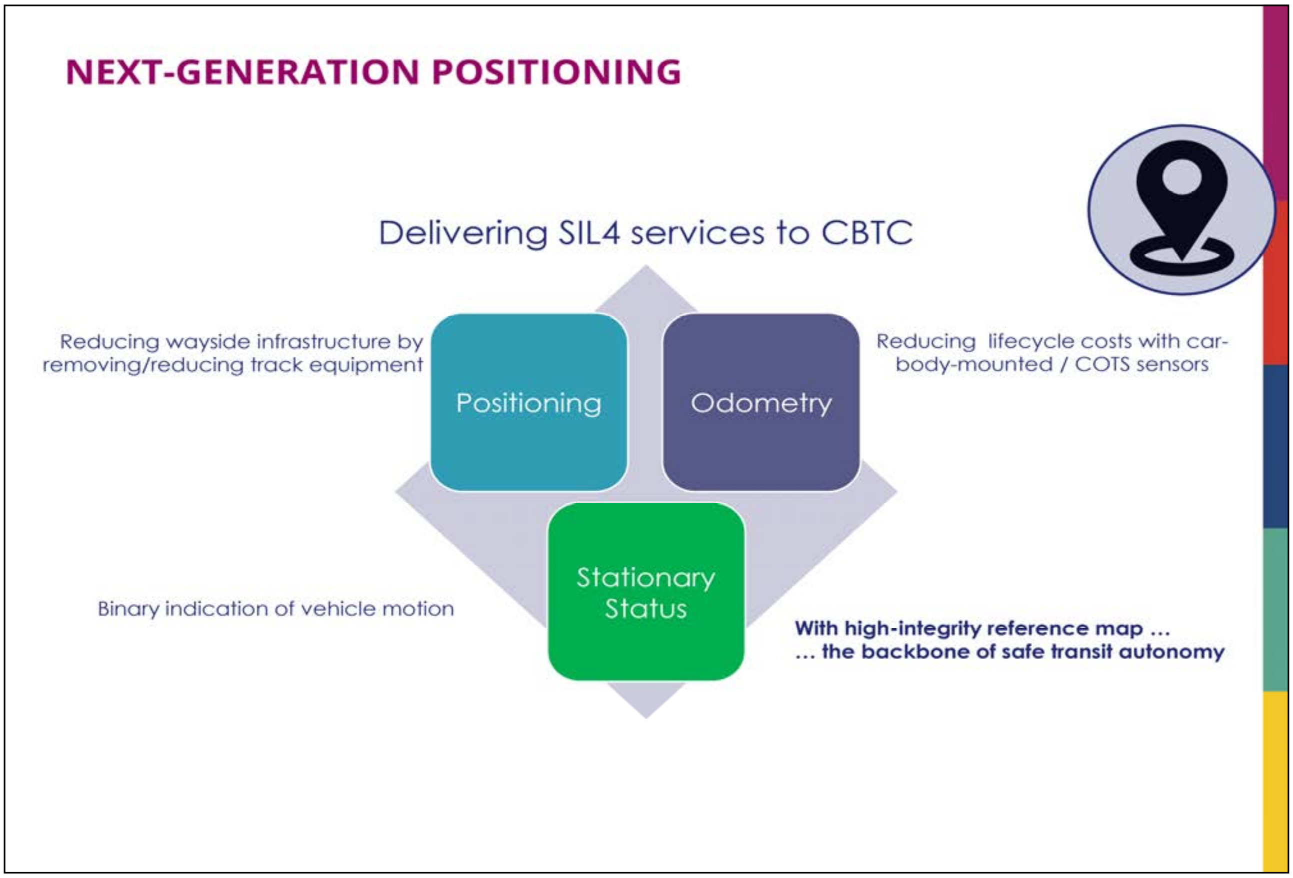
AUTOMATIC TRAIN: COMMUNICATION-BASED TRAIN CONTROL (CBTC)

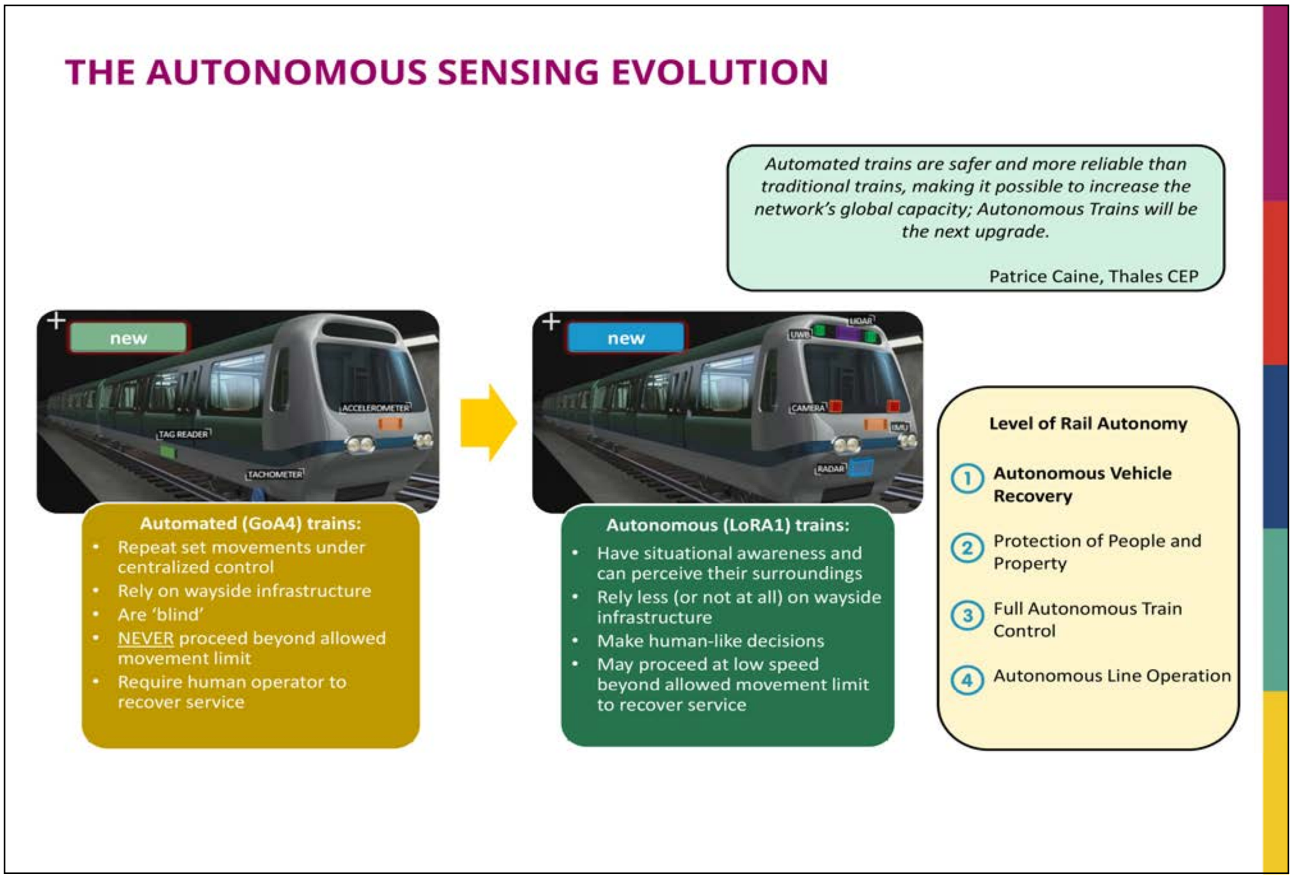


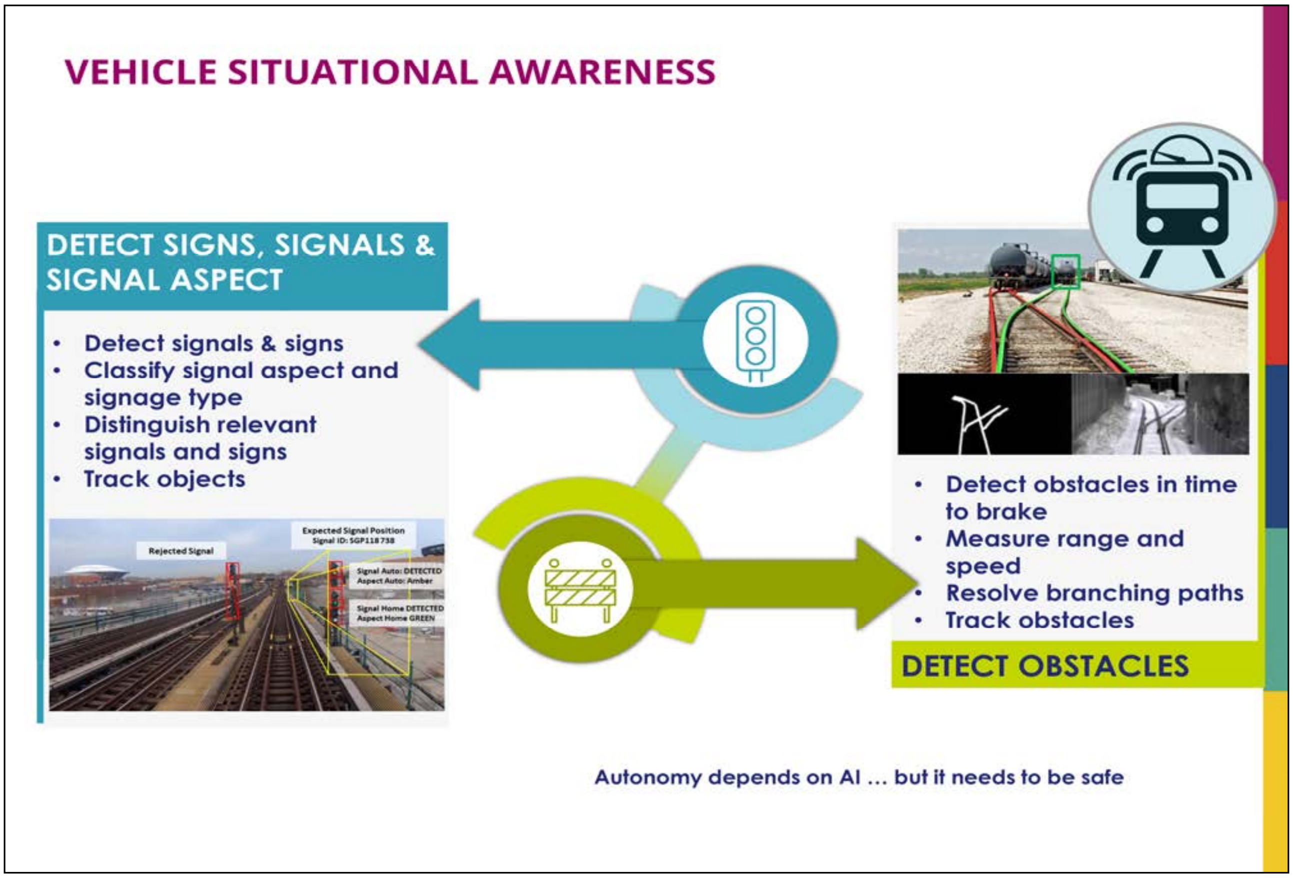
Grade of Automation (GoA)	Journey	Departure	Stopping at the station	Door closure	Disruption management
GoA 1	Locomotive driver with train protection system (ZUB, ETCS, etc.)	Locomotive driver	Locomotive driver	Locomotive driver	Locomotive driver
GoA 2	Locomotive driver with Automatic Train Operation (ATO) train protection system (ETCS)	Locomotive driver or automatic (ATO)	Automatic (ATO)	Automatic (ATO) or by locomotive driver	Locomotive driver
GoA 3	ATO, without locomotive driver, with train crew on board	Automatic (ATO)	Automatic (ATO)	Automatic (ATO) or by train crew member	As required member of train crew
GoA 4	ATO, completely autonomous train journey without staff	Automatic (ATO)	Automatic (ATO)	Automatic (ATO)	As required automatic, remote or with intervention staff

[1] 1474.1-1999 - IEEE Standard for Communications-Based Train Control (CBTC) Performance and Functional Requirements.
[2] Train Operation Systems | products and Solutions | transportation Systems | mitsubishi Electric
http://www.mitsubishielectric.com/bu/transportation/products/operation/
[3] Smartrail40

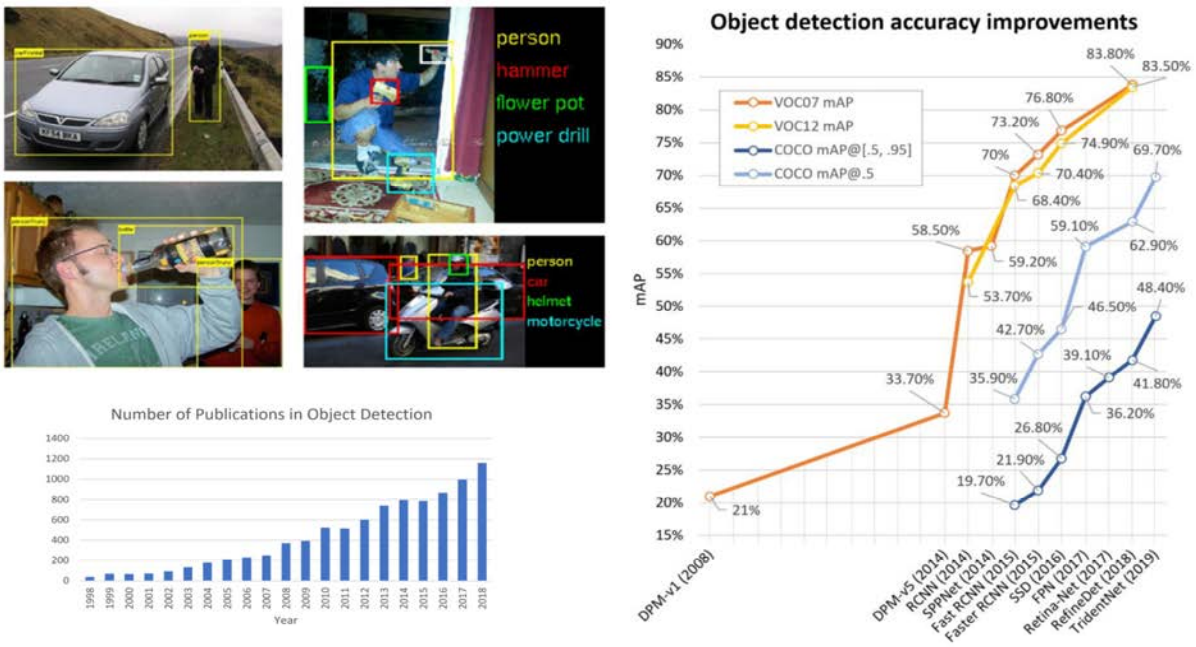

EVOLUTION OF TRANSIT AUTONOMY
Improve service
Reduce lifecycle costs
Reduce infrastructure
Maintain highest safety standards
LTE/5G
PROTEUS Big Data / Digital Twin
Vehicle Situational Awareness - LS
Vehicle Situational Awareness - RS
Next-Generation Positioning
LOA4
Full Operational Autonomy
LOA3
Line Speed Autonomy
LOA2
Recovery Speed Autonomy
LOA1
Autonomy-Ready Positioning


NEXT-GENERATION POSITIONING
Delivering SIL4 services to CBTC
Reducing wayside infrastructure by removing/reducing track equipment
Positioning
Odometry
Reducing lifecycle costs with car-body-mounted / COTS sensors
Stationary Status
Binary indication of vehicle motion
With high-integrity reference map …
… the backbone of safe transit autonomy


THE AUTONOMOUS SENSING EVOLUTION
Automated trains are safer and more reliable than traditional trains, making it possible to increase the network's global capacity; Autonomous Trains will be the next upgrade.
Patrice Caine, Thales CEP
new
ACCELEROMETER
TAG READER
TACHOMETER
new
LIDAR
UWB
CAMERA
IMU
RADAR
Automated (GoA4) trains:
• Repeat set movements under centralized control
• Rely on wayside infrastructure
• Are 'blind'
• NEVER proceed beyond allowed movement limit
• Require human operator to recover service
Autonomous (LoRA1) trains:
• Have situational awareness and can perceive their surroundings
• Rely less (or not at all) on wayside infrastructure
• Make human-like decisions
• May proceed at low speed beyond allowed movement limit to recover service
Level of Rail Autonomy
1 Autonomous Vehicle Recovery
2 Protection of People and Property
3 Full Autonomous Train Control
4 Autonomous Line Operation


VEHICLE SITUATIONAL AWARENESS
DETECT SIGNS, SIGNALS & SIGNAL ASPECT
• Detect signals & signs
• Classify signal aspect and signage type
• Distinguish relevant signals and signs
• Track objects
Rejected Signal
• Detect obstacles in time to brake
• Measure range and speed
• Resolve branching paths
• Track obstacles
DETECT OBSTACLES
Autonomy depends on AI ... but it needs to be safe

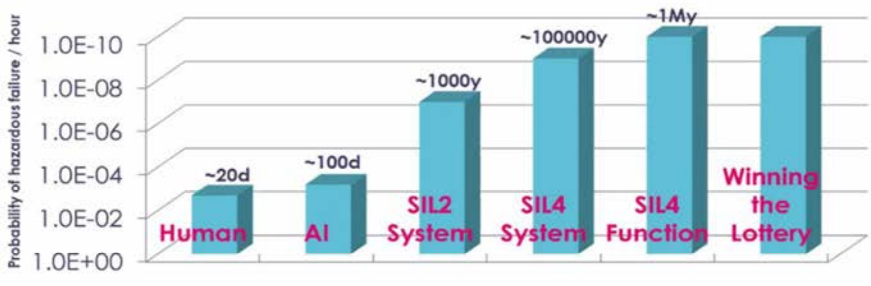
DEEP LEARNING FOR VISUAL ARTIFICIAL INTELLIGENCE



Zou, Z., Z. Shi, Y. Guo, and J. Ye. "Object detection in 20 years: A survey. arXiv 2019." arXiv preprint arXiv:1905.05055.
Krizhevsky, Alex; Sutskever, Ilya; Hinton, Geoffrey E. "ImageNet classification with deep convolutional neural networks"

WHAT DOES "SAFE" MEAN?

Dictated and quantified by Safety Integrity Levels, with corresponding probability of hazardous failure per hour of operation



Current state of the art neural networks can outperform humans, but the "integrity gap" to Safety Integrity Level 4 (SIL4) is immense!

AUTONOMOUS TRANSIT VS. AUTONOMOUS VEHICLES

Autonomous transit has unique challenges

- Require **longer stopping distance**
- Not being able to change **the direction of travel**
- Cause much larger degree of **fatalities per accident**
- Require **longer stopping distance**

Andr van Es. "2015 Overview Rail Transport Course"

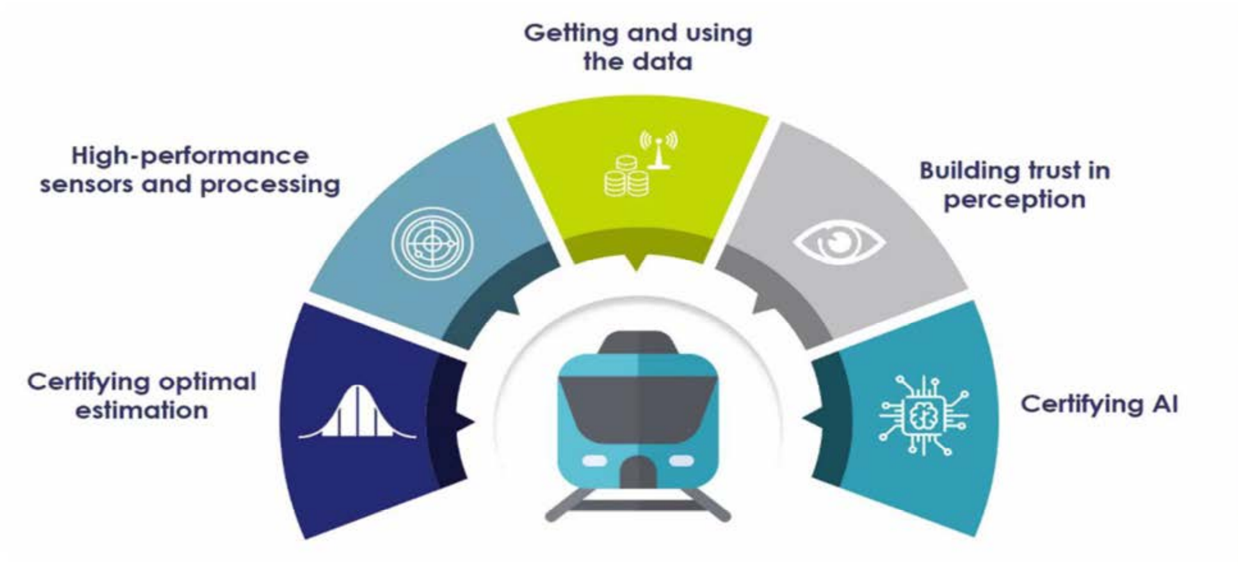
AUTONOMOUS TRANSIT VS. AUTONOMOUS VEHICLES

Autonomous transit is much more constrained

- Feasible **reference maps**
- **Restricted access and higher control**
- **Less dynamic and less complex scene**
- **Higher performance and safety needs**

Autonomous transit has unique challenges, but it will be realized before fully-autonomous cars

KEY CHALLENGES FOR AUTONOMOUS TRANSIT



ONTRAC: ONTARIO TRAIN AUTONOMY COLLABORATION

Safe and robust Obstacle Detection, Classification and Tracking

- Supports all use cases for Autonomous Vehicle Recovery
- Suitable for all expected operational conditions
- Integrated on existing Autonomy Computing Platform
- Multi-sensor data-fusion approach, utilizing both AI and classical algorithms

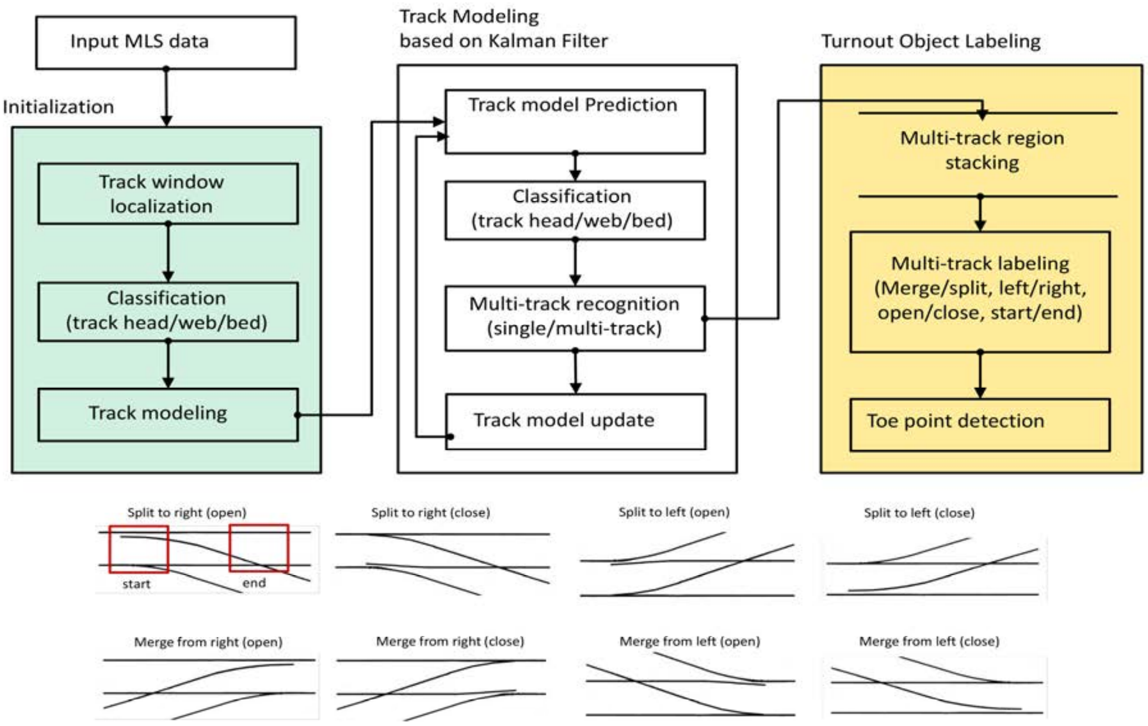
- To develop and demonstrate a prototype system of a high-performance "**Obstacle Detection, Classification and Tracking (ODCT) Solution**"
- To support the **Autonomous Vehicle Recovery capability of Level 1 (LoRA1) trains**
- Collaborating with **Thales Canada and Lumibird** supported by the **Autonomous Vehicle Innovation Network (AVIN)** (Stream 2) and **OCI TalentEdge Program**
- **York University** is leading to develop deep learning computer vision systems for object detection and path extraction using cameras and LiDAR point clouds.

