InfraTech Stock Take of Use Cases

Global Infrastructure Hub

G20 Infrastructure Working Group Reference Note

June 2020

1. Context and overview

1.1 Background

The G20 has highlighted the importance of infrastructure as a driver of economic prosperity and the basis for strong, sustainable, balanced and inclusive growth and development. However, a persistent and well-recognized infrastructure gap still remains. This has been addressed by the various G20 Presidencies – first in 2018 through the Roadmap to Infrastructure as an Asset Class and in 2019 through the Quality Infrastructure Investment (QII) Principles. In 2020, the G20 Presidency is developing an Agenda to accelerate the adoption of technology for infrastructure (InfraTech) that will help countries achieve better environmental, social and economic outcomes.

The need to close the infrastructure gap through the delivery of quality infrastructure and the implementation of InfraTech is greater now that it was before, as governments face increasing fiscal constraints due to the COVID-19 pandemic. While a global shift towards sustainable and resilient infrastructure was already in motion prior to COVID-19, it is now more crucial than ever that this is done (and done well) in light of new economic, social and political conditions.

1.2 Objective

InfraTech is defined by the G20's Infrastructure Working Group (IWG) as *"the integration of material, machine, and digital technologies across the infrastructure lifecycle"* and is supported by three reference notes produced in collaboration between the G20 IWG, the World Bank and the GI Hub: 1) The InfraTech Stock Take of Use Cases; 2) The Value Drivers for InfraTech; and 3) The InfraTech Policy Toolkit.

This paper serves as the reference note for the **Stock Take of Use Cases** and it supports the InfraTech Agenda by identifying InfraTech use cases in four quality infrastructure sectors (water, waste, energy and transport), identifying their benefits and how to use them. More specifically, the Stock Take identifies four key opportunities for InfraTech, which are:

1. Addressing the barriers to technology adoption
2. Engaging with the private sector
3. Supporting the advancement of Quality Infrastructure Investment (QII) principles
4. Supporting the government's response to COVID-19

These four areas are informed by the InfraTech Agenda's non-binding 'Elements' and other work streams delivered by the G20 IWG, MDBs and IOs over the last six months. Further details of how the Stock Take links with the 'Elements' and the above objectives are detailed in the following sections of this paper.

2. Addressing the barriers to technology adoption

2.1 The barriers to technology adoption

To support the development of the InfraTech Agenda and this Stock Take Reference Note, GIH undertook research in 2019 that investigated the levels of digital technology adoption in the infrastructure sector. The research showed that the uptake of digital technologies is relatively low in infrastructure compared with other sectors. This is illustrated by Figures 1 and 2 below.

Figure 1 shows that the construction sector, for example, has started on its digital journey but it is still well behind other industries.

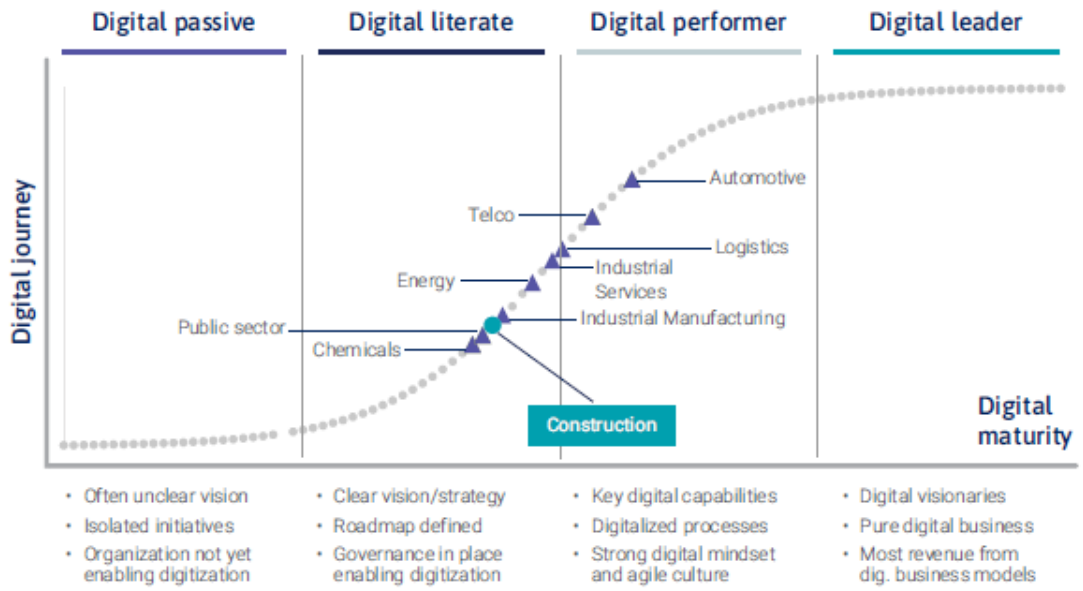

Figure 1: Digital maturity of the construction industry (GI Hub, 2019)

A similar situation exists with technology adoption across the infrastructure project lifecycle. Figure 2 below shows that the level of technology adoption across each infrastructure project stage is either 'low' or 'very low'.

