THA: SMART CITY VISIONING AND SMART CITY PLATFORM ASSESSMENT REPORT

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CONTENT

FIGURES, TABLES & BOXES

FIGURES

TABLES

BOXES

ABBREVIATIONS

AASCTF	ASEAN Australia Smart Cities Trust Fund
ADB	Asian Development Bank
AI	artificial intelligence
API	application programming interface
ART	Agile release train
ASEAN	Association of Southeast Asian Nations
BRM	Benefits Realization Management
Dev	software development teams
DevOps	hybrid development and operations teams
DFAT	Department of Foreign Affairs and Trade
EEC	Eastern Economic Corridor
EECO	Eastern Economic Corridor Office
GEDSI	gender equality, disability and social inclusion
GIS	geographic information system
ICT	information and communication technology
IoT	internet of things
ITIL©	Information Technology Infrastructure Library
ITSM	Information Technology Service Management
KPI	key performance indicator
O&M	operation and maintenance
OCM	organizational change management
OKRs	objectives and key results
Ops	IT operations teams
PMO	program/portfolio management office
PO	project/product owner
PPP	Public-Private Partnerships
R&D	research and development
RFID	radio frequency identification
SAFe©	Scaled Agile Framework
SCP	Smart City Platform

SIAM©	Service Integration and Management
SLA	service-level agreement
SteerCo	steering committee
SWOT	strengths-weaknesses-opportunities-threats
WAN/MAN	wide area network/metropolitan area network

EXECUTIVE SUMMARY

Project context

The Government of Thailand is advancing towards Thailand 4.0, an initiative aimed at creating a digital and sustainable economy. This initiative addresses various public issues, such as the middle-income trap, inequality exacerbated by the COVID-19 pandemic, and environmental degradation due to a narrow focus on economic growth. The goal of this initiative is to transform Thailand into a more livable, digitally smarter, equitable, and sustainable economy.

The Eastern Economic Corridor (EEC) plays a crucial role in this transformation. The EEC's development strategy centers around the eastern regions of Chonburi, Rayong, and Chachoengsao, concentrating on three key areas: infrastructure integration, targeted industry investment, and development of smart cities. The EEC aims to create a New Livable Smart City near Chonburi by 2037, which will serve as a model for developing smart cities across Thailand. With a goal of being among the top ten smart cities worldwide, the EEC must leverage innovative technologies and robust Information Communication Technology (ICT) & digital frameworks.

The THA: Smart City Visioning and Smart City Platform Assessment report presents an organized approach, considerations, and recommendations to assist the Eastern Economic Corridor Office (EECO) in developing and delivering its bold vision for the New Livable Smart City, along with its ICT & digital setup.

The report is structured in line with the general steps that the EECO is advised to take in the delivery of the smart city vision and platform prior to engaging ICT & digital vendors:

Smart city visioning and outcome-setting

Having a well-defined vision and outcomes is an important backbone in smart city planning. A robust planning approach is vital for successfully coordinating and addressing the complexities of delivering

a smart city. It is vital that the needs and perspectives of citizens and businesses are well understood before exploring the use of smart technologies to deliver the smart city's vision. A participatory and inclusive approach to smart city planning can provide local governments with a cost-effective way of delivering innovative solutions to challenges faced by their residents. It also allows for the identification of possible solutions and attained mutual support, learning, and commitment for implementation from stakeholders.

The baselining process is crucial for decision-makers, as it allows them to gain a deep understanding of people and place, as well as the constraints and challenges, which can then inform the development of their smart city vision. Setting strategic outcomes and monitoring metrics are also vital for the successful delivery of the vision.

To help ensure the success of the smart city visioning and outcome-setting process, the following recommendations have been identified for the EECO:

01 Commission a baseline study to understand existing and future place.

02 Conduct public consultation to ask the public about their vision for the city's future.

03 Host a workshop with internal stakeholders to conduct a strengths, weaknesses, opportunities, and threats (SWOT) analysis.

04 Revisit existing vision, outcomes and key performance indicators (KPIs).

Identifying smart technologies for the delivery of outcomes

While the visioning activities in the previous step are performed during the initial planning stages, the next step requires the EECO to be prepared to navigate a complex portfolio of programs, each with diverse objectives and desired benefits. Thus, bridging the vision for the New Livable Smart City with the acquisition of the appropriate ICT & digital infrastructure will require the adoption of a Benefits Management Strategy and the application of a scaled Benefits Realization Management (BRM) framework will help to define the level of uncertainty and complexity of EEC programs. Further, concrete management products are provided to adopt and utilize to continuously define, track, and realize benefits throughout the phases of the program lifecycles.

To help ensure that the benefits are aligned with their overall smart city vision, the following recommendations have been identified for EECO:

05	Adopt benefit-oriented practices and mindset.
06	Identify benefit categories and define measurable benefits.
07	Develop a benefits realization management strategy.
08	Map benefits, livability outcomes, and dependencies in collaboration with stakeholders.
09	Adapt and adjust the benefit realization plan continuously as the program progresses.

Smart City Platform, Information and Communication Technology Setup, and Operating Models

To enable the smart aspects of the New Livable Smart City, the EEC must build and manage a complex ICT & digital infrastructure and a smart city platform, consisting of Internet of Things (IoT) systems, connectivity, data, platforms, and applications. It is therefore crucial that such infrastructure is continuously developed and operated to achieve and maintain operational efficiency. It is important not to adopt "smart" technologies for the sake of being "smart". In many instances, low-tech IoT devices can be used in connected systems to create truly smart solutions.

The ICT & digital infrastructure will comprise multiple vendors, each operating a proportion of the complete ICT & digital ecosystem. Hence, the EECO must ensure a modular and scalable structure in which current and future technological products and offerings that arise can be continuously deployed. In this regard, EECO must become a service integrator and service-level agreement owner.

In considering the New Livable Smart City's ICT & digital infrastructure and smart city platform, the following is recommended for EECO:

10	Think in solutions and buy outcomes rather than technical components.
11	Balance vendor lock-in, alternative and attractive cashflow and funding models.
12	Get an information technology (IT) enterprise or system architect onboard, and focus on ensuring interoperability.

13	Create a modular operating model and manage operations through a SIAM© framework
14	Insist on vendors mapping technical ICT & digital features to the customer's architectural model.

Financial partnerships for smart city platforms

The key questions for implementing the relevant smart city platform solutions for the New Livable Smart City will be centered on how to finance the proposed investment. Given that such a platform is a collection of both software and infrastructure, among others, the financing will also involve many different stakeholders and sources of funding.

As the smart city platform will continue to evolve as the New Livable Smart City plan moves from planning to implementation, it will not be possible to decide on the optimal financial structure upfront. Rather, there will be a need to enter into partnerships with many stakeholders to ensure that the right financing will be available for the various parts of the platform.

In exploring the financial planning and potential sources of funding for the smart city platform, the following is recommended for EECO. These recommendations should be anchored by strong leadership and a systematic approach and methodology by the EECO due to the complex nature of the project.

15	Start with the end in mind.
16	Inventory your available assets.
17	Understand the business model.
18	Appoint a champion with clear decision-making authority.
19	Build local support.
20	Develop a business case that clearly lays out the value to potential partners.
21	Create a third-party entity.

1 INTRODUCTION

Photo: Envato Elements.

This report forms the output of Ramboll's work with the Eastern Economic Corridor (EEC) in Thailand and the Asian Development Bank (ADB) under the ASEAN Australia Smart City Trust Fund (AASCTF) program.

1.1 AASCTF PROGRAM OVERVIEW

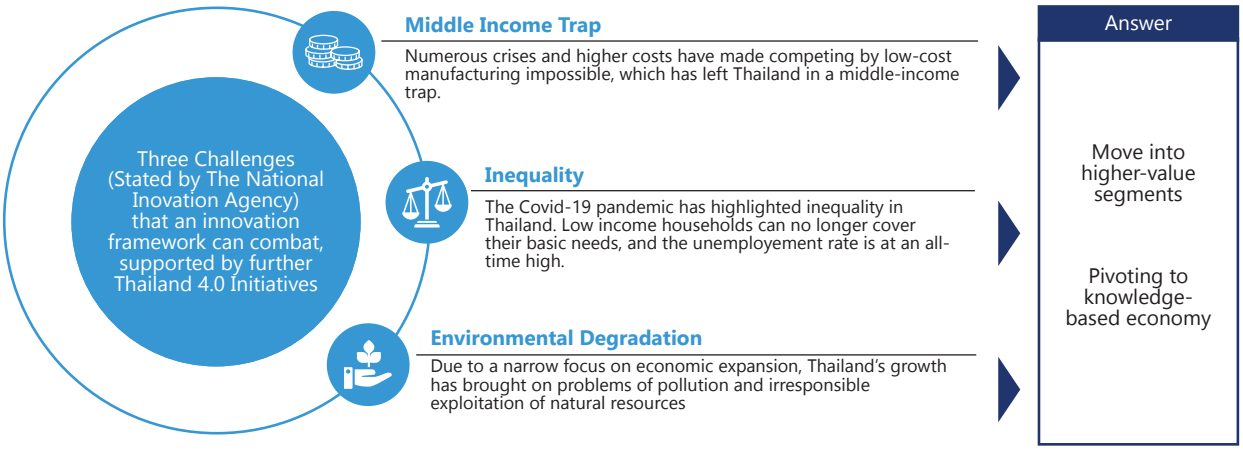
The AASCTF assists ASEAN cities in enhancing their planning systems, service delivery, and financial management by developing and testing appropriate digital urban solutions and systems. By working with cities, AASCTF facilitates their transformation to become more liveable, resilient, and inclusive, while identifying scalable practices to be replicated across cities in the region. Ramboll as a consulting firm additionally supports the development of holistic urban planning focusing on economic prosperity, inclusion, and diversity.

This project aims to design and deliver scalable benefits that are complementary to ongoing national and local, political, and economic development processes. The program is partly sponsored by the Australian Department of Foreign Affairs and Trade (DFAT) and ADB.

1.2 PROJECT CONTEXT FOR THE EASTERN ECONOMIC CORRIDOR

To empower industries and business growth, the Government of Thailand has moved forward with the journey toward Thailand 4.0, which aims to provide a digitally smarter, more equal, and growing economy as well as making Thailand more livable and sustainable. Specifically, the aim of Thailand 4.0 is to target three public issues that are illustrated in Figure 1. Among others, the objectives include increasing research and development (R&D) expenditure to 4% of the economy, increasing gross domestic product (GDP) growth to 6%, and developing at least 20,000 households into "smart farmers" within 5 years. By creating a value-based economy driven by innovation, technology, and creativity, Thailand 4.0 furthermore aims to triple national income per capita by 2032.

Figure 1: Thailand 4.0 Addresses Three Public Issues



Source: Authors, based on Thailand 4.0.

The Eastern Economic Corridor (EEC) plays a critical role in the Thailand 4.0 transformation by accelerating the regions' readiness to support all aspects of the 20-year national strategy that aims to (i) integrate infrastructure, (ii) invest in targeted industries, (iii) create livable smart cities (Box 1), and (iv) improve the area and community economically through innovation, investment in such, and more.

Box 1: Exploring the Concept of Smart and Sustainable Cities

Boyd Cohen[a] describes the three generations of smart cities as follows:

- "Smart cities 1.0: a technology centric vision of smart cities led by major technology companies to create efficient and innovation-driven cities.
- Smart cities 2.0: a government-led vision of utilizing technological solutions as enablers for improving quality of life.
- Smart cities 3.0: a citizen or human-centric vision of smart cities based on co-creating (with citizens) to improve quality of life and generate prosperity."

Cohen suggests that the delivery of smart cities 1.0 and 2.0 increase efficiency from a government perspective and create an innovative image but fall short in delivering solutions that improve prosperity, sustainability of place. The definitions of smart cities 1.0 and 2.0 also do not identify who the technology solutions will benefit. On the other hand, smart city 3.0 must start with reviewing the needs and problems of its inhabitants which requires active engagement with citizens, businesses, and others to identify, develop and implement suitable solutions. He recommends that prior to identifying smart city solutions, three questions should be posed:

- Why are the solutions needed?
- How can they be implemented?
- What benefits are for their users and whether possible risks or objectives exists?

In addition, Trencher[b] (2019), suggests that the vision of a smart city 3.0 is focused on citizen needs and measures to enhance effective governance and policymaking. Whereby smart technology is explored to improve the urban living experience and well-being of residents. This could take the form of generating previously non-existing data from sensors embedded into the urban environment and digitalization of government information stockpiles to inform urban decision-makers.

The Asian Development Bank's Smart City Analytical Framework (2020)[c] and Creating Livable Asian Cities (2021)[d] also provide useful insights for defining what smart could mean for the New Livable Smart City.

Notes:

[a] Cohen, B. 2015. Three generations of Smart Cities, IBI Group, https://www.ibigroup.com/ibi-insights/three-generations-of-smart-cities/

[b] Trencher, G. .2019. Towards the smart city 2.0: Empirical evidence of using smartness as a tool for tackling social challenges, Technological Forecasting and Social Change vol. 142, pp. 117-128, https://doi.org/10.1016/j.techfore.2018.07.033

[c] Asian Development Bank. 2020. Smartt City pathways for Developing Asia – An Analytical Framework and Guidance. ADB Sustainable Development Working Paper Series. Manila. https://www.adb.org/sites/default/files/publication/673441/sdwp-071-smart-city-pathways-developing-asia.pdf.

[d] Asian Development Bank. 2021. Creating Livable Asian Cities. Manila. https://www.adb.org/publications/creating-livable-asian-cities.

Source: Ramboll, 2023.

The EEC strategy strives to develop three eastern provinces that are strategic gateways to Asia. These provinces are (i) Chonburi, (ii) Rayong, and (iii) Chachoengsao, which together contribute 14.5% of Thailand's total GDP. Core to the EEC strategy is concentrating on investment opportunities within:

Five Clusters of EEC Targeted Industries

- **Medical & Health:** Medical and comprehensive healthcare
- **Digital:** Intelligent electronics; Automation and robots; Defense
- **Next-generation automotive**
- **BCG:** Green and circular; Biofuel and biomedical; Advance agriculture and biotechnology; Food for the future
- **Service:** High-value and medical tourism; Aerospace and logistics; Education and human resource development

Six Public–Private Partnership Infrastructures

- Intercity Motorway
- U-Tapao International Airport and Eastern Airport City
- High-Speed Rail Linking three Airports
- Maptaphut Industrial Port
- Laem Chabang Port
- Double Track Railway

Seven Domains of Smart Technologies

- Smart Economy
- Smart Living
- Smart People
- Smart Government
- Smart Energy
- Smart Environment
- Smart Mobility

In the pursuit of creating the New Livable Smart City, the EECO has identified five business clusters that will be key to the framing of the New Livable Smart City's economy. Since these objectives rely on novel technologies to digitize the economy, EEC must harness a strong framework for creating a vision, realizing the desired benefits, understanding the ICT & digital setup, and engaging with ICT & digital vendors to create a top 10 smart city in the world.

1.3 PROJECT OVERVIEW AND OBJECTIVES

As agreed between ADB, EEC, and Ramboll, this project provides EEC with:

Objective 1:

A best practice methodology for co-developing a vision for the New Livable Smart City and setting outcomes for its Masterplan.

Objective 2:

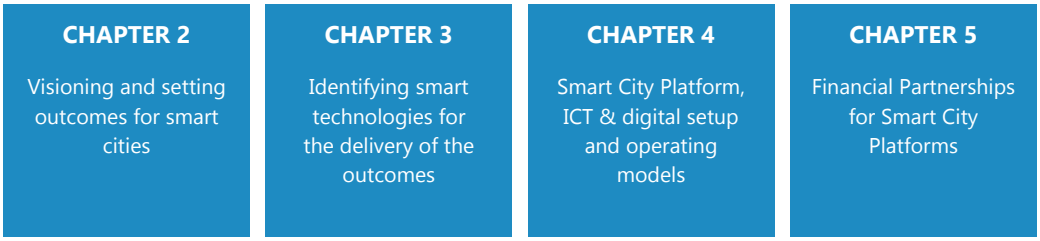
A strategic approach for conceptualizing the ICT & digital layers, and guidance on the procurement, operational models and funding of the ICT & digital components.

Objective 1 serves as a strategic guide for developing a vision, which will provide long-term perspective and direction for decision-making. Objective 2 helps EEC to understand the Smart City Platform (SCP) and its context, thus, providing concrete tools for EEC to use in procuring and implementing the full-scale ICT & digital environment once outcomes and benefits have been defined.

This report anchors all recommendations and methodology in gender equality, disability, and social inclusion (GEDSI) aspects. Recommendations for achieving GEDSI outcomes are in Chapter 2, to ensure marginalized groups are included in the visioning process and that GEDSI outcomes are set for the master plan. GEDSI recommendations are also featured in the vendor dialogues to ensure vendors and suppliers and committed to consider and deliver on GEDSI outcomes set.

Figure 2 illustrates the structure of this report.

Figure 2: Report Structure



Source: Authors.

The vision and the outcomes will be the backbone for informing the delivery of the SCP. The vision is the starting point for having defined capabilities, outcomes, and benefits, including inter- and intra-dependencies. Thus, the vision methodology is the first step for EEC, leading to a focus on benefits rather than specific components.

The benefits must guide the procurement of ICT & digital components. It is recommended that EEC acquires solutions, outcomes, and benefits rather than thinking in individual ICT & digital components. The aim is to describe the implications to the technical setup as well as the attention points for EEC when engaging in vendor dialogues.

The said benefits cases do not only set requirements to the data and technical setup, but also to the needed operational capabilities and capacities from a vendor. Thus, operational perspectives are described to assess these needed capabilities.

EEC seeks to enter public–private partnership (PPP) agreements to finance and operate the SCP. Explaining how such an IT infrastructure could be financed—including case descriptions on alternative funding methods of key IT infrastructure platforms is featured in this report.

Photo: Norbert Braun on Unsplash.com.

2 VISIONING AND SETTING OUTCOMES FOR SMART CITIES

Photo: Envato Elements.

2.1 INTRODUCTION

The identification of ICT & digital solutions and digital infrastructure components of the New Livable Smart City will be informed by the development of the shared vision and the set outcomes the city will strive to deliver on. This chapter describes a best practice methodology for the initial stages of the master planning process. The best practice methodology is described with the objectives of:

- Evolving the New Livable Smart City's existing vision so that it becomes a context-based shared vision and helps to establish development priorities for investment projects.
- Supporting EECO in making use of participatory planning approaches for the development of the New Livable Smart City.

Given the sensitivity and the confidentiality of the project, it was not possible to conduct interviews with locals, businesses, and local government in respect to the development of the New Livable Smart City. This reduced the ability of the study to define opportunities, identify challenged and formulate the city's unique selling point. A further limitation was the availability of baseline information on the natural characteristics of the location of the New Livable Smart City and of its potential inhabitants.

2.2 THE EASTERN ECONOMIC CORRIDOR OFFICE MASTER PLAN

EECO's Masterplan of the EEC Business Center and Livable Smart City[1] includes a vision for the New Livable Smart City for population growth ambition, investment volume, and source allocation, service levels for infrastructure and utilities, and other items. The master plan also includes zoning for business clusters and housing including indicators for the monitoring and evaluation of its development. Some of this information is summarized in Table 1. The following text is from EEC (2022) Eastern Economic Corridor: EEC Business Center & Livable City, April 2022. Handout.

The master plan[2] details the ambition of the New Livable Smart City to:

- Create a model of a city with world class standard to accommodate an increasing demand of urban living.
- Create a city for people with modern technologies for livability.
- Become a biodiversity circular green city with the concept of human-nature coexistence, zero carbon, zero waste and well-planned urban systems in EEC Aerotropolis.

The vision for the New Livable Smart City:

- Center of Regional Businesses and Financial Services.
- Prime area for the future living where the nature, people and technology come together.
- Place that moves toward (Bio-Circular-Green) BCG economy.
- Place of innovation and international life quality.
- Top 10 livable smart city in the world.

[1] EECO. n.d. Masterplan of EEC Business Center Project and Smart Liveable City.
[2] Eastern Economic Corridor: EEC Business Center & Livable City, April 2022. Handout.

Table 1: Key metrics of EEC Business Center & Liveable Smart City Masterplan

Location	Bang Lamung District, Chonburi Province, Thailand
Area	~15,000 rai (24 km^2) ~5,000 rai (8 km2) for the initial phase
Distance from Key Locations	~15 km from U-Tapao Airport ~10 km from Pattaya -Jomtien ~160 km from Bangkok
Development Duration	2022–2037 (1 year for the project's preparation and 10 years for development)
Population	350,000 people
Job Creation	200,000 positions
Development Cost	~B134 trillion (~ $40 billion)
Investment Ratio	Public Sector 2.8% Public & Private Investment 9.7% Private Sector 87.5%
Business Clusters	1. Regional HQ - Government Complex, Financial Services (CBD) 2. Precision Medicine & Wellness Center 3. Education, Research & Development Center for Future Businesses 4. Service Businesses (e.g. Sports Tourism, Entertainment) 5. Residential for all & Mixed-use as the livable facilities
Land Use Ratio	Commercial & Residential Arenas ~70% / Green Area ~30%

B = Thai baht, km = kilometer, km2 = square kilometers, R&D = research and development.
Source: Eastern Economic Corridor: EEC Business Center & Livable City, April 2022. Handout.

Box 2: Aizuwakamatsu Stands Out as a Unique Smart City Tackling Dire Social Conditions

Aizuwakamatsu, Japan, is home to120,000 residents, and like many cities in Japan, is suffering from population shrinkage and aging. Exacerbating the problem, radiation exposure from the Fukushima nuclear power plant disaster damaged the city's attractiveness as a living destination.

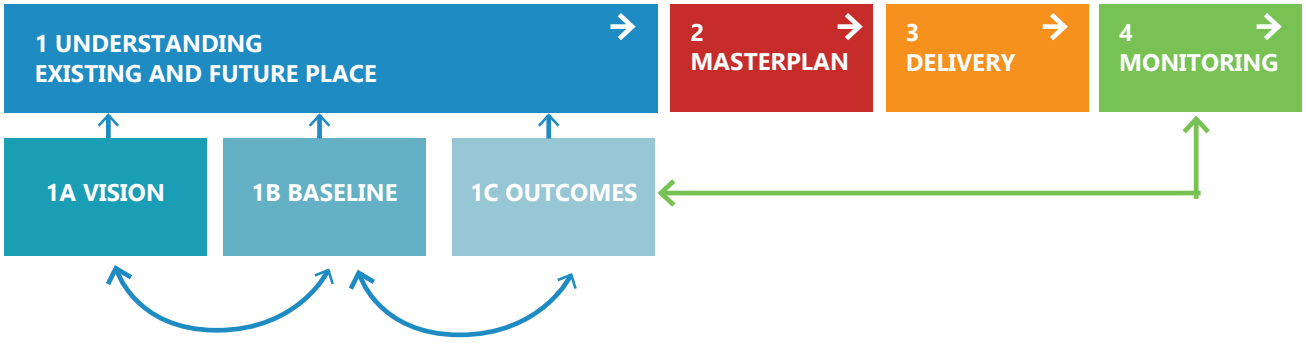
The municipality, the university, and numerous private sector firms, local ventures, stakeholders from government, industry, academia, and citizens, have united around the collective vision of delivering a smart city to drive socioeconomic revitalization. The smart city agenda involved integration of information and communication technology (ICT), data generation and analysis, and digitalization of public services into fields such as economic development, preventative health and longevity promotion, public planning and administration, agriculture, tourism and energy.
ICT and data (smartness) were used as tools for tackling cross-cutting social issues such as deterioration of public services, socioeconomic vitality, population aging, improvement of living conditions and resident well-being.

Source: Trencher, G. (2019).

2.3 BEST PRACTICE METHODOLOGY FOR INITIATING A MASTERPLAN

The development of a master plan of an area generally follows the four stages (Figure 3). The vision statement of the New Livable Smart City has been developed with a top-down approach and had limited baseline information. This report thus focuses on describing the steps and approaches in the first stage required to understand the existing and future place, to support EEC in the further development of their vision using bottom-up approaches. The step-by-step approach for each sub-stage is detailed in Appendix 1.

Figure 3: Four Stages of Master Plan Development



Source: Authors.

2.4 STAGE 1: UNDERSTANDING THE EXISTING AND FUTURE PLACE

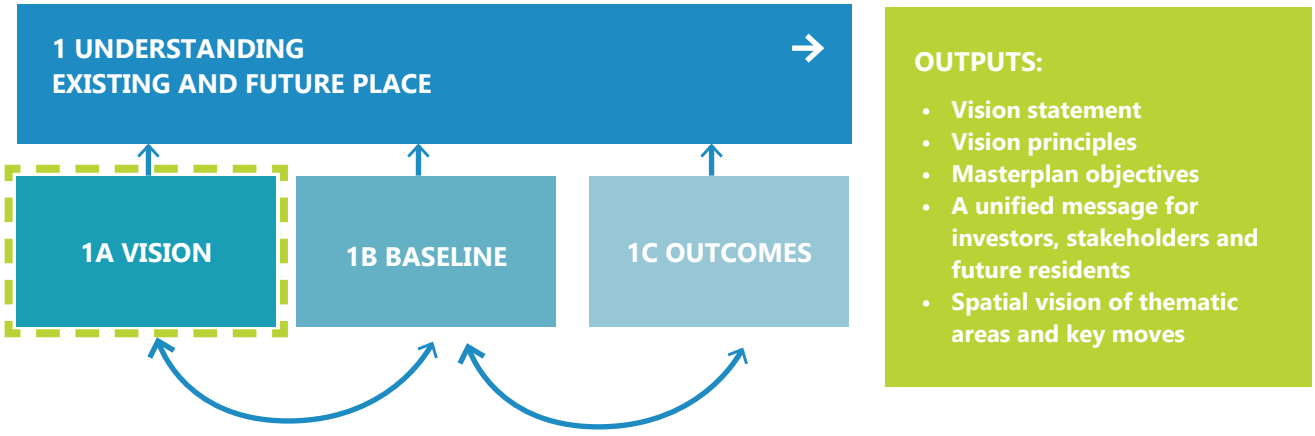
There are three sub-stages contained within Stage 1: Visioning, Baselining, and Outcomes. Figure 3 shows that the process between the stages and sub-stages are iterative, and that information derived in each feed into the other. There is a cross-over between sub-stage 1a and 1b, where the baseline information should be used to inform the vision discussion. As the master plan advances, and as new knowledge and opportunities become available, the outputs of these three sub-stages should be revisited and updated.

Given participation and collaboration across the diversity of stakeholders that make up a city is necessary for the creation of a smart city 3.0, the case studies and considerations for each sub-stage will focus on participatory planning, including considerations for GEDSI-aspects. These have been explicitly detailed to ensure the needs of each of these groups is met through the master planning process and thus reflected in the final designs, and that the use of technologies and infrastructure also cater to their needs.

Summarized case studies are shown in boxes, with the full texts in Appendix 1.[3]

2.4.1 Sub-Stage 1A: Visioning

Figure 4: Vision Sub-Stage



Source: Authors.

[3] Ramboll sought to include case studies from Greenfield/ new smart cities such as Masdar City, NEOM and other Saudi Arabian cities. Songdo and Cyberjaya, however, are not featured in this chapter for two reasons: (i) there was limited information on how the vision and strategy of those smart cities were developed, and (ii) their successes as smart cities 3.0 are contested by studies that claim development has focused on technology and economic growth rather than taking a human-centric perspective. Ramboll sought to include case studies from Greenfield/ new smart cities such as Masdar City, NEOM and other Saudi Arabian cities. Songdo and Cyberjaya, however, are not featured in this chapter for two reasons: (i) there was limited information on how the vision and strategy of those smart cities were developed, and (ii) their successes as smart cities 3.0 are contested by studies that claim development has focused on technology and economic growth rather than taking a human-centric perspective. Sources: Mcardle, M. 2018. Is Masdar City a ghost town or a green lab?, Popular Science, https://www.popsci.com/masdar-city-ghost-town-or-green-lab/; Cugurullo, F. 2016. Urban eco-modernisation and the policy context of new eco-city projects, Urban Studies. 53(11): pp. 2417-2433, https://www.jstor.org/stable/26151209 https://www.jstor.org/stable/26151209; *Continued on next page.*

The first step is to create a vision which refers to the function of the city, its unique identity, and future opportunities, and looks 10–30 years into the future. The vision can also act as a messenger for economic development, inward investment, economic migration, and entices early movers to relocate and start shaping the local business community.

An important contributor for attaining a successful vision is capturing diversity in thought and generating new thinking. This can be achieved by ensuring the visioning stage process includes meaningful public consultation, which is inclusive and brings a range of external perspectives to consider opportunities and issues. Another reason for co-creating a vision with stakeholders, learning from their perspectives, and sharing information early on, is to secure their buy-in and support. Public consultation and stakeholder engagement should be conducted using formats that foster meaningful participation.

The creation of a vision will need to be informed by the baseline, therefore is it recommended that the baselining is started early to inform the vision activities. The baseline data will also be used to test the vision and ensure the outcomes set are feasible.

GEDSI-groups must be consulted at this stage of the process—both to inform the current baseline information and include relevant groups in the visioning exercise to capture their needs and opportunities for an inclusive city. Baseline data (especially disaggregated data) on GEDSI is limited in the region, and in Thailand specifically. Data gathering efforts will build on existing AASCTF GEDSI data sets and networks, augmented by consultation with organizations and groups to ensure that understanding of the GEDSI context is comprehensive. A key way in which GEDSI may be further elevated is in purposefully highlighting the voices of these stakeholders and reflecting their needs and aspirations centrally in all outputs (from the vision to the master plan).

To move from vision to master plan, the co-created vision will need to be translated spatially by identifying physical interventions, management interventions, and ICT & digital interventions.

A good vision statement:

- Resonates with businesses and people and tells a story to investors.
- Builds on local, regional, and global needs and trends.
- Includes reference to the city's assets, proposes solutions for the future.
- Informs the intelligent management of the built environment.
- Provides a recognizable identity.
- Embeds sustainability and resilience.

Footnote 3 continued. Kim, M. 2022. Study on the Case of Songdo Smart City based on the Citizen Participation Approach. Webology. 19(1). https://www.webology.org/data-cms/articles/20220123013022pmWEB19312.pdf, https://www.webology.org/data-cms/articles/20220123013022pmWEB19312.pdf; Yoo, S. 2017. Songdo: the hype and decline of world's first smart city in Sustainable Cities in Asia, Chapter 12 https://www.academia.edu/40910064/Songdo_the_hype_and_decline_of_worlds_first_smart_city; Kobie, N. 2016. Inside Cyberjaya, Malaysia's failed Silicon Valley. Wired, https://www.wired.co.uk/article/malaysia-cyberjaya-silicon-valley-smart-cities (2016) Inside Cyberjaya, Malaysia's failed Silicon Valley, Wired, https://www.wired.co.uk/article/malaysia-cyberjaya-silicon-valley-smart-cities.

2.4.1.1 Public Consultation in the Form of Targeted Interviews

Targeted interviews may be used to support the vision development activities. For this report, telephone and in-person interviews were conducted by an experienced local consultant with the following groups:

- LGBT+
- Wheelchair users
- Small and Medium-Sized Enterprise (SME) Business owners
- Professionals (mid-level manager)
- Mothers

In total, seven interviewees from Bangkok and Chonburi were asked the following questions:

- What are the main challenges you are currently facing in your day-to-day life due to the design of the built environment?
- What solutions (infrastructure or technology) do you think would assist in overcoming such challenges?
- What does "livable city" mean to you?

Their answers are summarized in Table 2.

Table 2: Public Engagement Outputs

Themes	Needs	Challenges	Solutions
Housing	• Affordable and decent housing • Intragenerational housing	• Bangkok is crowded • Chonburi is noisy, busy, crowded and stressful	• Housing that is equipped with technologies appropriate for elderly and people with disabilities
Safety	• Feeling safe	• Petty crime and robbery on the streets	• Free Wi-Fi • Regular patroling • Effective reporting system
Economy and Education	• Access to employment • Regular events in the city to facilitate innovation	• Affordable restaurants and hair salons are not accessible to people with disabilities. End up having to go to the mall and pay higher prices.	• Digital platform for connecting Thai SMEs to international business opportunities • Innovation centre for youth • Annual science events
Environment and Health	• Clean air • Green and recreational space • Community space • Good quality hospitals with 15 minutes	• Air pollution • City parks are far	• Technology to reduce pollution • Several small green parks

Themes	Needs	Challenges	Solutions
Transport	• Easy mobility • Access to public transport • Dedicated parking spaces • Need public transport connecting suburbs into town • Safe and sufficient walkways	• Traffic jam • Deprioritise movement by car • Cars taking over pedestrian space • Public transport levels and coverage is not sufficient • Poor maintenance of roads	• Inclusive design (lifts/ramps/levelled flooring) that enables people with disability to use roads, footpaths, crossings and public transport and be able to move from a to b

Source : Juntopas, M. (2022) Interviews with stakeholders on What smart and inclusive city means to you?

Table 2 provides a snapshot of some of the needs and perspectives of citizens and some of the infrastructure and technology applications which the New Livable Smart City could consider. Further engagement with prospective and local citizens and organizations, especially those in the master plan's business clusters sectors, is required to get a fuller understanding of people and place and to inform early identification of solutions and investments.

Box 3: Team-Based Game Developed Key Themes for City Vision

The Future City Game, used in the city of Inverness in Scotland, was a successful mechanism for bringing together both stakeholders and residents to discuss the future of place. It has led to the development of future plans and projects including the Transformation of Inverness Castle. The key element of the city's vision was embedded in the Highland-wide local development plan (HwLDP) and the visions led to development of briefs and master plans.[a]

Capturing gender equality, disability, and social inclusion voices through the perspectives of marginalized citizens. The Future City Game was used in Bristol (2010)15 to create new ideas for tackling worklessness, youth unemployment and welfare dependency. The game included stakeholders from Bristol City Council's Economic Development team, Job Center Plus, employment brokers in the private and voluntary and community sectors, and importantly people from across Bristol with real life experience of being workless.

Prior to the start of the games, the Center for Local Economic Strategies (CLES), held focus groups interviews with lone parents, young people, over 50s, people with disabilities, and people from black and minority ethnic communities to understand the barriers to employment. The barriers identified were childcare, transport connectivity and perceptions among employers. The game was played upon the theme of worklessness, and the ideas developed were tested and accessed by experts.

Vision developed - Compass Village North
The 'winning' idea was for the development of an eco-village built by unemployed people; serviced by unemployed people; and resided in by unemployed people and their families. The village would be home to some 2,000 people with sustainability achieved through the growth of local food and the development of new enterprise. The village would be built on land previously allocated for physical development and would include full consultation with the wider community.

Continued on next page

Box 3 continued

Lessons Learned
This case study demonstrates that a participatory and inclusive approach to planning, can provide local governments with a cost-effective way of delivering innovative solutions to challenges faced by their residents.

Source: Qureshi, N., & Jackson, M. (2010) The Future City Game. Centre for Local Economic Strategies. https://cles.org.uk/publications/the-future-city-game/.

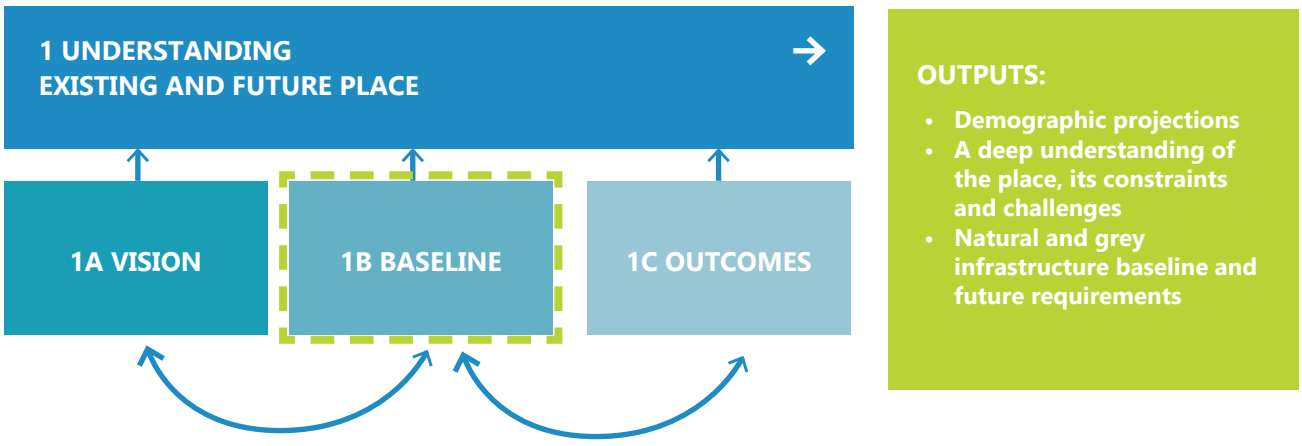
Box 4: From Vision to Engagement

The Pear Tree Crossing site is an ex-industrial area of Dublin with a vast amount of physical and cultural heritage and sensitivity. The focus of the master plan is the delivering of affordable housing in a new vibrant neighborhood with associated amenities. A design team and client workshop were used to bring a vision together. A vision statement, three themes 'Identity, Living and Unlocking' and 10 principles split under those themes formed the vision. This went on to form the basis of the master plan framework and indicators. Taking time to do this process onboarded all stakeholders for a shared vision, which could then be taken externally.