LASSONDE YORK U THALES LUMIBIRD MORE THAN LASERS AVIN Ontario

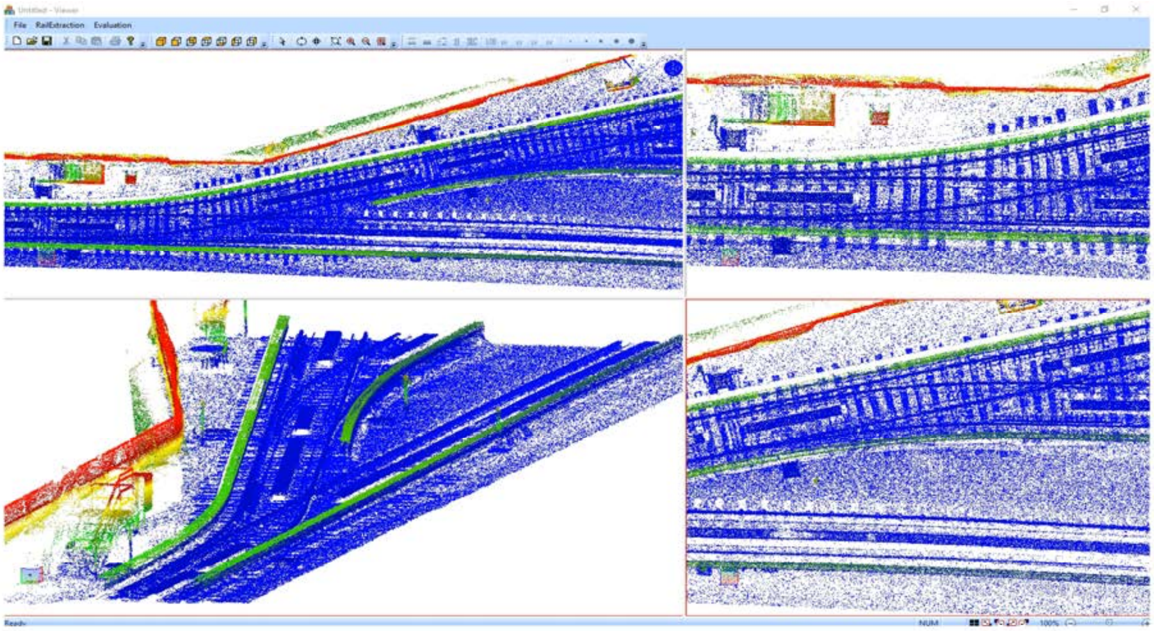
YDHR TEST SITE FOR AUTONOMOUS TRAIN

- 2.4km georeferenced LiDAR survey (1m accuracy)
- Full 16.7km geo-referenced LiDAR survey (~5 cm accuracy)
- Integration and verification testing on the YDHR Hirailer rail vehicle platform
- Installation of TCTS position landmarks
- Integration of RTK-based, UWB-based and Corrail ground truth system
- Full integration onto Durham locomotive for multiple ODCT testing

MULTISCALE RAIL TRACK EXTRACTION



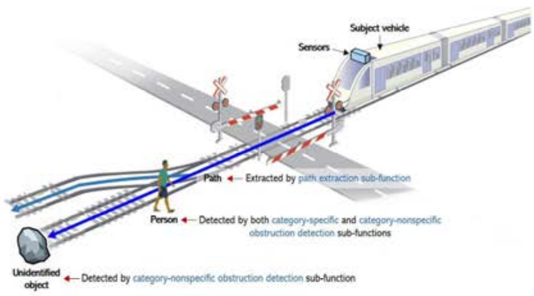
MULTISCALE RAIL TRACK EXTRACTION

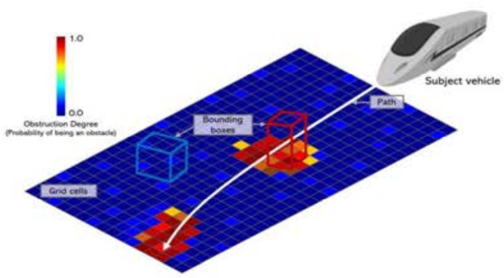


Patent - Point cloud rail asset data extraction (Jung et al., 2020)

POSE: PATH, OBSTRUCTION AND SWITCH EXTRACTION

- ❑ Function: detecting and classifying paths, obstructions, and switches from the sensor data
- ❑ Input: sensor data (LiDAR and/or Camera)
- ❑ Output: path (graph), obstructions (class specific and class non-specific), and switches

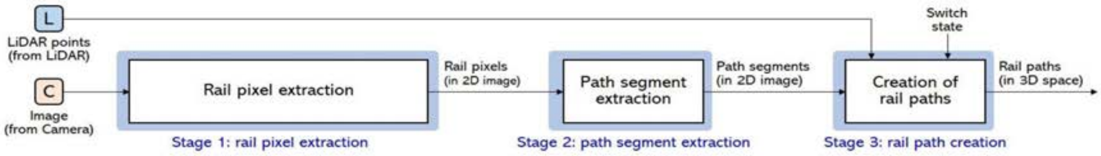




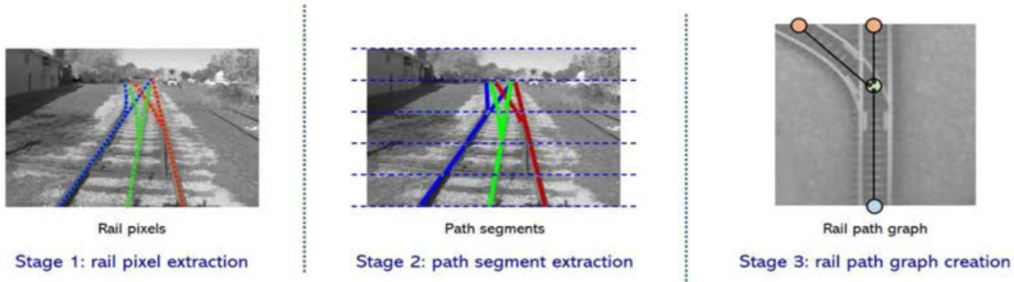
PATH EXTRACTION (PE) FUNCTION

❑ Overall Diagram for PE Sub-Function

- Rail pixels (Stage 1) → Path segments (Stage 2) → Rail path graph (Stage 3)



<Overall diagram for PE sub-function>



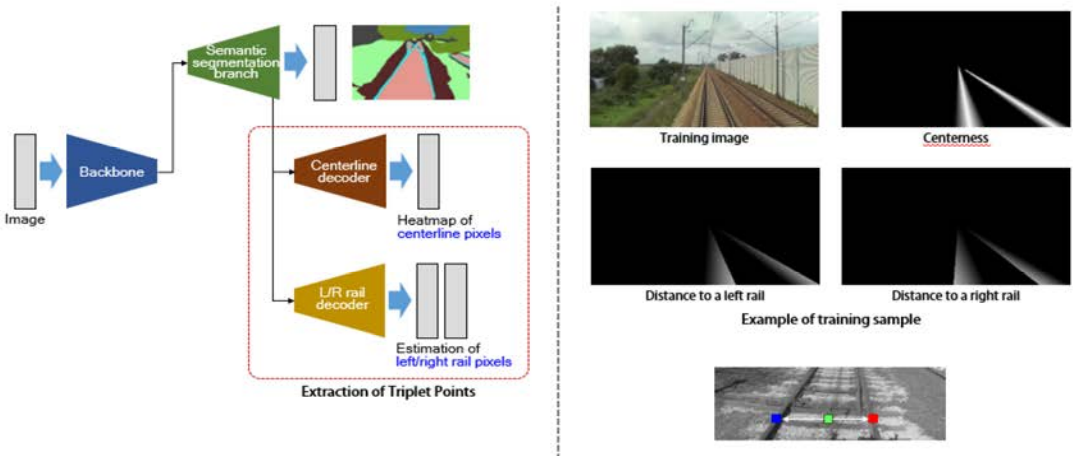
<Description of outcomes in each stage of PE sub-function>

PATH EXTRACTION (PE) FUNCTION

Triple (Centre and Left/Right) Point Extraction Network

❑ Predicting centerness, corresponding left & right rails for each pixel

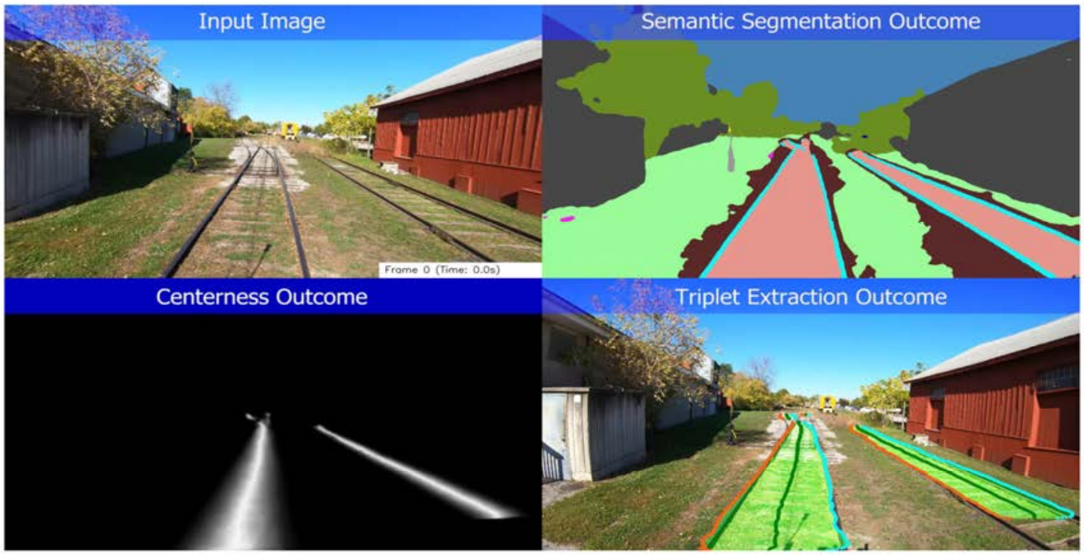
❑ Integrated semantic segmentation outcomes to reduce false positives in centerness



• [CenterNet] Objects as Points (2019)
• Multi-Task Learning for Segmentation of Building Footprints with Deep Neural Networks

PATH EXTRACTION (PE) FUNCTION

- Result Video for Triplet (Center and Left/Right) Point Extraction
  - Test on test7/nrs2 of YDHR Oct 10 2019 Data

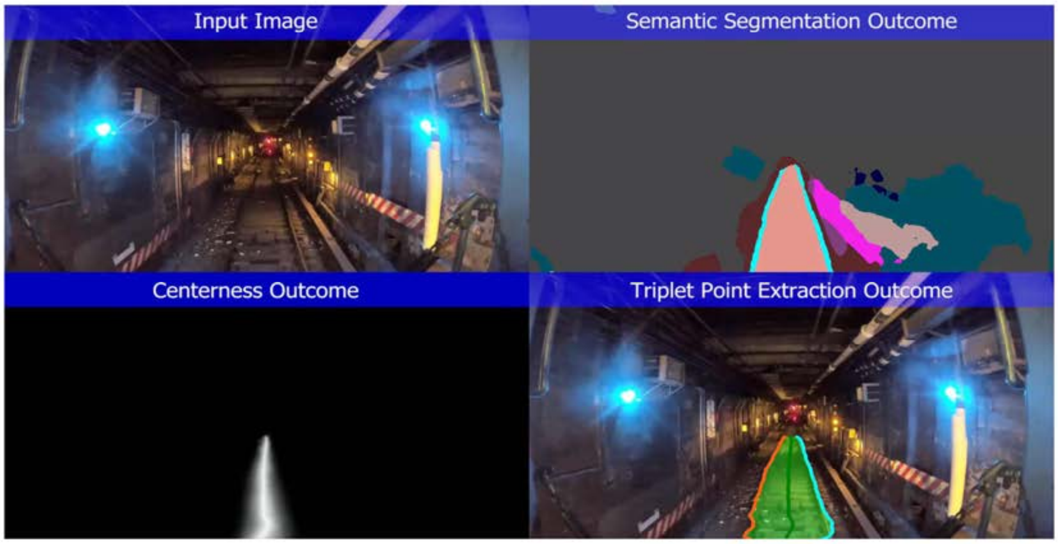


PATH EXTRACTION (PE) FUNCTION

- YDHR Results

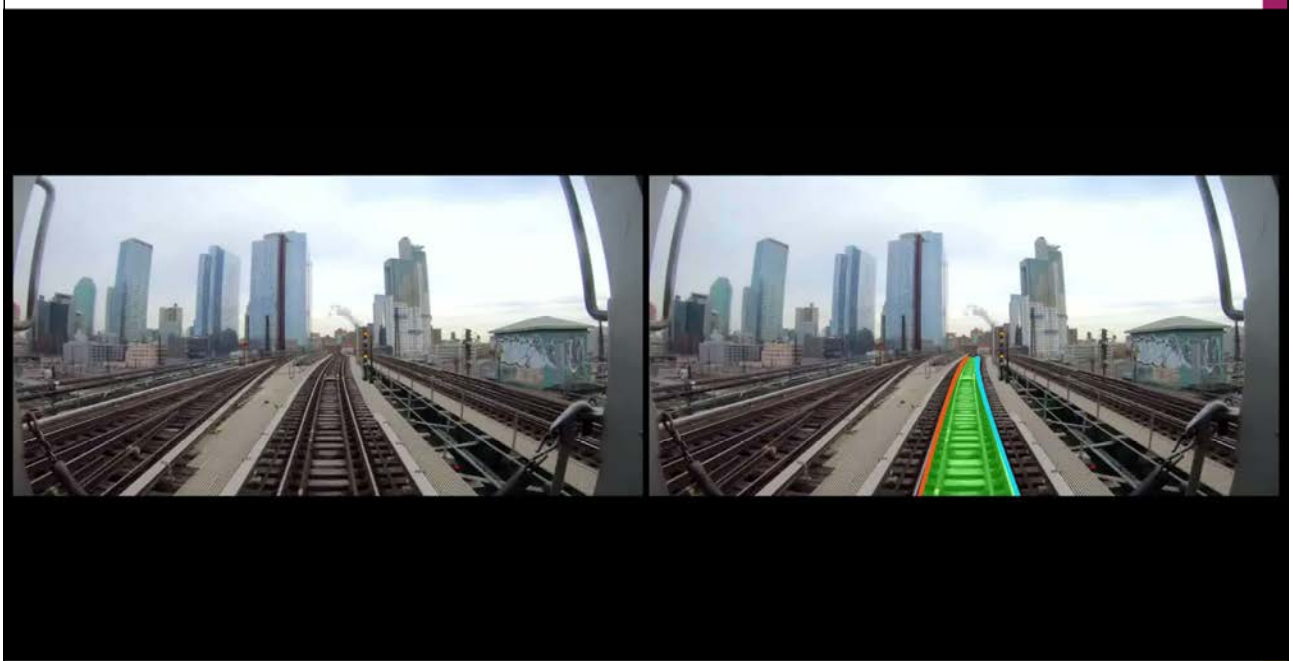
PATH EXTRACTION (PE) FUNCTION

- Testing in NYC Subway Images
  - Video source: NYC Subway Front Window View - The Manhattan-Bound 7 Express Line [https://youtu.be/ukOHqdPbYYg]



PATH EXTRACTION (PE) FUNCTION

- NYC Results



PATH EXTRACTION (PE) FUNCTION

❑ Test on both 8mm images and 25mm images

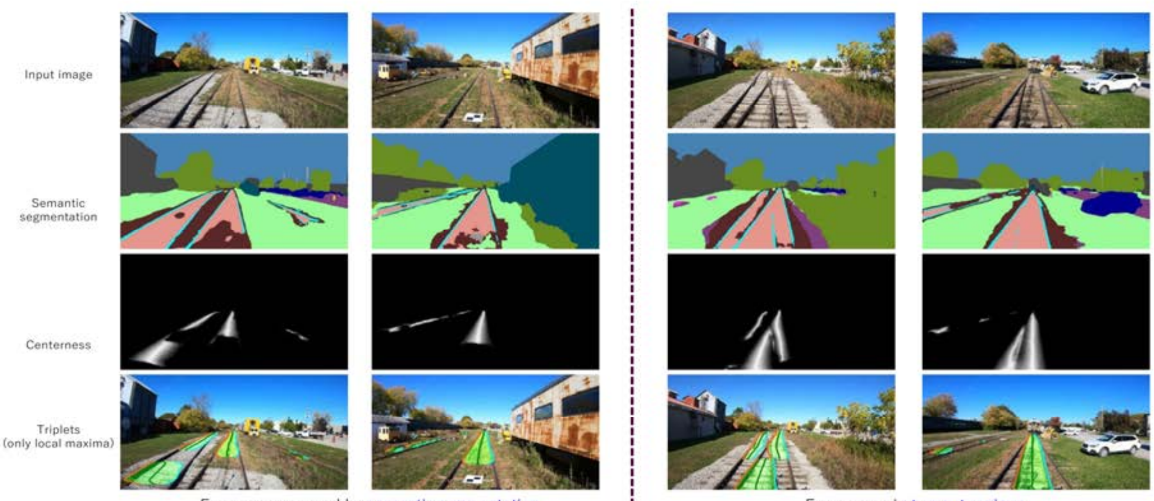
Testing Path Extraction Sub-Function on Metrolinx Images

*Path Extraction Sub-Function: PE with TPE-net (Sept 04 2020 ver)