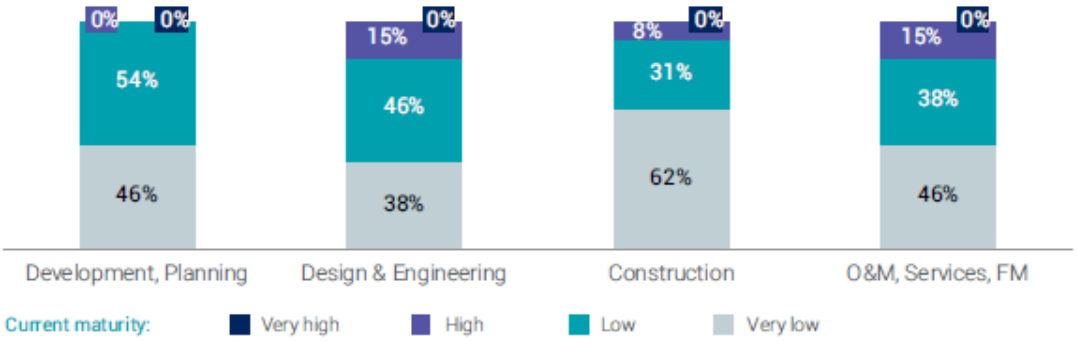

Figure 2: Digital adoption by stage of infrastructure lifecycle (GI Hub, 2019)

To shed some light on why these situations exist, a series of interviews were undertaken with representatives from governments, investors, contractors, operators, technology firms and advisors spread across the major global regions. Through these interviews, the GI Hub identified seven main causes of low technology adoption in infrastructure. These are outlined in Figure 3 below. One of the main causes is the education element – that is, a limited understanding of what's out there and what works.

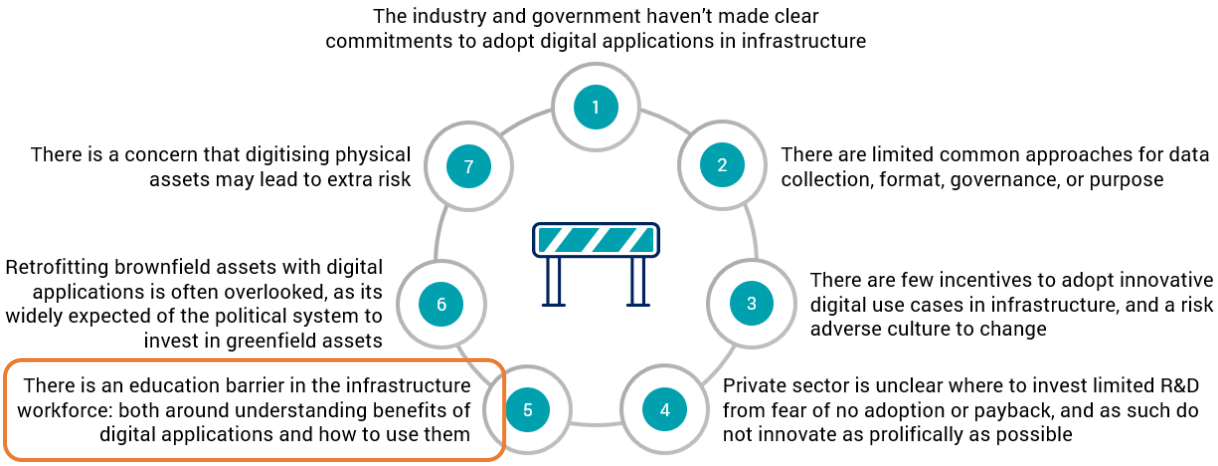

Figure 3: Seven key barriers to technology adoption (GI Hub, 2019)

2.2 Addressing the education barrier with a Stock Take of Digital Infrastructure Use Cases

The education barrier affects InfraTech adoption through a lack of knowledge around the technology landscape and the fear of being seen to be 'picking a winner'. This is not aided by the fact that digital technologies are rapidly evolving. Infrastructure is by nature long-term, therefore selecting technology is difficult. This already risky activity is made even riskier in the absence of skills and capabilities needed to evaluate, trial and implement technologies at scale. Consequently, public and private investors remain reluctant to adopt InfraTech. The content of the use cases can play a big part in addressing this education barrier and in bringing greater awareness of the risks and opportunities presented by InfraTech. The GI Hub

intends the use case library to be a living resource, which can be continuously updated as technologies and their applications evolve.