Source: The Land Development Agency (2023) Pear Tree Crossing. https://peartreecrossing.ie/.

2.4.2 Sub-Stage 1B: Baselining

Figure 5: Baselining Sub-Stage



Source: Authors.

This sub-stage involves capturing and analyzing data of built, natural, human resources, and cultural assets to understand current and future needs and demand across systems. The data will be used as contextual information for the visioning session, usually provided by facilitators. It will also be used as input to a strength-weaknesses-opportunities-treats (SWOT) analysis and to test and refine the vision.

The baseline stage is also important to inform the scale and types of interventions needed to support the development of the place and the realization of the vision.

Given that the New Livable Smart City does not yet exist, to gain an understanding of people's needs and the local potential challenges, the urban challenges faced by Thailand's existing cities could be reviewed such as flooding, unaffordable housing, traffic jams, and urban heat. Understanding urban needs and challenges will allow one to cater to them and put systems in place to address such challenges in the New Livable Smart City and for the new population.

An important aspect of the baseline will be the inclusion of climate justice and GEDSI considerations. Understanding the GEDSI context through collection of available (GEDSI disaggregated) data and supplementing that data qualitative methods such as focus groups and key informant interviews will be important to facilitating a robust understanding of GEDSI—including who are the marginalized and vulnerable, what the GEDSI issues and needs and opportunities are, and the social and political structures in place that affect GEDSI. This baseline understanding can, for example, ensure that the impacts of climate change are not further exacerbated for already disadvantaged groups. Understanding the physical environment and the exposure of the area to climate related hazards will allow for consideration around things like access to employment opportunities (via public transport, sustainable transport modes, communication technology, etc.) and diversity and location of social housing stock to ensure it is not located in areas of higher climate risk, for example.

Overall, baselining is done to obtain data to support decision-making, to measure and compare against other cities, assess reasons for differences, and to better support the strategic formulation of a city's unique selling point in increasing competitive environment

Box 5: Data Gathering for Greater Inclusion, Makassar

Funded by the Government of Australia, the Makassar Livable City Plan, finalized in June 2022, sought to deliver a strategic citywide framework that integrates existing smart city plans, actions, and initiatives to support the city's Medium-Term Development Plan. Makassar Livable City Plan Project was executed in three stages: **Urban Situation Assessment**, **Urban Development Scenario**, and **Makassar Livable City Plan**.

A key element of the Makassar experience is the need for cross-agency collaboration to maximize value of investments and to prioritize interventions that can leverage benefit to multiple sectors. To be truly people-centric in the approach, the team supporting Makassar on developing the digital city development plans, utilized inputs from both experts and citizens.

Findings and take aways from surveys helped identify interventions and projects that the city could consider as part of the City Plan. It is important that prioritization of key performance indicators (KPIs) are embedded early in the process to enable technical studies to establish a baseline that enables prioritization according to city needs. There was strong leadership and support for gender equality, disability, and social inclusion (GEDSI) by the Mayor of Makassar. A key lesson learned that leadership is the critical component in visioning and planning for a livable (inclusive) city.

Continued on next page

Box 5 continued

GEDSI consideration
When selecting methods for the engagement tool for the situation assessment in the Makassar Liveable City Plan Project the project team designed seven survey methods:

- Social media – Facebook/ Twitter/ WhatsApp
- Social media – Instagram
- Contact through telecom companies to randomized phone numbers
- University students' assignment
- Using local private surveyors to contact Kecamatan/ Kelurahan
- Physical Surveys in markets and transportation sites
- iPads in kiosks

Each method was assessed against several parameters including how easy the survey method could reach vulnerable groups including women in a representative manner. Representative distribution of respondents across the city in relation to location, gender, age, and vulnerability indicators (e.g., income and social welfare) were critical considerations in ensuring representative coverage of the survey responses.

Based on the assessment, it was decided to use physical and traditional survey method using university students and comparing the results with digitalized survey method using WhatsApp groups in different districts.

Source: ASEAN Australia Smart Cities Trust Fund (2022). Makassar Livable City Plan Project.

Box 6: Baselining and Socioeconomic Context, Dublin

A baseline study for the Pear Tree Crossing Masterplan was commissioned to provide an understanding of public realm, mobility, green infrastructure, land uses to allow for informed discussion on the site and wider context constraints, challenges, and opportunities. Socioeconomic indicators for the Liberties, which is the area where the project will be delivered, were analyzed compared against Dublin and Ireland. The baselining processes informed the visioning workshop and contributed to the selection of principles and identification of desired project outcomes.

The study assessed the current socioeconomic situation of the Liberties through:

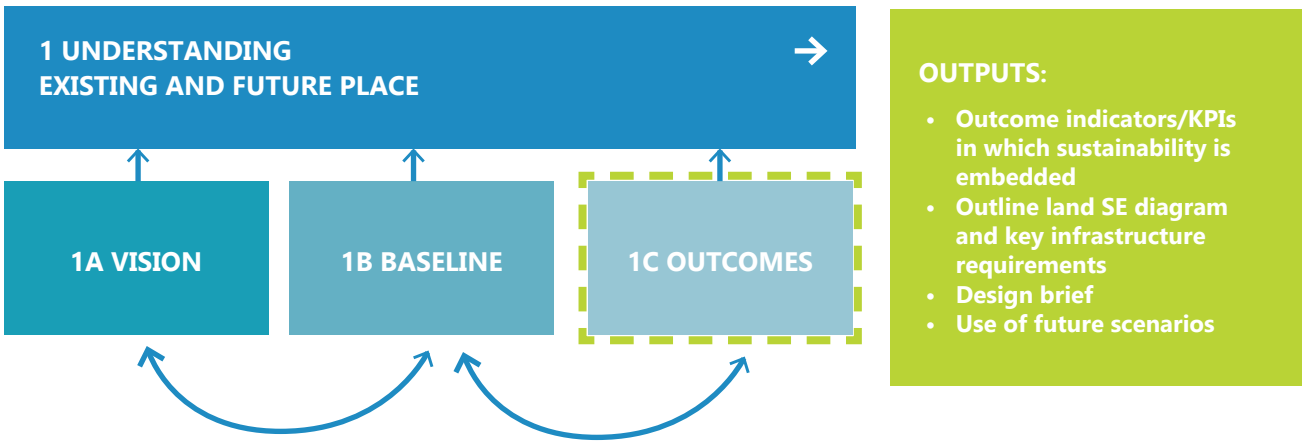
- Demographics
- Employment
- Deprivation
- Existing social infrastructure
- Access to green space
- Home ownership
- Use of personal computers, ICT and data connectivity
- Tourism levels and attraction

The baselining processes informed the visioning workshop and contributed to the selection of principles and identification of desired project outcomes.

Source: Ramboll (2021). The Digital Hub Economic Development Review. (PowerPoint slides).

2.4.3 SUB-STAGE 1C: OUTCOMES

Figure 6: Outcomes Sub-Stage



Source: Authors.

At this sub-stage both the development of the shared vision and the contextual information are used to set desired outcomes for the future city. These outcomes define what the master plan vision will achieve in a more tangible and specific way. Outcomes detail, as an example, what the master plan will deliver for different citizens or businesses. They may also define what outcomes the master plan will deliver for nature and the environment.

General or high-level outcomes can then be quantified using metrics or key performance indicators (KPIs). These are agreed with decision-makers and used to understand whether the desired outcomes are being achieved. Where possible, it is best practice to align KPIs or metrics to international or national standards (such as ISO 37106:2021) and accreditations. Aligning outcomes to the Sustainable Development Framework[4] can also ensure the outcomes are embedded with sustainable development principles.

Given one of the objectives of EEC's New Livable Smart City's vision is to become Top 10 livable smart city in the world, it is advised that EEC identify what index they want to benchmark against (e.g., Smart City Index,[5] Cities of the future index[6]), to inform the setting and defining of outcomes, as each will prescribe different outcomes and KPIs. See Appendix 2: Smart City Key Performance Indicators for a full overview and KPI comparison.

From the outset, it is important to:

- Identify and agree which city stakeholders and decision makers are ultimately responsible for the outcome and what the outcomes should align to.
- Decide how often progress will be reviewed and how often plans can be adjusted.

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4 UN (2023). The 17 Goals. https://sdgs.un.org/goals.

5 DTTM, Isi Lab & IfM engage (2022). Smart Cities Index Report 2022. https://smartcitiesindex.org.

6 EasyPark (date unknown). The Cities of the Future Index. https://easyparkgroup.com/studies/cities-of-the-future/en/#:~:text=The%20Cities%20of%20the%20Future%20Index%20analyses%20the,that%20contribute%20to%20entrepreneurial%2C%20environmental%20and%20societal%20progress.

Outcomes are desirable consequences in which the master plan will aim to deliver. They are usually categorized in themes such as health and well-being, economy, and environment, and a set of indicators are usually assigned to the outcomes to measure and track to what extend these are being delivered.

Outcomes can then be used to inform the design brief in the following development stage of the Masterplan, where they will inform the spatial considerations. Desired outcomes should guide the development of an initial land use plan and key infrastructure requirements (including technology requirements and smart application). They can also be used as a framework for conducting a preliminary viability assessment of the design brief.

Box 7: The Outcome Process

Example of outcome:

- Employment in knowledge-based sectors; e.g. financial, technology and researchers.

Measures to deliver outcomes:

- Invest in training programmes to upskill the existing workforce and those in the education (+16) to have the knowledge, capability and motivation to work on those sectors.
- Engagement with key businesses from those sectors

Key performance indicators:

- Number of people who have completed the training programs
- Percent of employment in those sectors

Gender equality, disability, and social inclusion considerations:

- Include targets for gender balance
- Tracking % and numbers to include gender equality, disability, and social inclusion-disaggregated data (by gender and disability at the very least)

Source: Ramboll (2023).

Box 8: Imagine Austin Comprehensive Plan

The Imagine Austin Comprehensive Plan is the City of Austin's plan for the future and provides direction for many city departments. The plan was created with input from thousands of Austinites and established a community vision of a city of complete communities where all Austinites have access to the amenities, transportation, services, and opportunities that fulfill their material, social, and economic needs. Priority programs and metrics were useful for communicating the direction of change, activities and initiatives needed for the delivery of the vision. The metrics were also then used to measure progress against the delivery of goals and vision of the plan. Based on the plan, Austin is a livable, safe, affordable, and accessible place, which promotes healthy lifestyles, community engagement, and inclusion.

Source: Austin City Council (2012) Imagine Austin Comprehensive Plan. https://www.austintexas.gov/sites/default/files/files/Imagine_Austin/IACP_2018.pdf

Box 9: Downsview Framework Plan, Canada

A Framework Plan will guide the future development of over 500 acres at Downsview, in the North York area of Toronto. The area was previously used as an airport and airbase. A Resilience and Sustainability Strategy contributed to the Framework Plan for Downsview. The use of key performance indicators ensures the outcomes set in the design narrative are delivered and monitored.

Source: Ramboll et al. (2021) Framework Plan: Proposed Redevelopment of the Downsview Lands. https://44e0cc70-0fba-43fa-98a1-d99b0274c6c3.filesusr.com/ugd/4ea6e4_83b2b0b8db67436782994a36ab9e5c3a.pdf

Box 10: A Gender Equality, Disability, and Social Inclusion Toolkit for Thailand

The *Enabling Inclusion in Smart City Development: A Policy Toolkit*[a] recognizes that smart cities have the potential to optimize urban infrastructures. However, many smart city projects overlook the needs of socially or economically disadvantaged groups that cannot participate in the use of the technologies and spaces.

To mitigate this risk, active engagement with multiple and diverse stakeholders from the outset of a project is crucial because it can help urban planners to understand how certain interventions can either benefit or unintentionally exclude certain groups in society.

This policy toolkit provides insights and recommendations for urban planners to help them adopt more inclusive and gender-sensitive approaches to smart urbanisation. It also provides a framework approach to analyse social equality impacts of smart projects.

Source: Adelina, C. et al. (2021). Enabling Inclusion in Smart City Development: A Policy Toolkit. Stockholm Environment Institute. https://www.sei.org/wp-content/uploads/2021/10/final-revised-policy-toolkit-enabling-inclusion-in-smart-city-development-.pdf

2.5 SUMMARY AND RECOMMENDATIONS ON THE EASTERN ECONOMIC CORRIDOR'S NEXT STEPS

A robust planning approach is vital for successfully coordinating and addressing the complexities of delivering a smart city. Sustainability outcomes, such as zero carbon and zero waste, are achieved through the accumulation of several integrated actions driven by policies, infrastructure designs and layout, initiatives, and economic incentives. Moreover, delivering on the concept of smart sustainable cities requires the development and implementation of indicators and metrics (and their evaluation) to ensure that the cities are in fact achieving their objectives. It is important not to skip the "Understanding existing and future place" stage, as these provide strategic direction for policy development, design briefs, and infrastructure plans relevant to the context.

Cities as well as big vendors and consultants have shifted the framing and delivery of smart city from technology and data driven focus (and top-down strategies) to co-creating solutions with citizens, to improve quality of life and generate prosperity. Having identified the needs and perspectives of citizens, the use of smart technologies is then explored to improve the urban living experience and well-being of residents.

The following recommendations have been identified for EEC:

01 Commission a baseline study to understand existing and future place.

It is recommended that the EECO understand current and future citizen needs and perspectives across urban systems. This can be achieved by collecting and analyzing data of built, natural, human resources, and cultural assets in the immediate area and of the region. The most appropriate sources and means for data collection may range from desk research, to purchasing private data sets and surveys.

The data and the new understanding of place and people can be used as contextual information for the visioning stage and as input to a SWOT analysis and to test and refine the vision.

The meaningful involvement of GEDSI-groups through targeted engagement and data gathering in this stage of the process is integral to secure influence on outcomes and ultimately to achieve the objectives for the New Livable Smart City.

02 Conduct public consultation to ask the public about their vision for the city's future.

When able or appropriate,[7] EECO should ask the public about their vision for the city's future. The form in which public consultation is carried should be in line with EEC's data and political sensitivities. Facilitators should be used to prompt stakeholders to reflect on what would draw them to move and

[7] It is acknowledged that the recommendations for engagement with external stakeholders may only be possible for the EECO to engage once the overall political "go ahead" for the new city has been received from the Government of Thailand.

invest into the New Livable Smart City and identification of future challenges. The responses should be summarized and grouped into themes. The EECO must be able to gather sufficient data that allows for a robust enough interpretation and identification of priorities and projects for the master plan. With regard to GEDSI, it is important that a range of voices including those from vulnerable or hard to reach groups are heard, not only to facilitate accessibility of public services and infrastructure, but to ensure the design and use of technologies and infrastructure (identified at later stages) is as inclusive and representative as possible. It is also recommended for EECO to engage with The Enabling Inclusion in Smart City Development: A Policy Toolkit (Box 10) to learn from the inclusion efforts of the City of Udon Thani in Thailand.

Conducting public consultation will help with the identification of priority areas and outcomes for the New Livable Smart City, enabling a strategic direction for the master plan. Public consultations will also enable citizens to feel involved in the development of the New Livable Smart City which in turn secures buy-in.

Public consultation should not be a discrete, one time exercise. The refinement of the vision and plans will need to be based on an iterative process with the diversity of stakeholders such that GEDSI groups are involved from visioning to realization of plans.

03 Host a workshop with internal stakeholders to conduct a strengths, weaknesses, opportunities, and threats (SWOT) analysis.

With planning and other technical experts including public authority members, the EECO should host internal workshops to discuss the findings from recommendations 1 and 2. During the workshop, conduct a SWOT analysis.

04 Revisit existing vision, outcomes and key performance indicators (KPIs).

Building on the previous three recommendations, the EECO should revisit and build on their existing vision statement and principles, master plan outcomes and outcome indicators. These can be refined and tested with key external stakeholders, when appropriate.

It is also recommended that interventions and high-level implementation plans for delivering the outcomes are identified to inform the next stage for the master plan.

Consider using the Sustainable Development Goals and other standards to set outcomes while using The Enabling Inclusion in Smart City Development: A policy toolkit, for Thailand to analyze social equality impacts of the Masterplan delivery.

The following chapters explore the use of smart technologies to assist in the delivery of the smart vision and outcomes. As the vision for EEC's New Livable Smart City takes shape, EEC must consider how to achieve and realize the value of the desired outcomes. The next chapter will provide an explanation of the key principles and practices of Benefits Realization Management (BRM) and describe an approach to successfully manage and govern the multiplicity of programs required for establishing the New Livable Smart City ensuring that projects continuously deliver as intended.

3 JOURNEY FROM VISIONING TO PORTFOLIO OF BENEFITS REALIZING PROGRAMS

Photo: Ramboll.

While EECO's first step is performing the visioning activities, EECO needs to be equipped to navigate a complex portfolio of programs with different objectives. This chapter proposes a framework to help EEC define and realize benefits that enable achieving the envisioned future state of the New Livable Smart City in said complex setup. To provide a comprehensive approach for such, the proposed framework draws upon a range of best practice frameworks, including the Benefits Realization Management Framework by Gerald Bradley, *Managing Successful Programs*, and *Program Management Professional*.[8] In combination, these best practice frameworks have been adjusted and scaled by Ramboll to establish a framework for **BRM** that accommodates the requisites of establishing the New Livable Smart City.

The chapter begins by illustrating why BRM is key to EEC and highlights the interfaces to the previous chapter on smart visioning. As later described, creating and implementing the full ICT & digital infrastructure in EEC's New Livable Smart City means acquiring entire ICT & digital solutions and outcomes rather than specific components. This illustrates the need for EECO to map the benefits that must be realized to achieve the envisioned strategic objectives, as well as the livability outcomes and capabilities necessary to realize the benefits. Thus, the activities described in this section are performed after the visioning activities (see prior chapter) but before EEC procures ICT & digital solutions (see next chapter). Note that vendor dialogues may be initiated simultaneously with phase 1 of the proposed BRM action plan described later in this chapter.

To assist EECO, this chapter includes (i) descriptions of pre-requirements to adopting BRM including a BRM process design; (ii) a scalable Ramboll framework for benefits realization; (iii) a description of key phases, actions, and management products that EEC needs to develop and implement, and (iv) concluding remarks and recommendations.

3.1 REALIZING DESIRED BENEFITS THROUGH BENEFITS REALIZATION MANAGEMENT

Following the steps from Chapter 2 to derive a smart vision, an appropriate question to then ask is how to identify benefits and the required livability outcomes and capabilities to realize these. To ensure that the New Livable Smart City is truly smart, the information technology (IT) backbone, which is required to enable true value-adding solutions, must have significant attention. As a result of the multitude of interdependent components in question, the interconnected New Livable Smart City will involve a large degree of complexity. Thus, this must be managed adequately to increase the possibility of successfully achieving the strategic objectives outlined in EEC Masterplan.

In this regard, achieving the envisioned future state of the New Livable Smart City by building the components constituting the technological foundation of a sustainable smart city from the ground up is extremely difficult. This endeavor can be considered a series of large, complex programs as the delivery mechanism, bundling together interconnected projects delivering the necessary outputs, capabilities, and livability outcomes to underpin the desired benefits.

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[8] EECO can find additional information on Benefits Realization Management here: Bradley, G. (2016). *Benefit Realisation Management: A Practical Guide to Achieving Benefits Through Change*. CRC Press.

Realizing predefined benefits is critical to determine the success of a program or project, while it represents the achievements toward the intended vision and objectives, the delivery of value, and ultimately justifies the investments in the initiation of an initiative or a change. Therefore, ensuring the realization of EECO's defined benefits, i.e., the successful achievement of the desired future state livability outcomes, requires a structured approach for EECO to define and manage benefits adequately throughout the entire life cycle of the portfolio of programs. Adopting the best practice approach of the BRM framework can support EECO in defining benefits and continuously managing the realization of these to achieve the overarching strategic objectives.

3.1.1 Benefits Realization Management: A Pathway to Succeed

In traditional programs, projects tend to focus on delivering a specific project scope to a program organization. However, the long-term duration of establishing EEC's New Livable Smart City implies uncertainty, and as program and project complexity increases, it often leads to conflicting outcomes as project-level decisions are more task- than benefit-oriented. Traditional approaches are often characterized by structuring project KPIs and objectives and key results (OKRs) around quality, time, and costs, which in many cases is proven to cause a lacking focus on realizing the intended end-benefits of a project. Appendix 3 provides an explanation and an overview of the predominant causes for how traditional pathways cause programs to fail.

To avoid the common pitfalls and prevent program fatigue or complete failure, a structured approach to benefits realization must be adopted. In contrast to the traditional approaches, the BRM pathway is anchored in defined, decentralized benefits. The BRM framework can be defined as the process of organizing and managing such that the potential benefits arising from the use of IT are actually realized. This chapter can be viewed as a collective set of processes and practices for identifying benefits that are aligned with the strategic objectives of EECs New Livable Smart City and managing the realization of these.

The overarching purpose of the BRM framework is to identify pathways for achieving the envisioned strategic objectives set by the master plan, delivering the desired outcomes by focusing on realizing defined benefits. Thus, adopting BRM throughout EECO and its program organizations ensures that all interventions are aligned and strive toward the overarching vision. Further, BRM will serve the instrument for succeeding with continuous developments through transformation programs to realize benefits, e.g., through building and implementing new technologies required to adapt to meet future demands and propel the growth of the New Livable Smart City. Furthermore, BRM taps into the funding perspective, as the increased possibility for program success fosters focused investments in benefits and outcomes that feed the return on investment for the holistic stakeholder landscape. Chapter 5 describes funding perspectives, which serves as a tool for weighing benefits and costs. The following sections describe the framework in further detail and dive into how EEC can adopt the BRM approach.

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[9] Bradley, G. (2010). *Benefit Realisation Management: A Practical Guide to Achieving Benefits Through Change*. Gower Publishing, Ltd.

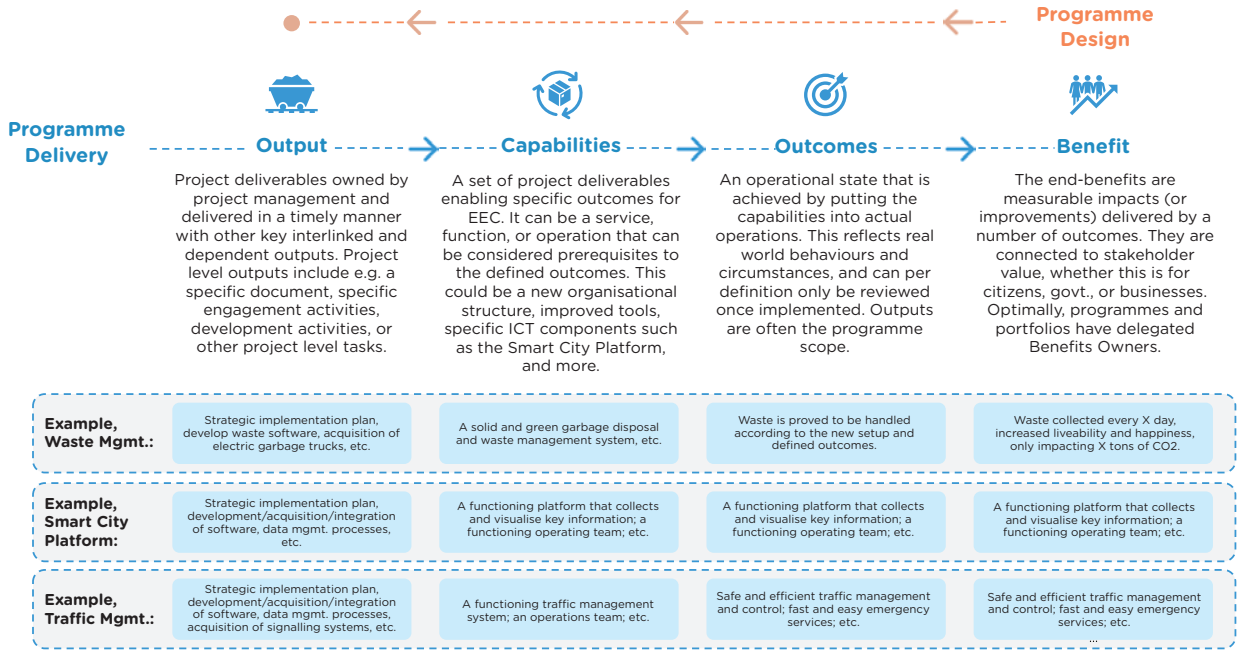
3.2 HOW CAN EECO ADOPT A BRM FRAMEWORK TO REALIZE DEFINED BENEFITS

3.2.1 Adopting Benefit-Oriented Practices and Mindset

Succeeding in achieving the vision of the New Livable Smart City requires the EECO to adopt benefit-oriented practices and mindset. Specifically, instead of solely delivering technology, projects within programs must focus on delivering benefits.

It must be emphasized how the technological output from one or several projects constituting a program does not in itself achieve benefits realization. Rather, the capabilities deriving from the from sum of project-level outputs are requisite to realize the end-benefits, hence, achieve EECs desired future state outcomes. Therefore, benefits must initially be defined to drive an initiative or a change toward the established end-goal constituted by EEC's vision. Realizing the defined benefits requires designing programs by working backward from defining and prioritizing benefits to determining what is required to create a road map from the current situation to the desired future state. Hence, to realize the defined benefits, EECO must determine the desired outcomes as the future state resulting from the program and the capabilities necessary to achieve the outcomes. Last, the specific project outputs (i.e., deliverables) required to obtain the capabilities and outcomes must be determined. The structured approach to designing the program backwards enables the program to deliver on objectives following the alignment with the key benefits. This connection between benefits, outcomes, capabilities, and outputs is illustrated and described further in Figure 7.

Figure 7: Outputs, Capabilities, Outcomes, and Benefits According to Benefits Realization Management



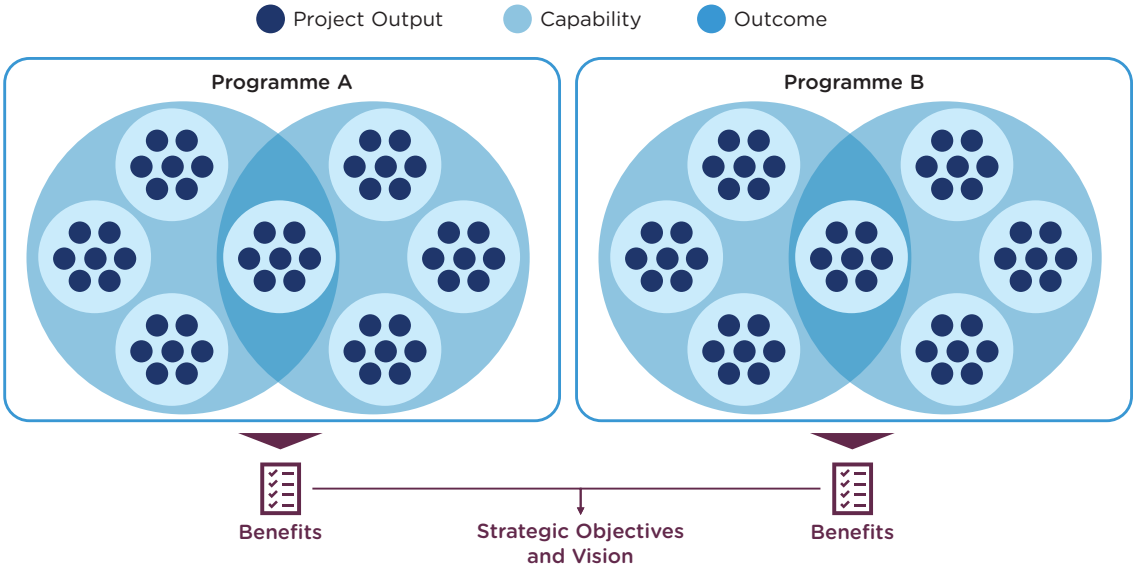
Source: Ramboll et al. (2021) Framework Plan: Proposed Redevelopment of the Downsview Lands.

Whereas the traditional path focuses on project metrics such as time, quality, and cost, which ultimately neglects the overarching goal of achieving strategic objectives, EEC's programs should be steered toward delivering benefits to determine the successfully achieved outcomes. This requires continuous benefits tracking as a monitoring exercise rather than traditional metrics exclusively, to govern the impact and determine the success throughout the program life cycle. Thus, benefits must be defined as measurable impacts and targets that create value for stakeholders. This requires clarifying benefits metrics to be used as a benchmark to measure the realization of benefits, while the frequency of measuring must be emphasized to track the progress effectively. Further, it is important to specify the method to measure the benefit, to which a range of qualitative and/or quantitative methods can be used, including surveys, interviews, financial analysis, and performance metrics. The frequency of measurement will depend on the nature of the benefit and the timeline for achieving it. Some benefits may be measured on a monthly or quarterly basis, while others may only be measured annually or at the end of an initiative or change.

Furthermore, to ensure strategic relevance when defining benefits, it is paramount to first identify and establish a line of benefit categories, based on EECs strategic areas. Such categories can include GEDSI, environmental, financial, governmental, and health, or even the specific Smart Domains, such as mobility. Specifically, it is important that EECO identifies GEDSI as a category, to make sure that benefits relating hereto are defined and thereby realized over time.

Each benefit category functions as an umbrella term under which the concrete benefits can be defined. For instance, a measurable benefit can be defined as: *X%* of citizens in the New Livable Smart City drive electrical vehicles. Realizing this benefit will contribute to achieve a determined outcome of, for example, *a city in which the amount of greenhouse gas emissions produced is no more than the amount captured (net zero)*. This will require ICT & digital capabilities of, for example, electrical vehicle chargers available across the city, delivered by various project outputs, to provide easy access to charging stations, hence incentivizing citizens to drive electric vehicles. In this way, the benefits tap directly into the hypothetical environmental benefit category, and the technology domains of smart mobility and smart living, thereby ensuring the given program ultimately contribute to EECs strategic objective of achieving a sustainable environment. The incentive to align outcomes with capabilities and project outputs at a program level and further with defined benefits and the strategic objectives and city visioning of the New Livable Smart City is illustrated in Figure 8.

Figure 8: From Project Outcomes to Benefits Realization



Source: Authors.

Adopting benefit-oriented practices and mindset implies creating a BRM strategy consisting of a strategically planned road map considering how, when, and at what level benefits must be tracked and realized. The BRM strategy should include a governance model designed to ensure that benefits are owned, managed, monitored, and tracked by the appropriate stakeholders throughout the program life cycle to assess progression of benefits on an ongoing basis, and capture learnings after project completion. Thus, benefits ownership should be assigned either at EEC, other ministerial entities, or integrated in vendor programs, to establish accountability for benefits from the outset and ensure stakeholders are aligned and committed to the realization of these. In this way, the benefit owner is accountable for tracking the measurable benefits regularly and evaluate programs and change requests based on benefit contribution and return on investment.

Additionally, EECOs BRM strategy should incorporate change management activities with the communication, training, and support necessary to effectively integrate solutions into the New Livable Smart City. These activities should be designed to transform the capabilities into outcomes and thereby realize benefits delivering on the strategic objectives of establishing the New Livable Smart City. This moreover implies involving appropriate stakeholders as a sounding board, such as the GEDSI community.

The recommended determinants for EECO to focus on to adopt benefits-oriented practices and mindset are illustrated in Appendix 3.

Box 11: Achieving Gender Equality, Disability, and Social Inclusion Objectives with Benefits Realization Management

The Eastern Economic Corridor (EEC) strives to mainstream gender equality, disability, and social inclusion (GEDSI) across development projects in context to the New Livable Smart City. Achieving this objective requires the Eastern Economic Corridor Office (EECO) to set a strategic direction and break down the objectives into measurable benefits, as well as the outcomes and capabilities necessary to realize these, creating a road map for program delivery. Alongside other strategic objectives, such as becoming a top 10 livable smart city in the world, the following exemplifies how EECO can utilize the Benefits Realizing Management (BRM) framework to increase the possibility of successfully delivering GEDSI objectives by focusing on realizing benefits within each program. **Box Figure 11.1** provides a visualization of such.

Benefit	One example of a **benefit** linking to the overarching gedsi objective could be: • X% of all citizens reports a sense of safety, regardless of gender, disability, sexual orientation, race, etc.
Outcome	One example of an **outcome** that must be delivered to realise the benefits could be: • Citizens have visibility of surroundings with omnipresent authorities looking after them with reduced uncertainty related to basic fear of darkness and crime, while risks of being discovered in committing a crime are high.
Capability	Achieving this outcome requires certain **capabilities.** Here, EECO may collaborate with vendors and draw inspiration from the Digital Solutions Catalog (see Appendix 9) to identify possible technologies that can contribute to deliver the outcomes. For instance, Smart Streetlights that enlighten streets automatically via IoT sensors are likely to create visibility when needed, while a Crime Incidents Map and Smart Surveillance contribute to track criminal activity, ultimately reducing uncertainty for citizens and increasing the risks for committing a crime.
Output	Each capability is constituted by numerous components, deriving from individual project outputs within a programme. For instance, the following examples on **outputs** must be developed at the project level, e.g.: Strategic implementation plan, Market analysis, vendor selection and negotiation, Develop operating model, Establish data management procedures, etc.

Box Figure 11.1: Objectives Broken Down into Benefits, Outcomes, Capabilities, and Outputs

Programme A (example): Ensuring Women's Safety – an example of a programme set up for realizing GEDSI-related benefits

Strategic Objective

Gender equality, Disability and Social Inclusion

Benefits

X % of all citizens report a sense of safety, regardless of gender, disability, sexual orientation, race etc.

Outcome

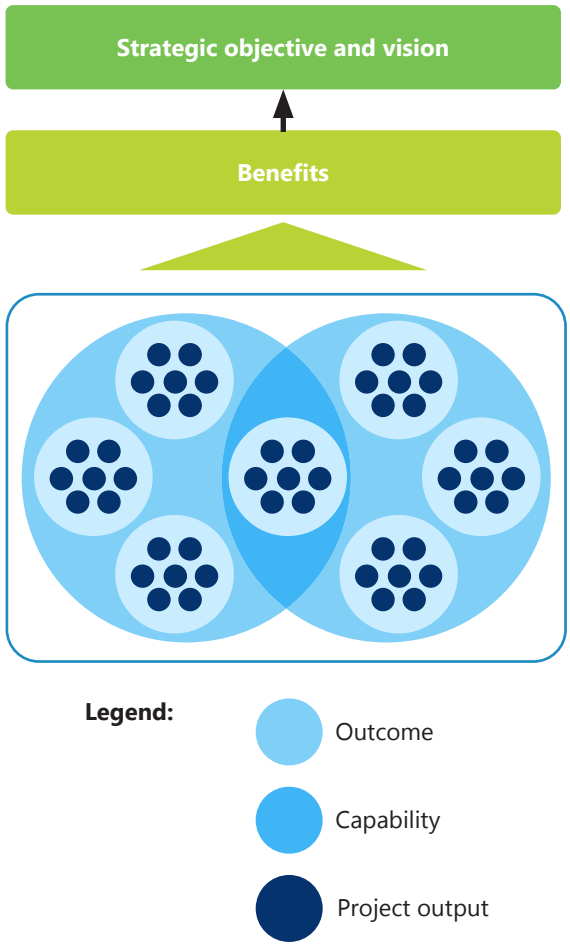
Citizens have **visibility of surroundings** with omnipresent **authorities looking after them** with **reduced uncertainty** related to basic fear of darkness and crime, while **risks of being discovered** in committing a crime are high.

Capability

- Functioning smart streetlights
- Mapping of crime incidents
- Test and pilot solution & full scale implementation of technical solutions

Project Output

- Strategic implementation plan
- Market analysis, vendor selection and negotiation
- Develop operating model & define roles and responsibilities
- Establish data management procedures
- Test and pilot solution & full scale implementation of technical solutions
- Etc.