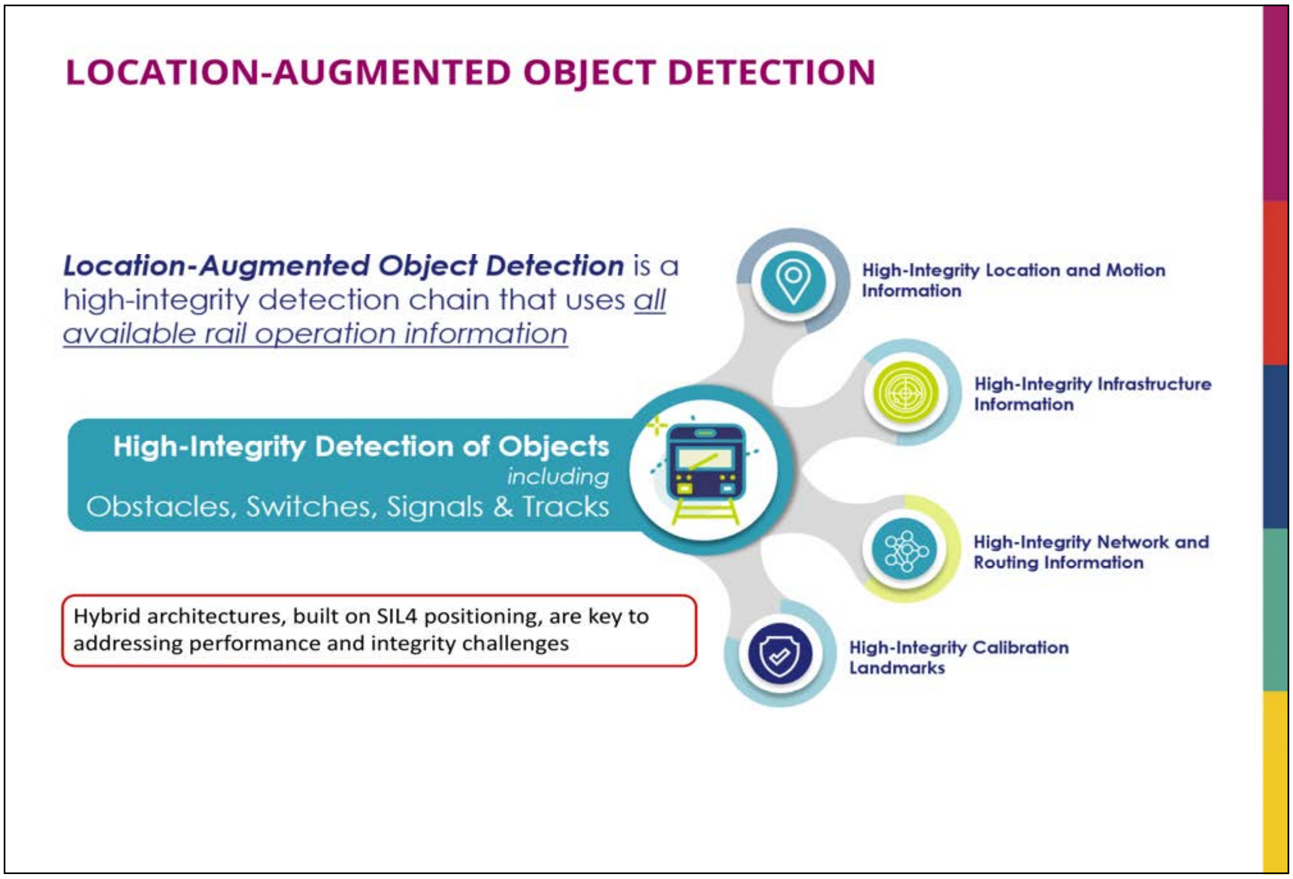
*Metrolinx images: 8mm images and 25mm images
acquired from 2:16:03 to 2:16:13 (PM)

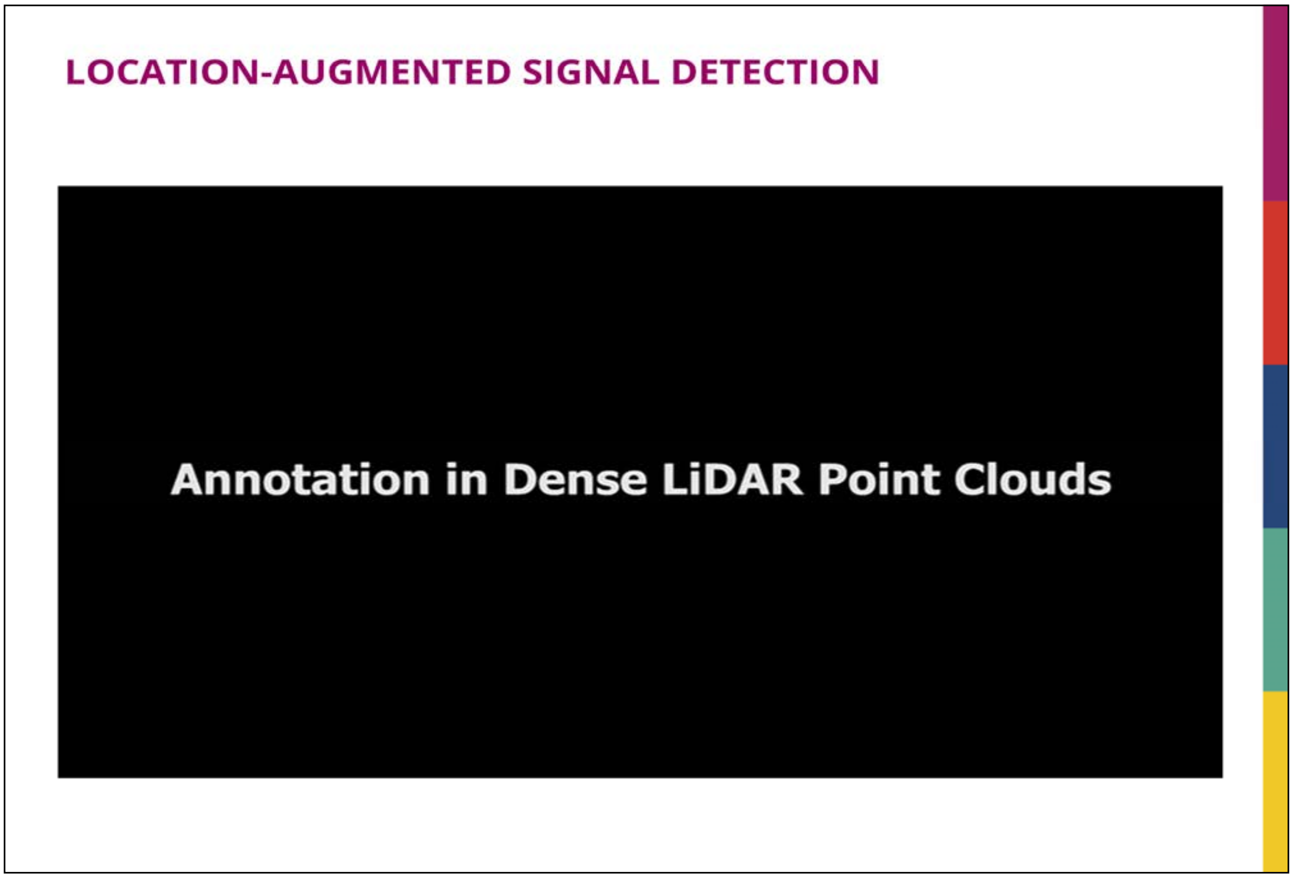
PATH EXTRACTION (PE) FUNCTION

❑ Implemented TPE Net
- Assigning centerness correctly only the center of area recognized as "track region", leading to the following limitations:
  - Highly sensitive to semantic segmentation outcomes
  - Incorrect centerness prediction in turnout regions



Error cases caused by semantic segmentation | Error cases in turnout regions

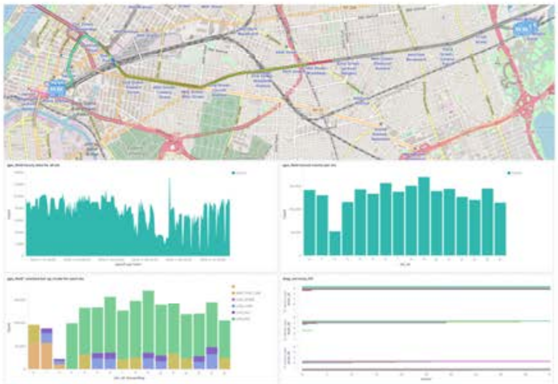

LOCATION-AUGMENTED OBJECT DETECTION
Location-Augmented Object Detection is a high-integrity detection chain that uses all available rail operation information
High-Integrity Detection of Objects
including
Obstacles, Switches, Signals & Tracks
Hybrid architectures, built on SIL4 positioning, are key to addressing performance and integrity challenges
High-Integrity Location and Motion Information
High-Integrity Infrastructure Information
High-Integrity Network and Routing Information
High-Integrity Calibration Landmarks


LOCATION-AUGMENTED SIGNAL DETECTION
Annotation in Dense LiDAR Point Clouds

BIG DATA PLATFORM

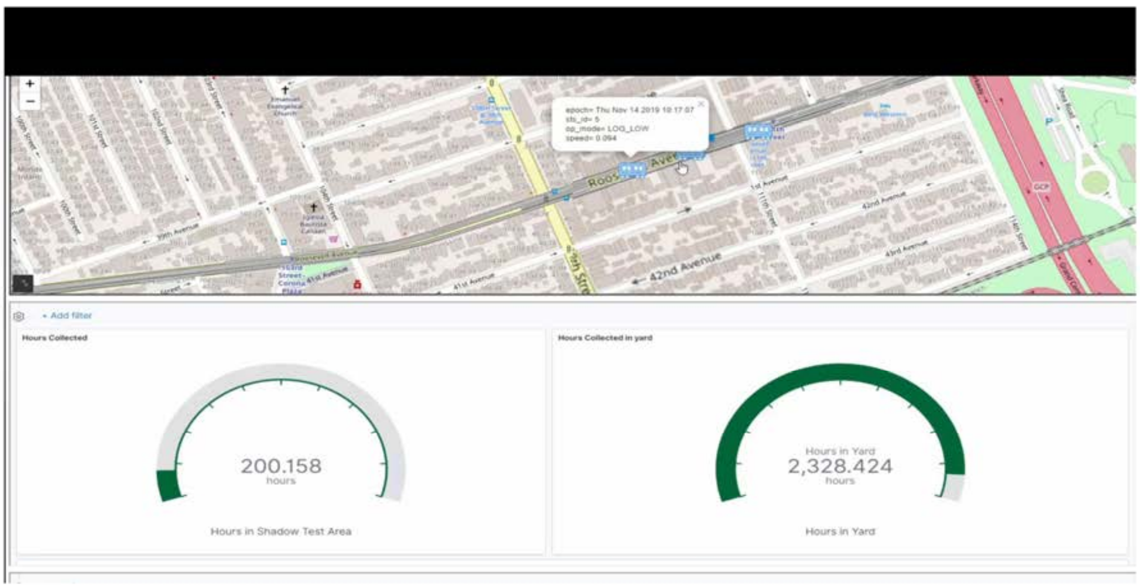
Advanced sensors produce enormous amounts of data

Advanced algorithms need more data for development and verification



AI provides new opportunities to explore data, discover corner cases, parse and purge large datasets, and explore complex operational spaces to ensure test coverage

BIG DATA PLATFORM



CONCLUSION

- Autonomous transit has unique challenges
- Artificial Intelligence is a critical enabling technology
- High-integrity (digital twining rail infrastructure and operations) increase the safety of autonomous transit
- Safety-critical systems can be built on AISAFETY-CRITICAL SYSTEMS CAN BE BUILT ON AI

Source from https://www.railwaygazette.com/sponsored-content/thales-latest-product-innovations-will-transform-journeys-in-and-around-cities/58978.article

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Thales Canada

Dr. Veronica Marin
System Engineer
Thales Canada

David Beach
Technical Specialist
Thales Canada

OCE Where Next Happens

AVIN Ontario

2021 ICGIS

International Conference
on Geospatial Information Science

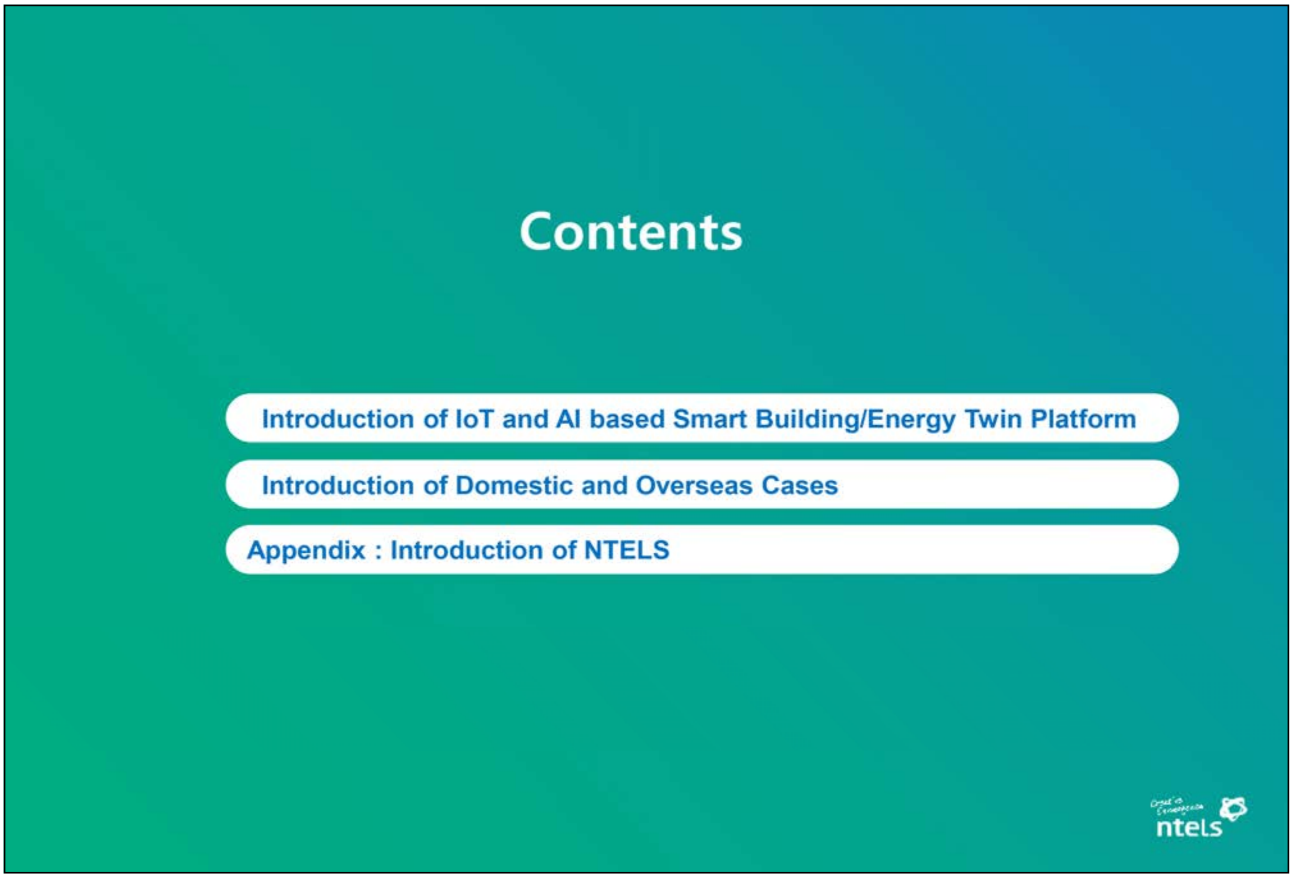
Smart GEO Expo 2021
2021 스마트국토엑스포

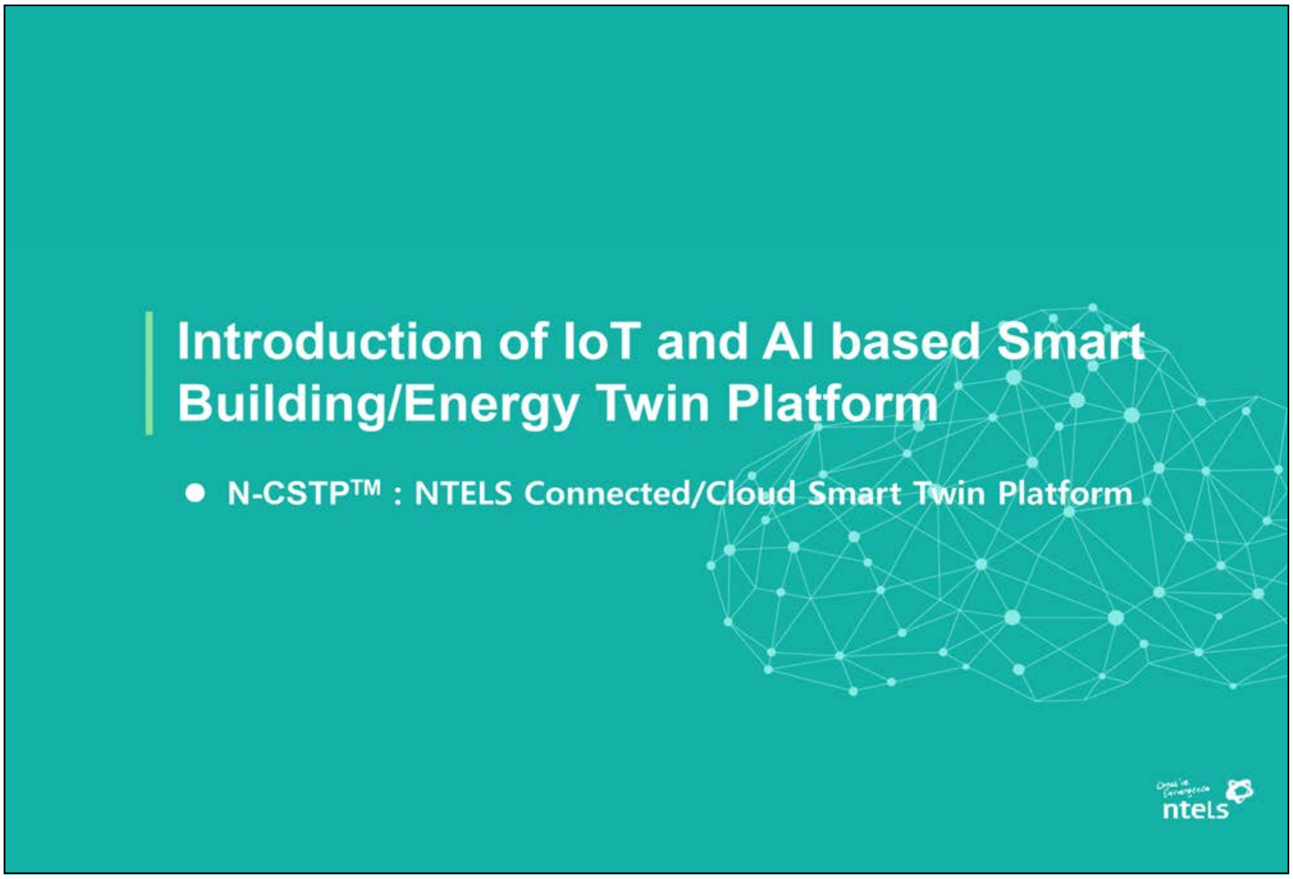
IoT and AI based Smart Building/ Energy Twin Platform for Smart City

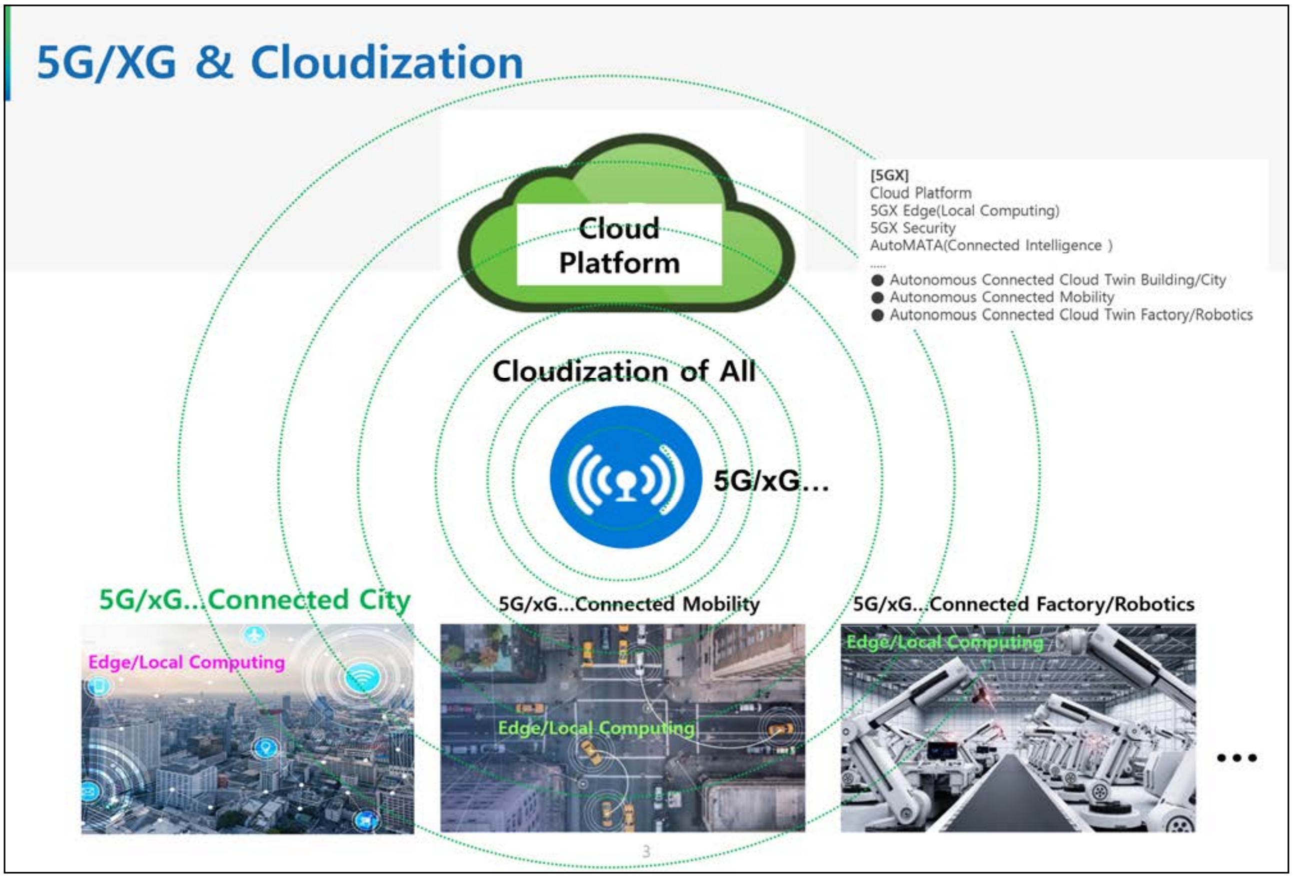
[스마트시티를 위한 IoT & AI기반 스마트빌딩/에너지트윈 플랫폼]