3. Engaging with the private sector

In the context of a post-COVID world, the participation of the private sector in quality infrastructure investment is now more important than ever. A draft G20/OECD report[1] released in April 2020 outlined seven key messages from the private sector to enable the environment for private investment. One of these is that technology and innovation can play an important role in encouraging private investment into infrastructure. That is, the adoption of new and disruptive technology (e.g. to improve infrastructure priority setting and optimize construction, operations and maintenance activities) can make infrastructure investment a more attractive proposition.

One example of a use case demonstrating these benefits is the *automatic pre-fabrication of stainless steel pipelines*. The case study was for the use of the disruptive K-TIG technology in Argentina. The adoption of the technology transformed the economics of the project by completing fabrication in 162 days instead of the original 720 days that would have been required if using traditional welding methods.

Other ways in which this Stock Take addresses the needs of the private sector are related to two technology-related recommendations made in the report, namely that the industry needs to:

- Respond in a proactive way to the shifting technological landscape, provide a vision for technology opportunities in infrastructure and develop long-term strategies to support the scaling up of opportunities and diffusion of knowledge
- Promote more broadly innovative firms and innovation ecosystems, cultivating creativity and knowledge to solve challenges in infrastructure systems[1]

In supporting the G20's InfraTech Agenda, the GI Hub's development and continuous update of the use case library will provide IWG members and the broader infrastructure community a 'go-to' resource for InfraTech trends and insights.

[1] 2020, G20/OECD, *A Report on the Collaboration with Institutional Investors and Asset Managers on Infrastructure*

4. Supporting the advancement of Quality Infrastructure Investment (QII) principles

Quality infrastructure and the efficiency of public spending has always played an important role in the infrastructure gap debate. InfraTech provides tremendous opportunities to facilitate the implementation of QII Principles by enabling cost-effective upgrades of existing infrastructure, extending asset life and deferring costly asset maintenance and renewals. Furthermore, quality infrastructure (and its enabling technology) can influence the outcome of crises such as the COVID-19 pandemic, which will be covered in the next section.

This Stock Take specifically helps to address QII Principle #2 - *Raising Economic Efficiency in View of Life-Cycle Cost*. It demonstrates how InfraTech can bring about efficiencies in life cycle costs for new and existing assets and identifies the relevant parts of the project life cycle that can bring about the most benefit if InfraTech is more broadly deployed. Furthermore, this Stock Take is focusing on the water, waste, energy and transport sectors – high impact sectors for the achievement of economic, social and environmental outcomes.

An example of a use case that supports the advancement of QII Principles is the *intelligent process optimization for water treatment*: This use case leverages AI driven data analytics to treat water to a better standard while reducing operational costs by up to 10%.

5. Supporting government responses to COVID-19

The need to close the infrastructure gap through the implementation of quality infrastructure is greater now that it was before, as governments face increasing fiscal constraints due to the COVID-19 pandemic. The InfraTech Agenda recognizes that technology plays a critical role in responding to the COVID-19 crisis and it enables infrastructure to become more resilient to future disasters and pandemics.

The purpose of InfraTech in pandemic response is **to ensure the continued operations of critical networks** – that is, ensuring that utilities, transport and telecommunications are resilient (and continue to operate) in the event of future disasters and pandemics.

InfraTech can be applied across three phases of a pandemic, including:

- **Alerting phase –** this is where technology can be used for early identification of unusual events and outbreaks. This includes combining sensors with AI technology to detect 'hotspots' for potential disease outbreaks (as per the example below).
- **Management phase –** this is where technology can be used to uphold pandemic management tactics and policies by enabling worker isolation and social distancing. For example, automated

manufacturing technologies reduces the need for workers to be physically present on site. Also, predictive maintenance of critical assets eliminates unnecessary site visits while still maintaining good levels of service (as per the example below).

- **Recovery phase –** this is where technology can be used to build resilience to future pandemics. For example, drones enable remote asset inspections and AI technology can be used to automate and optimize the operation of assets. These types of technologies reduce the need for human intervention in the event of future outbreaks and lockdowns.

11 out of the 41 use cases in this Stock Take are relevant to pandemic alerting, management and recovery as outlined above. Two examples of these use cases are as follows:

- *AI to slow the spread of disease outbreaks:* In this use case, AI is combined with temperature sensors to identify 'hotspots' for potential outbreaks. This technology can gauge the infection risk of an entire crowd within one minute without the need to make personal contact. This technology enables rapid 'testing' and assessment of infection risk while improving the safety of staff and ensuring that unaffected services continue to operate.

- *Predictive maintenance of physical assets:* This use case utilizes sensors combined with advanced machine learning methods to predict when asset failures are likely to occur. Predictive maintenance technologies can benefit asset owners by preventing catastrophic failure of critical assets by giving an early warning of potential failure. They can eliminate unnecessary maintenance and inspection of assets while still maintaining good levels of service.