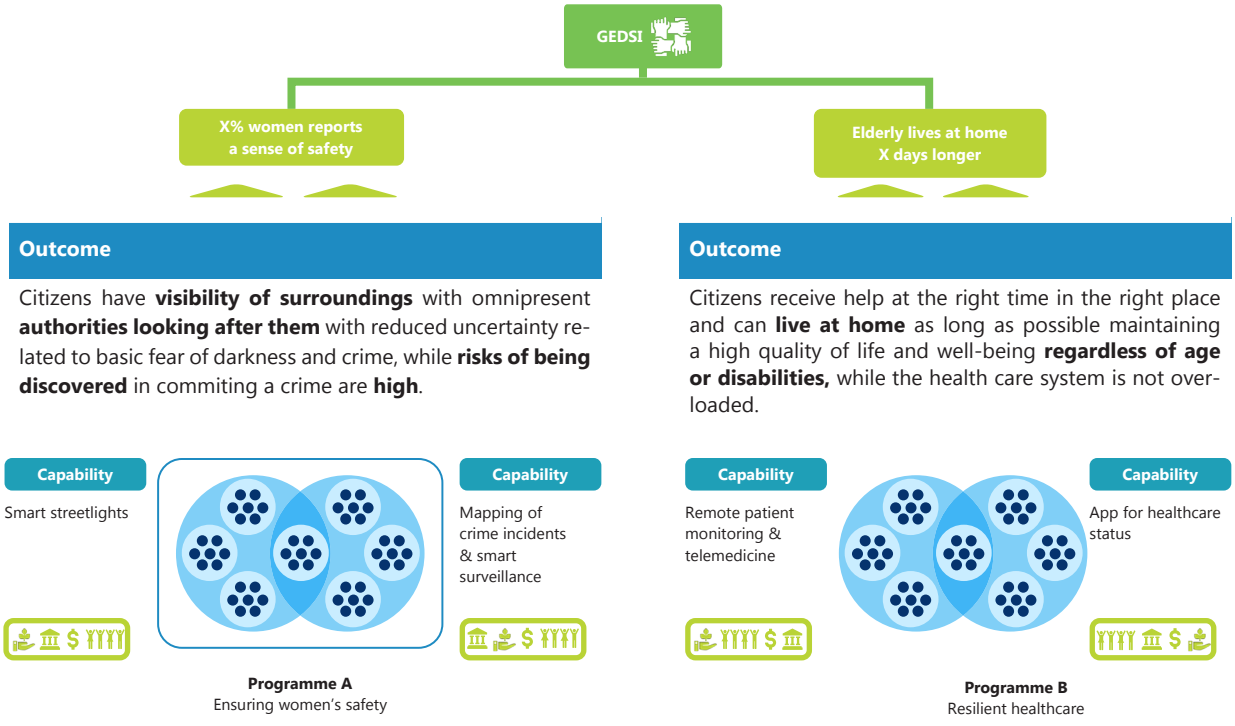
Source: Authors.

Furthermore, Box Figure 11.2 illustrates how various programmes can contribute to the GEDSI objective by focusing on the various benefits in the GEDSI category. Moreover, the capabilities developed to deliver the desired outcomes and realise defined benefits may contribute to other benefit categories. To exemplify, smart streetlights may also contribute to realizing environmental benefits, such as ensuring efficient energy utilisation, which can serve as a vital factor to achieve the EEC's strategic sustainability objectives, e.g., to become a top 10 livable smart city in the world.

Box Figure 11.2: Different Programs Contribute to GEDSI Objectives by Focusing on Categorized GEDSI Benefits

Individual programmes may contribute to realising GEDSI-related benefits and thereby deliver on EEC's strategic GEDSI objectives. Further, capabilities developed may also contribute to other categories of benefits.

Benefits category examples	Measurement examples
GEDSI	• Ensure women's sense of safety **(experience)** • Elderly lives at home longer **(time)**
Environmental	• Increase energy efficiency **(KW/Co2 savings)** • Reduce air pollution **(AQI)**
Financial	• Reduce operating costs **(monetary)**
Governmental	• Increase citizen satisfaction **(experience)**
Health	• Postpone hospitalizations **(time)**



GEDSI = gender equality, disability, and social inclusion.
Source: Authors.

To summarize the EECO must avoid solely focusing on traditional project metrics and programme objectives and instead focus on sustainable, liveable, and inclusive outcomes and benefits. Box Figure 11.3 illustrates a generic BRM process design with concrete GEDSI examples for EECO to follow in its endeavour to adopt BRM as a framework to realize defined benefits.

Box Figure 11.3: Benefits Realization Management Process Design – With GEDSI Examples

	Purpose	Activity	Pitfalls	GEDSI
01 Outline strategic GEDSI objectives	• Strategic GEDSI objectives serve as EECO's guiding light that must be accomplished to deliver the envisioned future state of the New Livable Smart City.	• Follow procedures described in **chapter 2** to set the strategic direction, incorporating GEDSI perspectives into the concrete objectives envisioned.	**Unclear objectives** • Objectives must be strategically aligned with EEC's mission as mutually independent entities. **Lack of senior sponsorship** • Senior representatives of key stakeholders must be committed.	**Strategic objective example:** Increased GEDSI in the New Livable Smart City.
02 Identify and categorise benefits & delegate ownership	• Adopting benefit practices and mindset is crucial. Benefits are defined to ensure strategic relevance and to be able to measure by when a certain outcome successfully has been achieved. Ownership ensures accountability for realising the desired benefits.	• Identify benefit categories (e.g.GEDSI), based on EEC strategic areas to ensure strategic relevance. • Engage with GEDSI stakeholders to identify measurable benefits. • Establish senior level Benefit Owners • Describe benefit details of what, when and how to measure.	**Unclear benefits and no responsibility** • Benefits must be aligned with objectives as mutually independent categories with stakeholder input. • Benefits must be measurable to enable tracking and governance. • Without ownership there is no one responsible for acting on deviations.	**Benefit example:** X% of all citizens report a sense of safety, regardless of gender, disability, sexual orientation, race, etc.
03 Map benefits with outcomes, capabilities and outputs needed	• Benefits mapping is performed to create a clear line of site between the capabilities and outputs required to deliver the outcomes, hence realise the identified benefits. Capabilities may contribute to various benefit categories.	• Use the Benefit Dependency Map template for mapping the benefit dependence on outcomes, capabilities, and outputs. • Involve key GEDSI stakeholders and engage with ICT & digital vendors to ensure focus on GEDSI across projects and in the selection of capabilities.	**Risks of becoming task-driven** • Without a clear map of dependencies between benefits, outcomes, capabilities and outputs, EECO risks becoming task-driven rather than benefit driven, thereby the BRM strategy cannot be executed appropriately and benefit delivery can not be controlled.	 Refer to Figure 11 (page 40) for scaled version of above schematic.
04 Scope programmes and projects based on benefit mapping	• Mapping the dependencies provides a plan with input to benefit realisation management, and thus to the scope of the programme that is the delivery mechanism enabling EECO to successfully achieve the outcomes and realise the defined GEDSI benefits.	• Ensure alignment across portfolio. • Develop benefits realisation strategy, including established governance with reporting, roadmap with communication, training and testing. • Inform and approve business case. • Create project charters with scope, time, budget, risks and milestones.	**% Programme Portfolio Management** Programme eaders and benefit owners structuring programmes individually. To mitigate this, a Programme/Portfolio Management Office can be established to prioritise, support and govern the portfolio from a holistic perspective.	• Coordinate GEDSI benefit contributions from a holistic level across the portfolio of programmes and projects, incorporating these into the benefits realisation strategy.
05 Execute programme and continuously adjust benefits realisation plan	• While the programme is designed backwards, various projects will be executing the scope focused on outputs to develop capabilities. The execution of the programme thus entail managing numerous deliveries and stakeholders, maintaining the benefit driven perspective.	• Establish a PMO to drive governance and manage stakeholders from PMs and POs to senior leadership. • Establish SteerCos including Benefit Owner representatives. • Continuously review business case and benefits realisation plan and adjust accordingly.	**Projects work in silos** A programme involve various projects, focused on outputs. A coordinating PMO as a governing entity is necessary to manage dependencies and issues, ensure alignment between projects, and track and adjust benefits plan to deliver the outcomes and realise benefits.	• Project change requests are evaluated based on benefit contribution with strong focus on GEDSI and Return on Investment.
06 Evaluate and sustain benefits	• Upon implementation, benefit deliverables are reviewed so any necessary actions can be taken to ensure benefits realisation. To sustain benefits in the long-term, a plan for continuous improvements and OCM must be initiated.	• Develop benefits report and review against predefined GEDSI benefits. • Develop business case report and review variations. • Capture lessons learned for sustaining benefits. • Define steady state model to operate the capabilities developed.	**No responsibility to sustain benefits** EECO should avoid closing programmes before benefits are realised. Ensuring benefits realisation requires clear ownership and procedures for operating the steady state of developed capabilities and a plan for continuous improvements.	• Owners of GEDSI-related benefits must take responsibility for continuously ensuring realisation — also post implementation.

EECO = Easter Economic Corridor Office, GEDSI = gender equality, disability, and social inclusion.
Source: Authors.

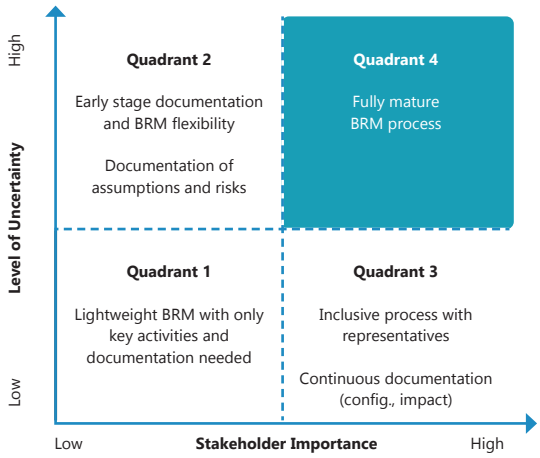
Having established a BRM process design, it is necessary to provide a clear understanding of how EECO can use BRM principles and practices across the portfolio of programs by determining the degree of uncertainty and stakeholder importance related to individual programs. This will be unveiled in the following sections, in which the BRM framework is scaled for EECO to tailor its approach to individual programs.

3.2.2 Scaling the Benefits Realization Management Framework

Ramboll has developed a scalable BRM framework tailored to the needs of EECO that supports different configurations depending on the program characteristics. These characteristics are determined by two axes: (i) the level of uncertainty, and (ii) the stakeholder importance (see Figure 10).

The following subsections aim to briefly unfold these parameters to assess the BRM maturity needed to manage IT-programs in the context of smart cities successfully. Appendix 3 provides a deeper analysis and explanation of such.

Figure 9: The Four Quadrants of BRM



Source: Authors.

Being a greenfield project, realizing the benefits of establishing the components of the New Livable Smart City involves both uncertainty and stakeholder importance . Hence, the focus of this section is to explain the fully matured BRM process as indicated in Quadrant 4. Nevertheless, the purpose of the framework is to assist EECO in determining the required maturity level of BRM for individual programs to enhance the possibility for success. For instance, minor projects may only require lightweight BRM with only key activities and documentation needed (Quadrant 1).

3.2.2.1 Determining the Level of Uncertainty of Programs in Smart Cities

The first axis, **uncertainty**, refers to the risk of the desired benefits not being realized. The higher the risk, the higher the need for stable governance, and thus, the higher the need for a more comprehensive BRM strategy. The degree of program uncertainty is affected by several factors, such as complexity, broadness, lifetime and urgency, relative resource allocation, and size of the impacted and related stakeholders. The level of uncertainty of most of the programs required to establish the components of the ICT & digital setup of EECs New Livable Smart City is ultimately high. This assessment is based on the outlook of the requisite design and execution of strongly interdependent integrated ICT & digital components from scratch.

In this regard, the large organizations constituting the current—and future—*stakeholder landscape* composes a level of complexity, while assets and processes are yet to be determined and developed. Moreover, the collective *broadness* of the programs implies numerous nonexisting entities across the New Livable Smart City. Thereby, new capabilities strategized and built by program organizations will impact various areas, such as the entities utilizing and teams operating the newly established workflows. Further, the envisioned setup will result in many programs of a longer duration, which poses as a risk to achieving the initially desired outcomes and realization of the defined benefits. Concurrently, the large scale and number of projects and programs needed to be established to develop the New Livable Smart City results in a need to set up a proper governance to control and manage resources, risks, and dependencies.

3.2.2.2 Determining the Stakeholder Importance of Programs in | Smart Cities

The second axis of the framework, the **stakeholder importance**, is directly linked to the impact and importance of the defined benefits. Specifically it refers to how critical the achievement of benefits are to future business operations. Because of the complex network of stakeholders and shareholders pushing to build, many of the current initiatives underscore the importance of stakeholders. With rapid changes in the environment a portfolio management office should be able to adapt to any changes that may occur by having a solid governance.

Due to the critical importance to address public issues of the New Livable Smart City, the EECO cannot afford to take risks to achieve the desired benefits. In contrast, a program that has lower significance for future business operations and competitiveness might carry a less significant risk budget. To understand the degree of stakeholder importance of a program, EECO must consider the entire stakeholder landscape (including but not limited to GEDSI stakeholders) and the purpose of initiating the program in the first place. A program might be initiated due to pressure from external stakeholders, or internal vision and goals.

External pressure may derive from (i) Competition with comparable societies—thus, once built, the New Livable Smart City will need to continuously enhance existing solutions while developing entirely new ones to sustain its position and competitive advantages. (ii) Regulation, which EECO must comply with, both during the initiation, e.g., due to data privacy and ethical implications, and to accommodate regulation of future technologies. (iii) Shareholders and Smart City Platform users (see Chapter 4) may push the development of new solutions or change present demands and behavior predicted over time.

Internal vision and goals involve operational levers (e.g., revenue improvements), financial levers (e.g., improving liquidity), strategic levers (e.g., guarding the New Livable Smart City against competitive entrants of other smart cities) and governance levers (e.g., expanding governance mechanisms).

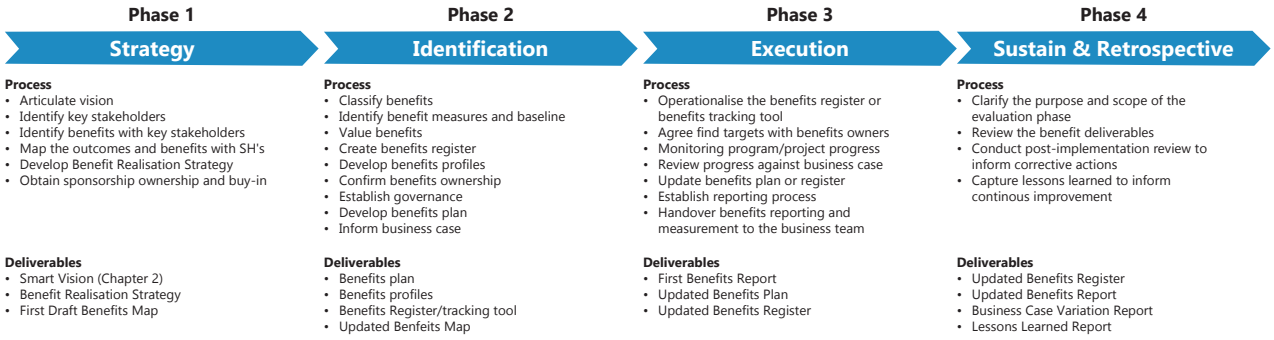
In conclusion, stable governance is needed in developing ICT & digital infrastructure. In programs where uncertainty and stakeholder importance are high, EECO must adopt the full BRM framework to deliver the desired outcomes and realize benefits. This consists of multiple management products that are key to successfully managing benefits realization of the programs.

3.3 KEY PHASES IN THE BRM PROCESS

Because of the complexity and importance of achieving program objectives, a fully matured approach to benefits realization should be adopted. The Ramboll suggested framework emphasizes the importance of identifying, executing, and sustaining benefits and livability outcomes articulated in EECs visioning the master plan of the New Livable Smart City. The standard process for BRM can be summarized into three crucial stages: (i) identify benefits, (ii) execute benefits, and (iii) sustain benefits. However, Ramboll has scaled the traditional framework into four stages. Undertaking certain endeavors within each stage ensures a reliable BRM approach by aligning program activities with realization metrics that represent the desired outcomes. Figure 10 illustrates these stages with the

BRM processes and deliverables in its full configuration needed for programs with a high degree of both uncertainty and stakeholder importance (Quadrant 4). EECO may refer to Appendix 3D which includes a visualization of the BRM approach for programs with a lower degree of uncertainty and stakeholder importance (Quadrants 1–4).

Figure 10: EECO's Phases of Implementing a BRM Framework and Realize Defined Benefits in Q4

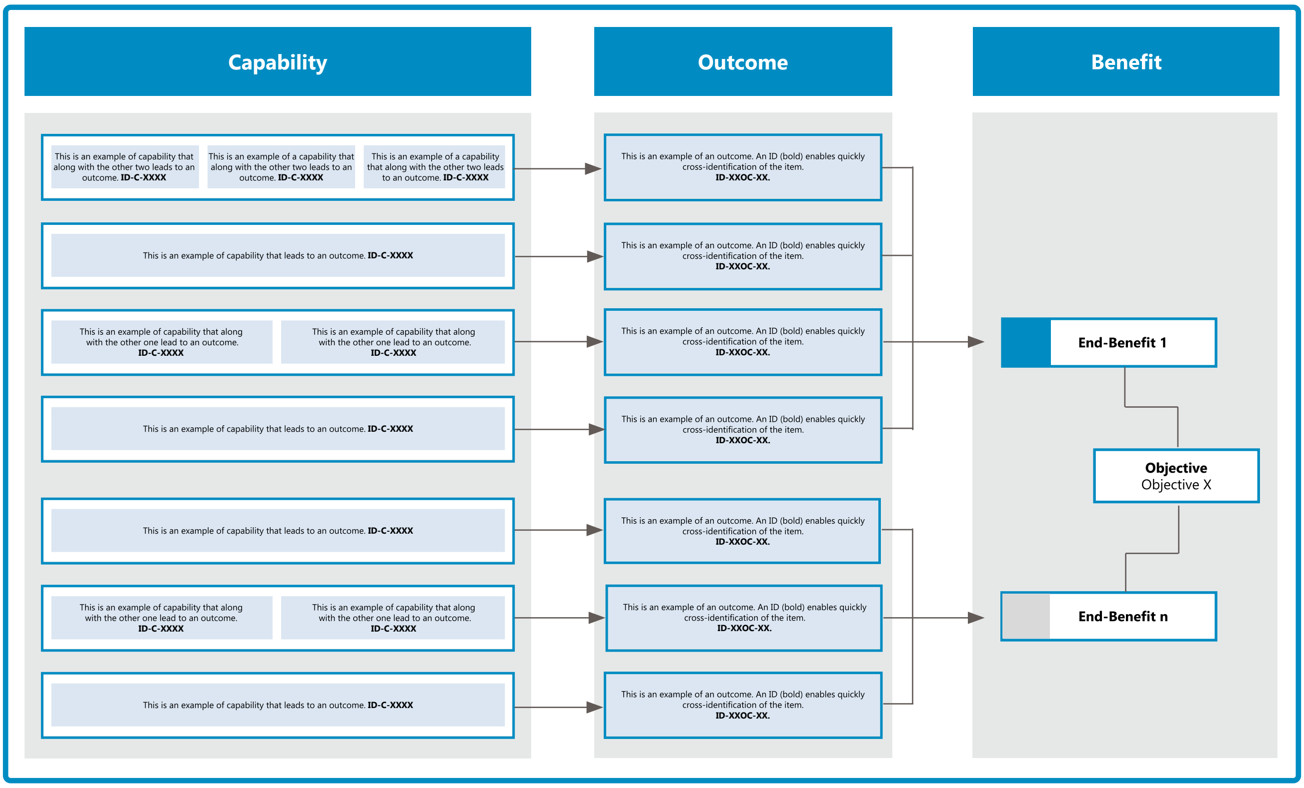


Source: Authors.

BRM in its total configuration contains several management products that should be thoroughly considered, processed, and maintained to realize the desired benefits throughout the life cycle of the programs. Here, a **product** refers to a working document that EECO should use as a tool for governing, tracking, and measuring benefits to ensure that the programs and projects are on track to deliver the expected benefits and to take corrective actions if necessary. Appendix 3E provides an overview with a description of all the key management products and the desired value that each respective product creates. This section highlights a few of the critical management products for EECO to focus on in the initial phases.

The Benefits Mapping links all defined benefits to the strategic objectives and the vision of EECs New Livable Smart City and enables visualization of dependencies between objectives, end-benefits, outcomes, and capabilities. Furthermore, the Benefits Map provides an overview of how the identified benefits are anchored in outcomes and capabilities, hence, it is an essential tool for becoming benefit-driven in practice. It forms part of the strategy and identification stage and provides an early view of risks, assumptions, dependencies, and constraints of the benefits and is thereby also a tool for ensuring that the focus of the people involved is maintained correctly at delivering the desired outcomes. In the benefits map, benefits are broken down into outcomes in a mutually exclusive, collectively exhausted structure and afterward further down into the required capabilities that are needed to reach each of the defined outcomes. Capabilities might appear in multiple places to make the visual readable when cross-dependencies occur. Refer to Figure 11 for a generic visualization of a Benefit Map.

Figure 11: Generic Benefit Map



Source: Authors.

3.4 CONCLUDING REMARKS AND RECOMMENDATIONS

After having articulated the vision and identified the stakeholders of the New Livable Smart City, and before EECO focuses on procuring ICT & digital solutions, a Benefits Realization Management approach must be adopted. This entails identifying benefit categories that ensures strategic relevance and defining measurable benefits with each of them linking to the categories. During this strategic phase, it is crucial for EECO to collaborate and engage with key stakeholders. Moreover, it is critical for EECO to establish a BRM strategy, encapsulating benefit owners that are accountable for realizing the benefits.

The defined benefits must be mapped to the desired outcomes of realizing the benefits, as well as to the capabilities required to achieve the outcomes, and, last, the project outputs needed to develop such capabilities. Such backwards approach constitutes the design and scope of the program to which BRM practices should be used throughout the life cycle of program delivery to ensure a benefit-driven approach. Having established a program scope further enables EECO to determine the level of uncertainty and stakeholder importance and thereby employ the scaled BRM framework to follow the adequate BRM configuration necessary to realize and sustain benefits. The assumed high level of complexity of most initiatives related to establishing the IT backbone of the New Livable Smart City necessitates flexibility within these programs. This allows to reorganize and reprioritize projects and programs to accommodate unforeseen opportunities, dependencies, and risks, which are expected to occur during the long-term horizon of the endeavors and enables EECO to continuously navigate toward the overarching vision regardless of the evolving circumstances.

The following recommendations have been identified for EEC.

05 Adopt benefit-oriented practices and mindset.

Succeeding in realizing the benefits of an initiative or a change requires EEC to adopt benefit-oriented practices and mindset, meaning that programs, projects, and workstreams must focus on delivering benefits, outcomes, capabilities, and outputs, rather than solely focusing on the delivery of technology and related sub-components. Effectively following BRM principles and processes will increase the likelihood for projects to not only be completed on time and within budget, but also meet or exceed the envisioned expectations of stakeholders.

06 Identify benefit categories and define measurable benefits.

To achieve the envisioned objectives, EECO is recommended to identify benefit categories that links to the individual objectives, after which measurable benefits can be defined.

07 Develop a benefits realization management strategy.

A BRM strategy must outline EECO's approach to manage benefits, including how, when, and at what level benefits must be tracked and realized, and a governance model to ensure benefits are owned, managed, monitored, and tracked throughout the program life cycle. This requires EECO to assign benefit ownership to establish accountability for benefits and ensure stakeholders are committed to realizing the defined benefits. Moreover, the strategy consists of a road map of change activities, including training, communication, and testing necessary to enable capabilities to be transformed into outcomes, hence, to realize benefits. The BRM strategy can be tailored to the individual program by using the scaled BRM framework, determining the degree of uncertainty and stakeholder importance. In this process, relevant management products must be thoroughly considered, processed, and maintained in accordance with the BRM maturity of the program in question, to continuously track and thus enable the realization of desired benefits throughout all phases of the program life cycle.

08 Map benefits, livability outcomes, and dependencies in collaboration with stakeholders.

Becoming benefits-driven in practice requires EECO to map benefits in close collaboration with relevant stakeholders, e.g., with strong emphasis on the GEDSI community. The Benefits Map provides an overview of how the identified benefits are anchored in outcomes and capabilities and furthermore links all the defined benefits to the strategic objectives and the vision of EECs New Livable Smart City—the Benefits Map should represent the objectives of the respective programs and the way in which these goals are expected to be achieved. Furthermore, mapping the dependencies between objectives, end-benefits, outcomes, and capabilities should provide an early view of risks, assumptions, dependencies,

and constraints of the benefits and moreover serve as a tool for ensuring that the focus of the people and stakeholders involved is maintained adequately at delivering the desired outcomes

09 Adapt and adjust the benefit realization plan continuously as the program progresses.

Being flexible and adaptable to stay ahead of rapidly changing conditions is of utmost importance to ensure the long-term sustainability and success of establishing the New Livable Smart City and enabling a continuous delivery of benefits over time. Thus, the planning of benefits should be designed with a long-term perspective accounting for a clear vision and goals of the future. EECO must continuously adapt, adjust, and modify the benefits realization plan as the respective programs progresses. This can include establishing a portfolio management office that should be equipped to accommodate these levers for change to adapt to new transformative programs in the future and improve performance over time. Benefits should be monitored and evaluated to recognize the wins, failures, and identify possible opportunities for improvements to the project deliverables and ensure that the desired benefits are adapted accordingly to the changes in the environment and stakeholder requirements. Therefore, relevant stakeholders must be continuously involved in reviewing and evaluating the project outcomes.

4 SMART CITY PLATFORM, INFORMATION AND COMMUNICATION TECHNOLOGY SETUP, AND OPERATING MODELS

Photo: Ramboll.

After having established a process for visioning as well as creating and managing programs to ensure that defined benefits are realized, this section dives into the ICT & digital setup for the New Livable Smart City. This section describes the ICT & digital setup with an emphasis on the SCP. However, since value is not derived from the platform itself, but through benefits that are realized at a program level, this section further dives into use cases and benefits derived from the applications layer. Next, this section provides key considerations on the operating models that are needed for operation and maintenance (O&M) of the key IT infrastructure components.

4.1 INTRODUCTION TO SUSTAINABLE SMART CITIES AND CORE PLATFORM

The European Union's definition of a smart city is "a city seeking to address public issues via ICT & digital-based solutions on the basis of a multi-stakeholder, municipally based partnership " (EU Parliament Report, 2014). Thus, the starting point for creating said smart city is to understand what public issues need to be addressed, starting with the vision and BRM Strategy (see Chapter 2 and Chapter 3). This could be addressing GEDSI related public needs and opportunities to ensure an equal, diverse, and inclusive city. As laid out in the introduction, Thailand 4.0 aims to address issues such as (i) solving the middle-income trap, (ii) solving inequality issues, and (iii) improving the environmental circumstances to solve the issues with environmental degradation. The prerequisites for EEC in taking the steps described in this chapter is therefore that the vision, outputs, capabilities, outcomes, and benefits have been mapped, benefits owners identified, and a portfolio of programs is initiated.

Any modern city relies heavily on the continuous processing of massive quantities of data. Greenfield city projects, such as EEC's New Livable Smart City, offer the unique opportunity of employing a purpose-build, scalable data collection and management platform—an SCP—from the very beginning enabling advantages such as reduced complexity, increased speed of deployment, scalability, and efficiency.

An SCP enables the use of smart-components by providing these with data storage, processing, and network capacity as well as the interfaces required to collect and share data. Due to the connected nature of a smart city and the pervasive use of networked technical components (e.g., sensors or cameras) from internet of things (IoT), a data platform will have to manage large quantities of data. The data to be managed are not uniform but can consist of everything from numerical values to photos and videos. For these reasons, a modern SCP will employ advanced data processing and networking technologies to ensure efficiency, availability, security, reliability, scalability, and usability.

An important design criterion for an SCP is that it must be prepared for both present technologies and for future deployments of technologies not yet in use. The various domains constituting a smart city (such as mobility, living, environment, energy, people, government, and economy) will develop

[10] Directorate-General for Internal Policies Policy Department A: Economic and Scientific Policy. Mapping Smart Cities in the EU. Brussels, Belgium: European Pariament, 2014. https://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET(2014)507480_EN.pdf.

rapidly in the coming years and the course of these developments are not fully predictable. A platform also must be available all the time and cannot be taken down in its entirety, for example, maintenance purposes. For these reasons, a platform must employ a modular design approach which allows some components to be isolated and replaced or further developed, without compromising other components

At the highest level, a data platform must support and enable two modes of operation: (i) Direct interaction with devices and data sources in the city, that uses the platform as the primary gateway and repository for data; and (ii) Indirect interaction with devices and data sources, where another IT-application serves as a gateway layer between data sources and the city platform. The distinction between the two modes is important, because the functionality and ways of interfacing differ greatly. The domains will each have their own set of technical components and applications to manage them. To bridge and connect the smart city data landscape, the data platform must provide compatible interfacing technologies to match the technical components and applications within each ecosystem.

Several large vendors in the ICT & digital-space today can provide a complete and integrated SCP matching the design criteria. The choice of design and ultimately choice of vendor(s) will depend heavily on the technical and data-wise characteristics of each use case ecosystem. Most large IT vendors have commercial product offerings both covering the data platform itself, and concrete subareas for each ecosystem (e.g., a traffic management system on top of a supporting data platform). For this reason, a strategic approach and high-level design strategy should be created before any concrete technical solutions are procured. This will ensure vendors the best prerequisites to offer solutions supporting the vision of an integrated SCP.

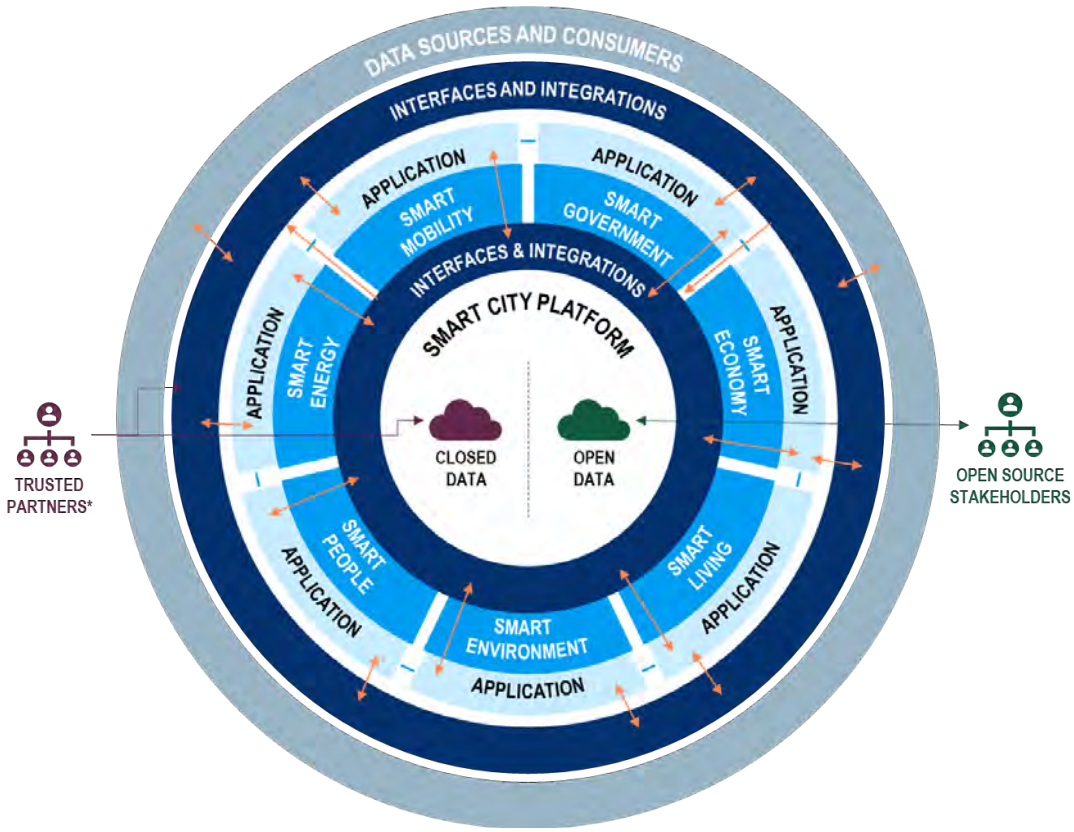
To conclude on the above, smart city is a commonly used term to describe a modern city administration that harness ICT & digital to increase operational efficiency, provide services, solve problems, and increase resilience in addressing environmental, social, and economic challenges in holistic urban planning.

A Smart City Platform is a common system for consolidating data and providing information in the context of a smart city

Utilizing technologies remains at the center of a smart city by digitizing society's infrastructure using e.g., IoT devices. IoT devices are sensors and control units used to collect data from urban spaces. However, the data collected by such devices only provide smart city value when being collected, gathered, and analyzed with adequate intelligence and analytics (e.g., machine learning, artificial intelligence, automated IT resource provisioning and data analytics). Data is collected in an SCP, which provides an overview of data, disseminates these to relevant applications and initiates actions based on rules and criteria determined and configured by the users. Thus, the smart city technology infrastructure is a key layer to consider when establishing a smart city.

Figure 12 illustrates a system overview by considering the SCP as the core in the smart city ICT & digital setup. Through interfaces and integrations, a SCP is a smart repository that gathers the converted data collected by various data sources, which can then be used for different smart applications. Each smart technology domain stated by the EEC Strategy has different applications and use cases (e.g., a Traffic management System is a part of Smart Mobility). Thus, the setup can be illustrated as shown in the figure.

Figure 12: Smart City Platform is the Core of Smart City Data



Source: Authors.

While population growth keeps increasing globally, people are moving to urban areas at an ever-increasing rate. This double effect puts a pressure on creating more livable, inclusive and sustainable societies and cities aligning with the Sustainable Development Goals. Smart cities harness technology to create an inclusive, safe, resilient, and sustainable environment. Thus, an SCP is:

A central hub that controls the flow of information within the smart city ecosystem

4.2 INFORMATION AND COMMUNICATION TECHNOLOGY OUTCOMES, INDEXES, AND SOLUTIONS CATALOG

While the SCP serves as the central hub that controls the flow of information within the smart city ecosystem, and thus enables smart applications and ICT & digital solutions (see Chapter 4.4), EEC must ensure that the ICT & digital setup supports the delivery of the city outcomes set during the visioning stage (refer to Sub-stage 1C: Outcomes). The criteria smart cities are evaluated against is specific to the index chosen. Some indexes such as the IMD Smart City Index even prescribe criteria for smart technologies (Table 3).

While the Smart City Index can in practice work as a benchmark and success criteria, other smart cities (and other cities in motion) have growth plans and visions for expansion as well. Thus, EEC may see the benchmark as a moving target, and EEC must establish benchmarks from the suggested BRM framework (Chapter 3) instead of only relying on an index. While a full overview comparing smart city indexes can be found in Appendix 2, Appendix 9 provides a full overview of an ICT & Digital Solutions Catalog that can be used to identify technologies that can assist EEC in reaching specific targets. First, however, it is crucial to map the technical layers of the ICT & digital infrastructure to understand where the value, which is captured by the indexes, are created.