Changsoo Park Ntels

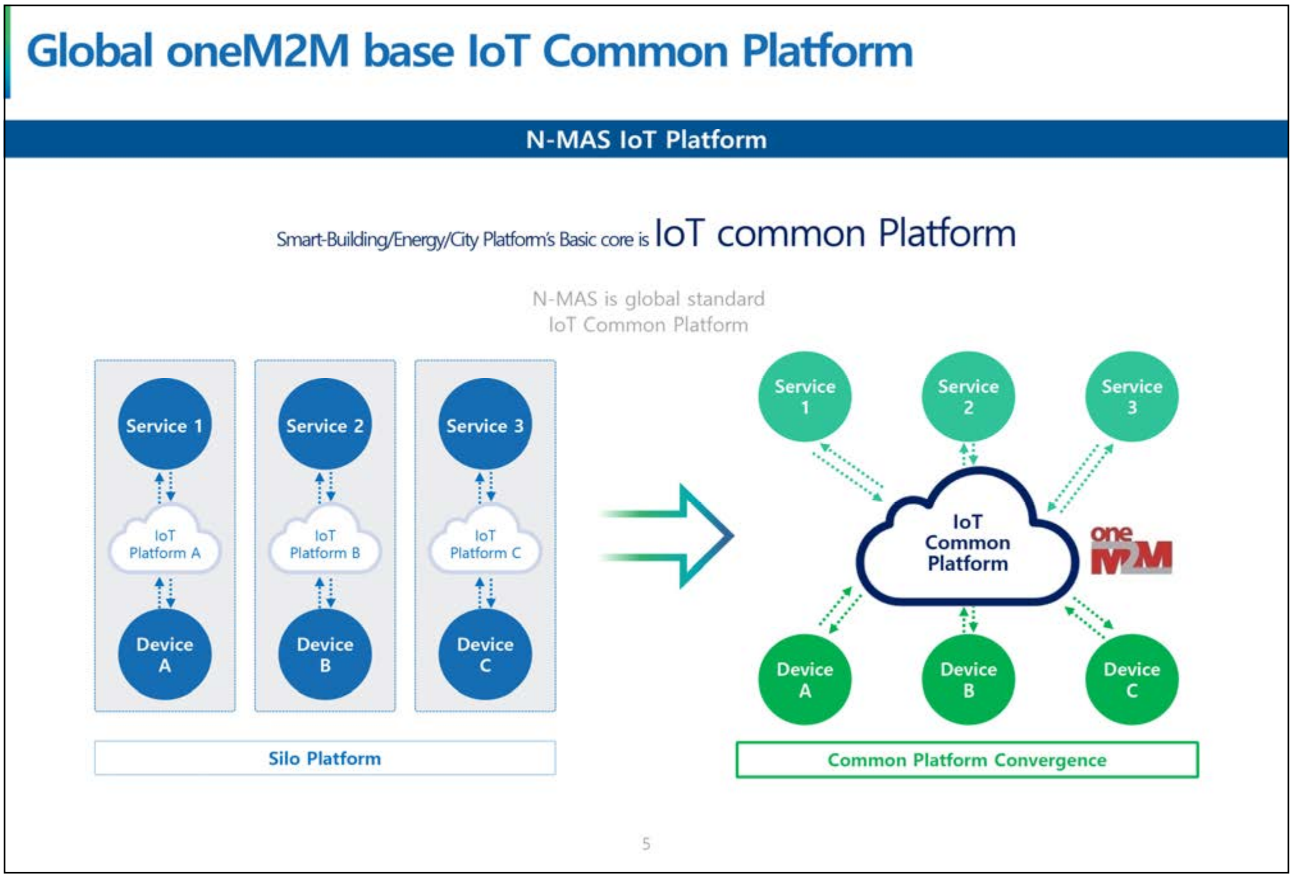

IoT and AI based Smart Building/Energy Twin Platform for Smart City
NTELS Cloud IoT Business Division/Cloud Energy Innovation Team
Changsoo Park
cspark11@ntels.com
www.ntels.com
22th July 2021
CREATIVE CONVERGENCE
INNOVATIVE PLATFORMS FOR BUSINESS INTELLIGENCE
ntels

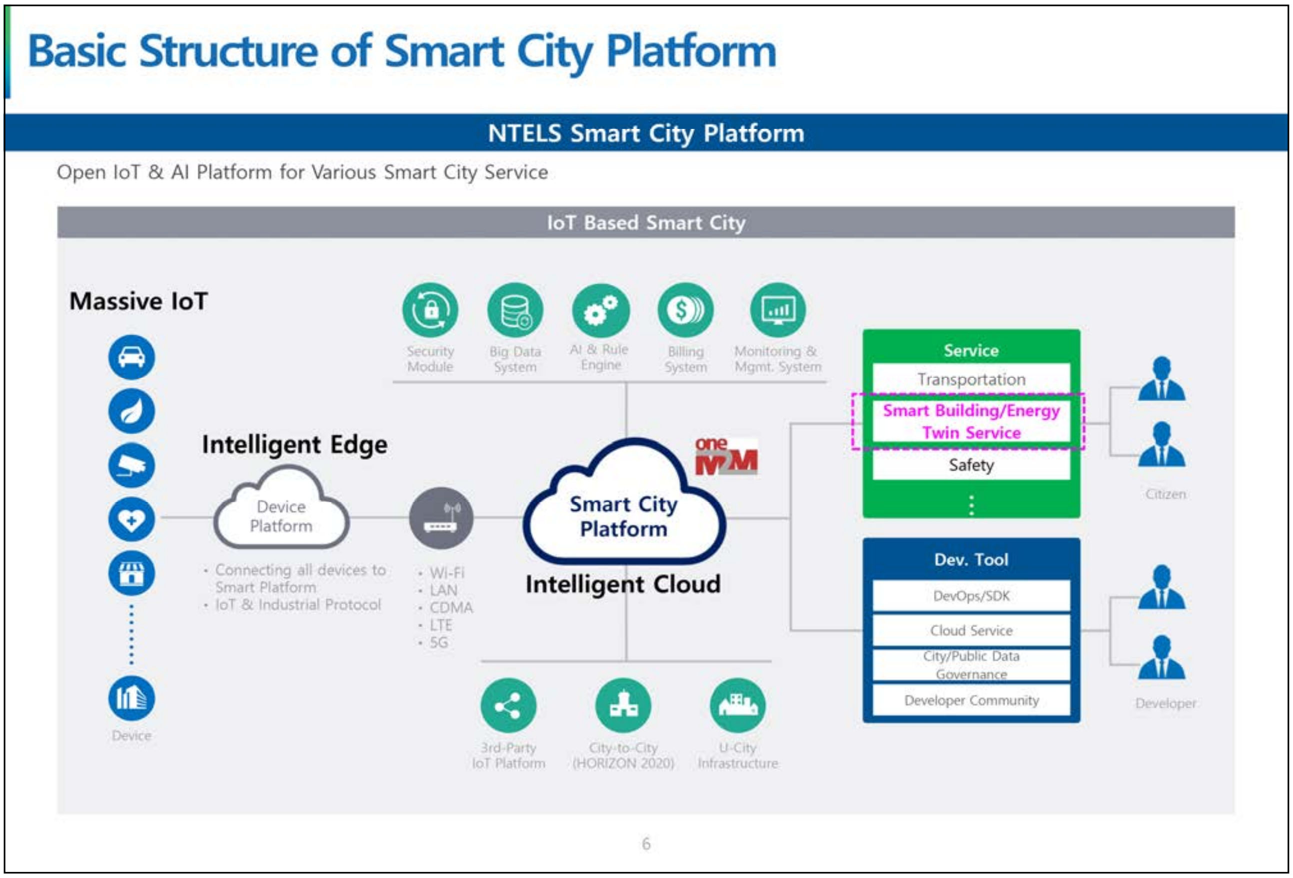

Contents
Introduction of IoT and AI based Smart Building/Energy Twin Platform
Introduction of Domestic and Overseas Cases
Appendix : Introduction of NTELS
ntels

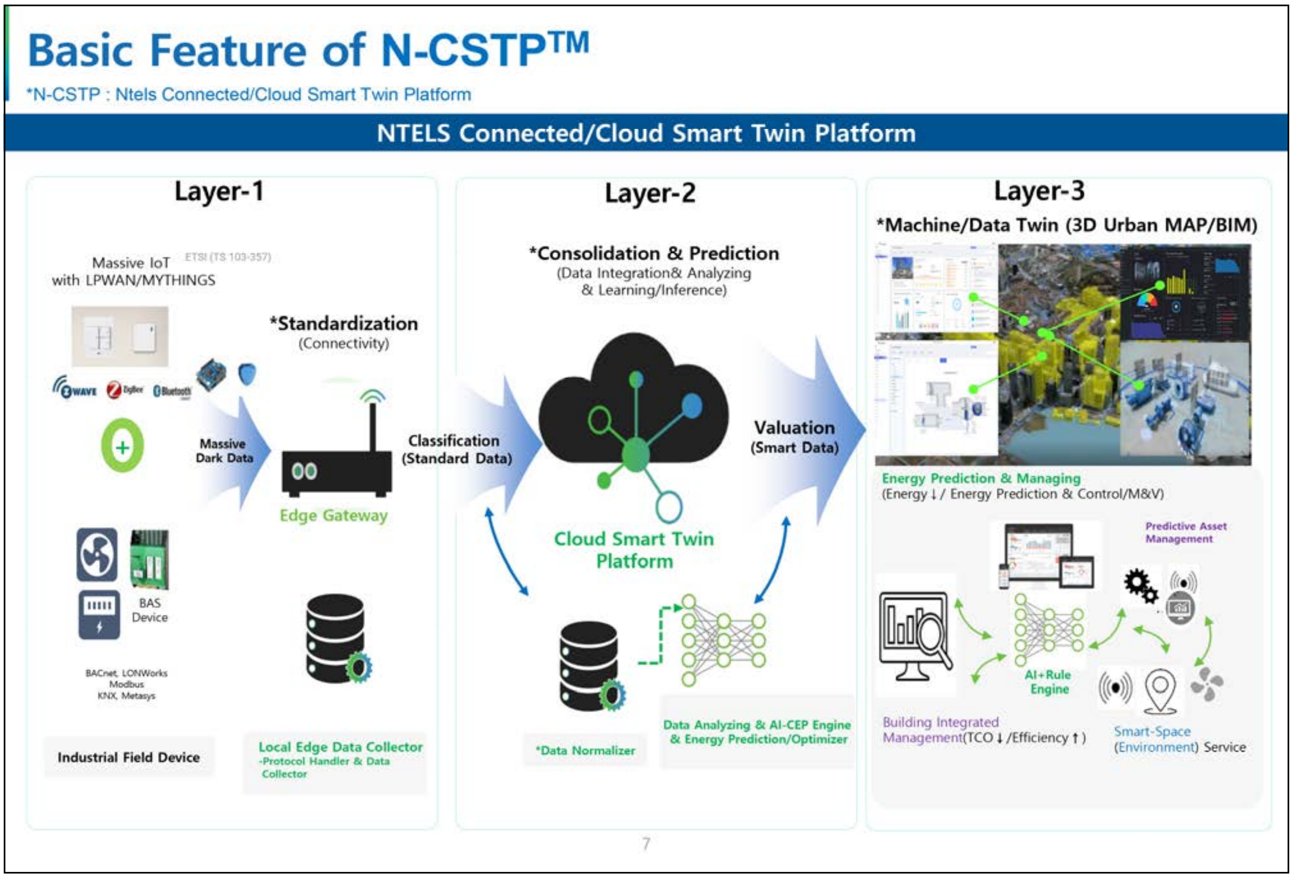

Introduction of IoT and AI based Smart Building/Energy Twin Platform
● N-CSTPTM : NTELS Connected/Cloud Smart Twin Platform
ntels

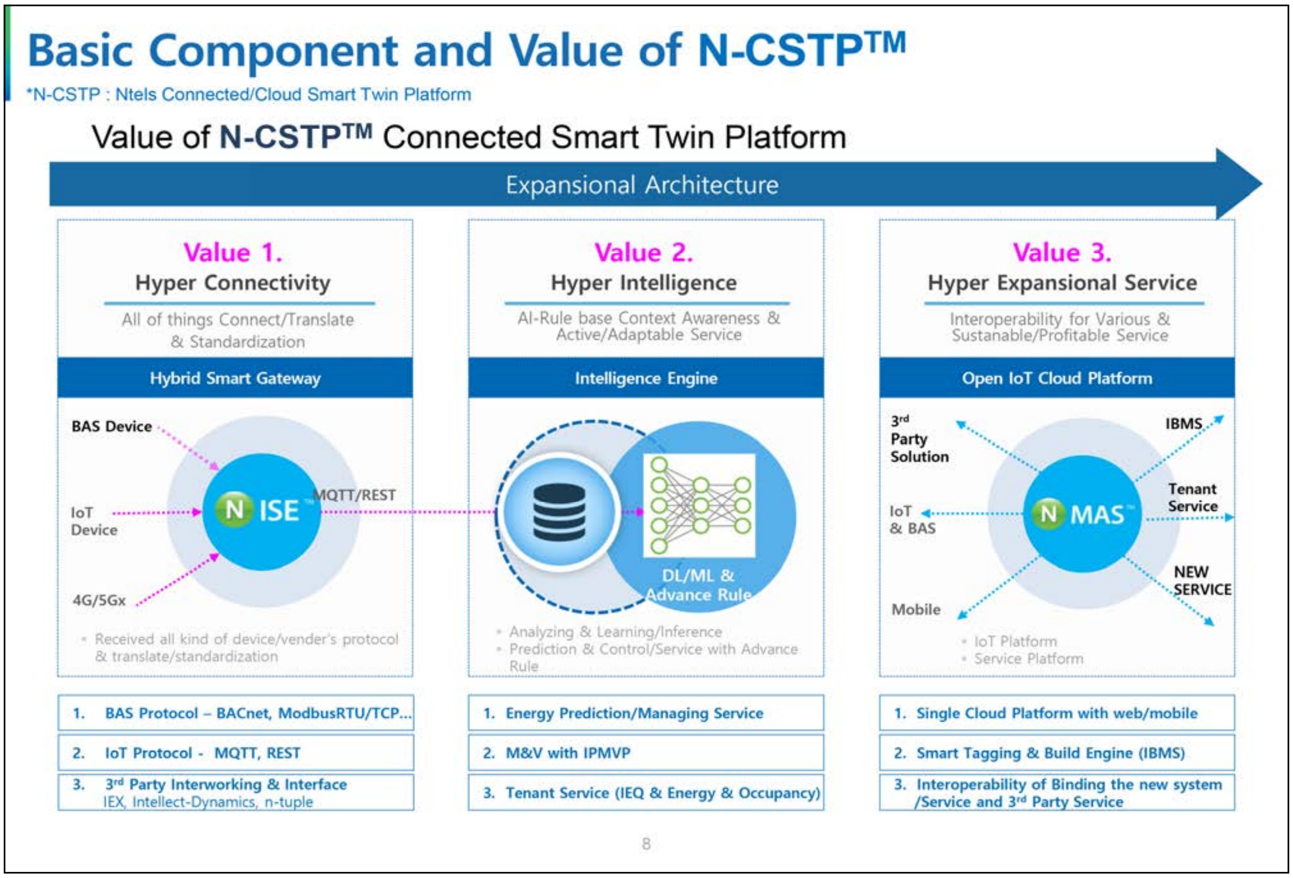

5G/XG & Cloudization
Cloud Platform
[5GX]
Cloud Platform
5GX Edge(Local Computing)
5GX Security
AutoMATA(Connected Intelligence)
● Autonomous Connected Cloud Twin Building/City
● Autonomous Connected Mobility
● Autonomous Connected Cloud Twin Factory/Robotics
Cloudization of All
5G/xG...
5G/xG...Connected City
5G/xG...Connected Mobility
5G/xG...Connected Factory/Robotics
Edge/Local Computing
Edge/Local Computing
Edge/Local Computing
...
3

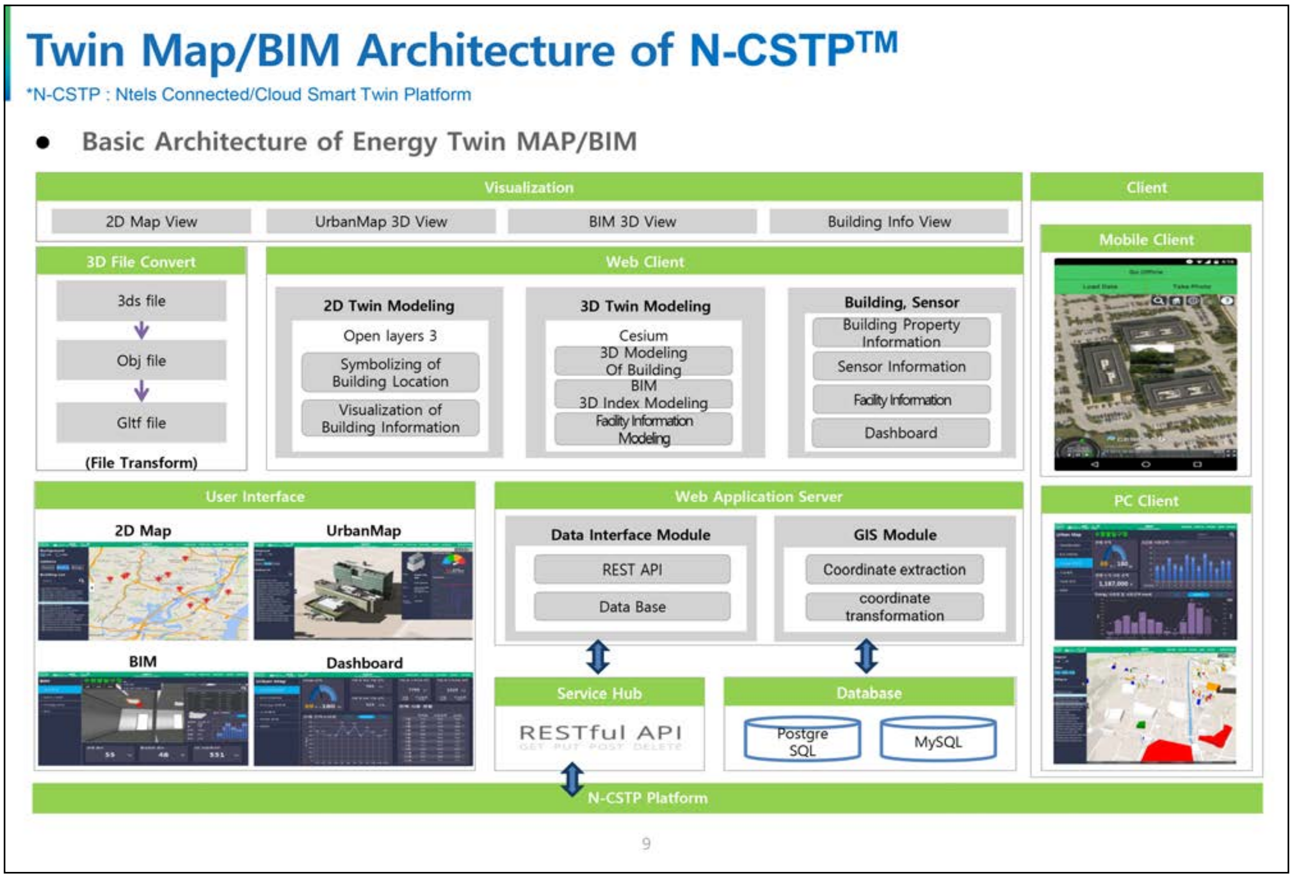

Overview
We have been offering the smart city platform for local municipalities and smart energy management services for public buildings.
SMART CITY
Smart Grid/
Smart Energy
Smart Agriculture
Internet of Things
Smart Retail
Smart Health
Smart Mobility
Smart Home
Open Data
OUT
Global Smart City Platform
Capable of connecting with global smart cities like Santander, Spain - globally connected platform and services
IN
Smart Cloud Service
From a Transportation, Building, Energy and any services are cloud-based specialized services for smart city
UP
Data Intelligence
Through big data-based intelligent analysis, value-up services for sustainable and fast growth
Latest
Reference
Pangyo Alpha dome Smart City(Building/Energy)
Daegu Smart City
Suwon Smart City(Building/Energy)
Busan Smart City(Building/Energy)
SK Telecom Smart City Platform
4