6. Coverage of the use case library

6.1 Defining a 'use case'

InfraTech use cases are enabled by digital technologies, but they are not the technologies themselves. The use cases show specific situations in which InfraTech products and services could potentially be used. Therefore, it is not just a list of technologies, but the combination of a technology and an application for which a value case or case study exists. For example, a use case for *last mile infrastructure for water provision in developing countries* will utilize smart water metering and billing technology to provide greater clean water access to low-income households while at the same time guarantee revenues to the water retailer.

Each use case includes the following information:

- The use case and its definition
- The infrastructure application
- The relevant stage in the project life cycle
- Case studies and value cases across a broad geographical spread
- The benefits achievable (in line with those identified in the InfraTech Agenda and Value Case report)

- The stage of development, from cutting-edge through to commercially available technology
- Identifying risks (in line with those identified in the InfraTech Agenda) and how they can be mitigated
- Impact on pandemic management, specifically in terms of safety and economic recovery
- Commentary on the pathway to successful government implementation
- The policy tools and levers that will enable a given use case

6.2 Breakdown of use cases

41 use cases have been developed by the GI Hub covering the transport, waste, water and energy sectors. Across these 41 use cases, over 100 technology-specific case studies were illustrated.

The use case library encompasses a broad range of use cases – including high and low-cost options and applications across both developed and developing countries – to ensure that it is relevant across all national circumstances.

The breakdown of the 41 use cases (and 100+ featured case studies) by geography, technology type, project stage and infrastructure sector are shown below.

Figure 4: Breakdown of case studies by geography

The geographic breakdown of case studies, as can be seen in Figure 4, maps the number of case studies identified in each region. It is important to note that one use case may feature several case studies (and will therefore be represented several times on the map above). This map only captures the current status of the use case library, but it is already able to demonstrate the relevance and potential viability of InfraTech across the globe. This picture will only become more compelling as the GI Hub continues to grow the use case library, adding to the greater pool of evidence in support of InfraTech adoption.

Figures 5 to 7 below show the breakdown in use cases by sector, technology type and project stage. Some observations from these graphs include:

- Figure 5 shows the prevalence of digital technology use cases in the water, transport and energy sectors. The use of digital technologies in the waste sector is less common than in others. This may present an opportunity for growth and development in the future.
- Figure 6 shows that there is roughly an even distribution of use cases in IoT, sensors and analytics. This is unsurprising given that these technologies are typically inter-dependent across the digital value chain.
- Figure 7 shows that more than half of all use cases fall within the operations and maintenance stage.

While the draft InfraTech Agenda 'Elements' for technology adoption were not specifically included in each of the use cases, it is also helpful to understand how the library of 41 use cases supports the delivery of the Agenda from this perspective. Figure 8 below shows the breakdown of uses cases by how they relate to the Agenda 'Elements'.

This library of 41 use cases provides an excellent foundation to build on over the coming months. In its current state, it is by no means exhaustive, however the GI Hub intends to continue efforts to build and maintain the library with the vision that this becomes the 'go-to' resource for InfraTech trends and insights.

The full list of 41 use cases is provided in the Annex to this document.