Table 3: Key Performance Indicators for the International Institute for Management Development Smart City Index

Category	Structure	Technologies
Health and Safety	• Basic sanitation meets the needs of the poorest areas • Recycling services are satisfactory • Public safety is not a problem • Air pollution is not a problem • Medical services provision is satisfactory • Finding housing with rent equal to 30% or less of a monthly salary is not a problem	• Online reporting of city maintenance problems provides a speedy solution • A website or app allows residents to easily give away unwanted items • Free public Wi-Fi has improved access to city services • CCTV cameras has made residents feel safer • A website or App allows residents to effectively monitor air pollution • Arranging medical appointments online has improved access
Mobility	• Traffic congestion is not a problem • Public transport is satisfactory	• Car-sharing apps have reduced congestion • Apps that direct you to an available parking space have reduced journey time • Bicycle hiring has reduced congestion • Online scheduling and ticket sales has made public transport easier to use • The city provides information on traffic congestion through mobile phones
Activities	• Green spaces are satisfactory • Cultural activities (shows, bars, and museums) are satisfactory	• Online purchasing of tickets to shows and museums has made it easier to attend

Continued on next page

Table 3 continued

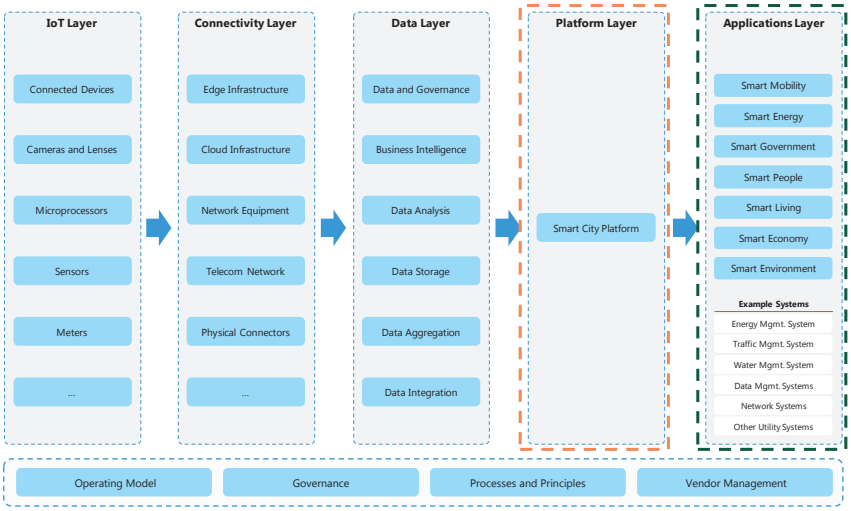
Category	Structure	Technologies
Opportunities (Work and School)	• Employment finding services are readily available • Most children have access to a good school • Lifelong learning opportunities are provided by local institutions • Businesses are creating new jobs • Minorities feel welcome	• Online access to job listings has made it easier to find work • IT skills are taught well in schools • Online services provided by the city has made it easier to start a new business • The current internet speed and reliability meet connectivity needs
Governance	• Information on local government decisions are easily accessible • Corruption of city officials is not an issue of concern • Residents contribute to decision-making of local government • Residents provide feedback on local government projects	• Online public access to city finances has reduced corruption • Online voting has increased participation • An online platform where residents can propose ideas has improved city life • Processing Identification Documents online has reduced waiting times

Source: IMD Smart City Index .

4.3 HIGH-LEVEL OVERVIEW OF INFORMATION AND COMMUNICATION TECHNOLOGY LAYERS

The first step toward setting the IT architecture is to identify and set the basic principles and layers of the ICT & digital set-up. Before we take a deeper look at the IT architecture, we must establish some of the basic principles and layers of the ICT & digital setup in a sustainable smart city. Traditionally, the ICT & digital layers can be simplified to five layers (i) IoT layer, (ii) connectivity layer, (iii) data layer, (iv) platform layer, and (v) applications layer. This is illustrated in Figure 14.

Figure 13: Data Layers in the Information and Communication Technology Setup

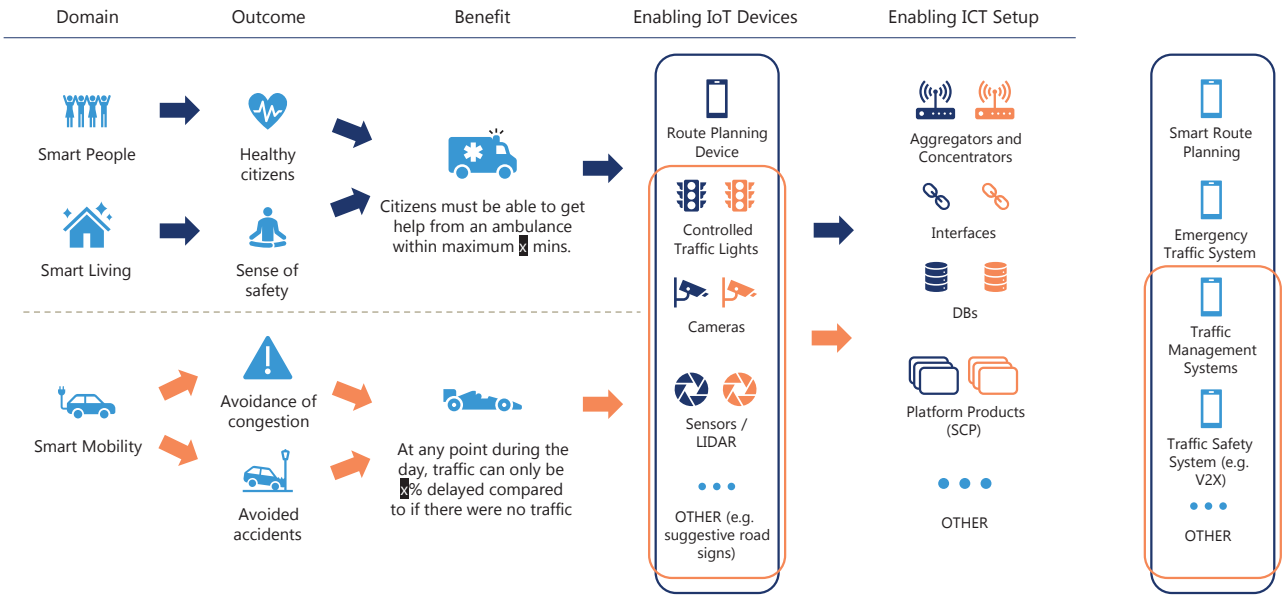


Note: Orange Box: Scope as requested by EEC. Green Box: Where Value is Derived and Benefits Realised.
Source: Authors' own creation based on common terminology and global data

Each layer has several focus areas for EEC. However, the core of the setup is the SCP. The defined benefits are only realized once integrated with an applications layer. An example is that benefits from Green Energy is realized through a system, where an energy management system is built on top of the SCP (e.g., applications layer). To illustrate how value is derived, and the connection to the previous chapters, EECO must understand the interdependencies between outcomes, benefits, and ICT & digital devices (many times these are outputs).

Figure 14 provides an example of smart mobility, where traffic management systems and emergency traffic systems tap into multiple outcomes and benefits, as well as shares a number of ICT & digital devices.

Figure 14: Interdependencies between Information and Communication Technology Layer and Benefits and Outcomes



Source: Authors.

4.4 REFERENCE VISUALIZATION OF TECHNICAL INFORMATION AND COMMUNICATION TECHNOLOGY LAYERS

This section visualizes all the ICT & digital layers and components before diving into each of these. Here, Ramboll has created a visualization that can guide EEC in their future vendor discussions as a tool to force vendors to describe all ICT & digital components of the technical framework. The smart city IT architecture highlights five components that entail vital enabling infrastructure that should be considered during vendor dialogues to achieve the desired benefits of an integrated SCP.

For this ICT & digital setup, the infrastructure must have (i) interoperability and multi-platform integration, (ii) scalability, (iii) elasticity, (iv) data management, and (v) operations and security.

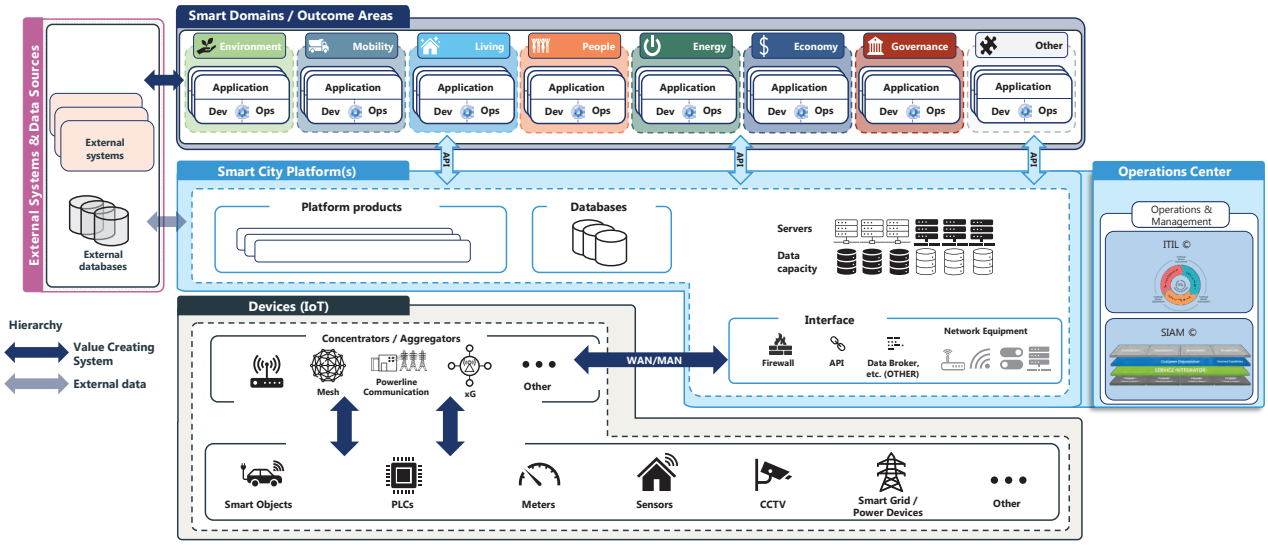
Box 12: Data Flow for Information and Communication Technology Setup

In the information and communication technology setup, the data flow consists of:

- From the bottom and up, the aim is to collect real-time data through internet of things (IoT) devices, aggregate this information via a concentrator, transfer the data via network capacity (e.g. WAN/MAN) into a coherent interface of the Smart City Platform (SCP), which must enable the integration of the IoT data into the platform databases.
- Further, it is a prerequisite that the SCP is open for multi-platform integration to connect with other platform products to prevent the city from being locked-in with a vendor using proprietary technologies.
- Moreover, the platform must provide to the data for developers across the Smart domain and value areas to harness, utilize and monetize these, e.g., via boundary resources, such as APIs. To this, integration with external systems and data sources must be enabled for them to combine multiple sources of data to build and operate the desired value creating service offerings.
- An operations center must be established to maintain and operate the SCP, which implies the integration of services from the multitude of external (and internal) vendors. Further, operations services include security and safety parameters, as well as support.

Source: Authors.

Figure 15: Visualization of Information and Communication Technology Setup in the New Livable Smart City

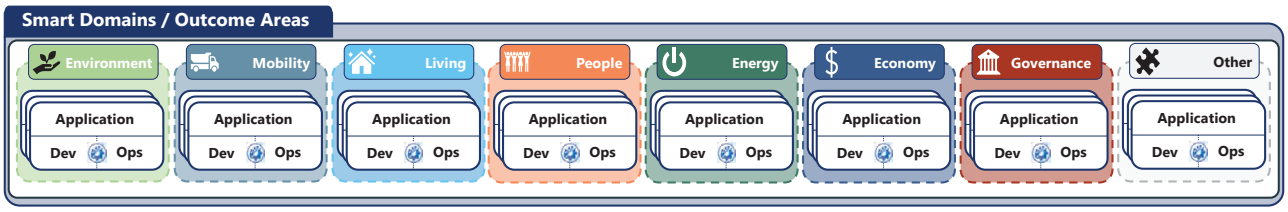


Note: See Appendix 7 for a scaled up version.
Source: Authors' own creation.

4.4.1 Applications Layer: "Smart Domains/Outcome Areas"

The outcomes should analysed first, which is commonly known as the applications layer. This is where the value is generated, and benefits are realised. Specifically, this section analyses the top layer in the visualised framework as illustrated in Figure 16.

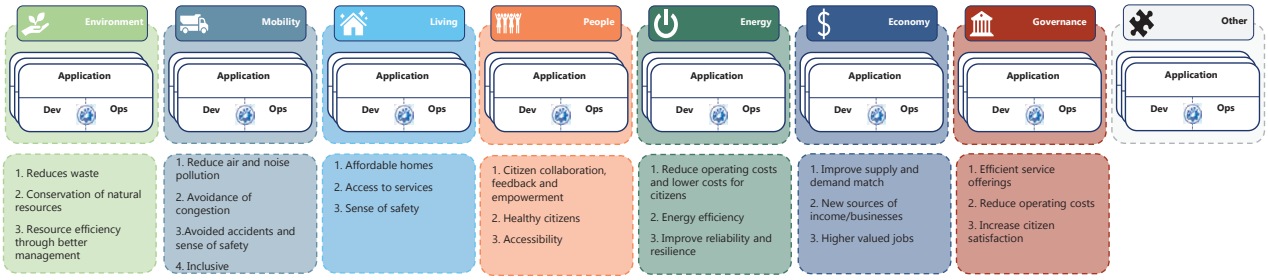
Figure 16: Focusing on the Outcome Areas



Source: Authors.

Zooming in, the applications layer defines the areas where data will be used. This could e.g., be for an Energy management system that builds on the data collected through the SCP. This layer consists of different applications, development (Dev) units, and operations (Ops) teams for each domain. Figure 17 illustrates that these bundles of applications, Dev- and Ops teams combined contributes to specific benefits and outcomes.

Figure 17: Applications Layer – A Bundle of Applications, Dev&Ops Teams, and Benefits.



Source: Authors.

To illustrate this and as requested by EEC, the next section highlights use cases of how value is derived. The list of cases is non-exhaustive.

4.4.1.1 Case Studies of Smart IoT Applications

Building a sustainable smart city implies finding 21st century solutions for 21st century problems. As an example, the old way of tackling heavy traffic was to build an extra lane on the road. This, however, only causes more cars, introduces lane-shifting conjectures, and ultimately leads to not only worse conditions for cyclists, pedestrians, and inhabitants, but an even heavier traffic, which causes worse air quality, increased noise, etc. Instead, a 21st century solution rethinks the way commuting is done by tapping into the smart mobility domain and modern freight logistics.

While the SCP provides little value, benefits are created by harnessing the streamlined and open data for multiple domains such as smart energy. This is further elaborated in the next sections. However, first, this section highlights a few use case areas as requested by EEC, illustrating how value is derived from a smart city ICT & digital setup.

Box 13: Case Studies of Smart City Solutions

SMART GOVERNANCE IN ALASKA - NEW WAYS OF WORKING

An example of smart government comes from the State of Alaska which managed to preserve critical services with citizens during the coronavirus disease (COVID-19) pandemic through transition to remote work. In summary, the state used smart government solutions to achieve the things described in Box Figure 13.1.

Box Figure 13.1: Results from Alaska

Business challenge summary

- Increase VPN capacity to handle unexpected loads due to transition to remote workforce.
- Rapidly provide a secure and reliable communications platform for thousands of workers.
- Modernize and enhance a secure line of communication and information sharing between government and citizens.

Network solution summary

- Integration of virtual instance of Cisco AnyConnect into existing network for rapidly expand secure VPN access for all remote workers.
- Significant increase in licenses to industry-leading Webex real-time video conferencing solution.
- Use of Webex to securely communicate and share critical information with citizens.

Business results summary

- Doubled VPN cpacity in just six days to stay ahead of demand, then by factor of ten to meet long-term needs.
- Maintained continuity of government and critical services while enhancing resiliency.
- Achieved strong public compliance to state requests via transparency and engagement with citizens.

Source: State of Alaska Enhancing Resiliency in Government During Time of Unexpected Stress. Cisco, 2020. https://www.cisco.com/c/dam/m/digital/elq-cmcglobal/OCA/Assets/SLG/Alaska-CS-Resiliency-in-government.pdf?ccid=cc001017.

Continued on next page

Box 5 continued

SMART MOBILITY IN COPENHAGEN: TRAFFIC MANAGEMENT AND PARKING

By extracting and transforming data, the city of Copenhagen, Denmark rolled out a Smart Mobility solution of 380 intelligent traffic lights that not only prioritize bikes and buses but also help clear congested streets after selected events such as soccer games have taken place. By using traffic signal prioritization and signal timing, the green light phase of a traffic light can be extended by up to 30 seconds according to the situation. Further, all roads in Copenhagen are mapped in an app that allows you to park anywhere and pay your parking fee based on GPS signals to the smart phone, which marks the appropriate parking zone and fees.

SMART LIVING IN LONDON: CYBERSECURITY ECOSYSTEM

Through collaborations between public and private entities and continuous initiatives, London has managed to develop a tech ecosystem that makes them a greatly acknowledged smart city. In 2018, a collaboration between the government and a London-based consultancy, Plexal, contributed to this development through cultivating the cybersecurity ecosystem by delivering the London Office of Rapid Cybersecurity Advancement that supports companies in cybersecurity attacks at an early stage by connecting them with business opportunities.

SMART ECONOMY IN BOSTON: INCENTIVIZING LOCAL SHOPPING

As a response to the economic challenges imposed by the COVID-19 pandemic, Boston has launched an application for smartphones, named B-Local, initiated to support local businesses by rewarding Bostonian people for shopping locally. The app uses a points-based system where discounts is redeemed for future purchases with the purpose of encouraging consumers to shop local and thereby support the local businesses.

SMART ENVIRONMENT IN SEOUL: AI-DRIVEN SEWAGE SYSTEM

In 2021, Seoul has announced several initiatives where AI appears as an enabler to revolutionize some of their critical infrastructures. Among other, Seoul is seeking to simplify maintenance of its approximately 9,000 kilometers of public sewers by installing AI-enabled cameras equipped with computer vision capable of detecting defects throughout the sewer system. As a result, this should increase maintenance accuracy, decrease costs, and enable quicker acting. Moreover, Seoul is currently in the first stage of developing an automated sewage treatment system operated by an AI-enabled system that ensures that less energy is wasted. This entails developing the digital infrastructure of the database that should accommodate pertinent data and facilitate remote monitoring from personal devices. The sewage treatment system is intended to be fully automated by 2030.

SMART GOVERNMENT IN SEOUL: CITIZEN ENGAGEMENT IN FUTURE PROJECTS

The Democracy Seoul engagement platform supports collective decision-making between the Seoul Metropolitan Government and the citizens by allowing residents to provide an opinion regarding the future projects in the city. This enables the government to identify the projects that is the most beneficial to the citizens.

Continued on next page

Box 5 continued

SMART ECONOMY IN NEW YORK CITY: BUSINESS CONDITIONS PLATFORM

As the optimization of a smart economy initiative, New York City created a tool called Business Atlas to help businesses research the economic conditions of neighborhoods where they might set up shops. The free, online portal shows a map with interactive data on demographics, density of restaurants, income, and even foot traffic. The Business Atlas can help entrepreneurs gain crucial knowledge before making a costly investment.

SMART LIVING IN SAN DIEGO: CITIZENS TO SUBMIT DATA

San Diego did not have a centralized process or system in place for residents to report non-emergency problems such as graffiti, street light repair, potholes etc. and due to that they instead reported such matters to 911. To fix this, the city made the "Get It Done" app, where citizens can upload photos of the problem, enter details about the issue, and submit requests for action.

SMART ENVIRONMENT IN SANTANDER: WATER TREATMENT

The Spanish city of Santander created a smart environment application that allows the users to access real-time information about their consumption, water quality (pH and turbidity) or the pressure on entry into the home (one of the most frequent supply problems in a hilly city like Santander).

SMART PEOPLE IN SINGAPORE: OPEN INNOVATION

Smart people solutions can be many things, but one example is the Open Government Data Portal of Singapore, which allows citizens to tap into government data, making government more open and accountable for the citizens. Opening government data increases citizen participation in government, creates opportunities for economic development, and informs decision-making in both the private and public sectors.

SMART ENERGY IN DENMARK: SMART GRIDS

Denmark appears as a showcase for smart grid solutions and renewable energy with more than 50% of the energy in the electricity grid being acquired from renewable sources. Furthermore, it is one of the most reliable grids in the world with an up-time of 99.8%[11]. A smart grid is an electricity network that is capable of supplying consumers with electricity via two-way communication based on digital technology. Hence, a smart grid enables the production and the consumption of electricity to fluctuate to a greater degree preventing imbalances by allowing suppliers and consumers to manage and coordinate the capacity of energy offered and demanded.

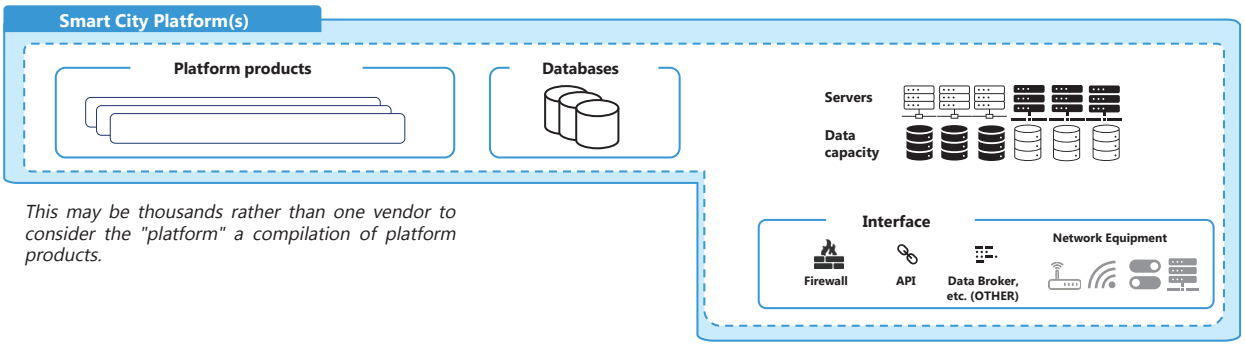
Source: Authors.

[11] According to the Ministry of Foreign Affairs of Denmark, as illustrated here: https://investindk.com/set-up-a-business/cleantech/energy-storage.

4.4.2 Smart City Platform Products

The applications layer is integrated to the platform layer through application programming interface (APIs). Next, this chapter explores the platform products, which is the core of the New Livable Smart City ICT & digital setup as illustrated in Figure 18.

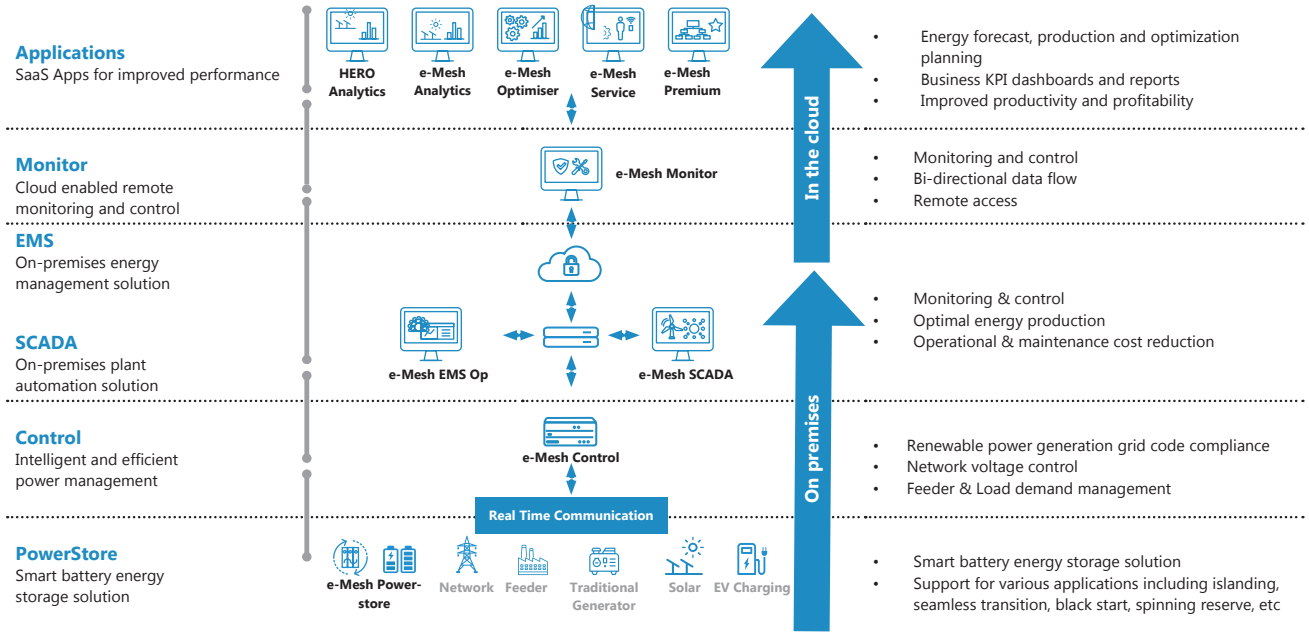
Figure 18: Smart City Platform Products



Source: Authors.

Here, it is important for EEC to understand that that while some suppliers may refer to a single system as a SCP, it should, rather, be considered as a bundle of platform products that integrates and merge as one data management and visualization solution. Thus, if the company Hitachi says that they offer one common platform (Hitachi© calls this "LUMADA©"), it is a multitude of different platforms and integrations that combined provides the solutions needed ("outputs", see Chapter 3) to realize the defined benefits. See Figure 19 for an example for the SCP that governs grid edge solutions.

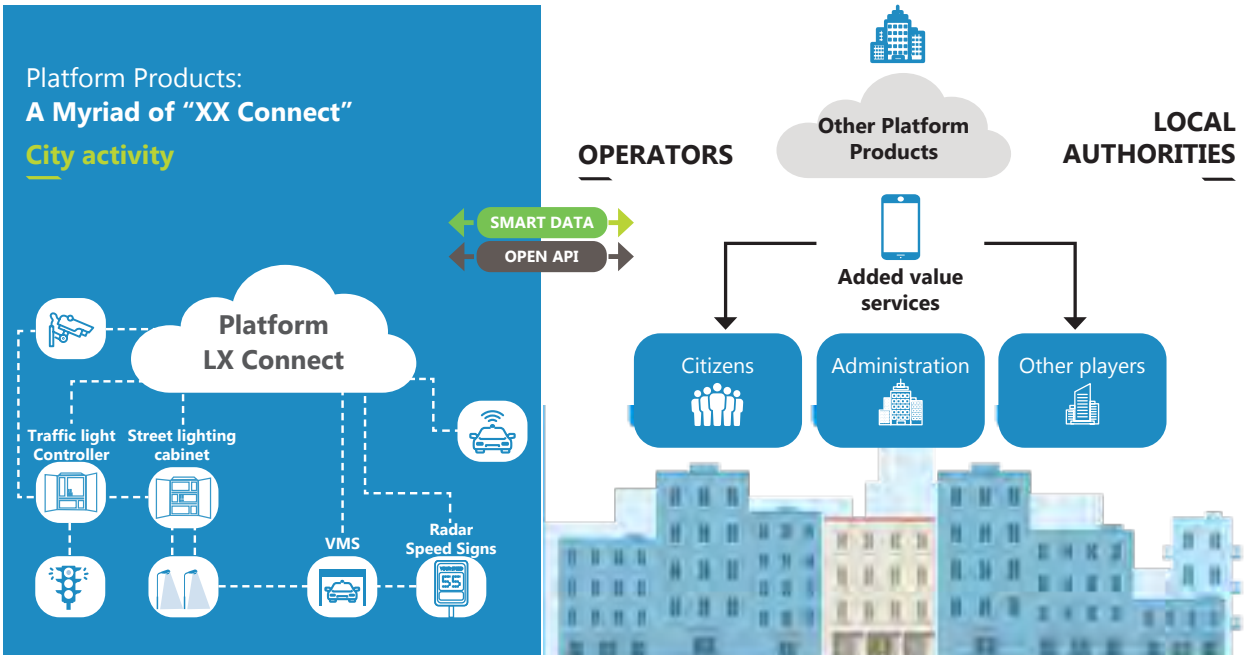
Figure 19: Hitachi© Smart City Platform Products for Grid Edge Solutions



Source: Hitachi, Ltd©.

Lacroix©, an IoT/ ICT & digital solution manufacturer specializing in traffic management and street lighting has illustrated this in a simple way as illustrated in Figure 20. See Appendix 4 for an overview of some of the solutions that Lacroix offers.

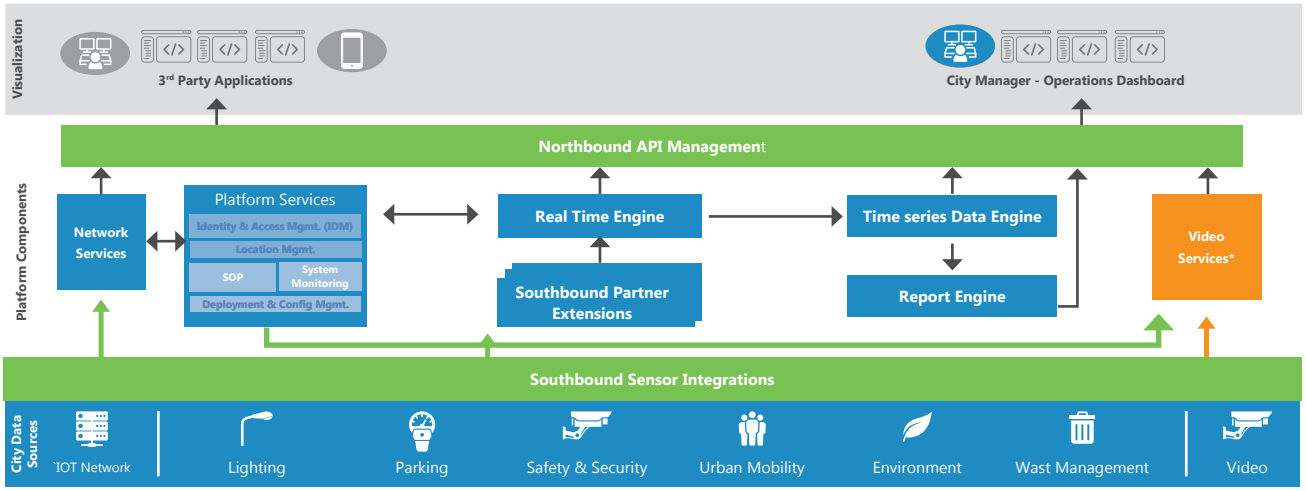
Figure 20: Lacroix© Visualization of Smart City Platform Setup



Source: Lacroix©.

Here, it is expected that each vendor that provides ICT & digital solutions will provide their own "connect" solutions, which structure the data and integrate in a myriad of other platform products. Another example is Cisco©, who calls "platform products" for "platform components" as illustrated in Figure 21.

Figure 21: Cisco© Kinetic Platform Components



Source: Cisco©.

4.4.2.1 Data Management and Governance in Platform Layer

Data can be considered the backbone of a smart city, while harnessing such enable the city to continuously optimize resources and assets, build new solutions to improve the conditions for citizens and businesses, and create a sustainable economy. Nevertheless, the tremendous amount of available data generated by the IoT and integrated across public and private sectors to break down data silos, must be managed through its life cycle and processed adequately to drive decisions and thereby realize the desired benefits of the New Livable Smart City. This requires intelligent data management techniques employed to provide consistency, quality, interoperability, granularity, re-usability, security, inclusivity and privacy with the purpose of sharing data, enabling developers of the application domains to utilize data to build new products, as well as analyzing information to continuously improve the systems. Ultimately, data management comprises a set of standards for the practices of collecting, organizing, storing, and protecting data to ensure effective and secure utilization as a resource. In line with this, EEC must enforce data management standards, and ensure roles and responsibilities are in place.

Another project under the AASCTF released in February 2023[12] a guided learning program about data management and governance. This information will be publicly available through the ADB e-learn platform. EEC should take this brief learning program about data management and governance for smart cities. Snippets from this section originate from said learning material. Further, data management perspectives are described in detail in the DEPA-report about SCPs, which is an exhaustive document that is available to EEC in Thai. Further information can be found using the two sources.

A key step in creating an inclusive smart city is the quality and type of data used. Disaggregated data (for example by gender and disability) is key, while qualitative data needs to be as valued as quantitative data. This includes for example, measuring phenomenon that might not have been considered important previously, such as sexual harassment, or vendor revenue lost from long queues at distant public toilets. To be truly "smart" (meeting the smart city 3.0 definition), the methods and type of data collected, how (and by whom) it is analyzed and facilitates decision-making is crucial. The AASCTF – Inclusive Cities Dialogue Project in May 2023 released the "Inclusive Cities" e-learning course, which delves into how cities in Southeast Asia can be designed and developed to better meet the needs of women, persons with disability, children and youth, older persons, migrants, members of the LGBTQIA+ community, and others in intersectional groups. The course covers topics related to GEDSI data gathering and assessment, and EEC actors are encouraged to take the course as the learnings are directly applicable to the models and frameworks to be applied in the new city.

Data sharing will help realize the full potential of smart cities. This is in terms of municipalities sharing data with citizens and companies as well as vice versa. The sharing of data between different stakeholders and data generated from technologies such as IoT sensors in the urban environment increase the volume, variety, and velocity of urban data. This creates new possibilities and opportunities for new business cases and for improving cities. However, it also creates new socio-technical challenges and

[12] Unleashing the Power of Data: An Introduction to Data Management for Smart Cities. ADB eLearn, 2023. https://elearn.adb.org/enrol/index.php?id=492.

risks that, if not managed appropriately, can compromise the rights, privacy, and security of citizens. Such data management will thus likely require a regime that controls the access to data for each user. Urban data can come from a variety of sources, from social media to IoT devices, which can present data in a variety of formats. This will depend on the nature of the data (e.g., structured, or unstructured data), the selected communication infrastructure between device and data storage (e.g., LoraWan, SigFox, NB-IoT) and the ontology used in describing how data is stored and structured in data storage platforms. Thus, these varieties can greatly challenge data exchange between different data storage platforms or the linking of data across different sources in a common data environment.

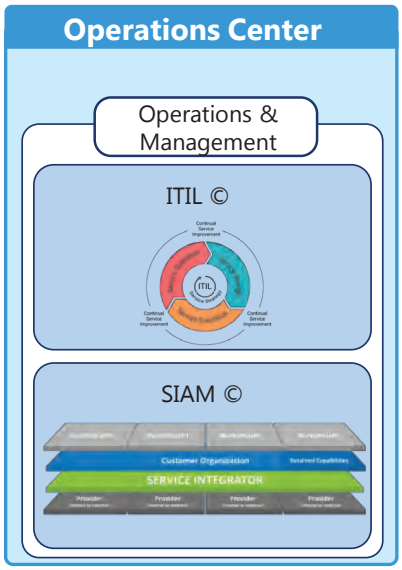
At its core, data governance is how a city's performance and quality of life can benefit from data-enabled technologies without compromising privacy. Cities are built and operated on data, much of it personal in nature. Consider the information that cities may store about you: your address, birthdate, medical history, income, criminal background, voter registration, permit requests, driving record, fines, education, and more.

It is crucial that EEC define guiding principles for the data management and governance processes. This includes both considerations about data privacy, cyber security, principles and processes for data consistency and quality, data interoperability, principles for data enrichment, and other data governance processes.

4.5 OPERATING MODELS

This section explores the operating models that could be harnessed in the new ICT & digital setup. As the SCP likely will constitute of a bundle of vendors with interlinking platform products, it is critical that EEC both (i) forces vendors to answer how they will operate their solutions using the best-practice ITIL© framework, and (ii) understands its position as a service integrator in coordination with the SIAM© framework. The hierarchical structure and reporting lines is yet to be determined by EEC, but this section explores how development, operations, and maintenance can be performed in coordination between public institutions, working as a Business Owner using SAFe© terminology, and Dev, Ops, and DevOps teams both controlled by said public institutions and vendors. As illustrated in Figure 22, this section mainly focuses on the operating models for the platform layer, but the principles can be applied to coordinate Biz, Dev, Ops, and the teams (see later in this section for definitions) at an applications layer as well.

Figure 22: Operations Center



Source: Authors.

Often in a smart city, the operations center refers to a unit that monitors dashboards and real time data for quick data-driven decision-making, harnessing the SCP itself. For example, Nokia calls this the Integrated "Operations Center for smart cities". This works as a system "providing a single pane of glass to intelligently control and manage all smart city assets and services including IoT and non IoT data sources, systems, applications and analytics engines". Operations center remains at the core of the operations of the city, thus EEC must determine who will provide this service and how the service-level agreements (SLAs) are arranged. For the remainder of section, the report focuses on the IT O&M models from a technical IT Service Management (ITSM) perspective. This is to ensure that all vendors that EEC may select to create a full-stacked smart city experience has considered all aspects of the backend IT operations as well as ensuring that EEC can manage potentially thousands of vendors in a scalable manner.

4.5.1 Bridging the Strategy with Execution

Developing a vision for the New Livable Smart City and procuring ICT & digital solutions cannot solely deliver the benefits to achieve the overarching strategic objectives, since the need for developing and operating the environment surrounding the SCP continuously remains essential. Hence, it is paramount to bridge EEC's strategy with the adequate processes by continuously operating and maintaining the IT backbone to execute and achieve operational efficiency. EEC is consequently obliged to consider the perspective of future day-to-day operations which ultimately requires an integrated operating model. Along with the exercises of performing strategic visioning, benefits mapping, and, based on these, procuring the appropriate ICT & digital outcomes, such a model should therefore be designed.