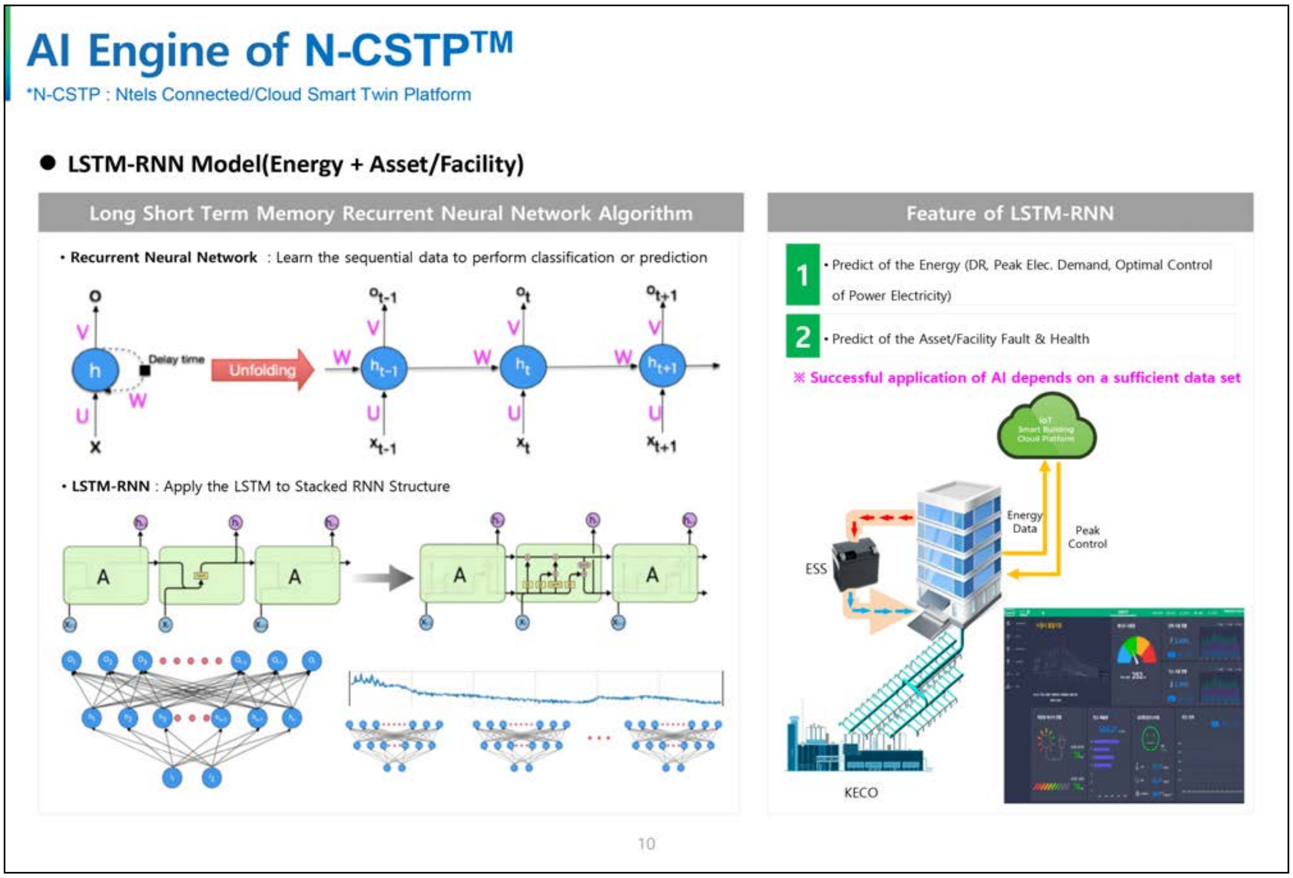

Global oneM2M base IoT Common Platform
N-MAS IoT Platform
Smart-Building/Energy/City Platform's Basic core is IoT common Platform
N-MAS is global standard
IoT Common Platform
Service 1
IoT
Platform A
Device
A
Service 2
IoT
Platform B
Device
B
Service 3
IoT
Platform C
Device
C
Silo Platform
Service
1
Service
2
Service
3
IoT
Common
Platform
oneM2M
Device
A
Device
B
Device
C
Common Platform Convergence
5

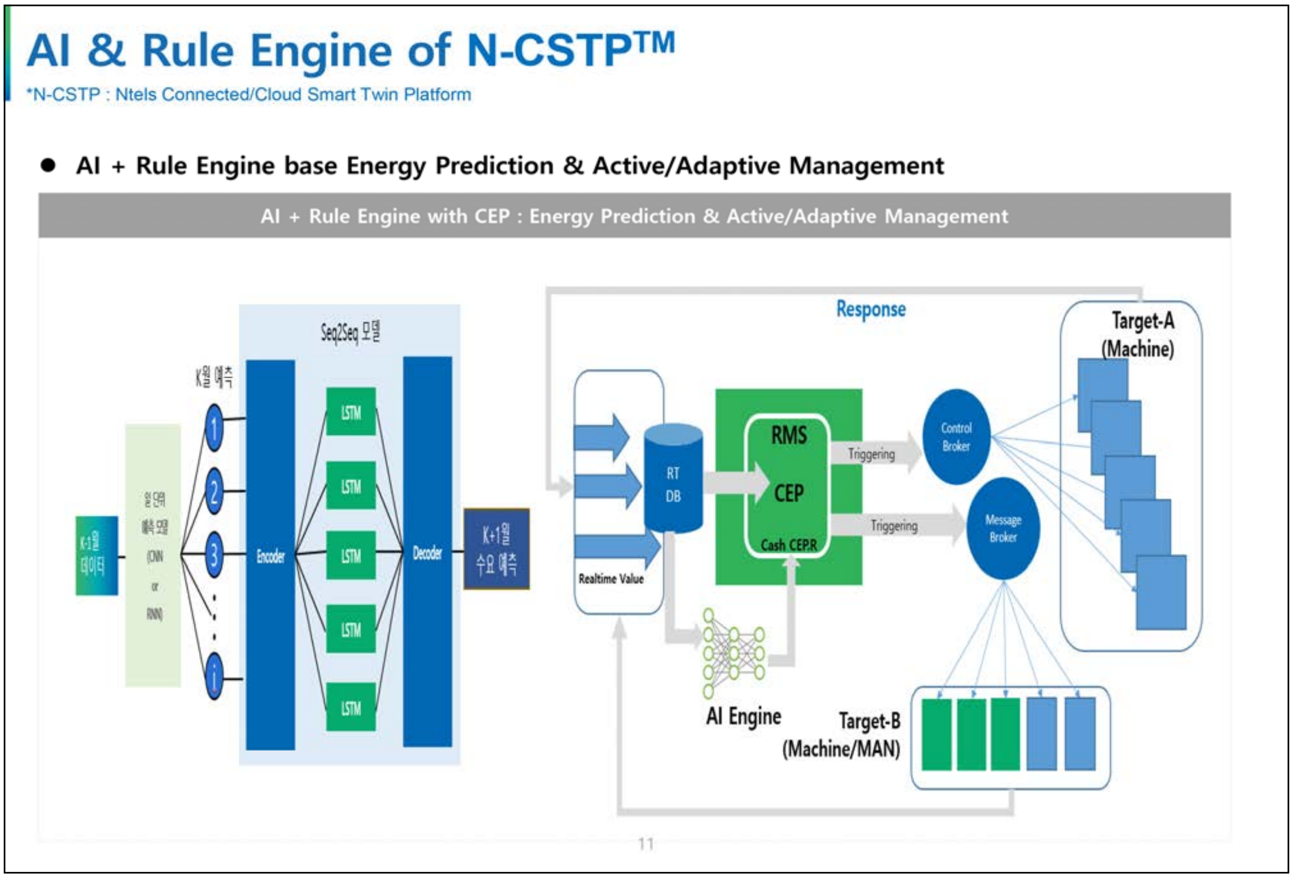

Basic Structure of Smart City Platform
NTELS Smart City Platform
Open IoT & AI Platform for Various Smart City Service
IoT Based Smart City
Massive IoT
Device
Intelligent Edge
Device Platform
· Connecting all devices to Smart Platform
· IoT & Industrial Protocol
· Wi-Fi
· LAN
· CDMA
· LTE
· 5G
Security Module
Big Data System
AI & Rule Engine
Billing System
Monitoring & Mgmt. System
Smart City Platform
Intelligent Cloud
oneM2M
3rd-Party IoT Platform
City-to-City (HORIZON 2020)
U-City Infrastructure
Service
Transportation
Smart Building/Energy Twin Service
Safety
Dev. Tool
DevOps/SDK
Cloud Service
City/Public Data Governance
Developer Community
Citizen
Developer
6


Basic Feature of N-CSTP™
*N-CSTP : Ntels Connected/Cloud Smart Twin Platform
NTELS Connected/Cloud Smart Twin Platform
Layer-1
Massive IoT with LPWAN/MYTHINGS
ETSI (TS 103-357)
*Standardization (Connectivity)
Massive Dark Data
Edge Gateway
BAS Device
BACnet, LONWorks Modbus KNX, Metasys
Industrial Field Device
Local Edge Data Collector
-Protocol Handler & Data Collector
Layer-2
*Consolidation & Prediction
(Data Integration& Analyzing & Learning/Inference)
Classification (Standard Data)
Valuation (Smart Data)
Cloud Smart Twin Platform
*Data Normalizer
Data Analyzing & AI-CEP Engine & Energy Prediction/Optimizer
Layer-3
*Machine/Data Twin (3D Urban MAP/BIM)
Energy Prediction & Managing
(Energy↓/ Energy Prediction & Control/M&V)
Predictive Asset Management
AI+Rule Engine
Building Integrated Management(TCO↓/Efficiency↑)
Smart-Space (Environment) Service
7


Basic Component and Value of N-CSTPTM
*N-CSTP : Ntels Connected/Cloud Smart Twin Platform
Value of N-CSTPTM Connected Smart Twin Platform
Expansional Architecture
Value 1.
Hyper Connectivity
All of things Connect/Translate & Standardization
Hybrid Smart Gateway
BAS Device
IoT Device
4G/5Gx
N ISE
MQTT/REST
Received all kind of device/vender's protocol & translate/standardization
Value 2.
Hyper Intelligence
AI-Rule base Context Awareness & Active/Adaptable Service
Intelligence Engine
DL/ML & Advance Rule
Analyzing & Learning/Inference
Prediction & Control/Service with Advance Rule
Value 3.
Hyper Expansional Service
Interoperability for Various & Sustanable/Profitable Service
Open IoT Cloud Platform
3rd Party Solution
IBMS
Tenant Service
IoT & BAS
N MAS
NEW SERVICE
Mobile
IoT Platform
Service Platform
1. BAS Protocol – BACnet, ModbusRTU/TCP...
2. IoT Protocol - MQTT, REST
3. 3rd Party Interworking & Interface IEX, Intellect-Dynamics, n-tuple
1. Energy Prediction/Managing Service
2. M&V with IPMVP
3. Tenant Service (IEQ & Energy & Occupancy)
1. Single Cloud Platform with web/mobile
2. Smart Tagging & Build Engine (IBMS)
3. Interoperability of Binding the new system /Service and 3rd Party Service
8


Twin Map/BIM Architecture of N-CSTPTM
*N-CSTP : Ntels Connected/Cloud Smart Twin Platform
Basic Architecture of Energy Twin MAP/BIM
Visualization
2D Map View
UrbanMap 3D View
BIM 3D View
Building Info View
Client
Mobile Client
3D File Convert
3ds file
Obj file
Gltf file
(File Transform)
Web Client
2D Twin Modeling
Open layers 3
Symbolizing of Building Location
Visualization of Building Information
3D Twin Modeling
Cesium
3D Modeling Of Building
BIM
3D Index Modeling
Facility Information Modeling
Building, Sensor
Building Property Information
Sensor Information
Facility Information
Dashboard
User Interface
2D Map
UrbanMap
BIM
Dashboard
Web Application Server
Data Interface Module
REST API
Data Base
GIS Module
Coordinate extraction
coordinate transformation
Service Hub
RESTful API
Database
Postgre SQL
MySQL
PC Client
N-CSTP Platform
9


AI Engine of N-CSTP™
*N-CSTP : Ntels Connected/Cloud Smart Twin Platform
LSTM-RNN Model(Energy + Asset/Facility)
Long Short Term Memory Recurrent Neural Network Algorithm
• Recurrent Neural Network : Learn the sequential data to perform classification or prediction
Delay time
Unfolding
• LSTM-RNN : Apply the LSTM to Stacked RNN Structure
Feature of LSTM-RNN
1 • Predict of the Energy (DR, Peak Elec. Demand, Optimal Control of Power Electricity)
2 • Predict of the Asset/Facility Fault & Health
※ Successful application of AI depends on a sufficient data set
Energy Data
Peak Control
ESS
KECO
10

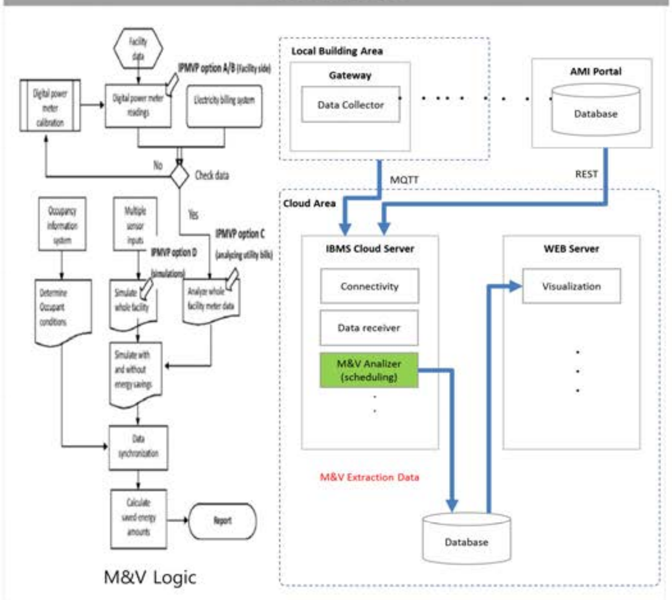

AI & Rule Engine of N-CSTP™
*N-CSTP : Ntels Connected/Cloud Smart Twin Platform
AI + Rule Engine base Energy Prediction & Active/Adaptive Management
AI + Rule Engine with CEP : Energy Prediction & Active/Adaptive Management
Seq2Seq 모델
K월 예측
Encoder
LSTM
Decoder
K+1월 수요 예측
Response
Target-A (Machine)
RT DB
Realtime Value
RMS
CEP
Cash CEP.R
Triggering
Control Broker
Message Broker
AI Engine
Target-B (Machine/MAN)
11

M&V Engine of N-CSTP™

*N-CSTP : Ntels Connected/Cloud Smart Twin Platform

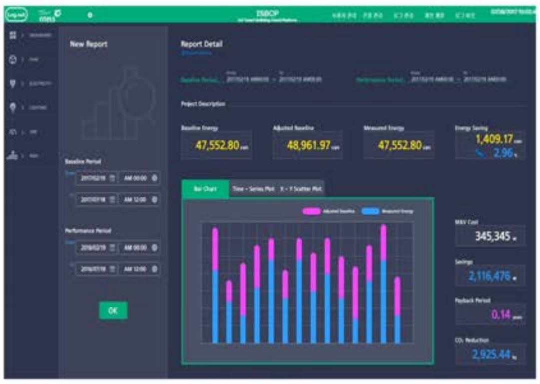
- **Measurement & Verification Algorithms (Energy)**

M&V Interface



Feature of M&V

Item	Description
Connectivity	Gateway MQTT, AMQP, REST
Data receiver	Building Energy Data Collect & DB Loading
M&V Analizer	IPMVP based M&V Logic Running & data extraction ✓Input : JSON ✓Output : CSV
Visualization	AMR chart/ELK



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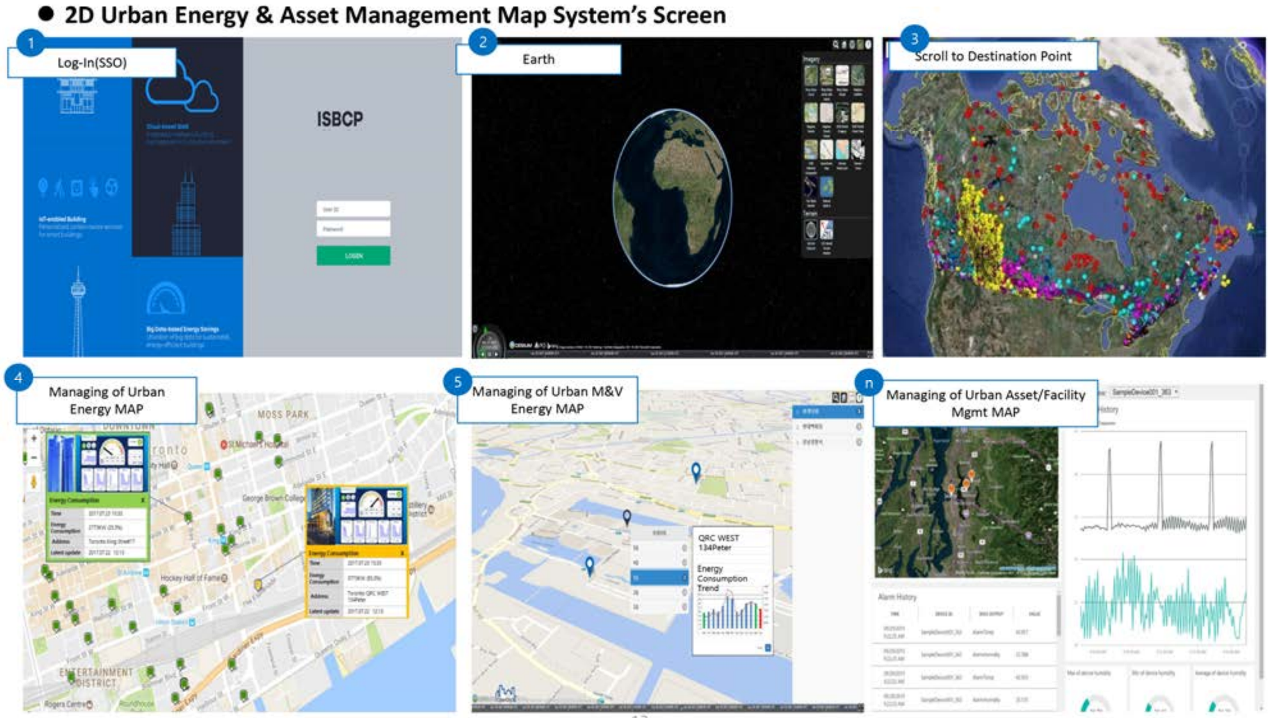
UX/UI of N-CSTP™ – Urban Energy & Asset Management Map (2D)

- **2D Urban Energy & Asset Management Map System's Screen**



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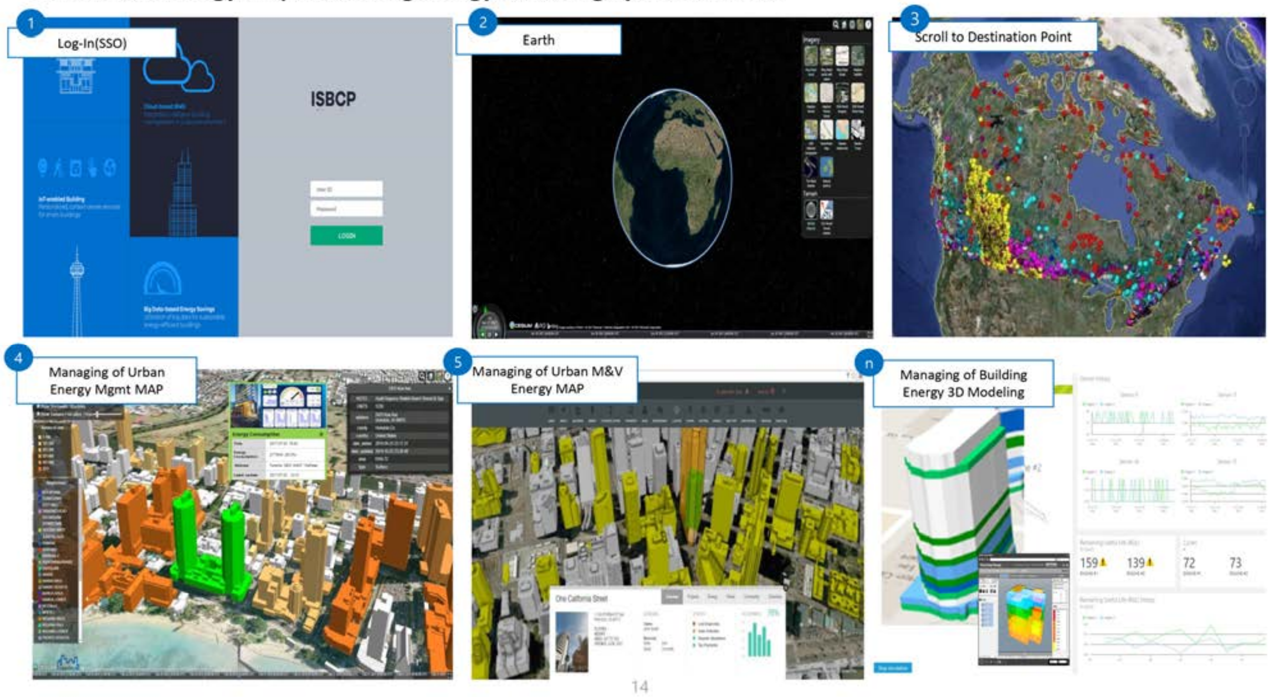
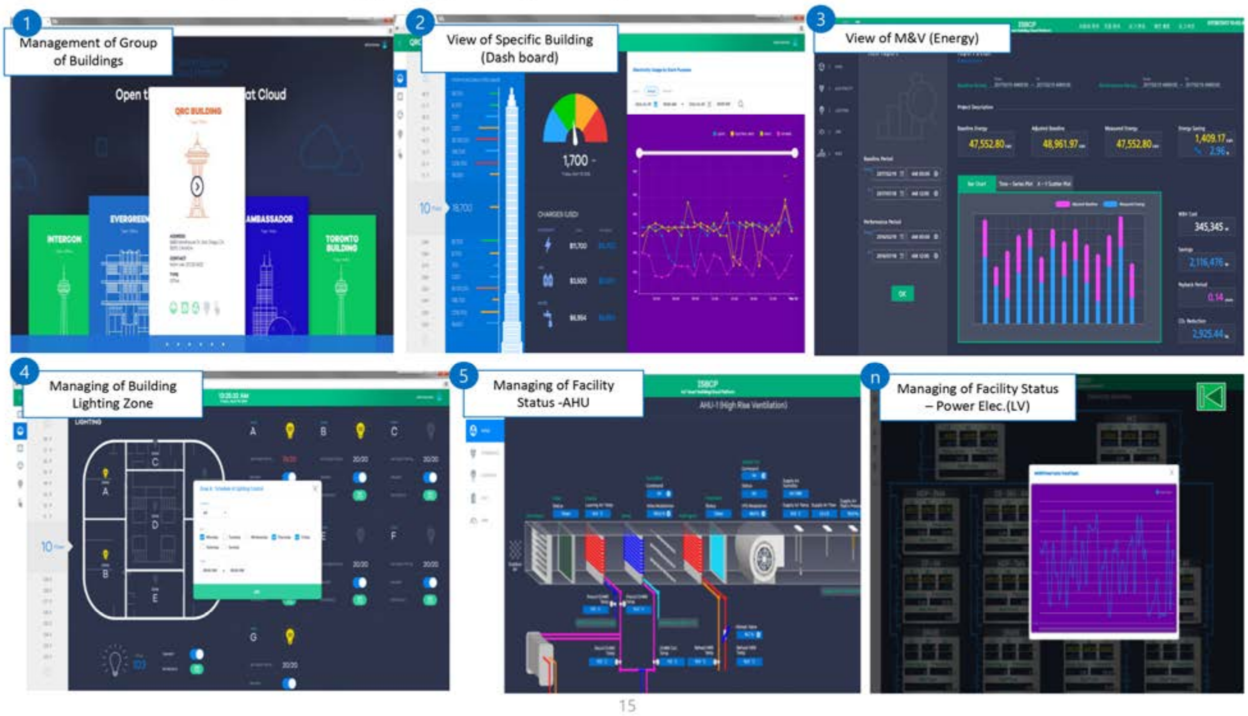
UX/UI of N-CSTP^{TM} – Urban Energy MAP & Building Energy Modeling (3D)