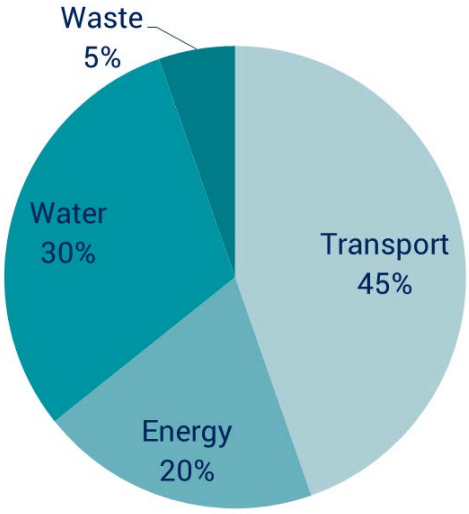

Figure 5: Breakdown of use cases by sector

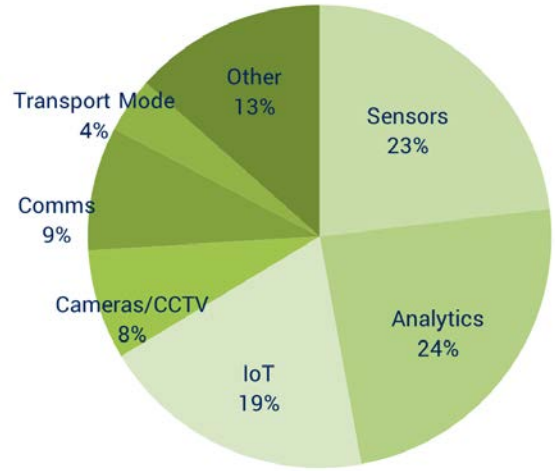

Figure 6: Breakdown of use cases by technology type

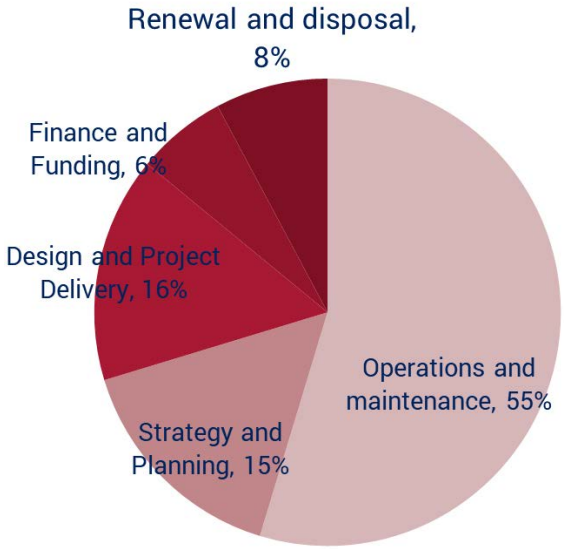

Figure 7: Breakdown of use cases by stage of project

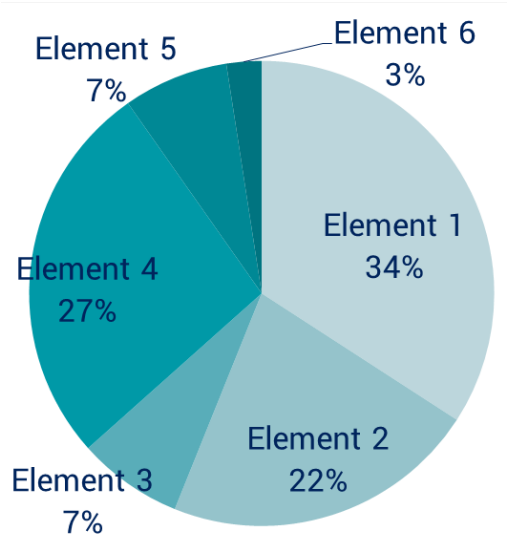

Figure 8: Breakdown of use cases by InfraTech Agenda Elements

6.3 Addressing InfraTech risks

The implementation of InfraTech is a complex undertaking and sometimes with uncertain outcomes that need to be managed through an adaptive approach. InfraTech can presents many benefits (as demonstrated by the use case library), but the risks of adopting InfraTech also need to be articulated.

The use case library outlines the various risks associated with adopting InfraTech. These risks are outlined below together with their definition as per the World Bank's Value Case Reference Note:

Implementation risk	• Uncertainty around the outcomes in InfraTech roll-out • Differences in delivery cycle times between infrastructure and technology • Technological obsolescence • InfraTech procurement capabilities and mechanisms • Public sector skills gap
Economic risk	• Impact of InfraTech on the job market and human capital (e.g. as with automation, sensors and AI) • Impact of InfraTech on ecosystems (e.g. as with sector disruption) • Loss of global competitiveness (e.g. as with countries at differing levels of technological maturity)
Social risk	• Widening the digital divide between different parts of society • Changing the nature of the social contract (e.g. as a result of access to data on people) • Addressing security and privacy risks through a combined approach of government policy, best practice operational procedures and technological solutions
Environmental risk	• Impact on energy cost and footprint due to more data being collected, processed and stored • Impact on mining of scarce resources (e.g. batteries requiring lithium) • Impact on pollution (e.g. in the case of ride sharing or e-waste production)

7. Conclusions and next steps

The adoption of InfraTech will not happen immediately, but instead will require the continued commitment of governments, private sector participants and the international community. This InfraTech Stock Take (and accompanying work undertaken by the G20 IWG and World Bank) is only the beginning of an ongoing journey and collaboration with the global infrastructure community to share insights and facilitate delivery of the InfraTech objectives.

The GI Hub interactive use case library – The InfraTech use case library is a living resource, and the GI Hub is committed to the ongoing collection and dissemination of InfraTech use cases. The GI Hub will produce an

interactive, online tool that will be publicly available and hosted on the GI Hub's website. This tool will enable the infrastructure community to better understand digital use cases, the technology's benefits and create a bias towards action.

InfraTech beyond 2020 – The use case library will spark a discussion around use case prioritization and begin the journey towards technology trials and full-scale adoption. The GI Hub will facilitate continued collaboration and engagement between countries, MDBs, private investors and industry to share knowledge and maximizing the positive impacts of InfraTech investment according to country conditions.