4.5.2 Designing Operating Models to Achieve Operational Efficiency

An operating model can be characterized as an engine which translates strategic objectives into operational capabilities. In a smart city context, this is exactly what keeps the ICT & digital (and

thus the city) going, and thereby enable benefits to be realized while continuously adapting to rapid changes in the environment, such as new technologies or needs from citizens and businesses. Further, it is designed with the aim to provide a breeding ground for execution and define clear guidelines for teams across the hierarchy. The purpose is to interact with customers, citizens, processes, data, and technology of the city, as well as continuously learning from those. In this way, the operating model supports benefits to be realized and sustained.

4.5.2.1 Linking Development and Operations with the Business: AGILE

Given the enabling IT infrastructure of smart cities, it is crucial that the effort of the IT vendors is strategically aligned with the needs of the business to achieve operational efficiency. Here, the effort is constituted by Dev and Ops capabilities. To this, EECO must establish the link to the business (Biz) as the authority that handles the strategic priorities, as well as owns and continuously manages the SLA. A development process based on agile principles (representing a hierarchy of strategic-, program-, and project-backlogs) must be developed. Appendix 5 describes, using the terminology from Scaled Agile Framework (SAFe©), how (i) EEC can set strategic "business objectives" through so-called "EPICS;" (ii) vendors and public developers can coordinate development activities ("Features") through a so-called Agile Release Train (ART) managed by a product manager, facilitated by release train engineers, and supported by system architects; and (iii) agile teams can harness agile DevOps methodologies to develop "stories." It is recommended that EEC understand and adopt agile multi-stakeholder methodologies. However, this requires a thorough understanding and analysis of the specific post-implementation operating model.

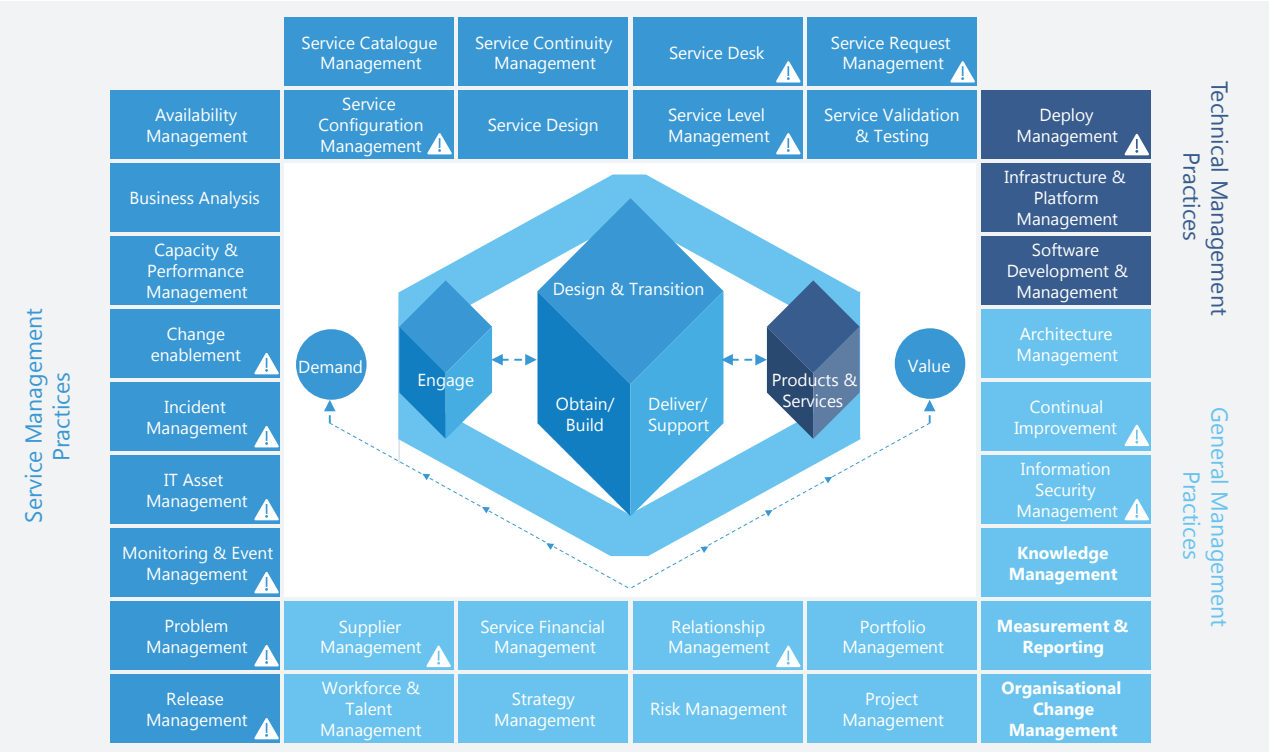
This strategic analysis is recommended for EECO to perform at a later stage, once the program goals, benefits, and objectives are clearly defined. Thereby, it is necessary to align with the individual vendors on their intended ways of developing and operating the solutions respectively to the needs of EEC (the Biz). The following section presents a best-practice ITSM framework, ITIL©, which EEC can utilize to facilitate the process of alignment with vendors and thereby establish an appropriate operating model.

4.5.3 IT Infrastructure Library (ITIL©)

ITIL© is an ITSM framework that focuses on the alignment between IT and business needs. The framework is internationally acknowledged for supporting the delivery of digital/IT services, and it serves as a comprehensive and well-documented practical guide for service vendors, containing extensive descriptions with a wide range of IT-related processes and considerations covered. Moreover, it represents general consensus on good practices and creates a common language with coherent structure and glossary of terms for ITSM.

ITIL© is by no means a one-size-fits all solution. Rather, it is highly generic and therefore EECO needs to tailor the framework to their specific needs. With a goal to ensure stability and safety within the SCP environment, the EECO can leverage ITIL© as a guideline to obtain alignment with vendors on specific areas regarding their Technical-, Service- and General management practices considered in the framework, as visualized in Figure 23.

Figure 23: Overview of Categories and Practices in the ITIL© Framework for IT Service Management



Source: Authors, based on Value Insights©.

4.5.3.1 Technical Management Practices (Dev)

The technical management practices consist of groups, departments, or teams that provide expertise and management of the IT infrastructure, including software development, deployment, and system architecture management. Ultimately, these resources are equipped to deploy and design, build, transition, operate, and improve the technology required to deliver and support IT services throughout the ITSM life cycle, including mainframe, servers, network, storage, and databases. The practices aim to support planning, implementation, and maintenance of a stable technical infrastructure to continuously provide seamless, uninterrupted IT service to EEC's New Livable Smart City. Therefore, the technical management practices designs resilient and cost-effective technical topologies to utilize technical skills adequate to maintain technical infrastructure and optimal conditions as well as detect the root cause of any technical event (e.g., failure) and quickly resolve it to restore service to users. Typically, the organizational structure of the technical management practices consists of specialized units grouped in relation to their technical expertise, which should be determined by the technology that has to be managed. Due to the depth of each of the sub-categories within the technical management practices, the ITIL© Foundation book should be consulted for best practices.

4.5.3.2 Service Management (Ops)

The service management practices manages the service levels, continuity, service desk, problems and incidents, changes, monitoring and analytics, and supporting ITSM services (e.g., testing and validation,

availability, and more), as well as managing the overall service catalog. Service management practices include processes for 17 different practices.

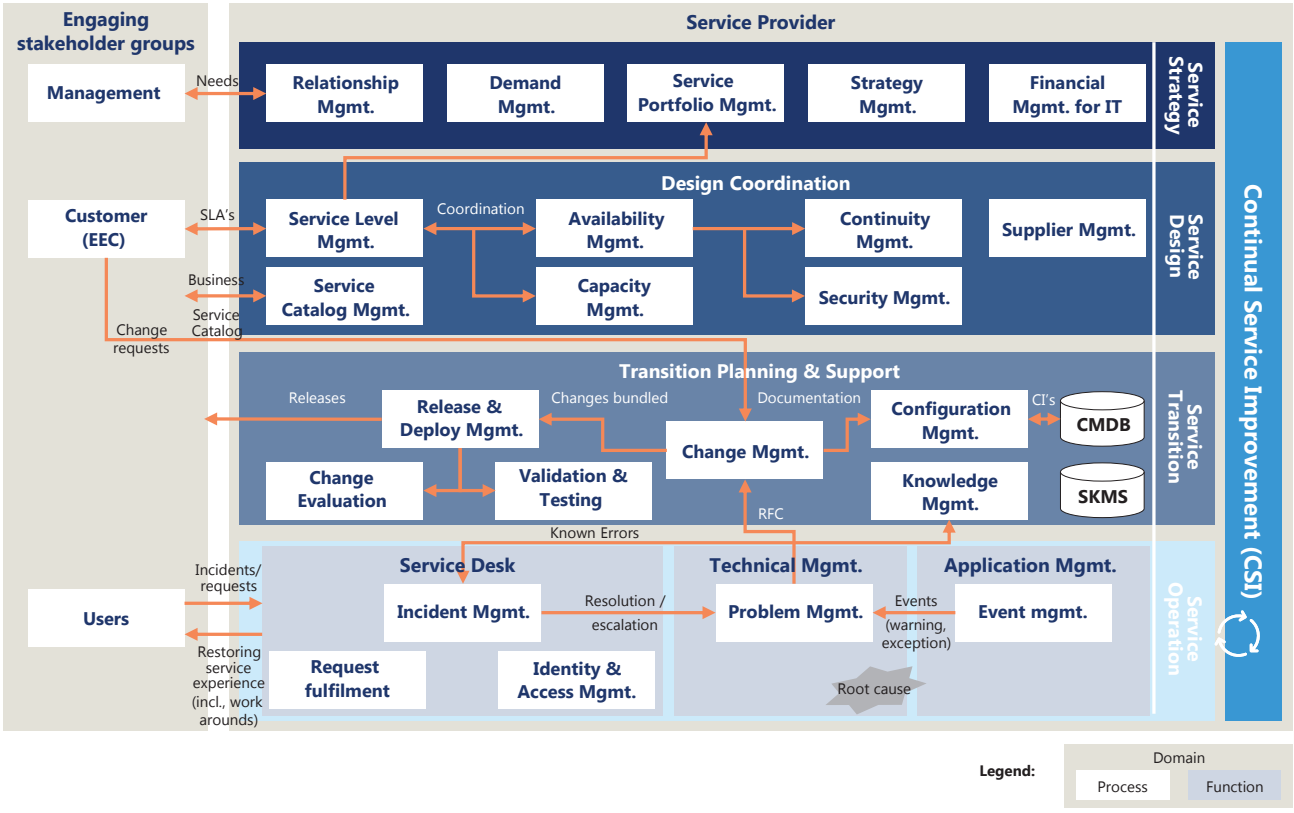
4.5.3.3 General Management

The general management practices manages the strategy, organizational change, suppliers, knowledge, and continuous improvements, as well as project-, portfolio-, risk-, financial-, workforce-, and security management. General management practices include processes for 14 different practices.

4.5.3.4 Process Flow and Actors using ITIL© Terminology

The practices illustrated in Figure 23 has implications for different engaging stakeholder groups. As illustrated in Figure 24, the management layer defines needs that dictates the service strategy. SLAs are then defined by the IT service acquirer ("customer" using ITIL© terminology), which defines the service management and catalog. "Users" are considered the actors that use the SCP, which could be entrepreneurs, providers of solutions to the applications layer (see Chapter 1.3.1) and other players that integrate to, use, or provide platform product components to the SCP. The service provider can be considered both public IT operations units that works as part of the City's ITSM or suppliers that offers any ITSM for the operations of EEC's New Livable Smart City.

Figure 24: ITIL© Operations Flow



Source: Authors, based on ITIL©.

4.5.3.5 What Does This Mean for EEC as a "Service Integrator"?

IITIL© provides a best practice framework for ITSM and can be harnessed for the EECO to consider all aspects in the future IT operations of EEC's New Livable Smart City. To develop, operate, and maintain the ICT & digital for the New Livable Smart City, hundreds of ICT & digital vendors will provide products and service offerings. Many of these vendors and organizations offering said products and services will have intra- and interdependencies. It is crucial for EEC that each of these vendors has operating protocols that limits system vulnerability (e.g., through incidents) and allows for scaling. This is especially true for the SCP, which is the backbone of data flows throughout the city.

Thus, it is recommended that the EECO forces vendors to answer how they will establish an O&M model that is aligned with the ITIL© best practice framework.

Further, it is important that EEC understands the role of the service integrator. Whether established by the EECO itself or by a new city IT management unit, the service integrator role is responsible for connecting layers of vendors in an interconnected, interdependent system governed by SLAs. The next section explores the role of the service integrator.

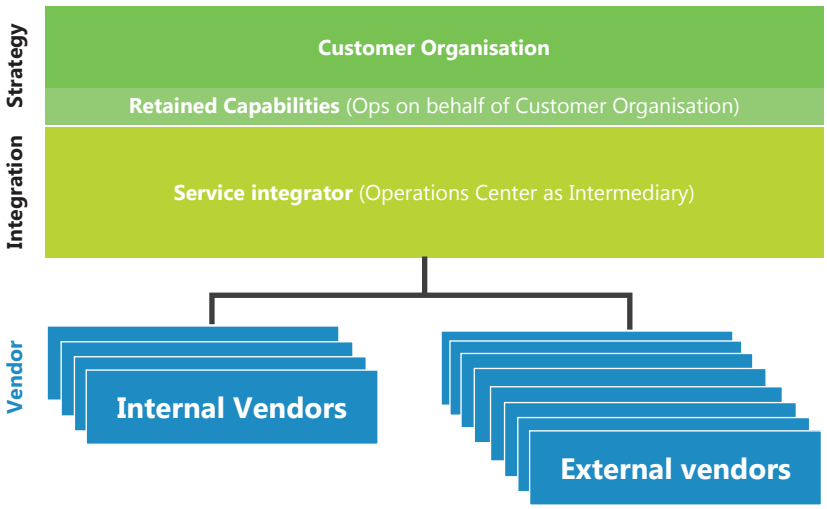
4.5.4 Service Integration and Managemeent (SIAM)©

In modern societies, municipal ICT & digital relies not only on a full-scale internal development of software components. Rather, it is a myriad of public and private entities that all provides components in a larger ICT & digital setup. While no IT infrastructure is simple, the SIAM© framework is a framework that enables administration and integration of independent internal and external service providers and vendors with the aim to create one integrated customer focused IT/OT/ICT & digital service offering. Thus, it enables the imitation of one IT- organization that, in fact, consists of a vast number of independent players. The SIAM© framework further ensures alignment with requirements and needs from the city management and customer (SLA-owner) by establishing governance, management, and integration through coordination. In the SIAM© framework, there is a need to create an environment in which everyone involved:

- Knows its role, responsibility, and context within the ecosystem.
- Has the mandate to decide and deliver.
- Is kept responsible for the outcome of the requested deliverables.
- Is encouraged to corporate across the IT-organization.

Figure 25 illustrates the link between the customer organization and strategic goals to service integration and vendor management.

Figure 25: SIAM© Overview of Service Integrator and Vendor Layers



Source: Authors.

As a service integrator, EEC (or the dedicated service integrator units) has a list of responsibilities. These include, but are not limited to:

- Handling daily management of procured and retained delivery of operations and support.
- Being responsible for delivery management, including management of incidents and problems.
- Administrating and strengthening continuous integration between daily operations processes and the work with operations and vendors.
- Representing the retained organization's responsibility for stability and performance for service towers, as well as service components from the vendors.

According to the SIAM© framework, the service integrator must, further:

- Create minimal complexity for contracts, alongside well defined and standardized service management methods across vendors.
- Prepare evaluations of vendors and recommend vendor choice (and termination) and future procurement of operations and support services.
- Consolidate the service components of the vendors into standard IT services, platform or service towers to enable a trouble free, coherent operations solution and support for business and standard IT services across internal and external vendors and technologies.
- Manage platform and service towers, desktop users, service desk and onsite support satisfaction and act proactively in delivering an enhanced service experience for the customers, and accommodate or exceed agreed SLAs and expectations.
- Manage vendors' performance, e.g., execution and governance structures, design of vendor dashboard, monitor performance related to defined KPIs, as well as continuously following up
- Analyze the performance and report to the business.
- Continuously evaluate the quality of and costs for the delivery from internal and external vendors
- Design, develop and ensure standardized ITSM routines and tools to frame and manage efficient collaboration with procured vendors.

In conclusion, the ICT & digital infrastructure will likely be a bundle of thousands of vendors that all operate a proportion of the ICT & digital ecosystem. This combined with the need to ensure a modular and scalable structure, where new products and offerings continuously can be deployed into the ecosystem means that EEC must understand the role as a Service Integrator and SLA-owner (ITIL© ITSM-customer).

4.6 RECOMMENDATIONS ON EEC'S NEXT STEPS

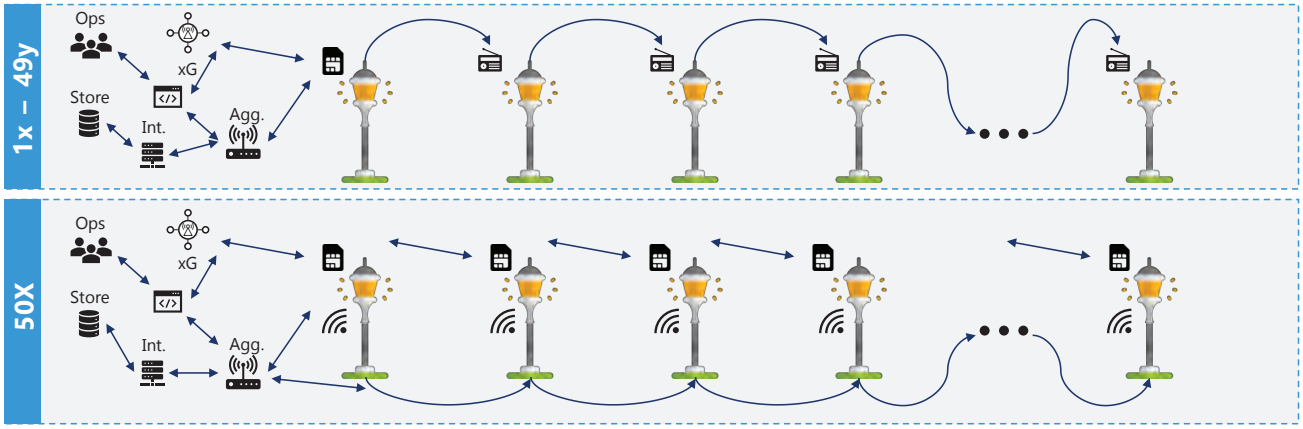
So far, the analysis has shown that EEC must pay extra attention to a few key areas when designing the New Livable Smart City. The recommendations below summarize the areas that have been identified so far in the report which EECO needs to consider when starting the work for the New Livable Smart City.

10 Think in solutions and buy outcomes rather than technical components.

Given the EECOs size and experience, it is important to start focusing on solutions and outcomes rather than specific IT requirements. Thus, rather than considering the use of fiber-optic cables, etc. EEC must start by identifying the vision and performing the BRM exercises explained in Chapter 3. Modern IoT devices has many use-cases e.g., power runs through lampposts across the city. Thus, the streetlights can be harnessed to connect for example cameras, WIFI routers, and sensors that can help in creating IoT components that may be vital for example smart mobility solutions. Thus, EEC should not focus on being smart for the sake of being smart, but rather to generate benefits and improve quality of life e.g., for GEDSI-groups.

Even for a modern streetlight system all lampposts do not have to be smart, but smart features can be derived from a simple low-tech solution using radio frequency identification (RFID). However, if the lampposts should be used to distribute WIFI, each lamppost may need a separate cabled or SIM-enabled technological component. If *x* represents a high-tech component and *y* represents a low-tech component, Figure 26 illustrates the above.

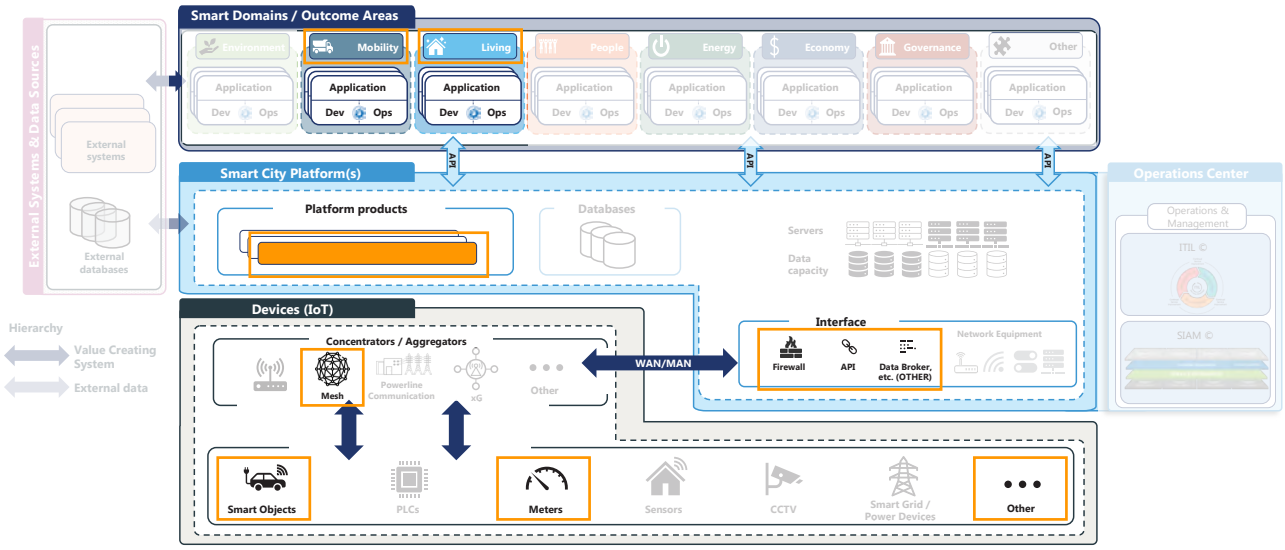
Figure 26: Streetlight System of High- and Low-Tech Solutions



Source: Authors.

Instead of focusing on components, EEC must - for now - allow vendors to map their solutions and benefits. For example, if the EECO were to engage with Lacroix©, the company would need to answer how they realize a number of the benefits that EEC has defined. Thus, instead of focusing on specific components, it is recommended that EEC lets the vendor answer what ICT & digital solutions fit with EEC's defined benefits and high-level requirements. Lacroix©, in this example, would then answer how they fit in the technical setup by marking the technical components. Such an answer from Lacroix© may, for example, include the highlighted areas in Figure 27. In conclusion, EEC must focus on buying benefits and outcomes in their vendor discussions.

Figure 27: How Vendors may Map Technical Components using Framework



Source: Authors.

11 Balance vendor lock-in, alternative- and attractive cashflow and funding models.

Optimally, EEC would not be dependent and reliant on any single vendor. Thus, it is generally advised that EEC ensure that it is possible to switch vendors and providers in a modular infrastructure. However, if vendors face a contract with unsure future cashflows, it is expected that EEC will receive a premium price on their offers. Thus, EEC must find a balance between vendor flexibility and investment attractiveness. An example is the creation of a Wide Area Network/ Metropolitan Area Network (WAN/ MAN), which carries a significant CAPEX investment. Here, a vendor may be willing to take the full CAPEX (through internal or third-party financing) if they get monopoly-rights after the WAN/MAN infrastructure has been built. Such a monopoly can co-exist with competition on the service operator level while fair pricing remains, given that the vendors have trust in the public entities and fears no government appropriation. Although the CAPEX investments at the time was part of the public infrastructure, EEC can be inspired from the Danish TDC© case highlighted in Appendix 6. Further, it is important that EEC understands that vendors may have different business models that is not related to traditional cashflow incentives. For example, a SCP may be funded from vendors that aim to harness

the data from citizens, which highlights the need to fully understand e.g., the described data governance models and have firm principles. Other key considerations on the financing models can be found in Chapter 5.

12 Get an information technology (IT) enterprise or system architect onboard, and focus on ensuring interoperability.

Due to the complexity of the setup, it is advised that EECO gets an IT Enterprise Architect onboard the team to lead the upcoming high-level requirement specification phase. EEC may initiate initial vendor discussions. However, as vendor negotiations continue, it is key that an IT Enterprise Architect or IT Procurement Specialist is involved to steer vendor negotiations in the right direction, ensuring that critical questions are asked to larger vendors, and that the solutions are scalable and interoperable, as well as providing a fair prioritization process.

13 Create a modular operating model and manage operations through a SIAM© framework

While it is key that vendors answer how they operate their solutions and perform their ITSM using the ITIL© framework, EEC must recognize that there is a need to appoint responsibilities to work as a Service Integrator using the SIAM© framework. This provides a scalable Operating Model that enables a multitude of vendors to solve parts of the IT operations.

14 Insist on vendors mapping technical ICT & digital features to the customer's architectural model.

The inherent complexity of ICT & digital infrastructures and architectures are described and visualized differently by individual vendors. In order to be able to compare and assess vendor propositions, it is important that vendors are requested to convey their solutions and products in the language and model framework defined by the customer (for example the models provided in this document). Vendors should be encouraged to first communicate in terms of value, benefits and capabilities and secondly in terms of technical components, mapped to the layers of an architecture framework.

Photo: Envato Elements.

5 FINANCIAL PARTNERSHIPS FOR SMART CITY PLATFORMS

Photo: Ramboll.

This section will establish a framework for analyzing and planning the financial aspects of the Smart City Platform options and will briefly look at how these investments can be financed both from public or private sources, and in partnerships. Smart City Platform investments will involve a good mixture of both large and small investments with varying durations, so a mix of public and private investments, as well as various forms of mixed partnerships in-between, will be beneficial to ensure the most optimal implementation of the new smart solutions.

In the new era of the "information economy" understanding the importance of data, information, and the value that data helps to create is crucial. Data is an asset in its own class.[13] When looking at smart, data-driven investments, direct investment costs, cash flows, and similar concepts that is usually evaluated to measure the benefits related to investments must be understood, as well as how data creates value in the new data economy.

5.1 ANALYTICAL FRAMEWORK

There is no fixed standard for how the financial analysis of a Smart City Platform options shall be performed. The following sections explores how an analytical framework prepared for ADB can be adapted to structure the analysis of various Smart City Platform options.[14] This analytical framework should help create a link between the visioning phase, the benefit identification of the digital platform and barriers described in the technical section.

It was mentioned that the visioning exercise should not just be a one-off exercise, but rather a recurring task that will need to be revisited as the New Livable Smart City vision gradually develops. The same logic applies to the analytical framework. As the New Livable Smart City develops, there might be good reasons for taking a renewed look at the analytical framework to see if things might have changed, and if there might be new opportunities that needs to be considered. A smart city is not a static city, and SCP technologies will continue to develop fast. What was not possible, or feasible yesterday might now suddenly be within reach due to new technological developments.

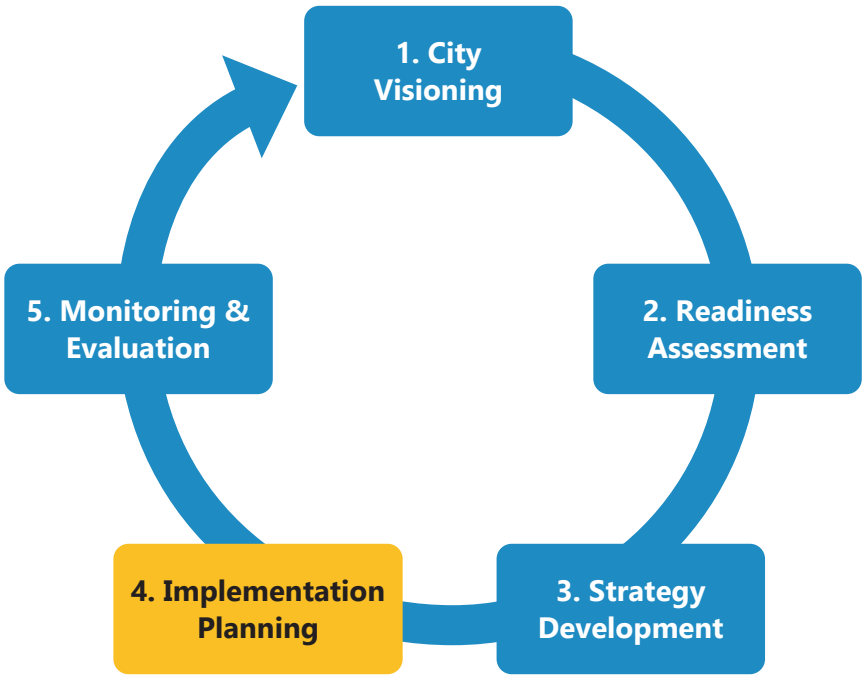
[13] An example of how valuable data can be in the information economy is how Google, or similar companies that offer "free" services, still manage to be among the most valuable companies in the world. This is only possible because the data that Google harvests from the free applications are so valuable and can be sold on to companies that want to advertise their product to potential customers.

[14] SMART CITY PATHWAYS FOR DEVELOPING ASIA. An Analytical Framework and Guidance. Seok Yong Yoon, Hong Soo Lee, Thilo Zelt, Ulf Narloch, and Elliot Aguirre. https://www.adb.org/sites/default/files/publication/673441/sdwp-071-smart-city-pathways-developing-asia.pdf.

5.2 FIVE PHASES OF SMART CITY IMPLEMENTATION

The five phases in the ADB analytical framework are shown in Figure 28. The first three of the five phases have been discussed extensively in the earlier chapters. The visioning phase has been covered in Chapter 2. The second phase, the readiness assessment, will not be relevant when dealing with a greenfield development so it will not be discussed here. The third phase, strategy development, has been covered under Chapter 3. Hence, this section looks at the fourth phase: implementation planning.

Figure 28: Five Implementation Phases



Source: Authors.

The questions that will face ECCO will now be: "How do we move from the vision and the strategy into the implementation? How do we see which options should be implemented first, and which might have lower priority?"

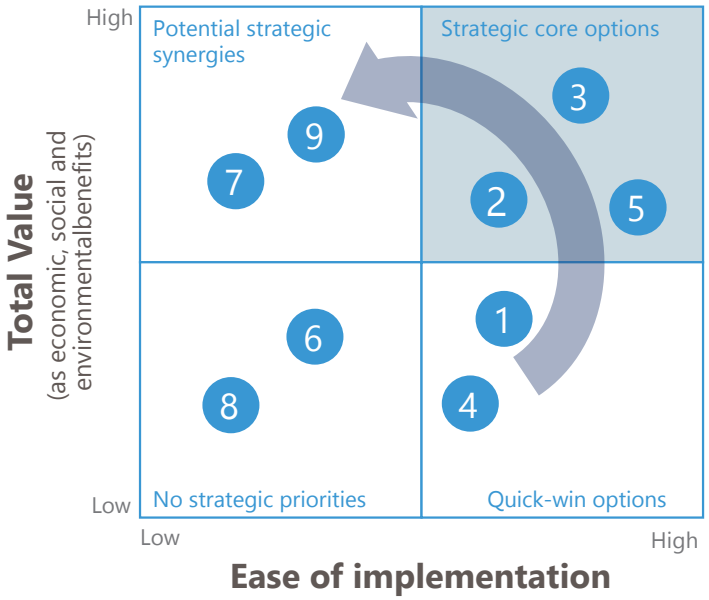
The first part of the implementation planning might emerge directly from the first three phases were the city visioning, the readiness assessment, and the strategic development of the smart city options have led to the identification of many options in the ICT & Digital Solutions Catalog. There could be hundreds, or thousands of possible options from many different vendors and service providers. For simplicity, nine options have been identified.

Workshops and consultations with key stakeholders can be used to discuss the various options to decide with what ease each option can be implemented, and what the potential value of the option will likely be. This is not an easy exercise, and different stakeholders might have divergent evaluations of both the value and the ease of implementation. Through such dialogues it should be possible to group the options in a matrix as shown in Figure 29.

The main purpose of the matrix is to first identify the "quick-wins", meaning the options that will be easiest to implement, and most likely also done at the lowest costs (see option 1 and 4 in lower right corner).

As indicated by the gray arrow the options next in line will be the "Strategic core options" (option 2, 3, and 5) in the upper right corner. These options are also relatively easy to implement, and despite a higher cost (and higher value of benefits) it is strategically important to the New Livable Smart City that these will be implemented in the early days—if not in the immediate phase—then in the medium-term to harvest the benefits of the options chosen.

Figure 29: Prioritizing Smart City Options



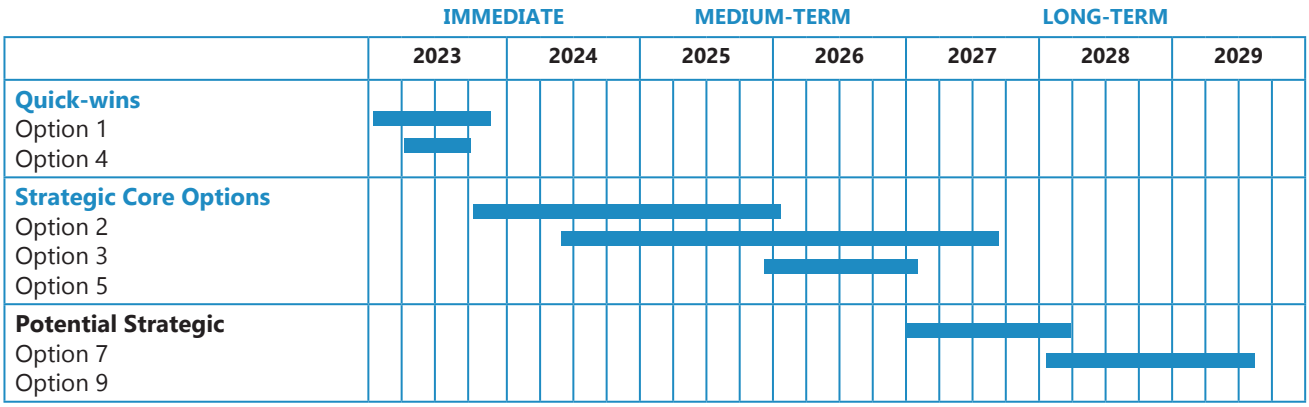
Source: Authors.

The third group of options (option 7 and 9) are called "Potential strategic synergies." These are options that are less easy to implement but with a high potential value due to the strategic synergies they have with other parts of the smart city.

Finally, the last group of options (options 6 and 8) has "No strategic priorities." They are complicated and bring little value. Most likely, it will not be worth implementing them. However, as mentioned above, smart city technologies develop fast, and options that might not be feasible today might have developed so much that they can be given a higher priority in the following years. Similarly, a new screening of the available options next year might downgrade options that are currently considered to be feasible.

EECO can affect the strategic options chosen by giving a higher priority to those options that benefit and add substantial value to GEDSI-groups. This is a way to ensure that initiatives chosen to be implemented prioritize the idea of an inclusive city, although this prioritization is something that needs to be decided by the EEC.

Figure 30: Implementation Time Plan



Source: Authors.

Once options to implement have been selected, the next step is to look at when each option can be implemented, and how long this will take. This will often require the development of a detailed implementation plan, which could include specific road maps, actions, and timelines. Figure 30 provides an example on what the implementation plan might look like. The "quick-wins" will be implemented first (if possible), and these options might not take long to implement. The "strategic core options" will also need to be implemented as soon as possible but might require a bit more preparation. Finally, the "potential strategic options" will often have to be postponed a bit; either because of lack of organizational capacity to implement numerous options simultaneous, or lack of funding perhaps.

Various smart city options will often be funded by both public and private sources, depending on the kind of options in question. Hence, there might also be different views on how the financial viability of each option should be calculated. In the case where a private company wants to pay for a "quick-win" option, it will normally be considered "for free" for the public sector. Although as mentioned above, in the digital economy the public might have to "pay" for the services by handing over data to the private company as they use the services. It might be difficult for outsiders to estimate exactly what the value of such data will be, but this still needs to be considered when evaluating the total value of the different options.

Due to the large number of potential options, there will also often be options that are mutually exclusive in the sense that if option 1 is implemented, then it will affect the possibility (or feasibility) for implementing option 2. To decide which option to implement, a financial analysis of the relevant options will need to be performed.

This will be a standard financial analysis that looks at both the costs and benefits of the options in questions and will normally focus on key figures such as the net present value (NPV), internal rate of return (IRR), payback time, benefit-cost ratio, or similar. Even if the financial calculations are standard, they will be based on assumptions and input data that might not be so easy to collect and verify. There could be uncertainties about the actual investment cost in case of new smart technologies that have not yet a lot of track record, and there could be even more uncertainty about the potential benefits, and how they should be valued as there might not be any straightforward market prices that can be used to "monetize" the benefits. As mentioned, it is also recommended to analyze the option

based on GEDSI outcomes and benefits. This focus should be an addition to the financial analysis , and is premised on the (ongoing) consultation and data gathered on GEDSI needs and priorities.