- 3D Urban Energy Map & Building Energy Modeling System's Screen



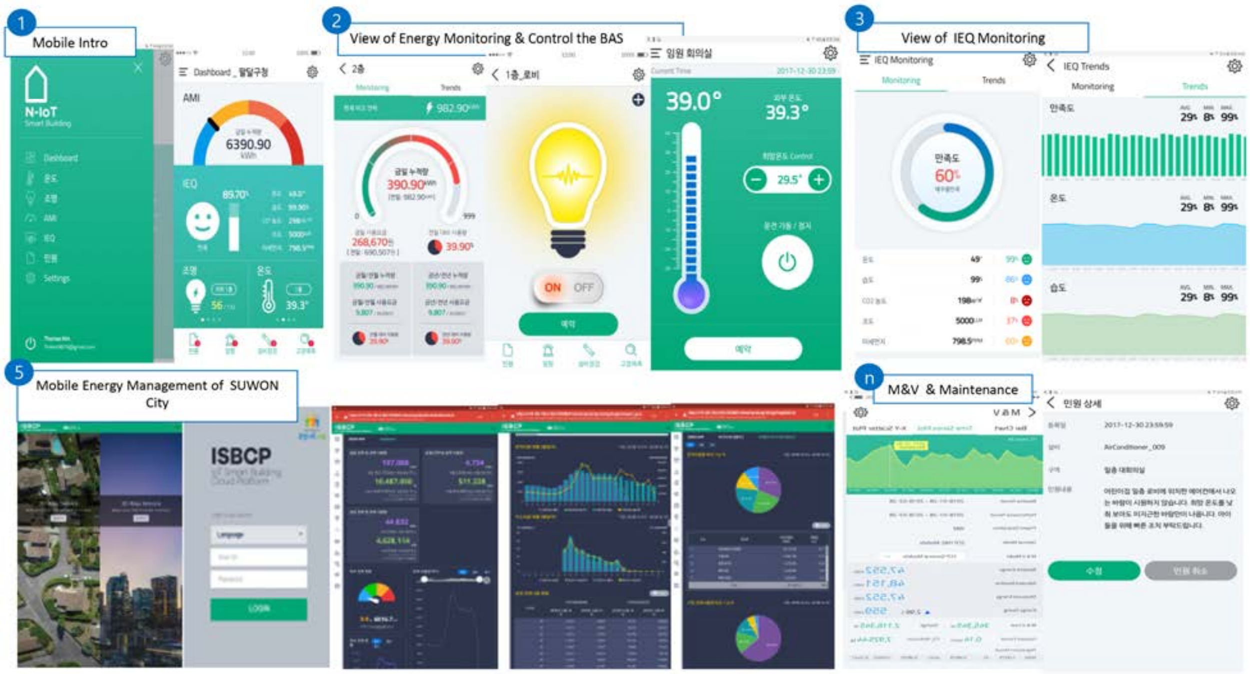
UX/UI of N-CSTP^{TM} – Building Facility & Energy Modeling

- Cloud-based Integrated Building/Energy Management System's Screens



UX/UI of N-CSTP™ – Mobile

- Mobile Service



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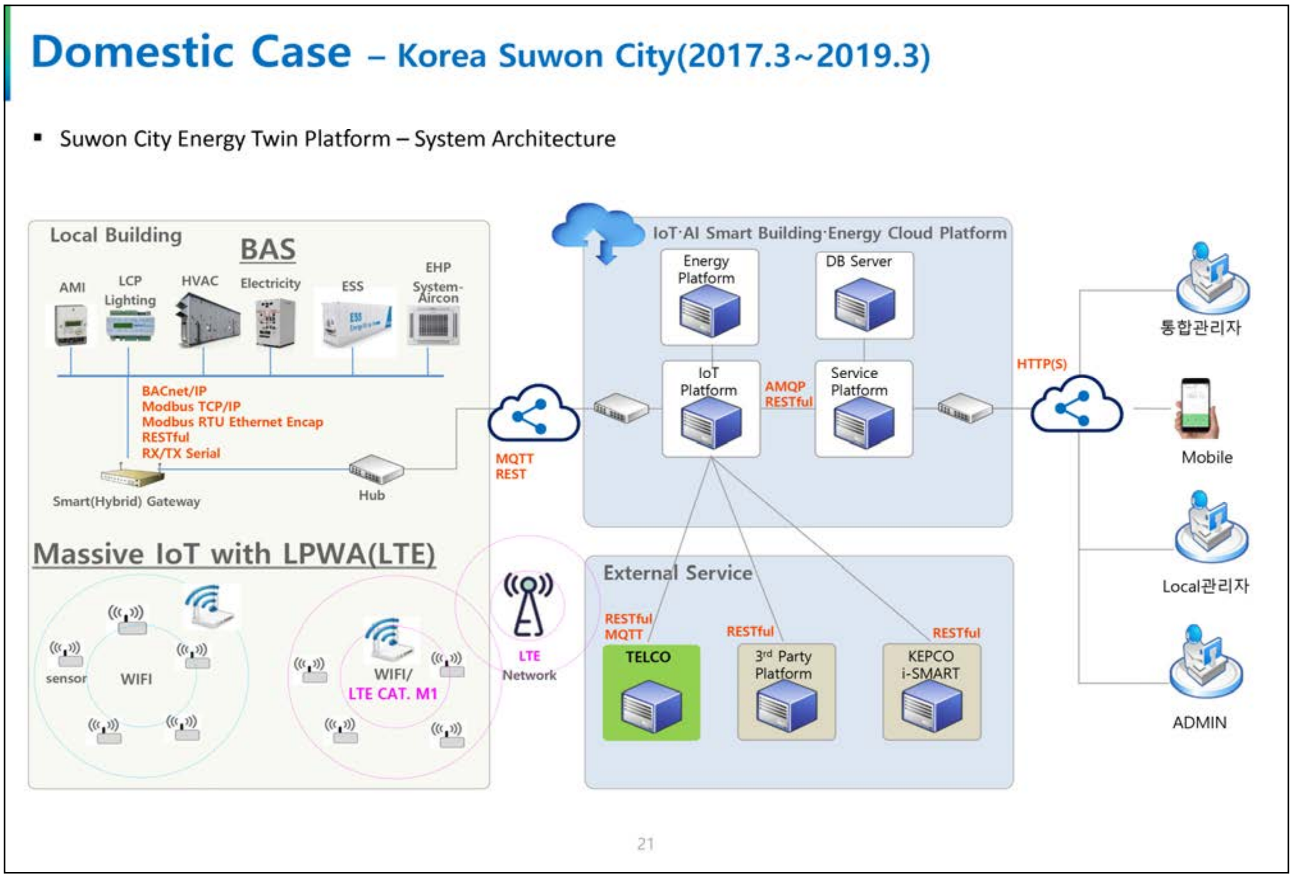
Introduction of Domestic and Overseas Cases

ntels


Domestic Case – Korea Suwon City(2017.3~2019.3)
Suwon City in Korea http://trans.suwon.go.kr:7000/etgi/
As part of national research projects of Ministry of Science and ICT, urban 3D energy map-based Cloud Smart Building Management System was implemented for 100 public buildings in Suwon City
Smart Building Management System to increase energy efficiency of 105 public buildings in Suwon City, Gyeonggi-do
Gyeonggi-do
Seoul
Suwon
18


Primary Contact : Changsoo Park [cspark11@ntels.com]
IoT & AI Smart Building and Energy City Platform in Suwon City
(KOREA Government Project)
3D Map Service
IoT·AI
Smart Building/Energy
Cloud Platform
Real-Time Monitoring
Gateway
Government of KOREA's IoT & AI Smart Buildings and Energy City Initiative
NTELS Smart Building & Energy City Platform was deployed in public buildings in Suwon City to provide optimal management building facilities, environment, and energy using the urban 3D map and 3D spatial modeling. With the M&V engine as well as data intelligence technology with deep-learning, the platform can quickly measure energy performance and determine city energy efficiency.
Creative Convergence ntels
nipa
사람이 반갑습니다
휴먼시티 수원
과학기술정보통신부
19


Domestic Case – Korea Suwon City(2017.3~2019.3)
Attend the USA GCTC2017/2018/2019, REALCOMM2017/2018, Spain SCEWC2018/2019, Singapore IFMA2018 Conference
수원시
사람이 반갑습니다
HUMAN CITY SUWON
Creative Convergence
ntels
nipa
2017~2018 Spain SCEWC AWARD
Suwon City Public Building Energy Platform Project
에너지정책 전환을 위한 지방정부협의회
2019년 정기총회 및 지역에너지전환 간담회
Suwon Smart City Platform
SMARTCITY EXPO WORLD CONGRESS
SMARTMOBILITY CONGRESS
13 - 15 NOV 2018 BARCELONA
GLOBAL CITY TEAMS CHALLENGE
5G
2020 -2035
Suwon City (2019.1.21)
2017~2019 USA GCTC/REALCOMM
2018 Smart City Summit ASIA/Singapore IFMA
20


Domestic Case – Korea Suwon City(2017.3~2019.3)
▪ Suwon City Energy Twin Platform – System Architecture
Local Building
BAS
AMI
LCP Lighting
HVAC
Electricity
ESS
EHP System-Aircon
BACnet/IP
Modbus TCP/IP
Modbus RTU Ethernet Encap
RESTful
RX/TX Serial
Smart(Hybrid) Gateway
Hub
Massive IoT with LPWA(LTE)
sensor
WIFI
WIFI/
LTE CAT. M1
LTE Network
MQTT
REST
IoT·AI Smart Building·Energy Cloud Platform
Energy Platform
DB Server
IoT Platform
AMQP
RESTful
Service Platform
HTTP(S)
External Service
RESTful
MQTT
TELCO
RESTful
3rd Party Platform
RESTful
KEPCO i-SMART
통합관리자
Mobile
Local관리자
ADMIN
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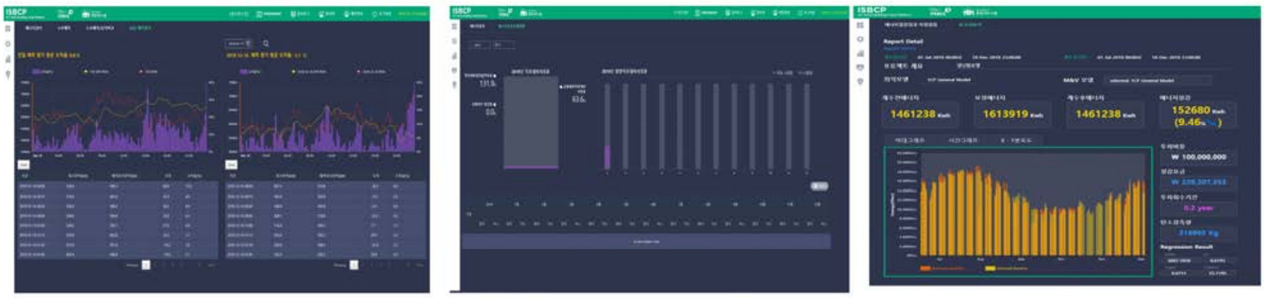
Domestic Case – Korea Suwon City(2017.3~2019.3)

- Suwon City Energy Twin Platform - UX/UI

Energy MAP POI, Dashboard, Prediction(AI), M&V



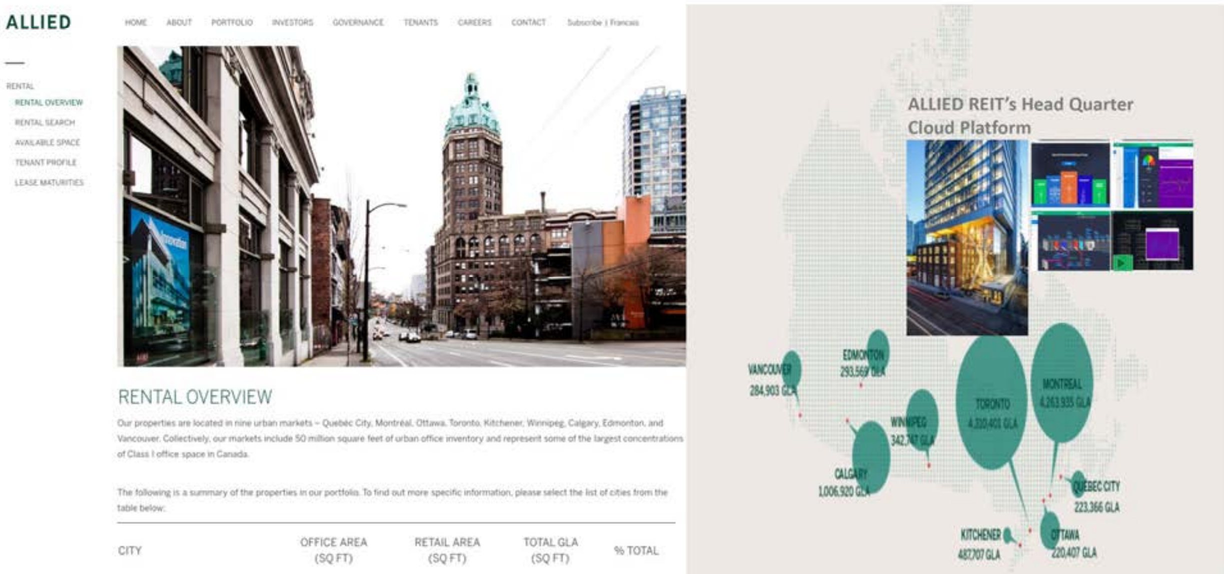
Energy Prediction with AI, Energy Goal Management, M&V(Measurement & Verification) of Platform Performance

22

Overseas Case – CANADA Toronto QRC West (2016.12)

- ALLIED REIT

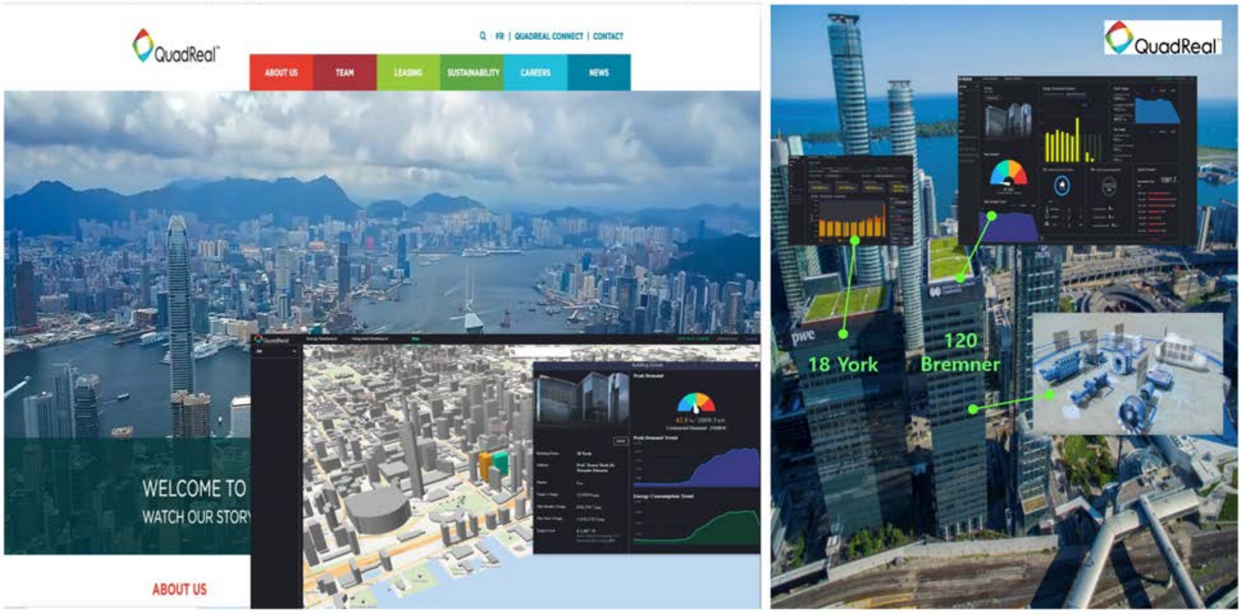
Allied is a leading owner, manager and development of urban office environments that enrich experience and profitability for business tenants operating in Canada's major cities. (Allied owns more than 150 buildings in Canada, and they has a rental business)



Overseas Case – CANADA Toronto Southcore (2019.11~)

- QUADREAL REIT

QuadReal has deep roots in the real estate industry with a foundation that was built from consolidating the assets and expertise of four seasoned players in the Canadian real estate investment and management industry. Built upon a strong foundation, guided by long-term vision, QuadReal's team is formed from diverse and complementary backgrounds in Canadian and international investment, development and real estate management.