9. Table of Use Cases

The following section provides an overview of each use case, categorized by sector, technology type and in line with the draft InfraTech Agenda's 'Elements' which are intended to be a non-binding guide to countries in the adoption of InfraTech. There are six Elements to adoption identified by the draft InfraTech Agenda:

- **Element 1:** Leverage InfraTech to enhance economic efficiencies and mobilize private sector investment to promote fiscal and debt sustainability
- **Element 2:** Promote technologies that foster inclusivity, sustainability, resilience and sound governance
- **Element 3:** Accelerate innovation and economic dynamism to support economic recovery and growth
- **Element 4:** Foster a robust in-country data ecosystem to improve resilience and better inform infrastructure planning, operation, maintenance, and investment decisions
- **Element 5:** Develop agile and flexible policy tools that promote potential growth, productivity and innovation while mitigating risks
- **Element 6:** Promote international cooperation in R&D and knowledge sharing

The 41 use cases are broken down below by Element. The full details of each use case are accessible through the use case library.

Element 1: Leverage InfraTech to enhance economic efficiencies and mobilize private sector investment to promote fiscal and debt sustainability

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Intelligent process optimization for water treatment	AI driven data analytics to treat water to a better standard and reduce operational costs by up to 10%	Water	Analytics AI augmentation Digital twins	• Createch360 usage in Brembate wastewater treatment plant, Italy • Emagin HARVI usage in the City of Calgary in Canada	✓
Automated pre-fabrication of stainless steel pipelines	Automation of labor-intensive pre-fabrication processes to reduce time, costs, waste and enhance worker safety	Water	Construction automation	• K-TIG usage in The Acueducto Gran San Juan project, Argentina	✓
Automated robot cranes for Ports	Automation of crane operations in ports to reduce the operational costs and increase capacity while also providing a safer working environment	Transport	Sensors Cameras/CCTV IoT	• Automated Container Terminal in Shanghai, China • Automatic Stacking Cranes in Port of Brisbane, Australia • Neo-Panamax ship-to-shore cranes at the Victorian International Container Terminal in Melbourne, Australia	✓
Sensors and Robotics for Bridge Maintenance	Sensors, robotics and special dehumidifying system to reduce bridge maintenance costs and increase the asset life of bridges ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Sensors Analytics IoT Construction automation	• Genoa bridge over Polcevera river, Italy	
Electronic Tolling	Electronic tolling technologies to optimize transport efficiency and increase toll revenues ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Cameras/CCTV Analytics IoT	• DarsGo electronic tolling system, Republic of Slovenia	✓
Dynamic Road Pricing	Dynamic pricing to optimize traffic flows, enhance revenues and reduce congestion ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Cameras/CCTV Analytics IoT	• Dallas-Fort Worth region highways, North America • Stockholm Dynamic Congestion Zone, Sweden	
Satellite Based Navigation to Optimize Traffic Flows	The use of GPS and other technologies to track and guide public transport to enhance its safety and efficiency ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Communications Analytics	• RNIS real-time control system in the Moscow Region, Russia	
Predictive maintenance of physical assets	Sensors and data analytics to monitor assets and predict maintenance requirements, thereby reducing operational costs and extending the life of assets	All	Analytics	• Data61 pipe failure prediction in Sydney, Australia • Voda AI software for pipe monitoring in Florida, USA • Movus machine condition monitoring in Brisbane, Australia	✓
Knowledge access platforms for construction and maintenance	Digital knowledge platforms and devices to create a single 'source of truth' for construction data, thereby increasing efficiency, reducing costs, minimizing waste and providing safer working environments	All	Analytics Wearables Distributed ledgers	• Hindsite knowledge management platforms in Sydney and Melbourne, Australia • RedEyeDMS platform in Southern Nevada, USA	
Augmented and Virtual Reality for Training and Inspection	Utilizing the latest visualization technologies to enhance worker training and provide greater access to information on	All	Analytics IoT	• AR for safety inductions at the Sydney Metro, Australia	✓

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
	the job to enhance safety, increase productivity and reduce costs			• Headsets for bridge inspections in Cambridge, UK	
3D printing for Maintenance	On-site 3D printing facilities for rapid response to maintenance requirements at a reduced cost	All	IoT	• Stratasys' Rail Industry Solution • Deutsche Bahn, Germany • Chiltern Railways, UK	
Smart Cities-as-a-Service	Smart Cities-as-a-Service and Platform-as-a-Service models to replace traditional vertical chain models in favor of more efficient, scalable and interoperable architecture based on microservices to optimize and maximize the provision of existing public services and goods ** This use case is a contribution from the Government of Italy*	All	Sensors IoT Analytics Communications Distributed ledger	• Smart Ivrea Project for Agency for Digital Italy (AgID), Italy	
Heritage Recovery with 3D Printing	Using advanced 3D scanning and printing to totally or partially replicate heritage pieces ** This use case is a contribution from the Government of Spain*	All	Construction automation	• Replica of "The Bear & Strawberry Tree" in Madrid, Spain • Replica of Romanic Arc "Arco de San Pedro de Las Dueñas de Leon" in Madrid, Spain	
Used cooking oil and grease trap waste converted to biodiesel	Innovative grease trap collection technique to reduce build-up of fats, oils and grease in sewer networks and reduce maintenance costs, while providing alternative sources of fuel for renewable energy	Water, Energy	Treatment	• PumpFree Energy in Sydney, Australia • Argent Energy in Europe	