5.3 USING THE BRM FRAMEWORK TO PRIORITIZE IDEAS

The BRM framework presented in Chapter 3 is a good place to start when looking at how to prioritize the many different smart solutions that could be relevant for the New Livable Smart City. Often the main problem is that the possibilities are much bigger than the available financial resources, so there is a need for a systematic approach when prioritizing the different options.

However, the BRM framework only includes a short description of proposed benefits, so to use this information in a financial analysis, EECO would need to revisit and update it with information about the actual financial values of the benefits. EECO would also need information about the related costs and it might not always be easy to quantify the benefits and the costs when working with limited resources. The easiest way to obtain the information might be to ask potential vendors and/or suppliers to provide the required financial data for each service offering. EECO should be aware that vendors might be "biased" in their assessments, so it is advised to check the assumptions on which the prices are based on.

The financial data will also need to be periodized as it is important for EEC to know when to expect costs along the way, but also when benefits might be realized. If financial data is to be compared, the EECO needs to ensure that prices are comparable. EECO should calculate the NPVs for a meaningful comparison.

The information in the extended BRM framework can then be used as input for a more detailed financial analysis of each smart city option, and this will then in turn help EECO decide which options to include in the New Livable Smart City and in which order to prioritize the many possible options.

5.4 MAIN CHALLENGES FOR FINANCING SMART CITY SOLUTIONS

The above section gives a clearer picture of the scale of the financial resources needed to implement the smart city vision. Often it will be apparent that the financial needs might exceed the internal financial resources directly available, hence there will be a need to look at how to design the most efficient external financing to meet the shortfall. ADB has already identified some of the main challenges encountered by cities when they look for external finance for smart city projects (footnote 12) which are listed below:

- The "perceived" risk and complexity of smart city solutions.
- Uncertain return on investment.
- Complexity of multisector interventions versus single-sector focus.
- Preference for long-term projects.
- Benefits not directly linked to financial value (incl. value of data generated).

To overcome these challenges, it is important that the public authorities understand the revenue model for each of the smart city options to be implemented. This includes not only the initial costs for CAPEX and OPEX, and the direct financial revenues and values, but as mentioned before also the value of data being generated as part of the service delivery.

5.5 FINANCING SMART CITY PLATFORMS

As shown in Chapter 4 there is not one standard Smart City Platform, hence there is neither one standard way of financing such platforms. Also, a digital platform might not just be one single investment, but will often entail three elements that might have different investment profiles:

- Front-End, or user interface, which could be mobile apps or similar.
- Sensors and other physical devices and infrastructures.
- Back-End, computational services, and core digital platform.

This section tries to explore how EECO can finance the different SCP elements. The different elements could be financed from various sources and financing structures and could lead to a cheaper overall financial cost, as well as sharing the risks with the stakeholders who are best placed to estimate the risks involved. Hence, the Smart City Platform will not only consist of hardware but also software and will in that respect be different from the typical infrastructure investment. This also means that the financing structure is likely to be different from a typical infrastructure project and could be a combination of:

- Basic public financing.
- Additional private financing.
- Combinations with PPPs.

The following section assesses the pros and cons of the different financial sources relevant to financing the SCP elements.

5.5.1 Basic Public Financing

Public financing will often be considered the basic financial source when it comes to infrastructure projects, including digital infrastructure. The main reason for this is that such projects might not always have a single clearly defined cash flow, but rather more diverse benefits that can be hard to monetize.

Financing of streets in a city will be a good example of infrastructure that is often financed from public sources. The easy collection of toll fees, like on the highway, might not be feasible for streets with many access points. Similarly, digital infrastructure where data is being collected and put at the disposal for others, are free of charge. Although it might be free of charge to use roads, the local and national government do not need to rely on the collection of direct road fees as they can use taxation as a way of "collecting" some of the benefits from improved streets.

The public sector might also be able to finance initiatives aimed at supporting specific policy considerations, such as access to affordable housing, or environmental considerations, in a similar manner. An example of how the public sector can use financial instruments to further specific policy issues is the so-called Green Finance, or Green Bonds, that use preferential interest rates to support projects that is in line with governmental climate and environmental policies.

In principle, the same considerations also apply when it comes to using public sources for financing new digital infrastructure but given that the public financing is often less agile than private financing,

the tendency is that only digital investments that are fully embedded in traditional public infrastructure (e.g., SCADA systems) or are closely related to policy implementation (like environmental monitoring) are public funded.

Public financing also includes financing from multilateral banks and financial institutions. As an example, ADB has decided to set aside specific support for urban climate resilience and gender mainstreaming (GEDSI) in cities, which could also be relevant for financing of smart cities.

ADB's Strategy 2030 identifies "making cities more livable" as one of its seven operational priorities for achieving the bank's vision. ADB wants to help cities in the region to become more livable, and ADB supports cities by improving urban infrastructure and services, and fostering inclusive, participatory, and integrated planning. The bank also works to strengthen blue, green, and climate bonds. Strengthening institutional frameworks and the capacity to apply value-capture mechanisms are also important ways in which ADB is supporting improvements in Asian cities.

Often public financing tends to be cheaper than private financing but is less agile and might come with many policy strings attached. In many cases it might be interesting to consider if private financing will be available due to these possible restrictions. Often the optimal solution will be to consider a blending of public and private financing, where the public financing will be used to catalyze increased private financing. If the financing can be structured in a way where the public financing covers the riskiest parts of the project, it will often be possible to pave the way for private financing taking the less risky parts of the investments.

Public financing does not only refer to public loans, but also includes various forms of financial guarantees that can be used to mobilize private financial sources.

In the following, a few examples of digital infrastructure that could be relevant for EEC's New Livable Smart City to invest in are shown to illustrate how similar infrastructure financing have been shared between public and private sources in other cities. These investments are closely related to the traditional infrastructure investments where ADB and other international policy lenders have a considerable track record. Hence it is recommended to consider how this expertise can be brought into play for the New Livable Smart City.

5.5.1.1 Smart Grid Solutions

Electricity grids in general - and smart grids in particular - provide good examples on how many different options there could be for various combinations of public and private financing. Different countries have various combinations for public, quasi-public, and private involvement in both electricity production and distribution. Often, the main operators will engage private companies to provide various parts and services under the overall system. When looking at smart grid, private involvement could include provision and operation of equipment and services (like data centers, hardware, and software, etc.) and often also the financing of these various arrangements such as operational leases etc.

When it comes to smart grid solutions for the New Livable Smart City, EECO will need to consider how to coordinate with the relevant national stakeholders as the provision of electrical energy will go beyond the city limits. First, there might be limitations on which parts of the system EEC can decide

on, and second, there will be many possible synergies from sharing development costs etc. with other cities and regions.

The smart grid system in Denmark, mentioned as a case in Chapter 4, is an example on how public investments can be reduced through a cooperation with the consumers. The critical issue for electricity grids is to cope with peak demand and if this peak demand is avoided, the investments in the grid system can be reduced significantly. With the introduction of smart electricity meter, the grid operator can send instant tariff information to all the individual electricity meters, and this information can be used by the consumers to shut down electrical appliances and machines when the price goes above a certain threshold. Each consumer can decide if they want to reduce electricity consumption, or if it will be too expensive to stop production etc. Major electricity consumers have implemented automated systems that can cut-off, for example, industrial freezers for a few hours or so, which will not cause any problems. Households will often just use an app on their mobile phone to see when the hourly electricity price will be low, and then set the dishwasher or washing machine to start when the tariff is low. This helps the consumers avoid the highest tariffs, and at the same time helps the grid operator in lowering the peak demand.

5.5.1.2 Smart Water and Wastewater Systems

Water systems are often publicly owned and financed, but there are many examples on how private contractors, operators, and service providers are involved in both operation and maintenance. Especially when looking at the smarter, more digital parts of the systems, public owners often rely on private expertise to operate and finance operational control and data centers. Even if it is not possible to physically connect the water systems, it is still possible to operate data centers that can service several utilities. This way investments in software development can be spread across a much larger group of customers.

Investments in water systems are in general expensive, but also have long lifespans. In many cities, parts of the water system date back 100 years. Hence, it is important to consider the long-term implications of the proposed investments. Often, these involve main parts of the system being sufficiently robust, but at the same time also flexible enough to accommodate whatever changes might be needed. In general, public ownership of the main infrastructure elements are easier to deal with in terms of changes compared to the situation where various private owners are involved. This does not mean that private involvement in the day-to-day operation (through outsourcing etc.) cannot be efficient, and the main issue will then be to get the interfaces right.

In the case from Santander (see Chapter 4) a smart water system allowed the individual consumer to monitor the real time developments in both water consumption, water quality, and water pressure. The water company undertook the investment in the systems required for making the data available to the consumers. The consumers themselves had to invest in a computer or mobile phone (which most people had) to access the data. The main benefit to the consumers is that they have easy access to monitor their water consumption and will be able to see if the consumption might be excessive due to a leakage. Similarly, the real time information on water quality and pressure can enable the consumers to provide valuable feedback in case of problems at the end of the distribution system.

5.5.1.3 Environmental Control Centers

Environmental control centers (ECCs) in many ways resemble the above description for the water systems, although ECCs are not normally as reliant on expensive physical infrastructure. In this example, the main investment will be the center itself, followed by investments in a network of relevant sensors for monitoring for example, air and water qualities, noise levels, or metrological data. In many cases, such sensors are operated by other authorities or private companies, and there could be many synergies and savings involved in coordinating the collection and processing of environmental data.

Looking at air pollution control as an example of a relevant investment for the New Livable Smart City, one of the considerations EECO will have to investigate is how to engage relevant stakeholders to secure alignment of goals. The aim should be that the right investments will be in place, and that duplications as well as lacking investments are avoided.

Many cities are testing how citizens can be involved in collecting data that might be difficult or expensive to collect otherwise. The case from San Diego described in Chapter 4, explained how citizens—using cameras and mobile phones—were able to alert the municipality about environmental problems, or just simple things like potholes needing fixing. The reporter might not have known exactly who to contact in the municipal administration, but by using a digital robot most reports are automatically directed to the right department, and only a smaller number of reports needs to be handled manually. The system is expensive but provides value to both the administration and the citizens.

5.5.1.4 Traffic Control Centers

Roads are often financed by the public sector, even though the vehicles using it might be a good mix of both public and private cars, buses and trucks. Traditionally traffic control centers were also public financed but with the advance of GPS and mobile phones private companies such as Google and Apple have shown that traffic data can be collected and made useful for drivers without public involvement. In fact, many traffic control centers now rely on the data collected and processed by private investors. For investments in future traffic control centers, it is very likely that the private sector will be more involved, not just to ensure access to finance, but also to ensure a continued flow of innovative solutions.

Besides the main considerations for traffic control, EECO should consider facilitating a partnership that can ensure that public and private initiatives will not be conflicting. Traffic control systems are being developed in many other cities, so most likely it will be worth looking to identify possible solutions being developed for other cities rather than starting expensive development activities. Again, this is likely to be in a partnership between both public and private partners.

The case presented in Chapter 4 on smart mobility in Copenhagen mentioned the parking apps provided by private companies. The use of the apps eliminated the need for investing in physical parking meters and payment machines around the city. By using the GPS on the mobile device, the parking app knows where the car owner wants to park, and then what tariff will be used on a specific time a day. The app will then charge a fee on top of what needs to be pay to the municipality (or the private owner of the parking lot) to cover the cost of the service.

Smart technologies need to be chosen based on the context they will be operating in. Thus, implementing a GPS parking app will only make sense if the citizens already have smartphones. Similarly, GEDSI-groups should be considered when designing or investing in solutions such as these, in order that the needs of GEDSI stakeholders are mainstreamed in the solutions and that GEDSI stakeholders are involved in the conceptualizing and implementation of such solutions.

5.5.2 Additional Private Financing

Private financing is not just about financing from private banks. One of the most likely sources of private financing for SCP will be in the form of supplier financing or direct private investments.

Supplier financing is often used to finance specific technical deliveries, and can sometimes also be combined with operational contracts, where the private supplier not only installs the equipment and/or software, but also is responsible for the operation for a specific period. The use of supplier financing, or leasing, can have many advantages, but also needs to be considered carefully to ensure that the cost will not be excessive compared with other financing options.

Private banks and other investments institutions will normally be interested in financing investments related to city developments, but for them to offer competitive financial terms, they need to understand and evaluate the risks related to the individual projects, and the securities that can help to safeguard their investments. This means that the most innovative and risky smart city investments might not be so appealing to the private banks and investors. Either they might require a higher interest rate to cover the potential risk, or they will require a solid security in the form of physical assets like land and buildings.

When considering using private sources of finance, different private investors might have different preferences when it comes to either short term or long-term financing. In general, banks find that the risk related to shorter time horizons are easier to estimate whereas some institutional investors, like pension funds, look for projects that can guarantee a long-term payoff that match their own long-term commitments to pensioners. Therefore, the source of private finance relevant for each of the digital platform options in question needs to be understood—is it short-term or long-term, what is the risk profile, and what securities can be offered?

5.5.3 Combinations with Public-Private Parnerships

PPP initiatives have been used by many cities to enable improved public health, or to expand Wi-Fi access to promote affordable housing, for example. Municipalities are forging innovative partnerships to improve the quality of life for their residents and to provide required infrastructure assets.

Over the past decades, various PPP models have often been proposed to either help public authorities in lack of funding, or as a way of ensuring better cooperation between public and private partners involved in different investment projects. Urban development requires substantial financial resources, and therefore PPPs have often been seen as a possible solution to encourage public funding. As an example, the government proposes that the big-ticket transportation projects, including the high-speed railways, can be funded through PPP.[15]

[15] Ben Davies,"Thailand bets on Infrastructure," Asiamoney, September 27, 2018. https://www.asiamoney.com/article/b1b-48vclpgryjy/thailand-bets-on-infrastructure.

As part of the Government of Thailand's Eastern Economic Corridor Act (EEC Act), certain PPP-projects are underway which will facilitate investment. Measures have been implemented to expedite overall project approval processes, where the approval timeline has been reduced to 8-10 months—compared to a much longer timeline generally required for PPP projects.

While the more elaborate PPP models can be a way to engage private finance, it is also a tool that requires substantial expertise, and a clear legal framework, to ensure that both parties feel confident in entering the transaction. EEC already has experience with PPP funding, and the EECO is in the process of finalizing guidelines that reflect best practice standards.

However, Thailand's recent record of PPP is not too impressive, based on the World Bank's recent "Procuring Infrastructure Public–Private Partnerships Report," Thailand scores 35 points out of 100 for preparation and a passable 64 for PPP contract management. In comparison, Viet Nam scores 70 for preparation and 70 for PPP contract managers, and even Indonesia scores better than Thailand, so there is clearly room for improvement.[16]

5.5.3.1 The ADB approach to PPP financing

ADB is also a keen advocate for PPPs as a mean to finance infrastructure and other public investments. Over the years, ADB has accumulated experience with PPPs, which in the ADB terminology is defined as:

> ***"[A] contractual arrangements where a government partners [together] with the private sector … build and run infrastructure, such as a road or bridge. PPPs can be used to finance and run not only traditional infrastructure, but also railways, ports, water and sewage facilities, and renewable power systems."***[17]

Different types of PPP arrangements can be used to secure other more digital types of services, where the private and public sector works together to implement a Smart City Platform.

ADB's Office of Public–Private Partnerships (OPPP) provides advisory services on how PPPs can play an important role in addressing the infrastructure investment shortfall in Asia. To support PPPs in the region, OPPP provides transaction advisory services over the entire range of activities associated with the development, structuring, and placing of PPP projects in the market. The provision of transaction advisory services is a unique service offering of OPPP and its team of experienced transaction advisors.

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[16] The World Bank."Benchmarking Infrastructure Development." https://bpp.worldbank.org.

[17] Asian Development Bank. "What We Do." https://www.adb.org/what-we-do/topics/public-private-partnerships/overview.

EECO and OPPP could have mutual benefits from working together on the further exploration of financing options for the Smart City Platform in Chonburi, and it is suggested that the EECO contact OPPP directly to see if it might be possible to arrange for exchanges of experiences that could be of mutual benefit to both organizations.

5.6 RECOMMENDATIONS ON USING PPPS FOR SMART CITIES

The consultancy Deloitte has produced a study on the early smart city PPP experiences, mainly from the US, where PPPs has been used in relation to smart city developments for a number of years.[18] They came up with seven recommendations on using PPPs for smart city projects, and the following provides a perspective on how these recommendations might be relevant in an EEC context for the New Livable Smart City in Thailand.

15 Start with the end in mind.

The best results will be achieved by clearly defining the desired outcomes at the outset of the project. Getting clarity on the needs trying to be addressed and ultimate objectives to be achieved, is a necessary first step for initiating a dialogue with potential PPP stakeholders.

The overall smart city vision needs to be understood and accepted by the stakeholders, and they need to use the vision as the lens through which they can evaluate all decisions and activities. The best way to ensure that the stakeholders have a buy-in on the vision is to involve them in the preparation of the vision. As explained in Chapter 2, the smart city vision will gain much from involving of a diverse group of stakeholders, which should not only include the direct PPP stakeholders (business, banks, etc.) but also the public and GEDSI stakeholders including women, people with disabilities, children and the youth, older persons, migrants, members of the LGBTQIA+ community, and others in intersectional groups.

It might seem time-consuming to engage all potential investors and other stakeholders early in the process where the scope for the smart city project might not yet be fully clear. But in in the long run the buy-in to the vision will be more valuable even if the short–term costs might be higher.

16 Inventory your available assets.

This advice focuses on the assets that are present in the smart city area and recommends taking stock of the assets you have at your disposal, including any digital assets in the form of data that can be of value to various stakeholders. Are there particular physical assets that could be recycled? If so, are you permitted to recycle the asset or are there barriers to transferring ownership or management of the asset? Once a public sector entity has established what it is permitted to do, the next step is understanding the relative value of the assets to both the city and to the private sector.

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[18] Deloitte Center for Government Insights.Using Public-Private Partnerships to Advance Smart Cities Part Two: Funding and Financing Smart Cities Series. Deloitte, 2018. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Public-Sector/gx-ps-public-private-partnerships-smart-cities-funding-finance.pdf.

For the data that can be made available from sensor and other kinds of digital data collection measures it will be important to understand how assets can be activated as assets of the New Livable Smart City. One of the major differences between digital data and physical data is that digital data often.

can be used simultaneous by several users without reducing the value to other users. Unlike a road where too many users can greatly reduce the value to other users due to traffic congestion. Assets are also not only a piece of land, or infrastructure, that can be sold or leased. The value of the land and the infrastructure will increase with the people who decide to move into the New Livable Smart City. An example could be a PPP financed toll road—the value of such a road will depend on how many people will use the road. If the forecast says that nobody will use the road, then the value will be close to zero as it is almost impossible to move the road to a more profitable site.

All the data generated in the New Livable Smart City will also become valuable assets. Even if they might not show up in the traditional financial accounting formats. But data might not be worth much if they are not accessible, and that is why the design of the SCP will be important to ensure that the value of the data will be unlocked.

17 Understand the business model.

Before starting negotiations with potential PPP partners, it will be beneficial to understand the revenue models for the potential partners, especially if the revenue model is based on digital data. It is also important to understand the related business risks that these partners will be facing. Projects need to be financially sustainable, which, in some cases, may require smart solutions on a scale beyond the individual smart city.

Before inviting partners and technology suppliers into the New Livable Smart City it will be important to understand their business plan, and value their proposition. What do they expect to gain from being part of the New Livable Smart City? Once this is clearer, it will be time to consider how a basis for a deal can be found so that both parties consider it to be a win-win deal.

18 Appoint a champion with clear decision-making authority.

A clear decision-maker (e.g., a chief innovation officer or department) within city government can streamline planning and aid in building key relationships. The city-led approach assists in project implementation by establishing a public champion to act as a face for the smart city. As AASCTF experience in the region has demonstrated, the role of champion is also particularly important in the fostering and delivering on the GEDSI ambitions of cities. Where city leaders have strongly and visibly championed inclusion, this has had a demonstrable effect in those cities (e.g., Baguio and Makassar).

One can argue that this is exactly the role which EEC is intended to play today. Armed with the mandate to take decisions for the New Livable Smart City, EEC is in a unique position to overcome many of the hurdles the city might face. But even with this mandate, EEC is not capable of doing everything without also involving external stakeholders, local governments, and many others.

19 Build local support.

When smart city projects have local support, cities are better positioned to attract private partners. Residents embrace projects that have clear social benefits and such projects appeal to businesses' (and financiers) social performance and responsibility goals. The likelihood of receiving philanthropic and investment support improves when the project serves the needs of a population and aligns with private partners missions and lending agencies' environmental and social safeguards standards.

Box 14: AIR Louisville, Kentucky, United States

AIR Louisville is a partnership between:

- The City of Louisville
- Propeller Health
- The Institute for Healthy Air, Water and Soil
- Local employers
- Healthcare providers
- Local advocacy groups

The city developed AIR Louisville, a public–private partnership (PPP) that uses data analytics to inform the public on triggers that aggravate asthma. The initiative used private grants in its early phases for funding. Since then, technology purchases by private companies that stand to benefit from the initiative have allowed AIR Louisville to expand further.

Giving asthma sensors to employees will help employers save money on healthcare costs. Once the private grant money has been depleted, it is anticipated that the private market will sustain the purchase and use of the sensor technology. As the number of deployed sensors grow, so will the data pool the city draws upon to support policy decisions, increasing the value of its analytics. AIR Louisville saved participating firms an average of $930 per year for each asthmatic employee.

Stakeholder involvement is important to build local support and it is important that both residents and investors can see themselves in the vision for the New Livable Smart City. In general, the earlier stakeholders are involved the easier it will be for them to build a stronger commitment to the overall smart city vision. Chapter 2 showed how various ways of stakeholder involvement can increase the local support for the overall ideas as well as individual smart city projects.

City skyline of Louisville, Kentucky (photo by Chris Watson from Wikimedia Commons).

Source: Authors.

20 Develop a business case that clearly lays out the value to potential partners.

A smart city must present a business case that clearly articulates the potential value of the project to the private partners. The value can take different forms, from direct returns on investment to indirect benefits like greater economic development, or access to valuable data.

Box 15: LinkNYC, New York City, United States

When cell phones became more common, New York City (NYC) faced a problem of what to do with the 8,400 public phone booths. The city recognized that the revenues would continue to decline, and the booths also presented problems: they frustrated residents, blocked pedestrian traffic, and appeared anachronistic.

In 2013, NYC awarded a contract to a private partnership that included Qualcomm and others. In 2014 they started replacing the obsolete payphones with smart kiosks— called "Links"— that provided free Wi-Fi, maps, transportation updates, video calls, device charging, and more. The consortium pays for and operates the entire LinkNYC system at no cost to the city and offers the services to users free of charge, funded with the support from advertising revenues.

The consortium invested $200 million to install the links. The city receives 50% of the gross advertising revenue, or $17.5 million (whichever is higher), each year. A total of 7,500 links was installed, and the city predicted that its share of advertising revenues would come to $500 million over the initiatives first 12 years.

The Eastern Economic Corridor (EEC) could help potential partners to develop their business cases to ensure more investments from private sources. This does not necessarily mean that EEC, or other public entities, must pay the private partners for services, but rather that EEC could help the private partners identify how they best can benefit from their investments in the New Livable Smart City. The value of data generated in the New Livable Smart City will also be a revenue source that needs to be considered in the development of business cases for vendors and suppliers of the digital platform or other parts of the future digital infrastructure

A LinkNYC station (photo by Jim Henderson from Wikimedia Commons).

Source: Authors.

21 Create a third-party entity.

Establishing a third-party entity encourages role clarity, political feasibility, and eases procurement of smart city infrastructure. A third-party entity can help partners and cities navigate the complex structure of both city governments and private corporations, and it can help defining risk sharing among the partners.

EEC can consider if it will be possible to establish cooperation with private partners in a consortium for the Smart City Platform. If it is difficult upfront to establish the potential value of data emerging from the platform, it could be useful to formalize the cooperation between the partners. Each partner might contribute to the consortium with a diverse range of assets, cash, or software etc.

One of the main challenges for forming a third-party entity will be to agree on a mutually acceptable valuation of the assets. This might call for external financial and legal advice, which could also help to define relevant exit strategies for the different partners. The cooperation agreement might need to include specific covenants to protect minority partners or defined share sales agreements with price setting structures (sometimes named put/call options) that specify when and how, and at what price, the partners can leave the entity.

Photo: Envato Elements.

APPENDIX 1 METHODOLOGY FOR VISIONING, BASELINING, AND SETTING OUTCOMES

I. VISIONING

A. STEPS

STEP ONE: As part of the development of a vision and given the scale of New Livable Smart City development plans, it would be good practice to **conduct public consultation** to ask the public and businesses about their vision for the city's future. This could be done through hosting an interactive exhibition, focus groups and workshop with different people, social media campaigns or interviewing a range of different types of future residents. The questions can be quite broad and aspirational in nature. The aim of this step is to generate interest and engagement from the public and businesses and to provide inputs to support the vision statements, goals, and objective development that will help guide the development of your Masterplan.

a. Identify different profiles of potential inhabitants, e.g., district locals, professionals from wider Chonburi province, from other provinces, international migrants and the types of businesses/ organizations that should be based in New Livable Smart City. Consider the building from the five key business clusters identified in the current master plan.
b. To reach the broadest possible audience, including citizens of all demographics and businesses, understand what the best way is to engage with them and group them accordingly. A combination of several methods is best including: online surveys, in person visioning meetings, telephone surveys, direct mail surveys, request for text message responses, other creative methods (like online games, contests)
c. Depending on the methods used, it may be necessary to have facilitators to drive discussion and ask questions that will prompt the audience and stakeholder to reflect on what would draw them into moving and investing in New Livable Smart City, as well as their thoughts on the future, such as:

    - What types of development should the city encourage or discourage?
    - What concerns do you have with regard to future development?
    - How can the city support you and the specific interests of your group or community?
    - Complete this phrase: "In the future, I want my city to be…"
    - What are our aspirations for this place?/ How should it compare nationally/internationally?
    - What should the city's strengths be?
    - What could be potential shortcomings?
    - Who do we want to attract to live here?
    - What makes this city unique?
    - What key industries should drive the city's economy?

STEP TWO: Gather data and analyze it.

a. Gather data from engagement that might influence the priorities and projects identified in the master plan.
a. Analyze the responses and summarize them into principles or themes.

- What types of development should the city encourage or discourage?
- What concerns do you have with regard to future development?
- How can the city support you and the specific interests of your group or community?
- Complete this phrase: "In the future, I want my city to be…"
- What are our aspirations for this place?/ How should it compare nationally/internationally?
- What should the city's strengths be?
- What could be potential shortcomings?
- Who do we want to attract to live here?
- What makes this city unique?
- What key industries should drive the city's economy?

STEP THREE: Host a workshop with internal stakeholders to conduct a strengths-weaknesses-opportunities-threats (SWOT) analysis

a. Building on from the results of the public consultation and using baseline information (see sub-stage 1B) conduct a SWOT analysis with other internal stakeholders. The SWOT can be pre-drafted or developed as part of the workshop activities.
b. Use the results of the SWOT and the baseline information to help guide the development of a vision statement and principles which will support this. This can be developed in a workshop setting with sub-teams working on different aspects and feeding back to the group to discuss each one in turn. This activity may also include the early identification of interventions which will support the vision realization.
c. The vision and principle that are developed can then be refined and tested with key external stakeholders to support wider engagement of these groups in the New Livable Smart City development, and also to allow maximize the deliverability of the vision.

Gender equality, disability, and social inclusion (GEDSI) consideration - Actively include the perspectives of GEDSI-groups by: Identifying marginalized groups; which are defined as those who are excluded from political, social, cultural and/or social spaces based on identity. For instance:

- Women and girls
- Children
- Older persons
- Informal workers
- Migrants
- Low income
- LGBQ+ members
- Persons with disability

Setting a targeted approach for capturing the perspective of GEDSI-groups in the process described above. This may involve contacting certain community groups, NGOs, charities, or advocacy and lobbying groups. Importance must also be given to the location, time, and medium for obtaining their input. Seeking active representation of these groups will ensure that designs do not fail to acknowledge systemic injustices and barriers.

B. CASE STUDIES

1. Case Study 1: Research Project Developed a Shared Vision and Used It To Guide Long-Term Energy, Transportation, and Waste Strategies[20]

Photo of a solar farm (photo by Taken with Canon IXY 430F from Wikimedia Commons).

Context

This Swedish case study illustrates the process of developing and using a shared vision of the "future sustainable city" to guide long-term direction for planning and development.

The objective of the project was to develop, compile, and spread knowledge of what a sustainable society could look like and to stimulate research to deliver long-term development. The research project developed a long-term vision for the city of Gothenburg to transition into a sustainable society; having equitable environmental space per capita, energy use of 20,000 kilowatt-hours (kwh) per capita, carbon dioxide (CO2) emissions of 1.5 tons per capita and people living a pleasant life.

Methodology

A back casting approach requires the setting of goals for how things should be like in the future, and then explores ways of achieving those goals with the today's knowledge of how the future could be. The back casting process used in this project consisted of the following steps:

[20] Anders Wester/Göteborg & Co.

1. Description of the present and trend analysis.
2. Setting sustainability criteria and goals.
3. Developing alternative images of the future.
4. Analysis of how to reach the society envisioned.

The project took a participatory form, with a wide range of stakeholders including Chalmers University of Technology and Gothenburg University, Gothenburg Energi AB, City of Gothenburg, the Swedish National Energy Administration, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, and Renova (private company).

Visions and scenarios for sustainable energy, transport system, urban design, water, and waste management, as well as food and grocery chain were developed.

Solar City Gothenburg 2050, visions and images were developed for strategic energy planning.

The sustainable energy system is a combination of smart and efficient use of energy, renewable energy supply, changing lifestyle, urban planning, and energy storage in a hydrogen society. In a future sustainable society, the population is foreseen to increase from 850,000 to 1.2 million inhabitants. Each person will use 25,000 kWh which is half of today, meaning that the energy supply reduces by one-third. Energy sources in this scenario will come from biomass, wind and marine current energy, solar electricity, and hydro power. Solar heat will apply half the yearly hot water supply and some of the district heating.

The Eco-Cycling Gothenburg 2050 was developed for sustainable water and waste management:
The work with sustainable water and waste management was carried out with greatly decreased amounts of waste, long-lasting products adapted to the ecosystem, re-use of products and material recycling, a clean and visible water environment, and few but safe final repositories. In the scenario for a sustainable eco-cycle society, it is possible to half the total amount of waste compared with today. As the total amount of waste decreased in the sustainable society, unsorted mixed waste is assumed to decrease from 70% of the total amount of waste today. The decrease in total waste amounts is a result of dematerialization, lifestyle changes, the use of more durable materials, and increasing in repair and re-use.

Lessons Learned

The use of visions and images of a long-term future was an important tool for developing long-term strategies such as a new energy plan for the city, urban planning, water and waste management planning and sustainable transportation of the future. The process allowed for the identification of possible solutions, attained mutual support, learning and commitment for implementation from stakeholders.

The project was completed in 2004, but the action for sustainable future will continue guiding development in Gothenburg and the surrounding regions. Today Gothenburg is well positioned at the top of the global destination sustainability index. This case study shows that participatory visioning and scenario development can serve as complimentary tool for sustainable city planning.

2. Case Study 2: Team-Based Game was Used to Develop Key Themes for the Vision of How a City Should Grow

Context

In 2010 the city of Inverness in Scotland had beenone of the fastest growing cities in Europe for a few years. The new city vision was needed to help set out a new approach to planning in the city, helping to meet the challenges of climate change and making effective transport linkages. The initial stage of creating a new city vision for Inverness took the form of an interactive team-based game designed to create new thinking and actions to improve the quality of life in cities.[21]

The Future City Games, developed by The British Council with the Center for Local Economic Strategies (CLES) and Urbis, is a process which stimulated creative thinking while also generating new ideas for city development. It was then delivered across 15 countries and 90 neighborhoods in Europe, with the aim of encouraging wider thinking and participation of citizens to develop solutions for long-term challenges relevant to where they live.

Figure A1.1: Themes informing Inverness City Vision

02. Building structures

[a] Big ideas

A series of Future City events produced a considerable number of ideas for the future Inverness. The ideas are shown graphically in the accompanying Wordle image: the bigger the words, the more often they were mentioned by the teams. Common themes that emerged start to guide how Inverness might grow and develop in the future. These themes are summarised as follows:

- **the economy should be at the heart of everything**
- **strengthen the city centre**
- **a better connected Inverness**
- **a city for all ages**
- **greenNess**
- **build on our assets**
- **think tourism**
- **culture, pride and identity**
- **health and well-being**

Methodology

Future City Games were run and facilitated by the British Council. Over three days, 30 participants were organized into teams of six to identify challenges facing the city and design solutions. These were tested and refined with the assistance of practitioners and community members. Each day was tailored to a different audience; including young people from schools and youth organization, and then local residents, businesses, architectural firms, voluntary organizations, public sector organizations. Players were provided with an economic, social, cultural and environmental current context pertaining to their city. There were three stages to the process; visioning, testing and presenting. The ideas were then voted and implemented.

[21] The Highland Council (2010) Over 90 people to develop a new City Vision for Inverness, https://www.highland.gov.uk/news/article/3886/over_90_people_to_develop_a_new_city_vision_for_inverness.

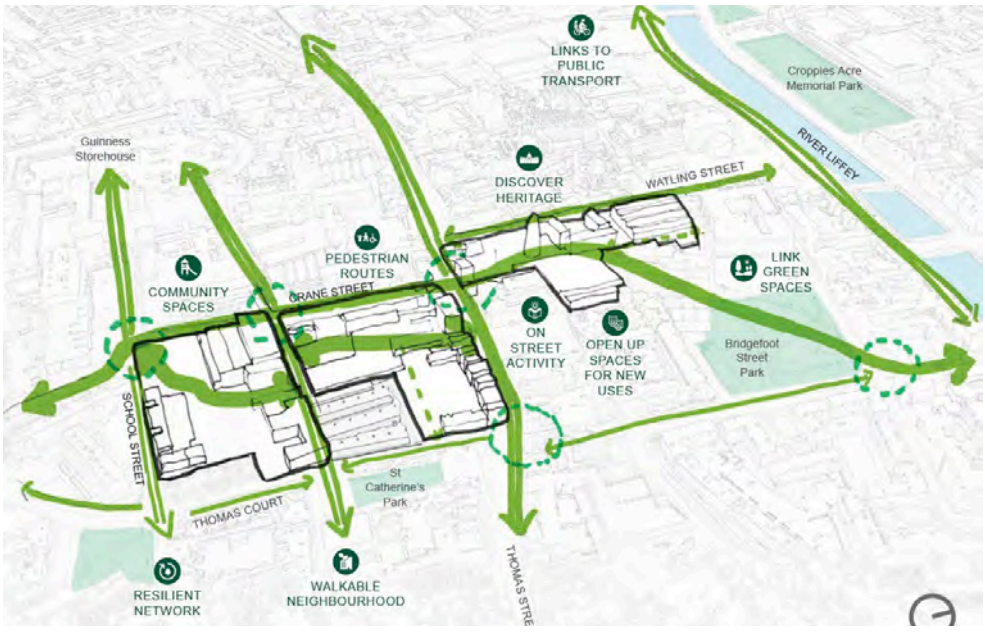
For the city of Inverness, the common themes that emerged from the games were used to guide how Inverness might grow and develop in the future and as such were featured in the Highland Council's Development Guidance – Inverness city vision. Citizens were then asked to answer how those themes would shape the quality of life, services, design, and brand identity of the city. Translating the vision to spatial deliveries, was done by identifying physical interventions, management interventions, enabling spaces, social and cultural actions, actions for the users of the city. City zones and action areas were then identified. The process of creating the new city vision for Inverness took a year and served as development guidance.

Lessons Learned

The Future City Game was a successful mechanism for bringing together both stakeholders and residents to discuss the future of place. It has also led to the development of future plans and projects including the Transformation of Inverness Castle. The key element of the city's vision was embedded in the Highland-wide local development plan (HwLDP) and the visions led to development of briefs and Masterplans.