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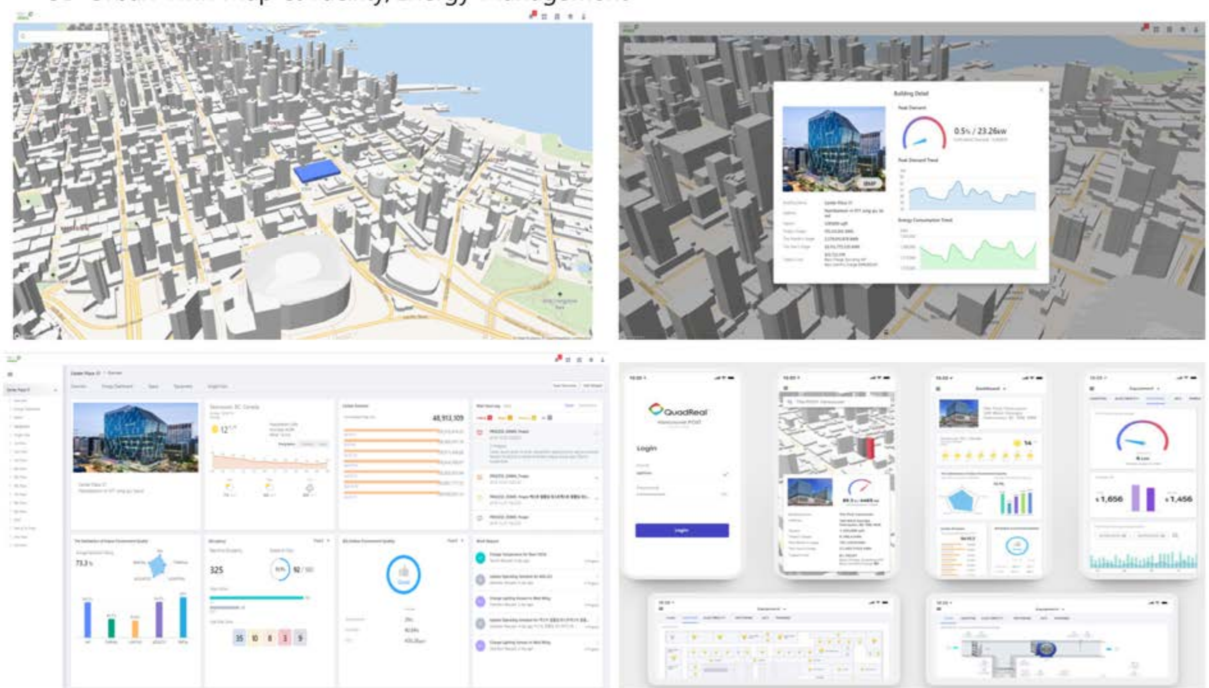
Overseas Case – CANADA Toronto Southcore (2019.11~)

- 3D Urban Twin Map & Facility/Energy Management



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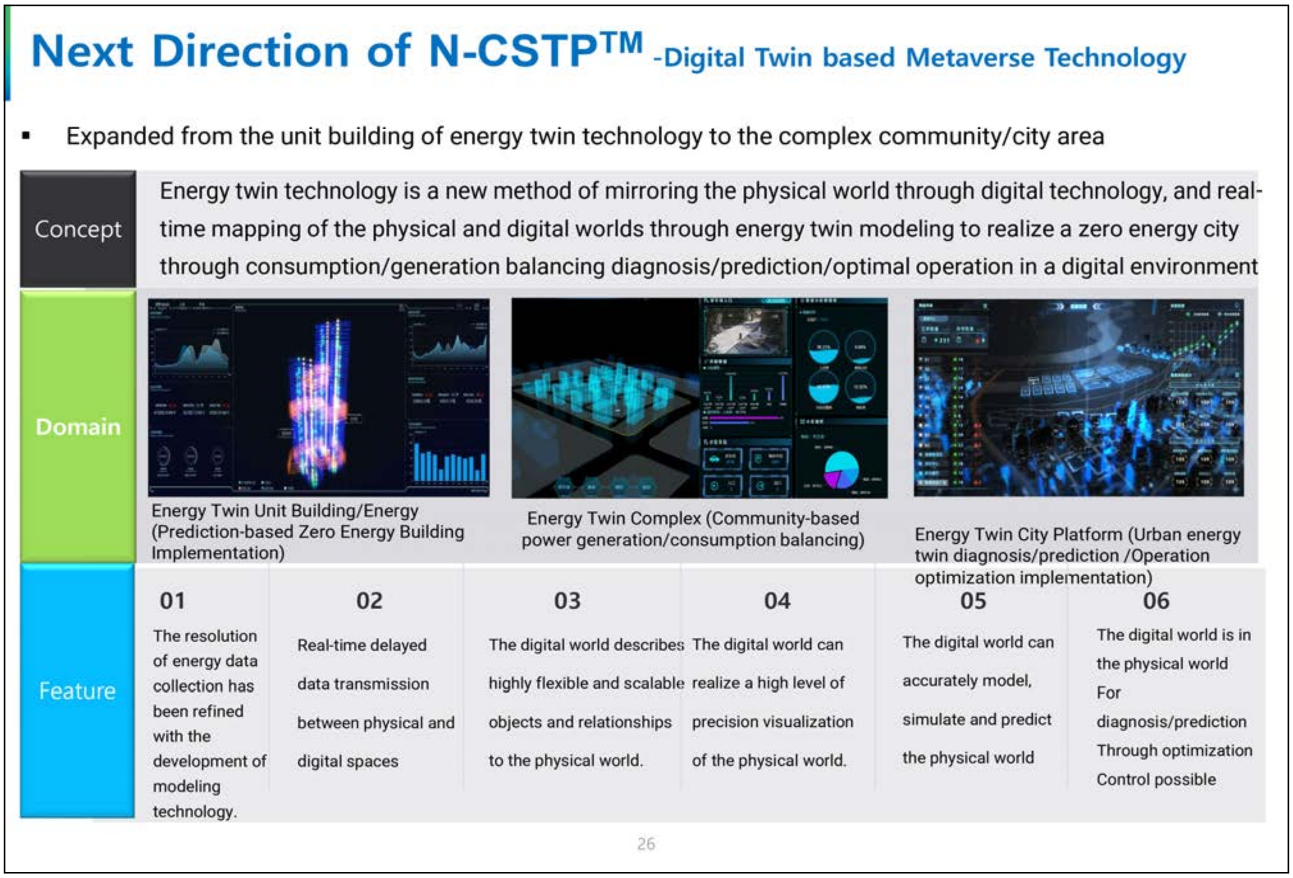
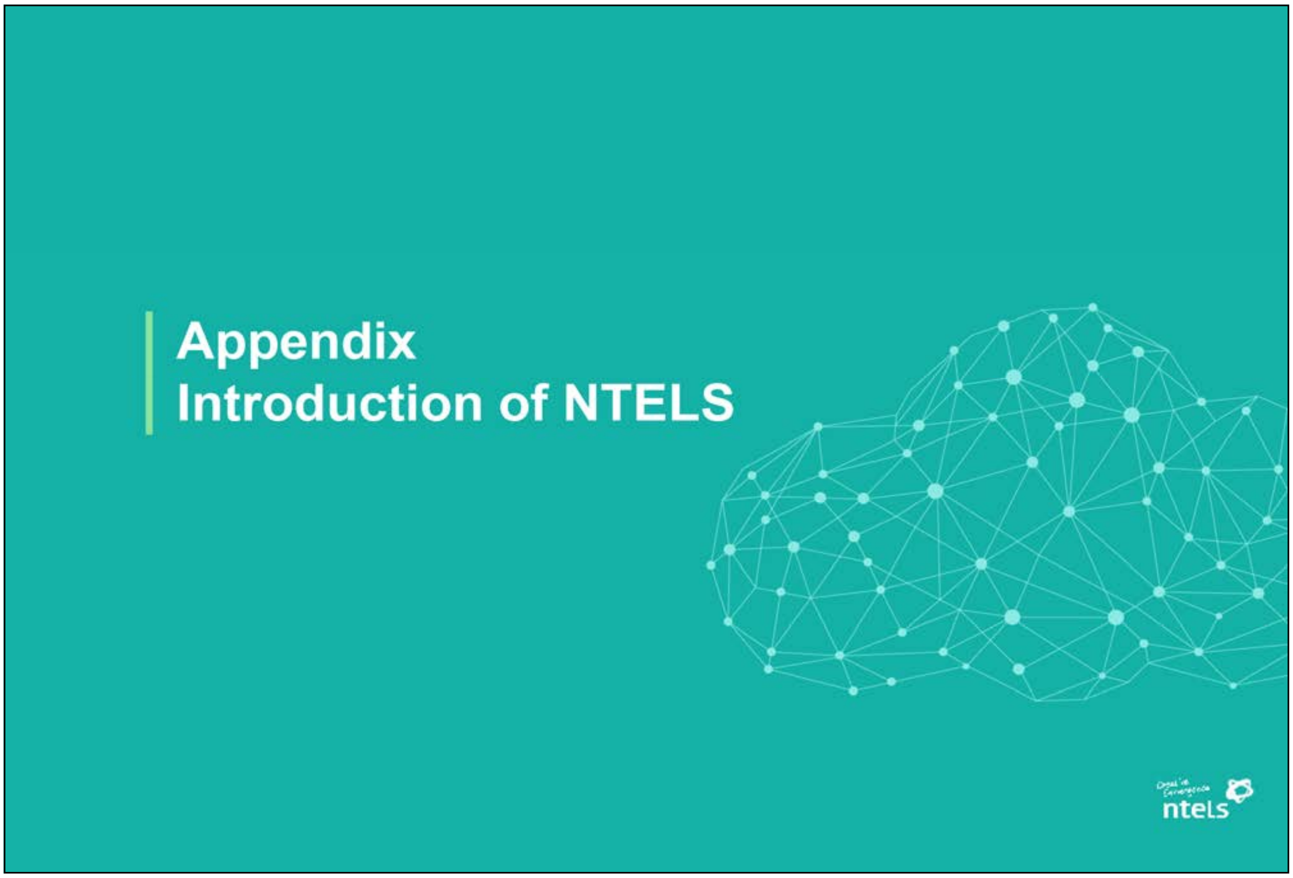

Next Direction of N-CSTPTM -Digital Twin based Metaverse Technology
Expanded from the unit building of energy twin technology to the complex community/city area
Concept
Energy twin technology is a new method of mirroring the physical world through digital technology, and real-time mapping of the physical and digital worlds through energy twin modeling to realize a zero energy city through consumption/generation balancing diagnosis/prediction/optimal operation in a digital environment
Domain
Energy Twin Unit Building/Energy (Prediction-based Zero Energy Building Implementation)
Energy Twin Complex (Community-based power generation/consumption balancing)
Energy Twin City Platform (Urban energy twin diagnosis/prediction /Operation optimization implementation)
Feature
01
The resolution of energy data collection has been refined with the development of modeling technology.
02
Real-time delayed data transmission between physical and digital spaces
03
The digital world describes highly flexible and scalable objects and relationships to the physical world.
04
The digital world can realize a high level of precision visualization of the physical world.
05
The digital world can accurately model, simulate and predict the physical world
06
The digital world is in the physical world For diagnosis/prediction Through optimization Control possible
26


Appendix
Introduction of NTELS
ntels

About NTELS

We have the agility to rapidly embrace the paradigm shift of convergence with the vision to improve customer experience and drive transformative innovation.

With our extensive capabilities in the era of ICT convergence and hyper-connectivity, we deliver innovative converged solutions and services across verticals that can help accelerate convergence of IT and traditional industries, such as manufacturing and energy.

We are on track to become the world's leading converged service provider by building best practices and pursuing both new business cultivation as well as high-value intelligence creation.

Company Name	NTELS Co., Ltd. (KOSDAQ 069410)
CEO	Young-Lae Choi
Date Established	July 19, 2000
Number of Employees	225 (proportion of R&D: 85%)
Corporate Address	Geumha Bldg. 8th Floor, Hakdong-ro 401, Gangnam-gu, Seoul, Korea
Regional Office	Jakarta Indonesia

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About NTELS

HISTORY

2000-2006

Positioned as a Solution Leader in telecommunications

Delivered the business support system for commercial deployment of CDMA services as well as communication and network solutions for MNO/MVNO

2008-2013

Expanded Business into New Areas as a Converged Service Provider

Repositioned as a converged service provider in verticals based on experience and expertise in communication solutions

2014-Current

Developed Services for IoT-driven Convergence of Industries

Delivering transformative services and solutions that help leverage the power of the Internet of Things and convergence of technologies as well as industries

2000

Established the Company

2007

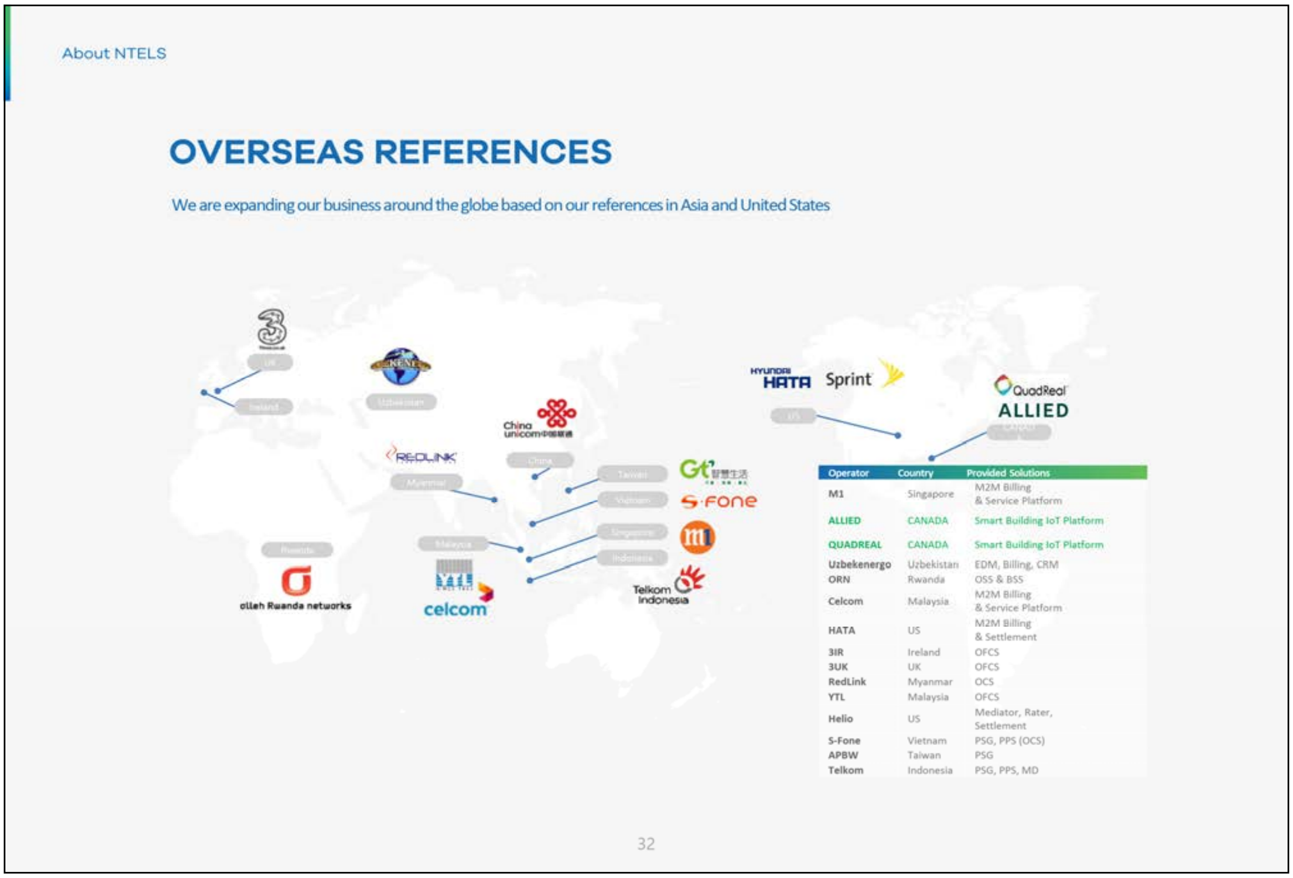
Listed on KOSDAQ

Listed on the Korean Exchange (KOSDAQ) as result of continuing investment in product development and responding to changes

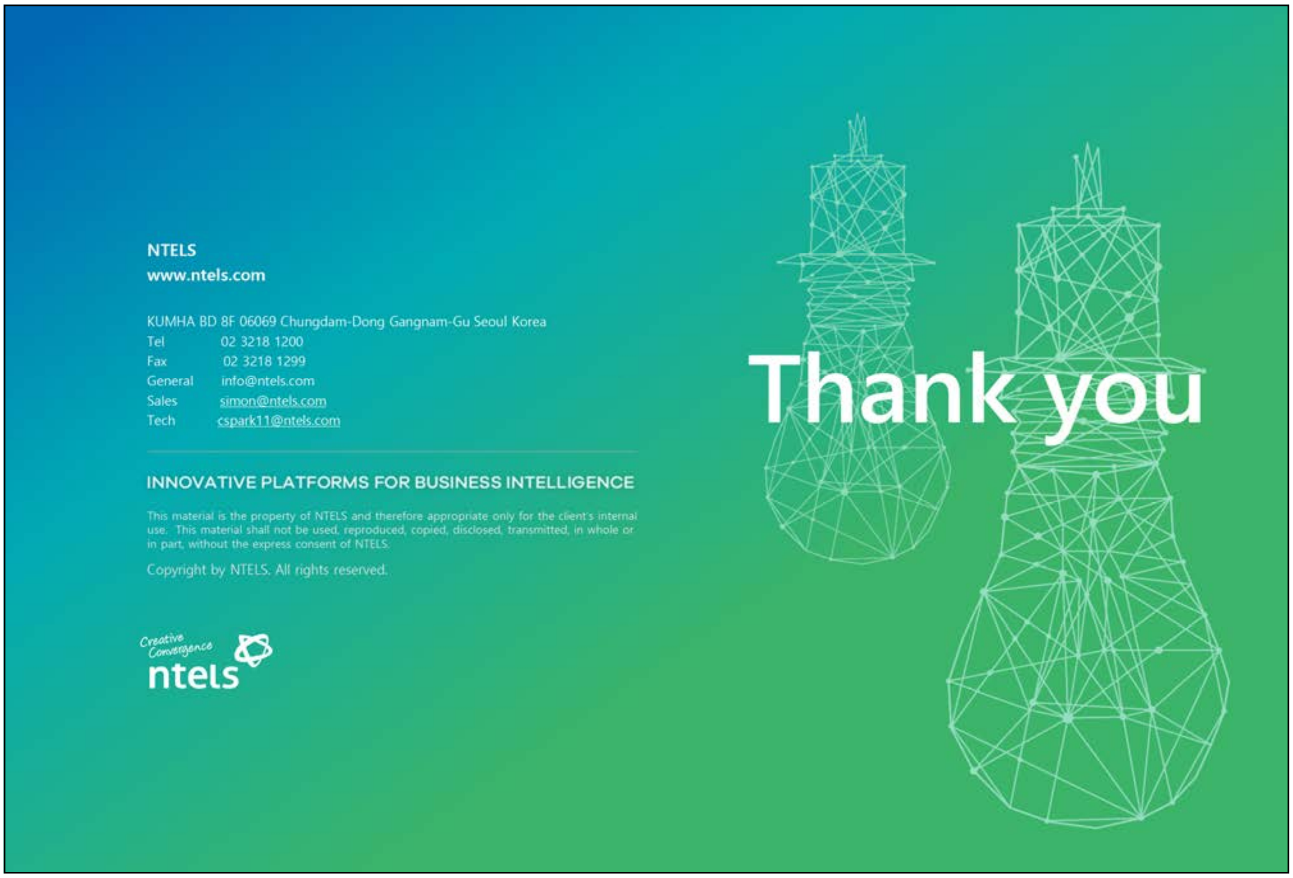
29


About NTELS
INDUSTRIES
We are expanding our product line to keep up with convergence on both the technology and service sides and improving our service offerings to make it easier to do business with us
Energy
Tomorrow's Energy Economy
Smart City
Sustainable Digital City
Telecommunications
A Future Network
Manufacturing
Embrace Digital Transformation
NTELS provides energy infrastructure technologies to effectively manage renewable and distributed energy resources for balanced energy consumption and to analyze energy data for stable energy supply. With our solutions adaptable to new energy business models, we can help gear towards the concept so called Energy 4.0, which is the digitalization in the energy industry towards smart energy generation and consumption.
NTELS can connect urban infrastructures using our platform, collect and analyze data in real time by adopting the Internet of Everything (IoE) that makes things smarter and people more capable, and provide context-aware personalized smart services.
NTELS provides agile smart network solutions from operations support systems to network optimization and virtualization management solutions that help you reconfigure the network to accommodate new service requirements and offer 5G services.
NTELS can help manufacturers respond to such challenges and disruptions caused by the paradigm shift in manufacturing and deliver cutting-edge customer experiences. With industrial Internet technologies, we provide smart manufacturing solutions for industrial safety management, facility & equipment management as well as energy management.
30


About NTELS
BUSINESS AREAS
NTELS can get you on the pathway to Digital Transformation by helping you enhance Customer Experience, improve Operational Efficiency and reinvent Business Models.
Internet of Things
5G
Smart Network
CRM & Billing
• IoT Platform
• IoT Business Support Solution
• Smart City Solution
• Integrated Building Management Solution
• Smart Home Solution
• Industrial Safety Solution
• Digital Signage Solution
• 5G-enabled Traffic & Subscriber Management Solution
• 5G Charging Management Solution
• SDN/NFV & Orchestration Solution
• IoT Connectivity Solution
• Big Data Analytics Solution
• Network Visibility Solution
• Convergent Charging Solution
• Billing and Revenue Management Solution
• Customer Relationship Management Solution
• Custom-Billing Solution
• Integrated Utility (Electricity, Gas, Water, etc.) Billing Solution
31



Operator	Country	Provided Solutions
M1	Singapore	M2M Billing & Service Platform
ALLIED	CANADA	Smart Building IoT Platform
QUADREAL	CANADA	Smart Building IoT Platform
Uzbekenergo	Uzbekistan	EDM, Billing, CRM
ORN	Rwanda	OSS & BSS
Celcom	Malaysia	M2M Billing & Service Platform
HATA	US	M2M Billing & Settlement
3IR	Ireland	OFCS
3UK	UK	OFCS
RedLink	Myanmar	OCS
YTL	Malaysia	OFCS
Helio	US	Mediator, Rater, Settlement
S-Fone	Vietnam	PSG, PPS (OCS)
APBW	Taiwan	PSG
Telkom	Indonesia	PSG, PPS, MD



2021 ICGIS
International Conference
on Geospatial Information Science

Smart GEO Expo 2021
2021 스마트국토엑스포

Urban 3D geospatial modelling for Realistic Geospatial Data

[실감공간데이터를 위한 도시 3차원 지형공간 모델링]

Si-yeong Lim Korea Research Institute for Human Settlements

Urban 3D geospatial modelling for Realistic Geospatial Data

- Achievement of R&D research group for Realistic 3D modeling -

2021.07.22

KRIHS

Geospatially Enabled Society Research Division

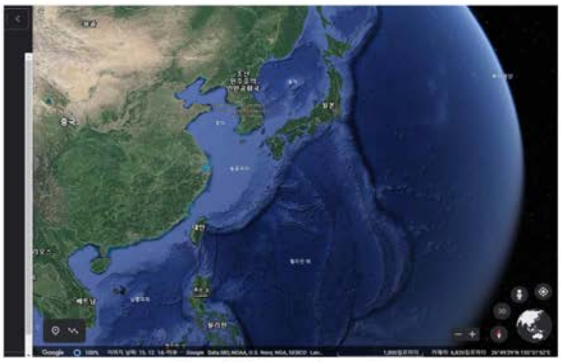
Si-Yeong Lim

- Contents-

1. Background

국토연구원

- Google Earth vs V-world



From 2005, google earth

From 2012, Korean Google Earth, V-world

Street view in Naver map

1

1. Background

국토연구원

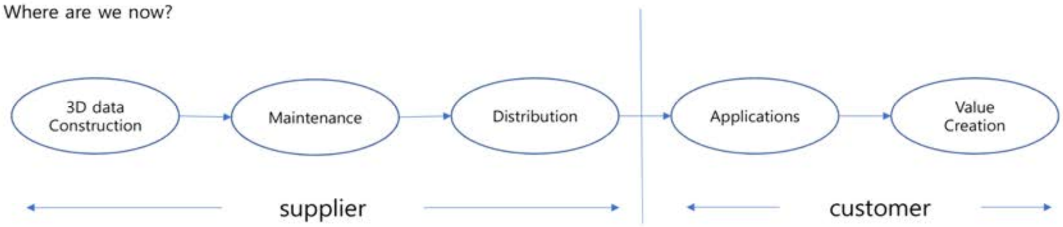
- Digital twin, Metaverse, & 3D ?