Element 2: Promote technologies that foster inclusivity, sustainability, resilience and sound governance

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Low greenhouse gas emission wastewater treatment	Monitoring technologies to better track and reduce greenhouse gas emissions, estimated to contribute 26% of the greenhouse gas emissions of the water supply chain	Water, Waste	Sensors IoT Analytics Treatment	• Cobalt Water N2O modelling in the Netherlands • Organics thermal ammonia stripping in Hong Kong • Cranfield University nitrogen and carbon removal in the UK	
Last mile infrastructure for water provision in developing countries	Inexpensive decentralized digital water supply, metering and payment kiosks to deliver inclusive access to clean water	Water	Sensors	• UNTAPPED PAYG smart meters in Malindi, Kenya • CityTaps pre-paid water meters in Niger	
Water Height and Flood Management System	Real-time collection and analysis of flooding data to enable targeted responses and predict future conditions to support governments to build more resilient infrastructure	Water	Sensors Analytics IoT	• Maeslant Storm Surge Barrier, the Netherlands • WaterNSW Water Monitoring Network, Australia • Oxford Flood Network, UK	✓
Smart AI-based waste management in stations	Robots embedded with AI to collect rubbish and clean transport hubs, including by spraying vaporized Hydrogen Peroxide to improve train hygiene standards during pandemics	Waste	Cameras/CCTV	• Whiz Cleaning Robot, Japan • 'BARYL' Smart Waste Bin, SNCF, France • Deep Cleaning Robots, Hong Kong • Neo Floor Cleaning Robot, Canada	✓
Demand Responsive Transport	Public transport options which respond to the specific needs of users to enhance service delivery	Transport	IoT Transport mode	• MOIA Hamburg • Kutsuplus, Helsinki	

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
				• Beeline, Singapore	
AI for Disease Outbreak and Pandemic	AI and thermal cameras to more efficiently and safely detect people displaying symptoms of illness to enable a tailored response to pandemics to minimize community and economic disruption	Transport	Cameras/CCTV Analytics	• Baidu's AI Tool, China • DJI Temperature Screening Drone • iThermo Tool, Singapore	✓
Smart Street Lighting	Sensor technologies to adjust lighting to respond to public needs, optimize energy usage, reduce traffic accidents and create a safer environment for pedestrians	Transport	Sensors Cameras/CCTV IoT	• Barcelona Lighting Masterplan, Spain • Shanghai Smart Lighting, China • Tilburg Smart Philips Streetlights, Various Countries	
Drone for Monitoring, Surveillance & Inspection	Pilot driven and autonomous drones to undertake otherwise dangerous and time-consuming tasks, such as inspecting operational network assets, to reduce costs and keep workers out of harm's way, particularly during times of pandemic	All	Sensors IoT	• Pedestrian Monitoring Trial, Yarra Trams, Australia • Dedicated Freight Corridor (DFC), India • Network Performance Improvements, SNCF, France	✓
Augmented and Virtual Reality for Planning and Design	Utilizing the latest visualization technologies to enable members of the community to experience a proposed design or concept in a real-life environment to help to garner feedback and shape ongoing policy and planning agendas	All	Analytics IoT	• Cross River Rail (CRR) Experience Centre, Australia • Sydney Metro, Australia • Uppsala Virtual City, Sweden	

Element 3: Accelerate innovation and economic dynamism to support economic recovery and growth

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Transition to Electric Vehicle Transport Networks	Governments transitioning to electric vehicles fleets to advance the technology, reduce greenhouse gas emissions from cars and provide cleaner more livable cities	Transport	Transport mode IoT	• Quebec Public Transit Electrification, Canada • Paris RATP And IDFM Electric Bus Plan, France • Heliox Fast Charging Stations, Luxembourg	
Hyperloop	Development of hyperloop technology to with the aim to provide a fast and affordable form of ground transport between city centers	Transport	Transport mode IoT	• Virgin Hyperloop One, Various Countries • Hyperloop Transportation Technologies, India • Hyperloop Alpha, USA	
Unmanned Aerial Vehicles for Passenger Travel	Development of unmanned aerial vehicle technology aimed at providing alternative transport modes, reduce travel times and reduce road congestion	Transport	Sensors Cameras/CCTV Transport mode	• CityAirbus, Various Countries • Volocopter in Germany and Dubai • Ehang 184 in China	

Element 4: Foster a robust in-country data ecosystem to improve resilience and better inform infrastructure planning, operation, maintenance, and investment decisions

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Smart Metering	Real-time monitoring of water usage to reduce water loss and enhance operator revenue sources, as well as better utilize scarce water resources	Water	Sensors Analytics	• Suez smart metering, Singapore	