3. Case Study 3: From Vision Workshop to Website for Engagement

Figure A1.2: Map of Pear Tree Crossing



Source: The Land Development Agency and Ramboll

Context

The Pear Tree Crossing site is an ex-industrial area of Dublin with a vast amount of physical and cultural heritage and sensitivity. The focus of the master plan[22] is the delivering of affordable housing in a new vibrant neighborhood with associated amenities.

[22] The Land Development Agency (2023) Pear Tree Crossing. https://peartreecrossing.ie/.

Methodology

A design team and client workshop were used to bring a vision together. During the day-long workshop baselining information and case studies were presented, before breaking the wider group into small groups to discuss questions and themes. At the end of the day each group presented back to the other and common themes and principles were captured by the facilitators. These were developed into a document and website which made the messaging clear and consistent. All internal stakeholders, such as planning, development and sustainability local authority members bought into this before it was launched to a public facing website and booklet used for wider engagement.

A vision statement, three themes "Identity, Living and Unlocking" and 10 principles split under those themes formed the vision. This went on to form the basis of the master plan framework and indicators.

Figure A1.3: Themes for Pear Tree Crossing

Source: Author's own creation based on Pear Tree Crossing Draft Masterplan

Lessons Learned

It is essential to have all internal stakeholders being part of the initial visioning process and that all relevant information is shared at the early stage of the project. Taking time to do this process onboarded all stakeholders for a shared vision, which could then be taken externally.[20]

II. BASELINING

A. STEPS

STEP ONE: Define the scope and relevant material. The objective of this step is to provide contextual data for which the vision can be built from.

a. Define the geographical scope for the physical development: most likely will be the city boundary and immediate surroundings;
b. Define the geographical scope for the human characteristics: this could be based at district level/region level; given the assumption that a majority of future inhabitants will be coming from those areas.
c. Define scope for comparison and benchmarking: for greater interpretation of the data, collect regional, national or data for Bangkok for comparison. Benchmarking allows for the identification of differences and for the formulation of competitive advantages.
d. Define the themes, city drivers or enablers for which data will be collected, such as:

- Population and housing
- Society and health
- Land use
- Transportation
- Utilities
- Digital access
- Economy
- Environmental resources
- Education and health
- Arts and culture
- Development policies

STEP TWO: Collect data

a. On historical, current, and future trends.
b. Use GIS spatial data for the identification of distributional trends.
c. Use available data sets from all available sources, recognizing the potential quality. issues with data which has not been externally verified.
d. Consider using surveys where data is not available.

STEP THREE: Analysis and interpretation

Given the baseline information will be used for the vision developed and in specific for a SWOT analysis, consider processing the data by answering the following questions:

a. What are the strengths, weaknesses, threats, and opportunities, relevant to built, natural, human resources and cultural assets?
b. What is the existing environmental and demographic context?
c. What are the opportunities and challenges?
d. What will the demographic context be in the future?
e. How might climate change influence or affect the challenges and opportunities identified? How resilient could the city be against future climate change projections?

Gender equality, Disability, and Social Inclusion Considerations

Gather both quantitative and qualitative data on GEDSI. Data gathered on GEDSI will need to consider political, technical, normative, and social aspects that make-up the GEDSI context. Political aspects refer to the relationship citizens have with the state. The technical aspect addresses the legal, policy, and built environment for GEDSI, while the normative aspect looks at prevailing social norms and values, for example, attitudes of members among dominant groups in society. Finally, the socio-economic aspect considers the dynamics of interaction within public spaces.

If conducting surveys or collecting data via other mediums, assess if the methods are accessible for GEDSI-groups and allows for data disaggregation based on gender, age and physical abilities.

B. CASE STUDY: BASELINING AND SOCIOECONOMIC CONTEXT, DUBLIN

Context

A baseline study for the Pear Tree Crossing Masterplan was commissioned to provide an understanding of public realm, mobility, green infrastructure, land uses to allow for informed discussion on the site and wider context constraints, challenges, and opportunities. Socioeconomic indicators for the Liberties, which is the area where the project will be delivered, were analyzed compared against Dublin and Ireland.[23]

Methodology

The study assessed the current socio-economic situation of the Liberties through:

- Demographics
- Employment
- Deprivation
- Existing social infrastructure
- Access to green space
- Home ownership
- Use of personal computers, ICT and data connectivity
- Tourism levels and attraction

These themes were then compared with the rest of the country.

Also, onsite and desk research was used to map:

- Public realm conditions
- Transport and connectivity
- Land use

[23] Ramboll (2021). The Digital Hub Economic Development Review. (PowerPoint slides).

Figure A1.4: Baselining and Socioeconomic Context, Dublin

	0-14 years	15-64 years	65+	Marital status (% married)	Households without a car	Catholic residents	Residents with other religions	Residents with no religion
The Libertines	13%	80%	7%	23%	60%	56%	18%	26%
Dublin City	15%	72%	13%	31%	36%	70%	12%	18%
Republic of Ireland	21%	66%	13%	38%	16%	80%	9%	10%

Source: Authors.

Table A1.5: Summary of Socioeconomic Context, Dublin

Significant economic drivers	Challenges
• Location and proximity to city centre (between 20 and 40 minute walk to St. Stephen's Green and Grafton Street for most residents) • Major teaching hospital • Key tourist attractions • Internationally famous brewery • Third level college, including Art college • Tradition of entrepreneurship • Diverse population • "Hustle and bustle"; one of the most densely populated parts of Ireland (close to 25,000 residents in a 2 kilometre square area)	• Lack of economic investment in recent years. Most has been residential with retail/commercial at ground floor • Levels of local employment have been impacted by the decline in traditional industries, and improved technology of remaining industry • large tracks of under-used land • Significant concentrations of disadvantage, high proportion occurring in local authority housing estates • Areas with poor image and reputation, associated with crime, drug abuse and anti-social activities • Poor quality public realm and an almost total lack of open space or public parks

Source: Authors.

Lessons Learned

The baselining processes informed the visioning workshop and contributed to the selection of principles and identification of desired project outcomes.

III. OUTCOMES

A. STEPS

STEP ONE: Describe the desired outcomes resulting from the Vision and Principles set out in the visioning stage. These will be used to guide the development of an initial land use plan and identify key infrastructure requirements. These will also serve as input to the BRM process discussed in the next chapter.

a. This might include questions such as: What are the outcomes that we want for people? What are the outcomes that we want for nature?
b. Set outcomes for the following thematic categories:

STEP TWO: Set outcome indicators. For each outcome, define what success would look like using key performance indicators or metrics. Considerations include:

a. Developing indicators that are SMART (Specific, Measurable, Attainable, Relevant and Time-bound)

b. Aligning indicators to international accreditation and national standards

- Place Quality – Design and People
- Health and Wellbeing
- Environment – Conservation and Improvement
- Climate Change
- Homes and Community
- Economy and Town Centers
- Movement
- Engagement and Service

STEP THREE: Test the outcomes, identify actions and an implementation plan

a. How can the outcomes support city resilience?
b. How can outcomes facilitate gender equality, disability and social inclusion?
c. Can desired outcomes be aligned with Sustainable Development Goals?
d. Who is responsible for ensuring the outcomes are achieved?
e. Who needs to be involved in the decision-making process?
f. How often will progress be reviewed?
g. What resources do they need to ensure actions can be completed?

STEP FOUR: Use outcomes to inform the master planning process. Outcomes can be used to inform and assess the design brief by considering questions such as:

a. What spatial considerations need to be applied and what land use is required to deliver desired outcomes? What key infrastructure is required to support this?
b. What are the implications for the supporting urban systems? What types of energy, waste, mobility, ecosystems are required to deliver intended outcomes?

GEDSI considerations

Explore what does it mean to achieve such outcomes for GEDSI members. For example, if one outcome is to have accessible green spaces for all, what needs to be in place for the outcome to be achieved. This will inform the early land use requirements have included GEDSI considerations.

B. CASE STUDIES

1. Case Study 1: Data Gathering for Greater Inclusion, Makassar

Context

Funded by the Government of Australia, the Makassar Livable City Plan, finalized in June 2022, sought to deliver a strategic citywide framework that integrates existing smart city plans, actions, and initiatives to support the city's Medium-Term Development Plan.

Methodology

Makassar Livable City Plan Project was executed in three stages:

1. Urban situation assessment to identify key baseline data and rapid needs assessment of current conditions in Makassar
2. Urban Development Scenario to review plans and projects for city development
3. Makassar Livable City Plan to make Makassar smarter and more livable using digital solutions in planning, financial management and service delivery.

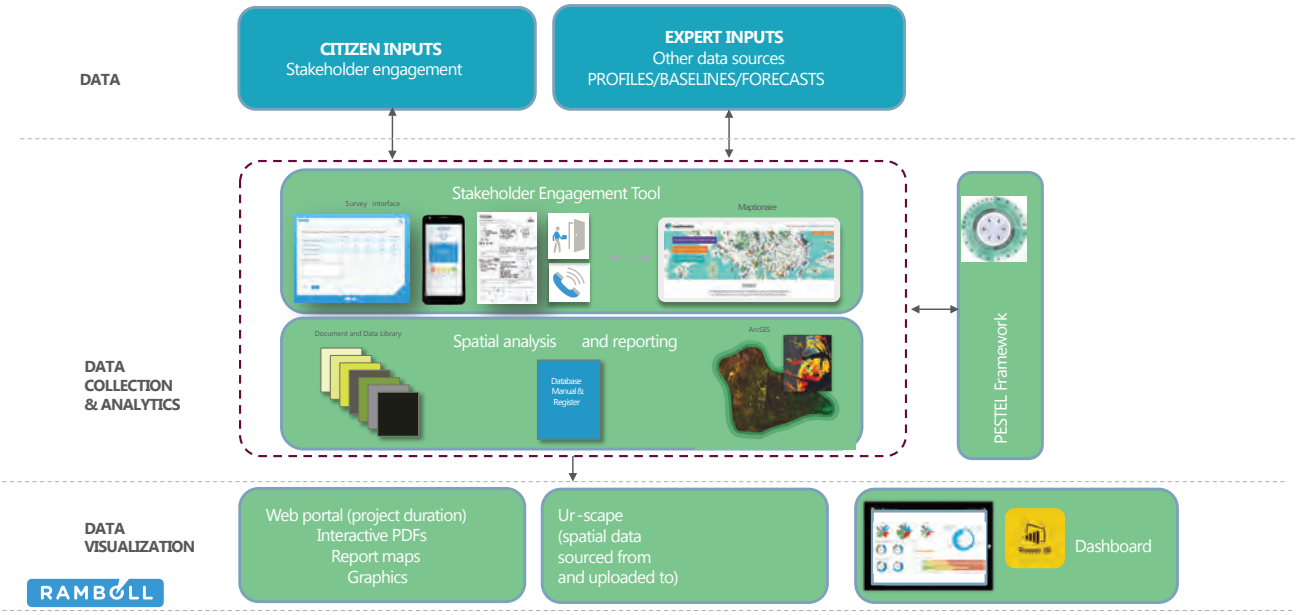
The urban situation assessment describes the existing conditions of Makassar with respect to the four main dimensions of the ADB Livable City Analysis Framework namely: Built Capital, Human Capital, Natural Capital and Social Capital. Assessment on social capital focused on the effectiveness, efficiency and ICT & digital infrastructure of governance and community. A Socio-economic profile of the city and its vulnerable groups were further assessed and its challenges and potential broadscale interventions and recommendations provided.

The Urban Development Scenario builds on the situation assessment conducted, by considering the likely future scenario for Makassar and resulting needs and challenges from a socio-economic and GEDSI-perspective. The Urban Development Scenario builds on the assessment of the existing needs and challenges in Makassar by projecting future population at the macro level and applying a land use analysis to evaluate how the population densities will change over time. This enables a citywide cross-sectoral review of future needs and the effects of population growth. Based on the Urban Development Scenario a range of GEDSI city interventions were identified and evaluated within a prioritization tool. City officials were then able to compare scenarios and group interventions to prioritize investments according to preferences.

A key element of the Makassar experience is the need for cross-agency collaboration to maximize value of investments and to prioritize interventions that can leverage benefit to multiple sectors. To be truly people-centric in the approach, the team supporting Makassar on developing the digital city development plans, utilized inputs from both experts and citizens. For the latter, a citizen/stakeholder engagement tool, with both digital and field survey elements, was used for the data collection and

analysis process, with the aim to better understand citizens issues–both cultural and social. 2,104 residents participated in the online survey.

Figure A1.6: Data Methodology Makassar Citizen Engagement Tool



Source: Authors.

The Citizen Engagement tool and survey was used to collect information on the needs and perception of different demographic groups on which services are important to them and how they rate the access to these services. Citizen's perceptions and ratings of services was considered as an important guidance for city governments and service providers in order to identify gaps in the service delivery, and service areas. The survey also enabled citizens to feel involved in the development of their city.

Lessons Learned

Findings and take aways from the surveys helped identify interventions and projects that the city could consider as part of the City Plan. It is important that prioritization of Key Performance Indicators (KPIs) are embedded early in the process to enable technical studies to establish a baseline that enables prioritization according to city needs. Regarding the results, flood early warning systems, safe streets, and fire hazard including rescue were among the most important services to improve.

Citizen's perception of which city services are important in their daily lives and how they rate the access to these services could be used as an indicator of overall livability of a city.

There was strong leadership and support for GEDSI by the Mayor of Makassar which ultimately saw the very strong focus on GEDSI in the Livable Smart City Plan. Therefore a key lesson learned that leadership is the critical component in visioning and planning for a livable (inclusive) city.

2. Case Study 2: Imagine Austin, Priority Programs, and Indicators

Context

The Imagine Austin Comprehensive Plan[24] is the City of Austin's plan for the future and provides direction for many city departments. The plan was created with input from thousands of Austinites and established a community vision of a city of complete communities where all Austinites have access to the amenities, transportation, services, and opportunities that fulfill their material, social, and economic needs. These places are livable, safe, affordable, and accessible, and they promote healthy lifestyles, community engagement, and inclusion.

Methodology

The initial step was an extensive community engagement process that took two years and involved over 18,000 people. From this a 30-year vision for the community and indicators were defined. Building on those, eight priority programs were identified to organize Imagine Austin's key policies and actions into related groups to make it easier to implement the plan. Goals and metrics were then set for each priority program under a specific timeframe.

Related vision components were mapped against each priority area, related policies, leading delivery government departments/agencies, and other partners were also identified. Indicators are openly shared with businesses and citizens to reflect on their own community and to take a proactive stance for improving these.

The priority programs and metrics were useful for communicating the direction of change, activities and initiatives needed for the delivery of the vision. The metrics were also then used to measure progress against the delivery of goals and vision of the plan.

The following content has been retrieved from Imagine Austin Comprehensive Plan (2012):

Output 1: Vision

Imagine Austin vision statement

"As it approaches its 200th anniversary, Austin is a beacon of sustainability, social equity, and economic opportunity; where diversity and creativity are celebrated; where community needs and values are recognized; where leadership comes from its citizens, and where the necessities of life are affordable and accessible to all".

[24] Austin City Council (2012) Imagine Austin Comprehensive Plan. https://www.austintexas.gov/sites/default/files/files/Imagine_Austin/IACP_2018.pdf.

Output 2. Themes and Outcomes

Figure A1.5: Themes and Outcomes of Imagine Austin Comprehensive Plan, 2012

Source: City Council of Austin. (2012). Imagine Austin Comprehensive Plan. https://www.austintexas.gov/sites/default/files/files/Imagine_Austin/IACP_2018.pdf.

Output 2. Priority Programs

- Invest in a compact and connected Austin
- Sustainably manage out water resources
- Continue to grow Austin's economy by investing in our workforce, education systems, entrepreneurs and local businesses
- Use green infrastructure projects to protect environmentally sensitive areas and integrate nature into the city
- Grow and invest in Austin's creative economy
- Develop and maintain household affordability throughout Austin
- Create a Healthy Austin Program
- Revise Austin's development regulation and processes to promote a compact and connected city

Output 4. Key Performance Indicators

Goals and metrics were formulated for each priority program. The example below is for measuring Investment in compact and connected Austin.

Box A1.8: Imagine Austin Overview of Engagement

SHAPING IMAGINE AUSTIN

Thousands of Austinites shaped *Imagine Austin* throughout the public process. some key numbers are included here:

18,532 inputs from the community over more than 2 years

4 rounds of public input, including:

- **5** rounds of surveys
- **21** public meetings
- **422** meetings-in-a-Box distributed
- **57** traveling team events
- **112** speaking events

Each round built on input gathered during the previous round

More than **150 articles and stories** in local media

2,535 email subscribers
2,224 Facebook likes
1,153 Twitter followers

7 building block Working Groups, with **373** participants, **22** meetings, and **2** surveys

38-member Citizens Advisory Task Force, meeting more than **100** times over more than 2 years

Monthly oversight meetings with the task Force, a committee of the planning Commission, and a committee of City Council

19 Boards or Commissions briefed twice each

55 stakeholder interviews with key interest groups

5 neighborhood or Contact Team meetings and presentations, plus **1** survey of Contact Teams

Support from more than **300 staff members** across all City departments

GOALS
Increase non-vehicular trips.
METRICS
• Transit ridership numbers • Number of transit stops • Percentage of trips by biking and walking • Annual trips per capita

Source: City Council of Austin. (2012). Imagine Austin Comprehensive Plan. https://www.austintexas.gov/sites/default/files/files/Imagine_Austin/IACP_2018.pdf.

3. Case Study 3: Downview Framework Plan, Canada

Context

The Framework Plan will guide the future development of over 500 acres at Downsview, in the North York area of Toronto. The area was previously used as an airport and airbase. The area is also the traditional territory of the Mississaugas of the Credit First Nation and the historical homeland of the Huron Wendat and Haudenosaunee people. The landowners and developers, Northcrest and Canada Lands, are working together with the rights holders and want to honor these connections in the development.

Methodology

The Resilience and Sustainability Strategy, which contributed to the Framework Plan for Downsview,[25] was developed using the following approach:

1. Develop key themes for the design narrative
2. Describe desirable outcomes for each theme
3. Develop a framework for sustainability and one for resilience
4. Set KPIs for each category based on the Framework Plan's land use distribution and their relation to the city standards
5. Review and assess each supporting urban system

The development of the KPIs builds on the desirable outcome of each theme and on standards and land use requirements (e.g., distance and number of amenities). The use of KPIs ensures the outcomes set in the design narrative are delivered and monitored.

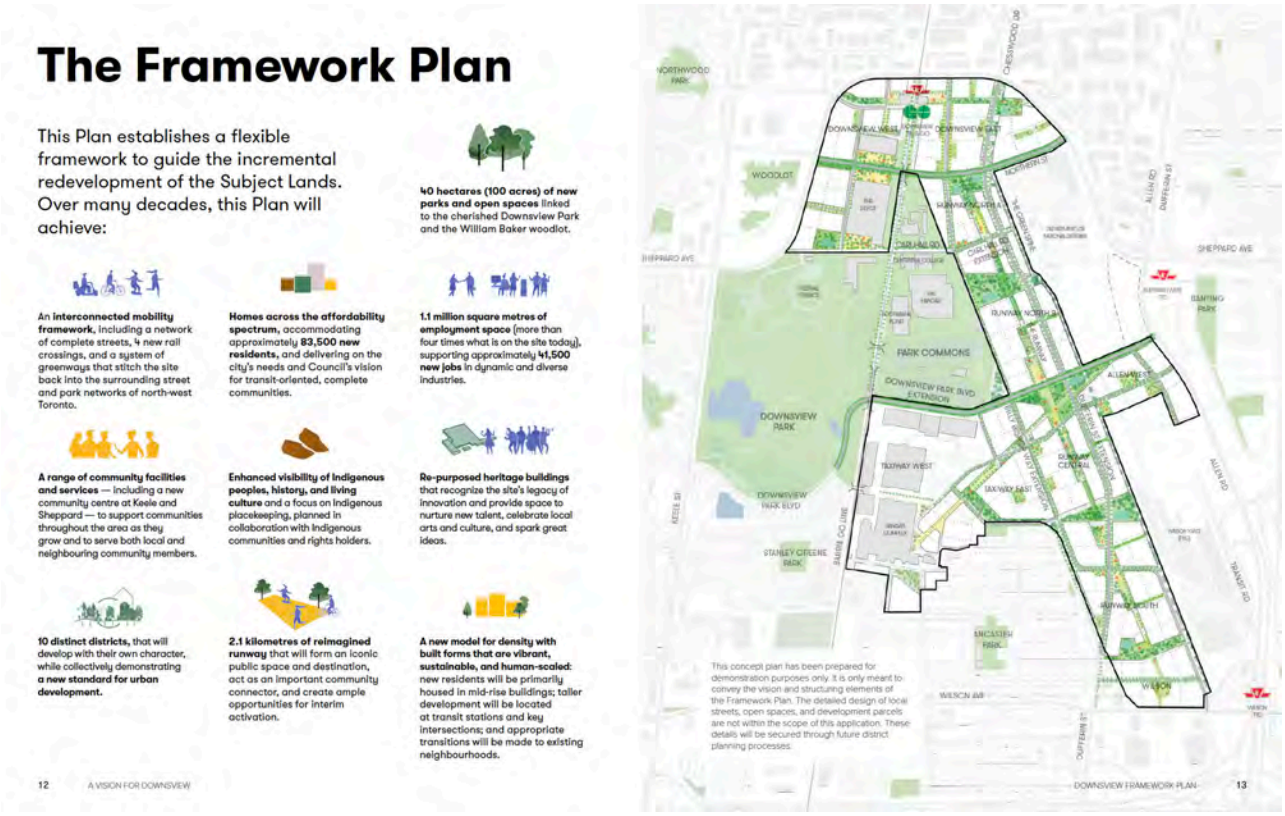
Figure A1.9: Key Performance Indicators for Downsview

Source: Ramboll et al. (2021) Framework Plan: Proposed Redevelopment of the Downsview Lands.

[25] Ramboll et al. (2021) Framework Plan: Proposed Redevelopment of the Downsview Lands. Available from: https://44e0cc70-0fba-43fa-98a1-d99b0274c6c3.filesusr.com/ugd/4ea6e4_83b2b0b8db67436782994a36ab9e5c3a.pdf.

Assessing the urban system's strategies against the project KPIs allowed for the identification of the potential land use prioritization, conflicts, and synergies across systems, that the design team should be mindful of. This led to the development of a framework plan which consisted of outcomes and outlined land use diagram and key infrastructure requirements.

Figure A1.7: The Framework Plan for Downsview



Source: Ramboll et al. 2021. Framework Plan: Proposed Redevelopment of the Downsview Lands.

Photo: Envato Elements

APPENDIX 2: SMART CITY KEY PERFORMANCE INDICATORS

As part of their Inventory of Callous-Unemotional Traits (ICU-T), Louisiana State University has created an overview[26] that compares different smart city indices. These KPIs are divided into various sustainability dimensions as described below in Tables A2.1 and A2.2.

Table A2.1: ICU-T's categories and components of the environment and sustainability dimension

City infrastructure and governance	
Policy and management	**Infrastructure**
• Integrated environmental management • Strategy • Municipal administration • Effective conservation	• Urban planning • Buildings and physical infrastructure • Mobility, transportation and traffic • Public safety
Energy and climate change	
CO2 emissions	**Energy**
• CO2 from energy production • Emissions per capita	• Energy performance • Conservation

Pollution and waste			
Waste	**Air**	**Water**	**Noise**
• Waste • Management • Wastewater • treatment	• Urban particulates and air quality • Indoor air pollution • Local ozone • Regional ozone • NOx and SOx	• Drinking water • Water quality index Water stress • Water management	• Noise pollution

Source: ICU-T (footnote 26).

Table A2.2: ICU-T's categories and components of the social dimension

Social, economy and health		
• Social services • Citizen satisfaction • Education • Culture and recreation • Social inclusion • Demographics (aging)	• Gross Domestic Product (GDP) • Employment • Financial resilience	• Adequate sanitation • Disease control and mitigation • Citizen health services

Source: ICU-T (footnote 26).

[26] FG-SSC Source1, An overview of smart sustainable cities and the role of information and communication technologies. https://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/website/web-fg-ssc-0029-r14-overview_role_of_ICT.docx.

Table A2.3: ITU's Key Performance Indicators Definitions for Smart Sustainable Cities

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D1 ICT	D1.1. Network facilities	I1.1.1 Fixed (wired)-broadband subscriptions per 100 inhabitants		X		X	X		X		X						X	X	X		
		I1.1.2 International Internet bandwidth (bit/s) per Internet user	X	X		X			X	X				X			X	X	X	X	
		I1.1.3 Wireless-broadband subscriptions per 100 inhabitants		X		X	X		X		X		X				X	X	X		
		I1.1.4 Percentage of households with Internet access	X	X		X			X		X						X	X	X	X	
		I1.1.5 Coverage rate of next-generation broadcasting network	X				X														
		I1.1.6 EMF compliance framework in place																			
		I1.1.7 Planning legislation incorporates ICT & digital networks and antenna requirements																			
		I1.1.8 ICT & digital EMF information availability to the public																			
	D1.2. Information facilities	I1.2. I Percentage of enterprises providing network-based services (e-commerce, e-learning, e-entertainment, cloud computing)	X			X			X												
		I1.2.2 Proportion of business based on cloud computing				X	X														
		I1.2.3 Proportion of business based on GIS (location, navigation, etc.)																			

Continued on next page.

Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D1 1CT	D1.2. Information facilities	I1 .2.4 Percentage of households with at least one computer		X		X			X					X			X		X		
		I1.2.5 Level of cyber-security				X															
		I1.2.6 Ratio of children online protection																			
D2 Environment Sustainability	D2.1.Environment	I2.1.1 Proportion of information published on environmental quality				X													X		
		I2.1.2 Progress degree of ICT & digital in the protection of main city water resources				X				X			X		X			X	X		
		I2.1.3 Effect of flood control monitoring by means of ICT & digital measures											X					X	X		
		I2.1.4 Proportion of water pollution control by means of ICT & digital measures				X				X	X		X		X		X	X	X		X
		I2.1.5 Proportion of air pollution monitoring by means of ICT & digital measures			X	X		X	X				X		X		X		X	X	X
		I2.1.6 Proportion of toxic substances monitoring by means of ICT & digital measures				X				X											
		I2.1.7 Proportion of noise monitoring by means of ICT & digital measures				X		X					X								
		I2.1.8 Solid waste disposal management with ICT & digital measures	X		X	X				X	X		X		X		X		X	X	X

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Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D2 Environment Sustainability	D2.2 Energy and natural resources	I2.2.1 Improvement of civilian electricity usage (per capita) with ICT & digital measures				X			X	X			X	X							X
		I2.2.2 Improvement of industrial electricity usage (per GDP) with ICT & digital measures			X	X			X	X			X	X					X		
		I2.2.3 Improvement of civilian water usage (per capita) with ICT & digital measures					X		X	X			X	X							X
		I2.2.4 Improvement of industrial water usage (per GDP) with ICT & digital measures					X		X	X				X							
		I2.2.5 Improvement of fossil fuel usage with ICT & digital measures (per GDP)	X		X		X	X	X	X							X				X
		I2.2.6 Improvement of rare metal/noble metal usage (per GDP) with ICT & digital measures								X											
D3 Productivity	D3.1 Innovation	I3.1.1 Percentage of R&D expenditure in GDP						X	X				X								
		I3.1.2 Ratio of knowledge-intensive enterprises						X					X							X	
		I3. I .3 Revenue share of knowledge-intensive enterprise										X									
		I3. I .4 Patent number per 100,000 inhabitant						X					X				X				
		I3.1.5 Importance as decision-making centre (HQ, etc.)											X								
		I3.1.6 SSC new projects opportunities															X			X	

Continued on next page.

Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D3 Productivity	D3.1 Innovation	I3.1.7 Penetration of teleworking system							X										X		
		I3. I. 8 Improvement of traditional industry with ICT & digital				X	X														
	D3.2 Economic Sustainability	I3.2. I Percentage of knowledge economy in total investment			X		X		X											X	
		I3.2.2 Percentage of knowledge economy in GDP							X											X	
		I3.2.3 Employment rate in knowledge-intensive sectors			X		X		X	X			X	X	X		X		X	X	
		I3.2.4 Percentage of e-commerce transaction amount				X	X		X	X							X	X	X		
D4 Quality of life	D4.1 Convenice and	I4.1.1 Satisfaction with online commercial and financial services				X	X			X					X	X		X	X		
		I4.1.2 Satisfaction with environmental safety				X	X								X						
		I4.1.3 Convenience of government services				X	X	X	X					X				X			
		I4.1.4 Convenience of smart traffic information administration and service				X	X						X			X			X		
		I4.1.5 Satisfaction with quality of public transport				X							X	X	X			X	X	X	
		I4.1.6 Satisfaction with crime prevention and security control				X				X			X	X	X					X	
		I4.1.7 Satisfaction with countermeasures against disaster							X				X								
		I4.1.8 Satisfaction with food drug safety monitoring				X															

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Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D4 Quality of life	D4.1 Convenice and	I4.1.9 Convenience of urban medical care				X									X						
		I4.1.10 Convenience for citizens to access education resource				X							X	X	X						
		I4.1.11 Perception of proof against risk of poverty											X	X	X	X					
		I4.1.12 Satisfaction with housing conditions											X		X					X	
	D4.2 Security and safety	I4.2.1 Accident prediction ratio			X					X											
		I4.2.2 Penetration of ICT & digital for disaster prevention				X							X					X	X		
		I4.2.3 Publication rate of disaster alert				X												X	X		
		I4.2.4 Penetration of city video surveillance																	X		
	D4.3 Health care	I4.3. I Percentage of archiving electronic health records for residents				X			X												
		I4.3.2 Usage rate of electronic medical records				X			X												
		I4.3.3 Sharing rate of resource and information among hospitals				X			X												
		I4.3.4 Coverage rate of household e-health services							X												

Continued on next page.

Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D4 Quality of life	D4.2. Education and training	I4.4. 1 Effectiveness of hatching smart tech from knowledge centres (research centres universities etc.)				X								X							
		I4.4.2 Penetration of e-learning system etc.)				X			X										X		
D5 Equity and social inclusion	D5.1 Openess and public participation	I5.1.1 Immigration-friendly environment contributed by ICT & digital measures												X							
		15.1.2 Improvement of turnout at city hearings by means of ICT & digital			X	X	X		X				X	X	X				X		
		15.1.3 Online civic engagement			X	X	X		X		X			X	X				X		X
	D5.2 Social sustainability	15.2.1 Feasibility of appealing online			X	X			X						X				X		
		15.2.2 Atmosphere of free online comment				X	X		X						X				X		
		15.2.3 Contribution in increasing consciousness of citizenship and social coherence				X			X					X	X						
	D5.3 Governance Sustainability	15.3.1 Digital access to urban planning and budget document				X	X		X				X			X			X		
		15.3.2 Appliance Of smart community services																	X		
		15.3.3 Penetration rate of government online services			X	X	X		X							X			X		
		15.3.4 Percentage of government information open				X	X		X				X			X			X		
		15.3.5 Penetration of smart impediment removal (accessibility) system					X						X								

Continued on next page.

Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D6 Physical Infrastructure	D6.1 Building	I6.1.1 Application level of energy saving technologies in public buildings				X							X		X				X		
		I6.1.2 Percentage of public buildings with integrated technologies				X			X									X	X		
		I6.1.3 Proportion of smart home automation adoption				X												X	X		
	D6.2 Transport	I6.2.1 Coverage of installation of road sensing terminals	X			X													X		
		I6.2.2 Coverage of parking guidance systems																	X		
		I6.2.3 Coverage of electronic bus bulletin board																	X		
	D6.3 Sanitation	I6.3.1 Sewage discharge management with ICT & digital measures	X		X		X						X					X	X		X
		I6.3.2 Improvement of waste water recycling with ICT & digital measures	X		X		X											X	X		
	D6.4 Municipal pipe network	I6.4.1 Drainage system management with ICT & digital measures	X		X		X											X	X		
		I6.4.2 Lighting system management with ICT & digital measures					X												X		
		I6.4.3 Gas system management with ICT & digital measures	X				X	X											X		

Continued on next page.

Table A2.3 continued

Dimensions	Sub dimnesions	Indicators	ISO	IDI	UN Habitat	CIC	MOHURD	ECI	Italy	TTC	GCIF	GPC	ESCI	ERMC	EUSI	Wheel	Ericsson	IBM	IDC	PwC	Simensw
D6 Physical Infrastructure	D6.4 Municipal pipe network	I6.4.5 Water saving smart metering					x											x	x		x
		I6.4.6 Electricity supply system management With ICT & digital measures	x		x		x	x										x	x		
		I6.4.7 Improvement of underground pipelines and spatial integrated administration With ICT & digital measures					x												x		

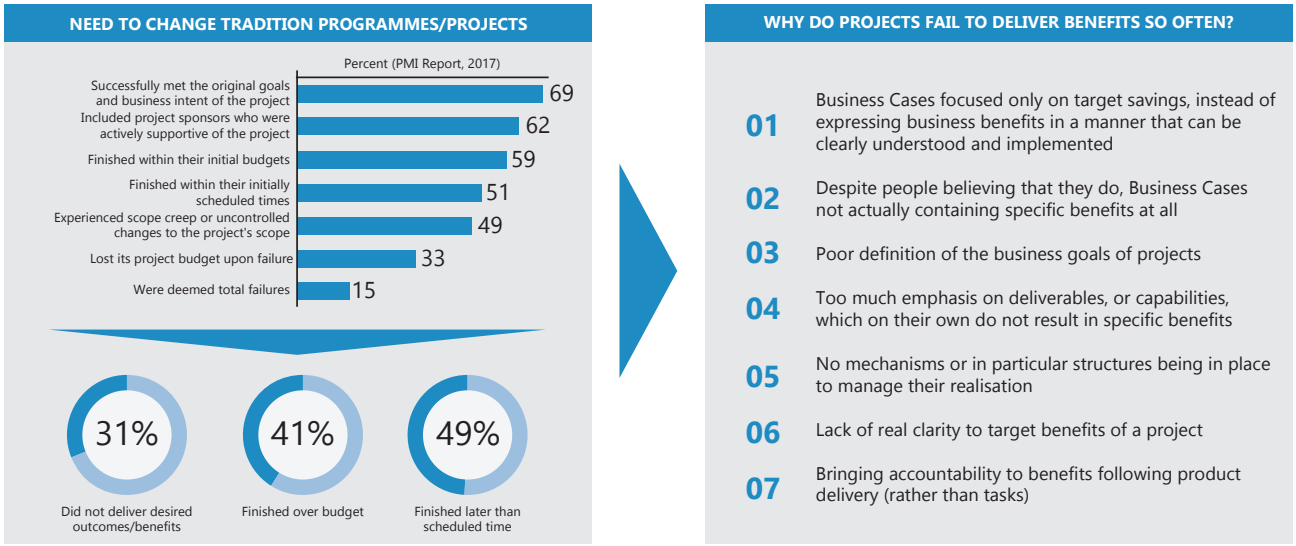
ISO = International Organization for Standardization Technical Committee 268: Sustainable cities and communities - Smart Community infrastructures (ISO/TC 268/SC1), IDI = International Telecommunication Union ICT Development Index ITU, UN-Habitat = United Nations Human Settlements Programme City Prosperity Index, CIC = China Institute of Communications, MOHURD = Ministry of Housing and Urban-Rural Development, People's Republic of China, EC = European Common Indicators,, Italy = Index system of smart city and smart statistics, Italy, TTC = Telecommunication Technology Committee Sub-Working Group for Smart Sustainable Cities, Japan, GCIF = Global City Indicators Facility, GPC = Global Protocol for Community-Scale Greenhouse Gas Emissions,ESCI = Emerging and Sustainable Cities Initiative, ERMC: European Smart Cities, Ranking of European Medium-sized Cities, EUSI: European System of Social Indicators, Wheel: The Smart City Wheel by Boyd Cohen, Ericsson: Ericsson Networked Society City Index, IDC: International Data Corporation Smart City Index, Spain, IBM: International Business Machines Smarter Cities Assessment Tool, PwC: PricewaterCoopers Cities of Opportunity, Siemens = Siemens Green City Index.
Source: International Telecommunication Union [ITU] (2015) Key performance indicators definitions for smart sustainable cities, https://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/website/web-fg-ssc-0270-r3-KPIs_definitions.docx

APPENDIX 3: BENEFITS REALIZATION MANAGEMENT

A. TRADITIONAL PATHWAYS CAUSE PROGRAMS TO FAIL

In traditional programs, projects focus on delivering a specific project scope to a program organization. However, as complexity increases, this often leads to conflicting outcomes and project-level decisions that are more task than benefit-oriented. When project KPIs are structured around quality, time, and costs, projects often lack focus on realizing the end-benefits, which delivered the hypothesized value to the sponsors and program organization. While benefits realization can be considered a key criterion for program success, projects, and programs often tend to fail. Many studies show that only 20%-40% of the potential benefits are realized. In a report from 2019, Project Management Institute (PMI)[27] found that 31% of projects did not deliver on the desired outcomes/benefits, 41% of projects finished over budget, and 49% finished later than the scheduled time. In this regard, the common causes can be attributed to various mistakes, such as business cases solely focusing on target savings, poor business goal definitions, as well as a lack of realization management. Last, for a long-term project such as establishing the New Livable Smart City, livability outcomes, benefits, costs, and other decision criteria change continuously over the portfolio lifetime. This emphasizes the need to establish a framework that is continuously reviewed and updated. See Figure A3.1 for a list of common mistakes related to the failure of projects.