2009
Pre feasibility study
for 3D

<Digital twin>

<Metaverse>

- Where are we now?



2

1. Background

- Some Questions !

1. How can we make 3D geospatial data more useful?
2. In advance, is it possible to know who will use the data ?
3. How can we create it quickly and inexpensively?
4. Would it make sense to update in the parts instead of making the whole thing?
5. At the same time, can the original purpose be maintained?

3

1. Background

- We made up our own answer!

1. How can we make 3D geospatial data more useful?
   - ➡ We have to create what user wants.
2. In advance, is it possible to know who will use the data ?
   - ➡ In disaster management, virtual moving object simulation, & tourism content fields
   - ➡ Multi- ministerial R&D project including demand-par.t
3. How can we create it quickly and inexpensively?
4. Would it make sense to update in the parts instead of making the whole thing?
5. At the same time, can the original purpose be maintained?
   - ➡ Let's develop related technology.

4

1. Background

국토연구원

- We made up our own answer!

5-1 Aerial Image => too expensive and too slow

➡ UAV(Drone), MMS, Mobile... etc

5-2 Using UAVs is not as effective as we might think

➡ Flight path simulation

➡ Efficient photographing(Gimbal, Antenna, shooting angle, supporting SW)

5-3 Many processes in 3D-construction are done manually

➡ Automated Solid model generation from point-cloud

➡ Occlusion area processing by AI

5-4 Check the partial change and correct only that part

➡ Change-detection for 3D object

➡ 5-5 Since we don't know exactly what the consumer wants

↓

So we must have the raw data for 3D modeling

5

1. Background

국토연구원

- We made up our own answer!

5 At the same time, can the original purpose be maintained?

➡ Make 3D object for the various sources we currently have

➡ Supply 3D object of the various formats

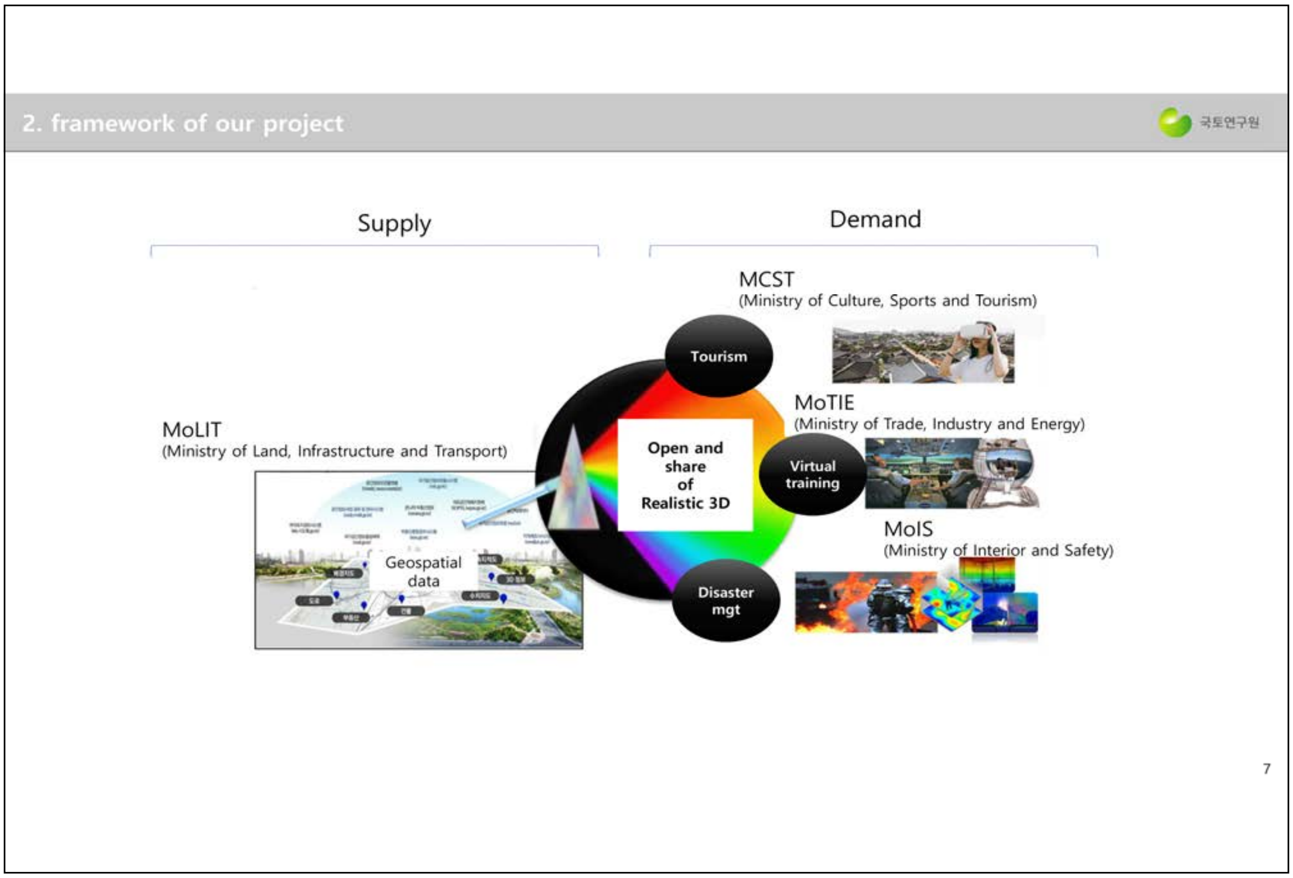
➡ Provide an functions that users create what they want

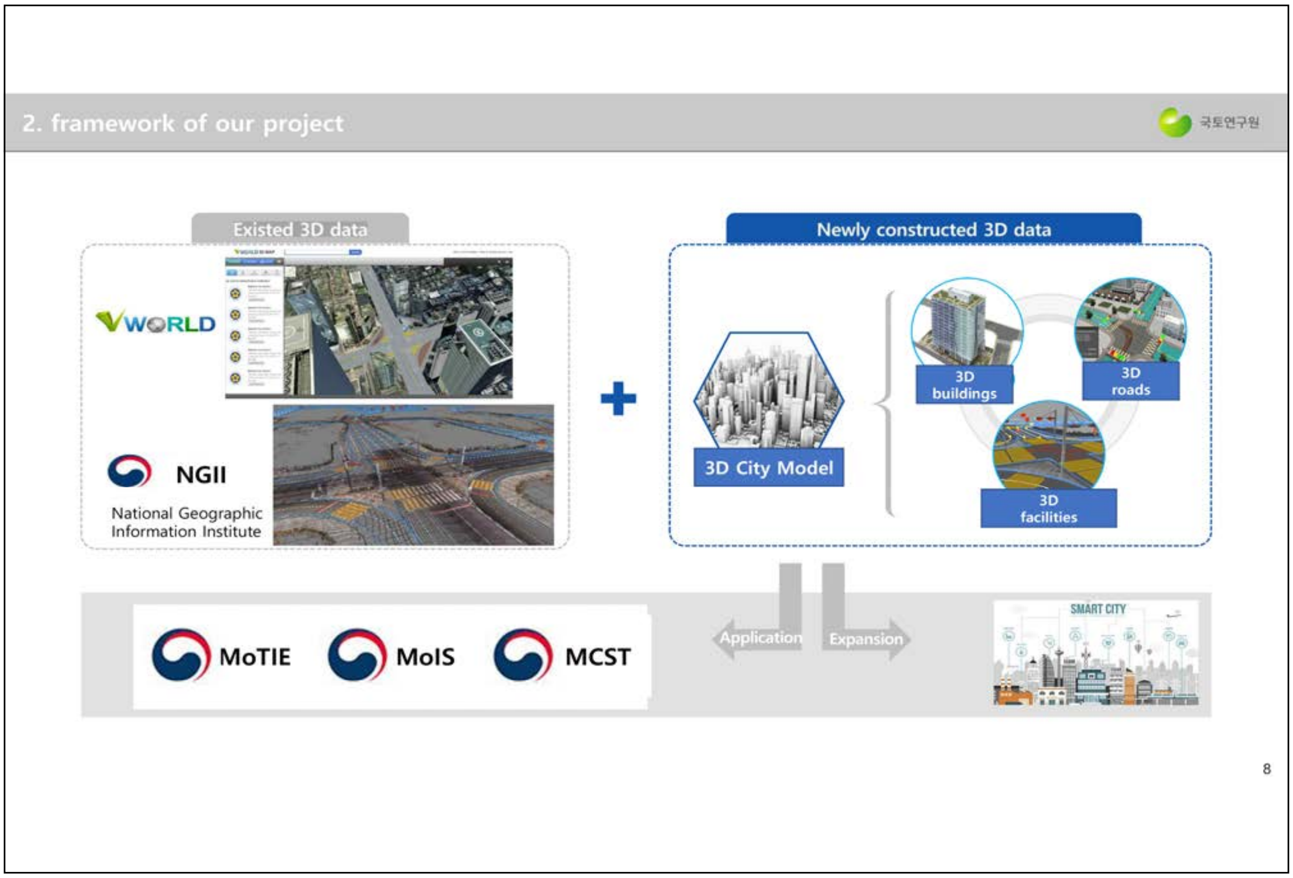
➡ Make 4D(AR/VR) applicable for the future

➡ And,

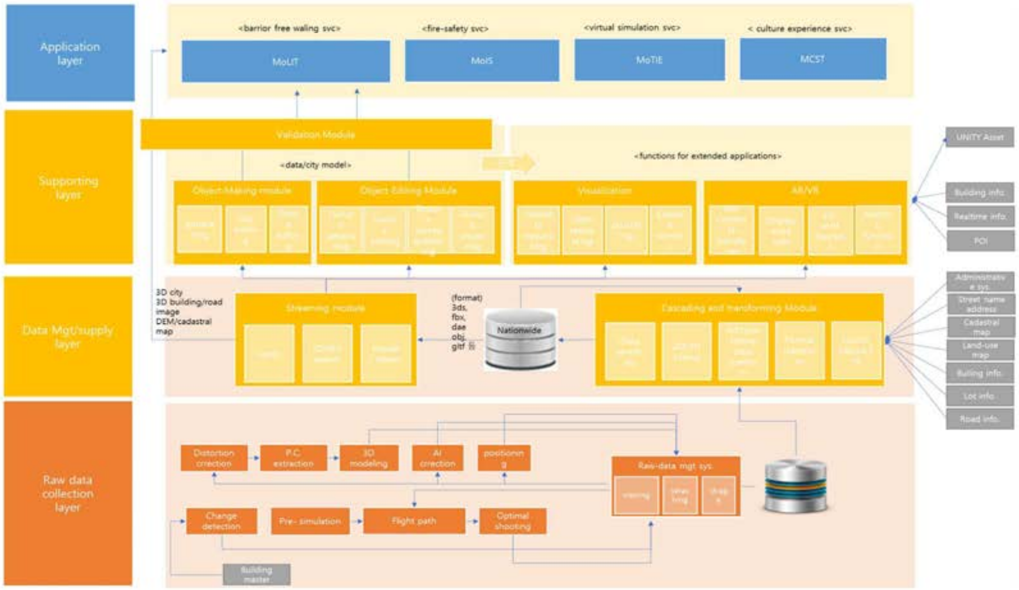
It is needed the Quality Assurance and Practices for proving our results

6


2. framework of our project
국토연구원
Supply
Demand
MCST
(Ministry of Culture, Sports and Tourism)
Tourism
MoTIE
(Ministry of Trade, Industry and Energy)
Virtual training
MoLIT
(Ministry of Land, Infrastructure and Transport)
Open and share of Realistic 3D
Geospatial data
MoIS
(Ministry of Interior and Safety)
Disaster mgt
7


2. framework of our project
국토연구원
Existed 3D data
VWORLD
NGII
National Geographic Information Institute
Newly constructed 3D data
3D City Model
3D buildings
3D roads
3D facilities
MoTIE
MoIS
MCST
Application
Expansion
SMART CITY
8

2. framework of our project



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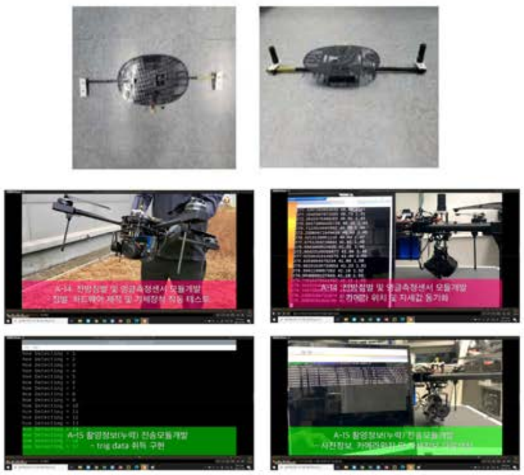
3. Results

1. UAV(Drone), MMS, Mobile… etc
   - Before : Aerial Image => too expensive and too slow
2. Using UAVs is not as effective as we might think
   - Flight path simulation
   - Efficient photographing(Gimbal, Antenna, shooting angle, supporting SW)
3. How can we create it quickly and inexpensively?
   - Automated Solid model generation from point-cloud,
   - Occlusion area processing by AI
4. Would it make sense to update in the parts instead of making the whole thing?
   - Change-detection for 3D object

Since we don't know exactly what the consumer wants

So we must have the raw data for 3D modeling



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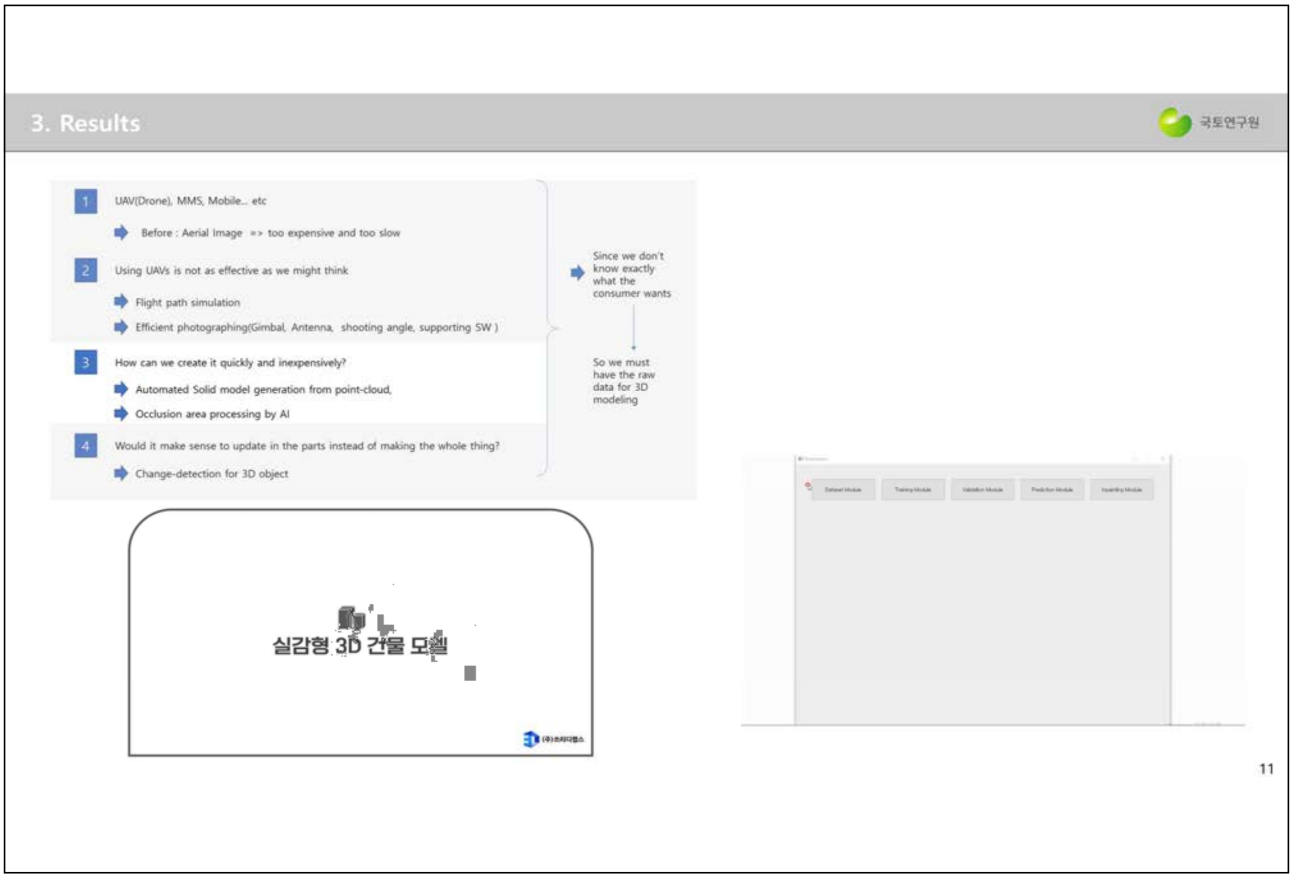
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So we must have the raw data for 3D modeling
실감형 3D 건물 모델
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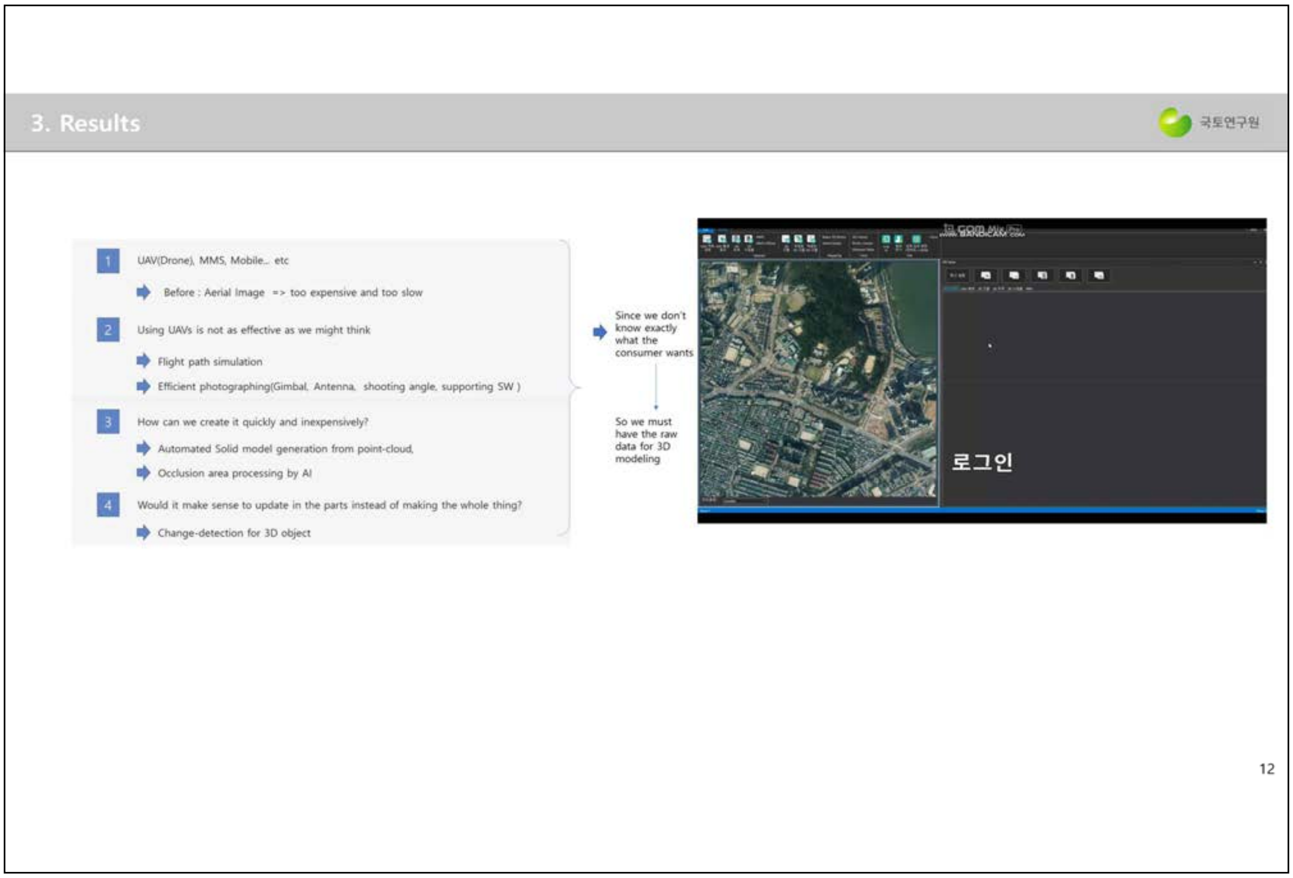
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로그인
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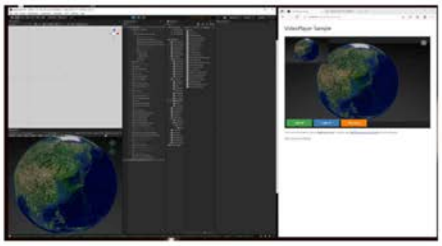
3. Results

국토연구원

5 At the same time, can the original purpose be maintained?

- Make 3D object for the various sources we currently have
- Supply 3D object of the various formats
- Provide an functions that users create what they want
- Make 4D(AR/VR) applicable for the future

And,
It is needed the Quality Assurance and Practices for proving our results



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3. Results

국토연구원

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시계열 가시화

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3. Results

국토연구원

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** I think ...

국토연구원

MORE
Subdividable
R&D

MORE
Participants
In finding out
Demands

MORE
Various
Geospatial Data

16


Thank you

MEMO

MEMO

MEMO

MEMO