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Remote monitoring for algae risk in water bodies	Drones and satellite technology with advanced risk modelling techniques to better manage algae risk in water, reduce water treatment costs and enhance water quality	Water	Analytics	• Cyanolakes EONEMP project in South Africa • NASA early warning system, USA	✓
Smart Parking Infrastructure	Sensors and communications devices to better utilize parking spaces and support drivers to leave roadways faster, reducing up to 30% of traffic volume, to reduce congestion	Transport	Sensors Cameras/CCTV Analytics IoT	• SFpark Smart Parking Pilot, USA • Intelligent Search for Parking Spaces Pilot, Germany • AppyWay Smart-Parking Scheme, UK	
Real-time Traffic Management	Sensors, connectivity technologies and data analytics to better manage traffic flows to optimize road assets and reduce congestion	Transport	Sensors Cameras/CCTV Communications	• Active Traffic Management Approach, UK • LTA Intelligent Transport Systems, Singapore • The Urban Lab Dynamic Traffic Forecasting, Spain	
Weather and Pedestrian Sensors	Sensor technologies to better track movement of pedestrians and real-time weather conditions to reduce accidents and optimize traffic flows	Transport	Sensors Cameras/CCTV Analytics	• Smart Crossing Trial, Australia • Pedestrian Recognition IoT, Finland • Starling Crossing, South London, UK	
Electric Vehicle Charging Cloud Platform	A cloud platform for scaling up of EV charging operations and managing wide charging networks more efficiently to lower costs and improves operational efficiency ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Sensors Communications Analytics IoT	• Allego system, Netherlands	
AI-enhanced Digital Maritime Logistics Platform	Advanced digital platforms to improve data flows between stakeholders to optimize port assets and increase speed and reliability of delivery of goods ** This use case is a contribution from the D20 Long Term Investors Club*	Transport	Sensors Communications Analytics IoT	• Calista supply chain platform, Singapore and Belgium	
Digital Service Platform for Transportation Hubs	Connectivity technologies, cloud computing and data analytics to create operational efficiencies in transport hubs. ** This use case is a contribution from the Government of China*	Transport	Communications Analytics	• Beijing Daxing International Airport, China	
Digital Twins	The integration of data including real-time sensor data to better visualize and optimize assets, ensure continuity of services and make well-informed new investment decisions	All	Digital twins	• SNCF Digital Twin, France • Tamba City, Hyogo Pulp factory, Japan • Singapore Digital Twin, Singapore	
Smart Sensing System for Water Service and Urban Mobility	A data collection system to provide decision makers with key data, such as flow of people and water consumption and quality to improve government planning and management capabilities ** This use case is a contribution from the Government of Italy*	All	Communications IoT Distributed Ledger Analytics	• Smart, Secure, Reliable and Distributed Monitoring through 5G, University of Cagliari, Italy	
Digitizing water access data for regulatory use	The collection of water access data for regulation (i.e. compliance and enforcement) can be kept cybersecure through a system that is designed with security from end to end. The solution includes metering, logging, transfer of data, collection and ingestion in data storage and visualization of the data. All these components require cybersecurity elements to minimize risk at vulnerable locations and ensure the system works as intended.	Water	Sensors Communications Analytics IoT	• NSW Dept of Planning Industry and Environment, Australia	

Element 5: Develop agile and flexible policy tools that promote potential growth, productivity and innovation while mitigating risks

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Mobility as a Service	Digital platforms which integrates end-to-end trip planning across transport modes with payment methods to provide an enhanced service to users and improve transport access	Transport	Sensors Communications Analytics IoT	• Whim, Finland • MinRejseplan, Denmark • NaviGoGo, Scotland	
Smart Containers	Containers enabled with sensors to track shipping deliveries and ensure goods can be quickly processed through ports with fewer losses of cargo and the containers can be updated as the technology develops	Transport	Sensors IoT	• Silk Road Intelligent Shipping Containers • Port of Rotterdam Pilot, Netherlands • Mediterranean Shipping Co.	
Decentralized Microgrids and Peer-to-Peer Energy Transactions	Distributed ledger technologies to enable peer to peer electricity transactions, reduce transmission and distribution costs and create greater reliability of electricity networks	Energy	Analytics	• Brooklyn Microgrid, USA • Bangkok T77 Precinct, Thailand • Hackney, Banister House Estate, UK	

Element 6: Promote international cooperation in R&D and knowledge sharing

Use Case	Description	Sector	Technology Type	Case Studies and Locations	Relevant to COVID-19 Response?
Vehicle to Vehicle (V2V) Connectivity	Utilization of data and connectivity between vehicles to avoid accidents and optimize traffic flows, where common standards for interoperability is essential	Transport	Sensors Communications IoT	• Queensland CAVI Program, Australia • CETRAN Singapore • Nevada trials, USA	