Figure A3.1: Predominant Causes for Project and Program Failure

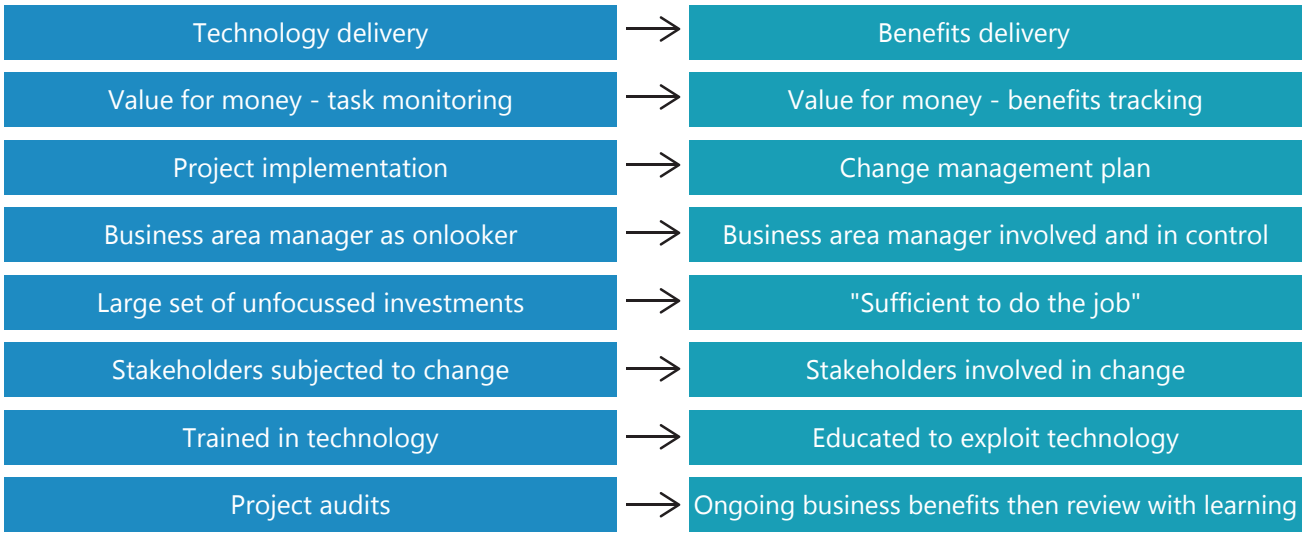


Source: Authors.

[27] PMI (2019). Benefits Realization Management: A Practice Guide. Project Management Institute Inc. Global Standard

B. RECOMMENDED DETERMINANTS TO INCREASINGLY FOCUS ON GOING FROM TRADITIONAL IS PROJECT APPROACHES TO BENEFITS MANAGEMENT

Figure A3.2: The Eastern Economic Corridor Must Adopt a Benefit-Oriented Mindset



Source: Authors.

C. SCALING THE BENEFITS REALIZATION MANAGEMENT FRAMEWORK

1. Determining the level of uncertainty of IT-Programs in smart cities

The first axis, **uncertainty**, refers to the risk of not achieving desired benefits. The higher the risk of not achieving desired benefits, the higher the need for governance stability, and thus, the higher the need for a more comprehensive BRM Strategy. The degree of uncertainty is affected by several factors, including complexity, broadness, program lifetime and urgency, relative resource allocation, and size of the impacted and related stakeholders.

In increasing the **complexity,** there will be an increased need to define program benefits to keep projects aligned with program objectives. Complexity captures stakeholder complexity (e.g., large and complex organization, group of citizens, or number of related stakeholders), implementation complexity (e.g., organizational inertia and agile culture), asset and process complexity (e.g., the complexity of the underlying assets and individual processes needed to achieve the desired program benefits), environmental complexity (e.g., complexity from the external environment such as competitive- and legislative landscape). Furthermore, referring to the degree of inclusion, a **broad** program includes various departments and workflows, whereas a narrow program refers to one where the business change component only impacts a limited group of people. Moreover, increasing the duration of the **program lifetime** results in higher risks of losing focus on core objectives/benefits. Likewise, a longer program period results in more handovers if program staff change. Thus, a longer program lifetime increases the need to systematically work with benefits continuously. As a result of a changing city's

environment over time, new benefits might be discovered, and old ones deemed irrelevant. Thus, BRM works consistently with tracking such, and ensuring that the relevant benefits are achieved by the stage of program closure.

Further, **resource allocation** refers to the degree to which resources have been allocated to the program relative to the organizational size. A program that requires more committed capital and labor results in the need to manage a larger variety of individual resources and components while, generally, inferring a lower tolerance failure. Last, a l**arger organization and interrelated stakeholders** will need a higher degree of organizational and governance stability due to two factors: (i) higher absolute resource allocation, and (ii) pressure for lower risk from stakeholders.

2. Determining the stakeholder importance of IT-programs in smart cities

The second axis of the framework, the **stakeholder importance,** is directly linked to the impact and importance of the defined benefits. Specifically, it refers to the level of criticality of ensuring the achievement of desired benefits to future business operations. The higher the stakeholder importance, measured as e.g., the level of criticality to address public issues and GESI related aspects, the lower the risk willingness for deviating from desired benefits. Stakeholder importance therefore reflect the risk-willingness for EEC not to realize the defined benefits.

While assuming critical importance to address public issues, less risk can be taken regarding achieving the specified benefits, whereas a program that has lower significance for future business operations and competitiveness might carry a larger risk budget, regarding achieving the desired benefits. To understand the degree of stakeholder importance of a program related to establishing ICT & digital infrastructure in the New Livable Smart City, the EECO must consider the entire stakeholder landscape (including but not limited to GESI stakeholders) and the reason for initiating the program in the first place. A program might be initiated due to **pressure from external stakeholders, or internal vision and goals.**

External pressure. While the context for EEC is different (see below), external pressure for corporations include pressure from *competition and entrants, regulatory institutions, shareholders,* and *changing costumer & citizen demands and behavior.* Before deeming these factors irrelevant for a smart city yet to be built, it must be understood in what ways they both implicate initial and future programs. EEC's New Livable Smart City may not have been established yet, nevertheless, the city already competes with comparable societies on being best in class on several parameters, while the New Livable Smart City entrants that are based on novel technologies constantly evolve globally. Thus, once built, the New Livable Smart City will moreover need to continuously enhance existing solutions while developing entirely new ones to sustain its position and competitive advantages.

Furthermore, while EEC operates in a regulatory sandbox in many regards, other institutions may impose legal requirements for smart city solutions with which to comply. This includes e.g. DEPA requirements regulating data management processes. Compliance could already cause problems during the initiation of the initial programs, for instance, due to data privacy and ethical implications. To this, future technologies will arguably be regulated to an increasing extent. As technologies permeate all aspects of smart within the city, future risks that enforced legislation will drive the initiation of new programs to meet new requirements are high, hence allowing critical infrastructure to function.

Depending on the funding model of the individual initiatives, various types of shareholders may put pressure on the organizations (public/ministerial entities, vendors etc.) involved to develop new, specific solutions or change existing ones. Moreover, Smart City Platform users, such as citizens, developers, start-ups or established businesses may change present demands and behavior predicted over time, for instance, calling for actions that require further ICT & digital-related integrations. This emphasizes the advantages of ensuring flexibility to allow future adaptations to projected outcomes, while sustaining the benefits continuously, which is further explored in the later sections.

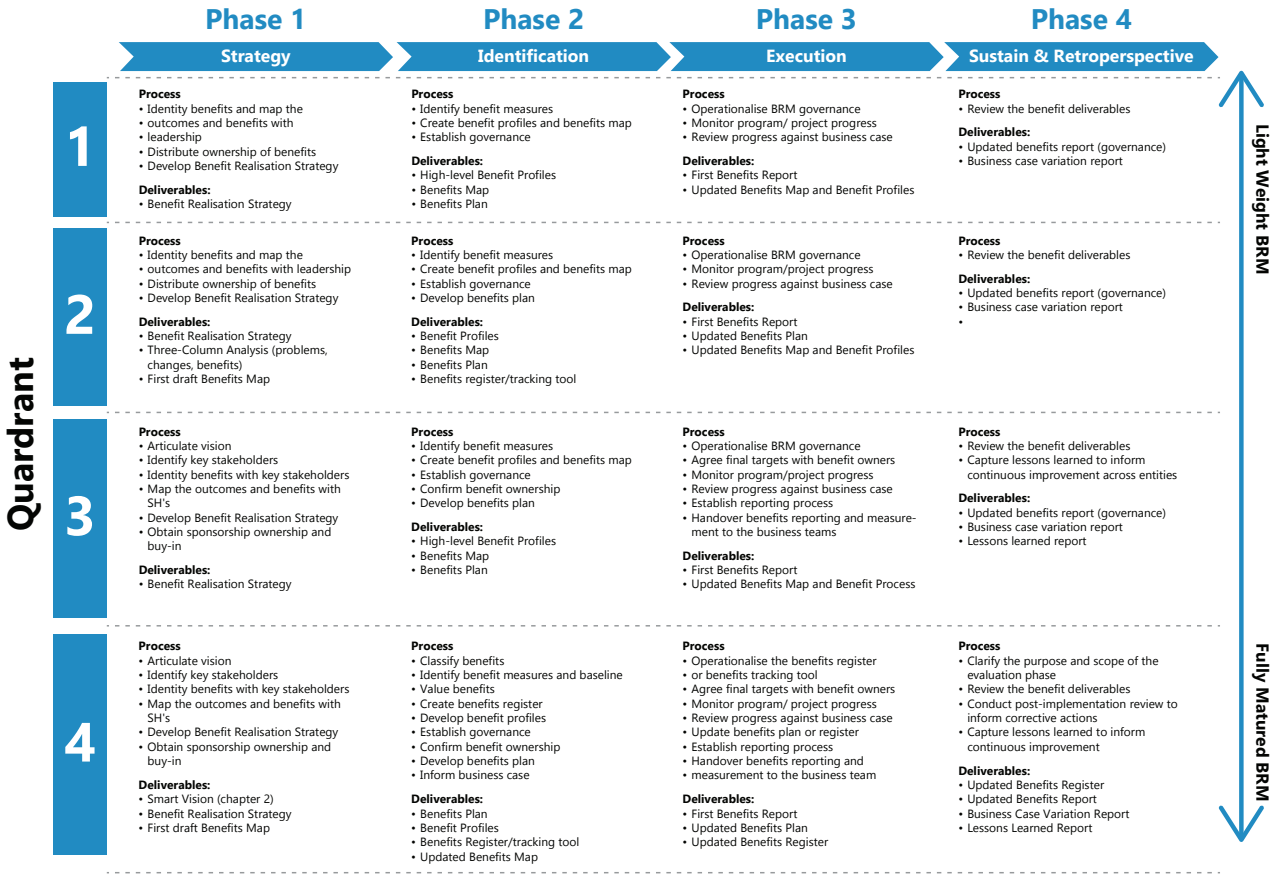
Internal vision and goals. Besides external pressure, programs can be initiated due to the internal vision and goals, which encompasses operational levers, financial levers, strategic levers, and governance levers. The first – **operational levers** – involves revenue improvements (i.e., regarding new products, markets and segments, and penetration of current segments with current products), improving margins (i.e., lowering fixed costs or decreasing variable costs), and operational backbone and support (i.e., changing to-be for outdated support functions, systems, or assets). **Financial levers** revolve around increasing valuation multiplies, improving liquidity, financial arbitrage, or optimization of capital structure. Moreover, **strategic levers** include guarding the city against entrants/competitive moves of other smart cities, corporate and governmental refocusing, being at the forefront of future market trends and accomplishing non-financial goals. Last, **governance levers** of streamlining or expanding governance mechanisms may contribute to triggering program initiation.

In this regard, establishing a new city is on one hand optimal, given the opportunity to define adequate benefits to enact the desired ways of working, financial structures, strategic vision, and appropriate governance setup from its inception. On the other hand, the areas at hand highlight several critical aspects to accommodate at ground zero. Thus, with a complex network of stakeholders and shareholders that are pushing to build the IT backbone of the city to enable smart solutions, the current programs in scope accentuate a high level of stakeholder importance. In addition to this, with rapid changes in the environment a Project Portfolio Office should acknowledge and be equipped with a setup to accommodate these levers for change to adapt through new transformative programs in the future.

In conclusion, while benefits differ on a program-to-program level, and the EECO must consider each program and group of benefits in isolation, the general characteristics of developing the ICT & digital infrastructure results in a high (general) need for governance stability. With both parameters of *uncertainty* and *stakeholder importance* being high by nature, EEC must adopt the BRM framework in its full configuration to support the organization in delivering the desired outcomes of the ICT & digital setup. This consists of multiple management products that are key to managing benefits realization of the programs successfully. These will be unfolded in the following.

D. PROCESS AND MANAGEMENT PRODUCTS FOR EACH PHASE AND QUADRANT OF THE BRM FRAMEWORK

Figure A3.3: Process and Deliverables in the Benefits Realization Management Phases for Quadrant 1–4



Source: Authors.

E. OVERVIEW OF BENEFITS REALIZATION MANAGEMENT KEY MANAGEMENT PRODUCTS

PRODUCT	DESCRPTION (PMI,2019)	VALUE CREATED
Benefit map	Linking all benefits to the respective strategic objectives and Drivers (including capabilities and outcomes; sometime coined Intermediate benefits, enabling changes, project outputs, and Drivers)	Assisting in planning activities and Illustrating dependencies in order To explain what, how, and when Business change is expected to Deliver business benefits. It is, Moreover, used to create a Common understanding across Several areas of a project.
Benefits Management Strategy	A document for a project or programme outlining the Approach for managing benefits, including a description of How, when and at what level, benefits realisation management Will be applied. Includes outlining roles and responsibilities, Governance and reporting arrangements and how benefits Management aligns with other project and programme Management activities.	The strategy describes in a top- Level way how plans, structures, Governance structures and Processes are in place to Successfully realise the core Benefits of the programme or Project.
Benefits Register	Typically an excel spread sheet that includes line items of Each benefit, a short description, the objective the benefit Links/contributes to, the benefit owner, the beneficiaries, the Baseline, target and measurement methodology. The benefits Register is the collection of all benefits and relevant Information, the details of which are broken out into separate Benefit profiles (see next) for the benefits owners.	Providing real-time clarity on Planned benefits, who the benefit Owner is, how to measure these Benefits (baselines and threshold Levels), and when the benefits are Expected to be realised.
Benefit profile	Template that contains all information for a single benefit such As the measure, baseline, target, frequency of measurement And associated risks. It is often provided to the benefit owner As an 'instruction' for how the benefit will be realised and the Change that needs to take place. Moreover, it often explains The dis-benefits associated with the programme.	Identifying the benefits, as well as The responsible, how the benefit Supports strategic objectives, the Enablers connected to that benefit, Baselines, and what potentially Could go wrong in the benefit Realisation process.
Benefit realisation plan	A document profiling all of the benefits and how they are Forecast to be realised from baseline to target, including Baseline and measurement information, dependencies, Identified benefit risks and benefit realisation milestones	Identifying investment outcomes, Collecting benefit measurement Data, plan steps to deliver the Capabilities that feed into each Benefit, and in a detailed manner Explain how governance Mechanisms for each capability, Outcome and benefit work.
Benefit Report	A report produced at an agreed frequency demonstrating the Realisation of benefits to date, usually comparing the baseline, Target and actuals. It is important that any data provided has Sufficient narrative to explain additional context and rationale To explain whether performance is as planned.	Having an updated version for Each separate benefit if Performing compared to timelines And baselines, target and actuals. It is used as an assurance tool to Benefit owners and programme Management.
Benefit Handover Certificate	A formal signoff between the project and the Benefit Owner confirming responsibility' for realising a benefit is transferring from the project to the most suitable person in BAIJ. The Benefits Handover Certificate could include the Benefits Profile, and should also include the handover date and any terms and conditions agreed (such as reporting arrangements for example).	Making sure that benefits are sustained in the business change phase when incorporating such into the basis organisation when the benefits becomes business as usual.

Source: Authors.

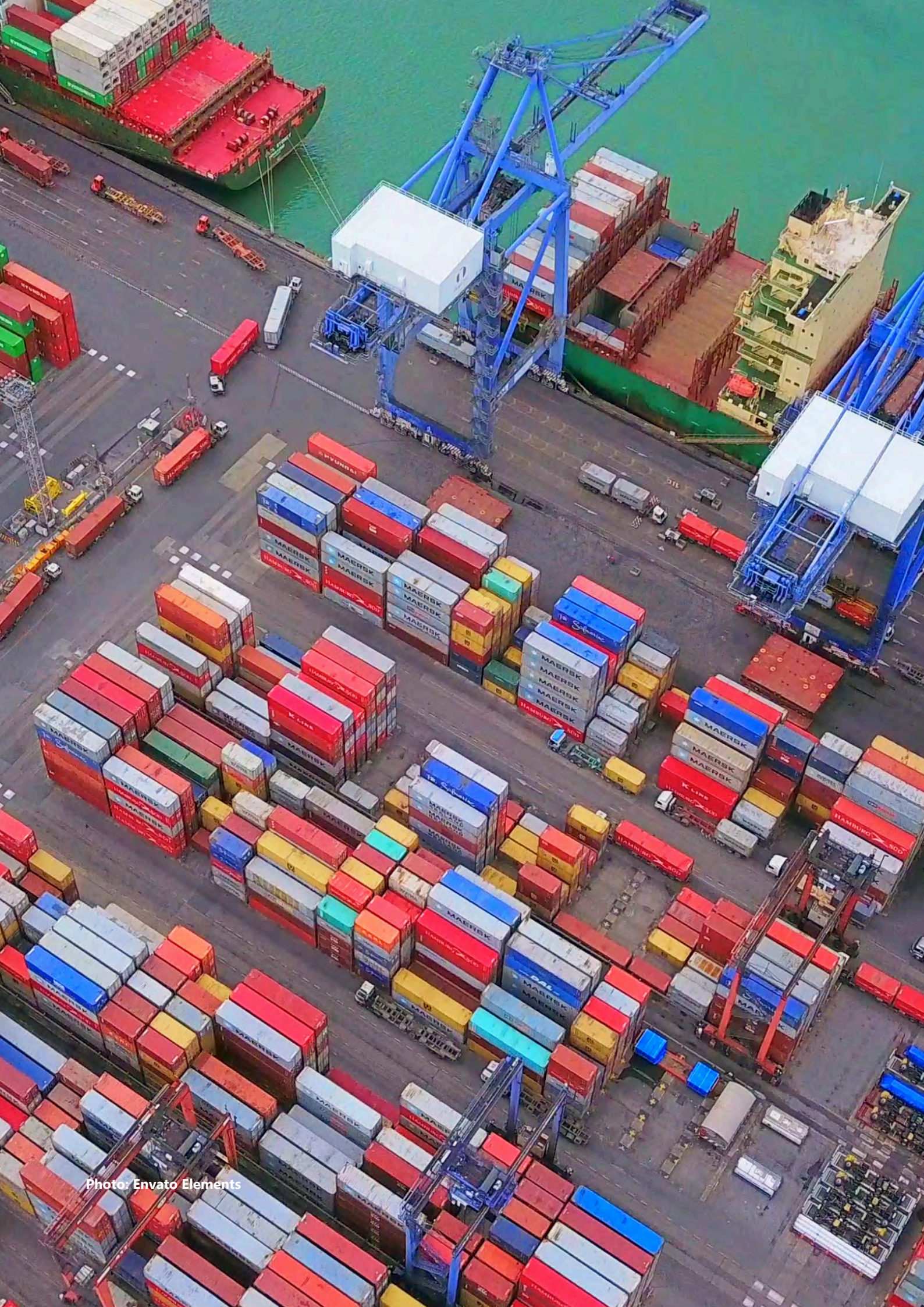
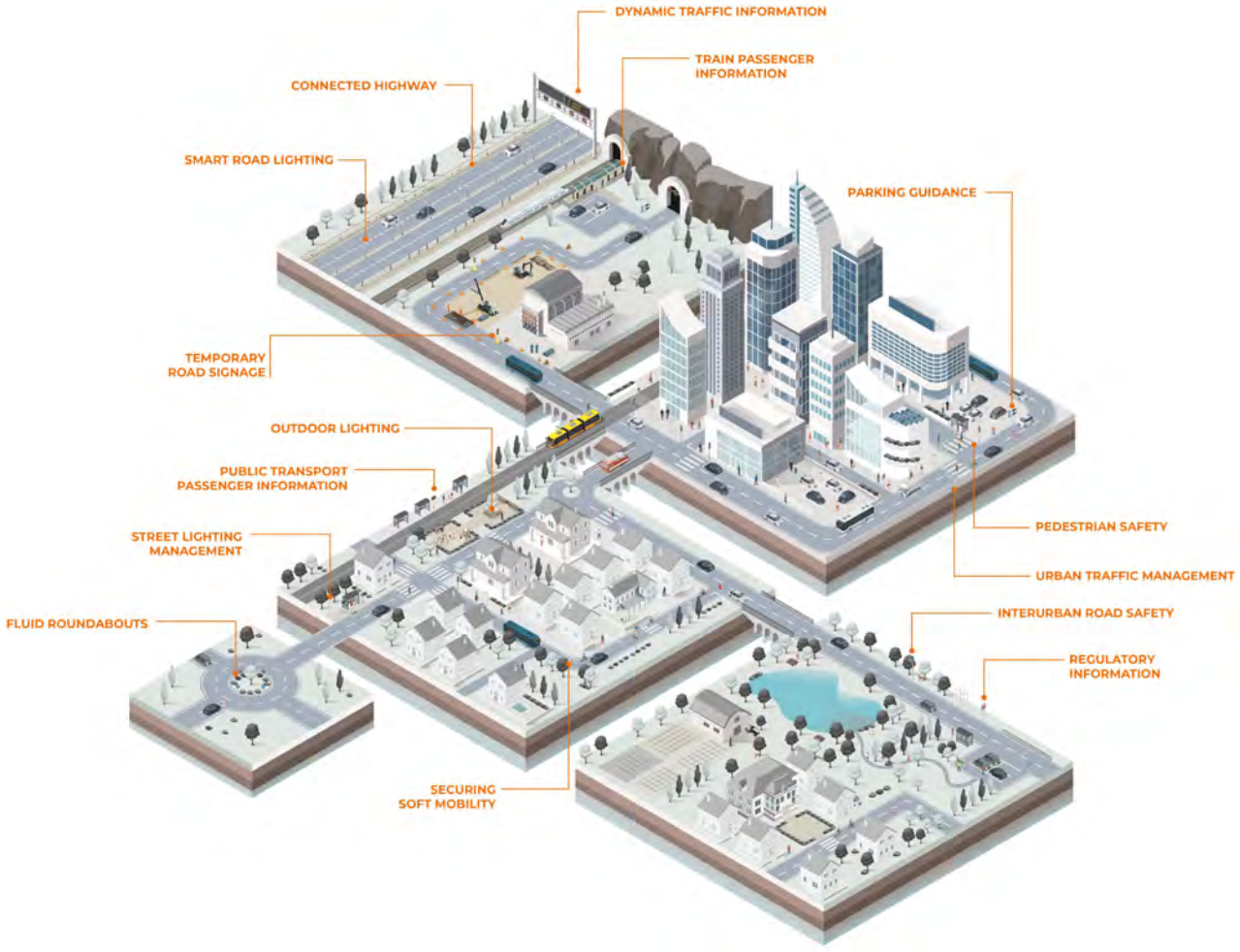


Photo: Envato Elements

APPENDIX 4: LACROIX© SERVICE OFFERING AREAS

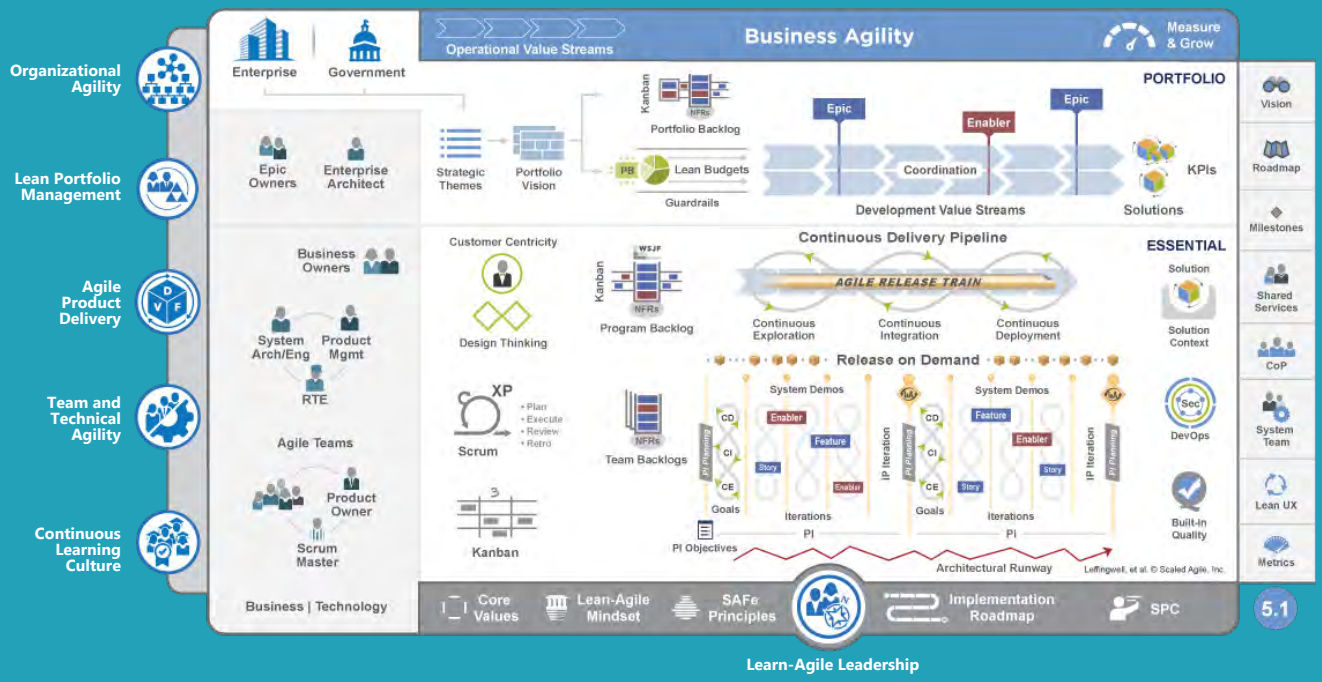
Figure A4: Lacroix© ICT & Digital Solutions



Source: Lacroix.©

APPENDIX 5: AGILE DEVOPS AND ALIGNMENT

Figure A5: Full Scaled Agile Framework©



Source: Scaled Agile Framework©

The suggested agile approach can be viewed as a hierarchy of backlogs managed from the portfolio level down to the program and project, and team level.

From the top, the portfolio level manages a backlog of Epics, which are characterized as a collection of desired Features or functionalities to be developed. Any business, organization, or public authority can benefit from delegating managers (i.e., Business Owners) to continuously manage the backlog of epics and take charge of placing the IT orders from the Service Catalog.

At the program level, ARTs can be established as a long-term organization constituted be several Agile Teams and stakeholders of relevance that plans, executes, tests, and adjusts deliverables centered around the value stream. The ART backlog consists of the Features prioritized by the Business Owners of the public authority and is managed by Product management. Moreover, the steering entity of the ARTs involves a Systems Architect, as well as a specified Release Train Engineer responsible for coordinating risks and dependencies across the program through Program Increment (PI) Planning approximately every three months.

At the executing level, Agile Teams works to continuously develop and operate the requested Features, split into a backlog of Product Increments. This backlog is managed and groomed by Product Owners, while a team of developers executes the prioritized items in sprints, overseen by a Scrum Master through daily Stand-Up Meetings.

As previously emphasized in Chapter 3, the ITC components of a Smart City involves a myriad of vendors to deliver the desired livability applications. All these vendors have dedicated, agile teams that develop and operate such components to ensure stability and safety. Therefore, whether EEC intends to develop and operate the SCP environment internally, or outsource the effort to the vendors, these will in most cases take part in the continuous DevOps loop.

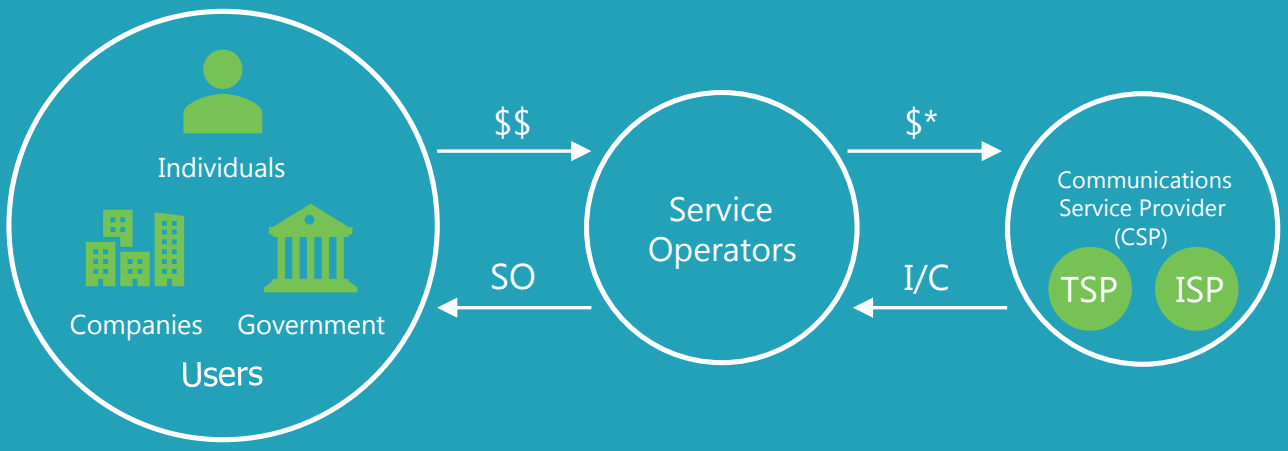
Figure A5 illustrates the full SAFe© overview (essential, large solution, and portfolio). This is a scaled framework that coordinates both internal and external ARTs.

Designing the Operating Model properly to focus on the most important matters for delivering value allows IT vendors (Dev & Ops) to better provide the necessary means to benefit the business (Biz). For instance, it enables IT to quickly react to the rapid changes in the market, to provide optimal availability and performance for end users, to reduce issues and the impact and cost of these, enable users to understand the services and where to find them, provide better service at low cost, and comply with regulatory requirements.

As previously described in Chapter 3, the ITC components of a Smart City involves a myriad of vendors to deliver the desired livability applications. All these vendors have dedicated, agile teams that develop and operate such components to ensure stability and safety. Therefore, whether EEC intends to develop and operate the SCP environment internally, or outsource the effort to these vendors, the vendors will in most cases take part in the continuous DevOps loop.

APPENDIX 6: TDC CASE

Figure A6: TDC Case



Source: Authors.

TDC A/S (and Global Connect) is a private provider of wired and wireless Telecom connectivity. They own the COAX cables, Fiber Optic Cables, servers, aggregators, etc. that ensures that a proper WAN/MAN is installed across Denmark.

By doing so, the Danish state has **no direct funding** of these components or the needed operations, which ensures that inhabitants have one of the globally best mobile connections, TV signals, and internet speeds and coverage.

Requirements ensure that any vendor can use the TDC infrastructure, and that TDC must comply with several criteria. Thus, this means that:

- There market is highly competitive, and there is no monopoly. TDC must provide access to all cables and infrastructure to any vendor.
- There is a high degree of freedom for users when choosing a vendor.
- There is not unnecessary number of cables installed on each road.
- There is a requirement that all households have access to telecom services such as internet at a predefined minimum speed (revised annually, a.k.a. "Forsyningspligt").
- TDC receives money from their service offerings (*) only; vendors pay a small fee for using the TDC wiring.
- Prices are estimated from wholesale conditions set by independent and public decision makers based on theoretical models.

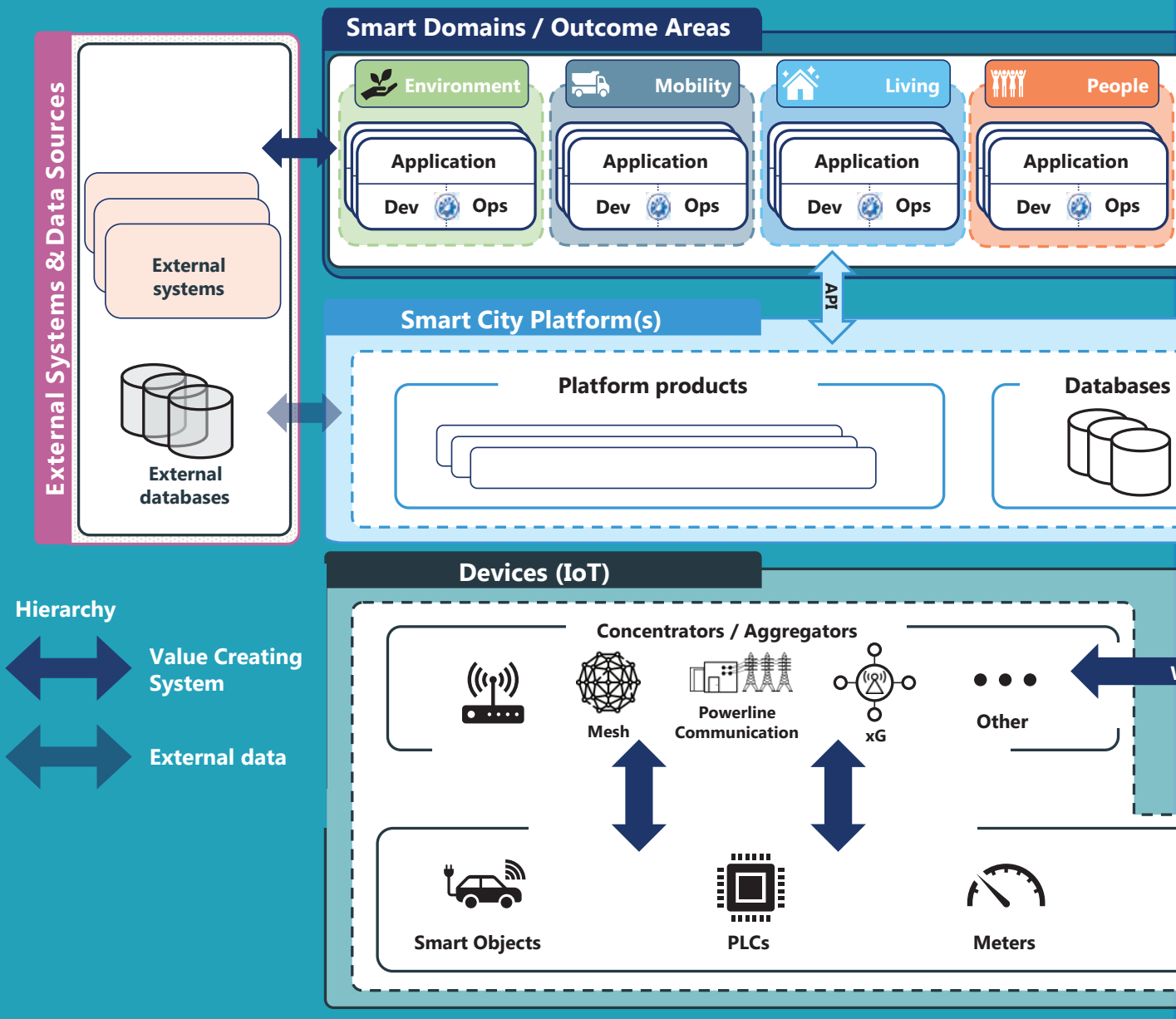
TDC, thus, in practice works as an infrastructure provider but allows for many service providers as illustrated in Figure A6.

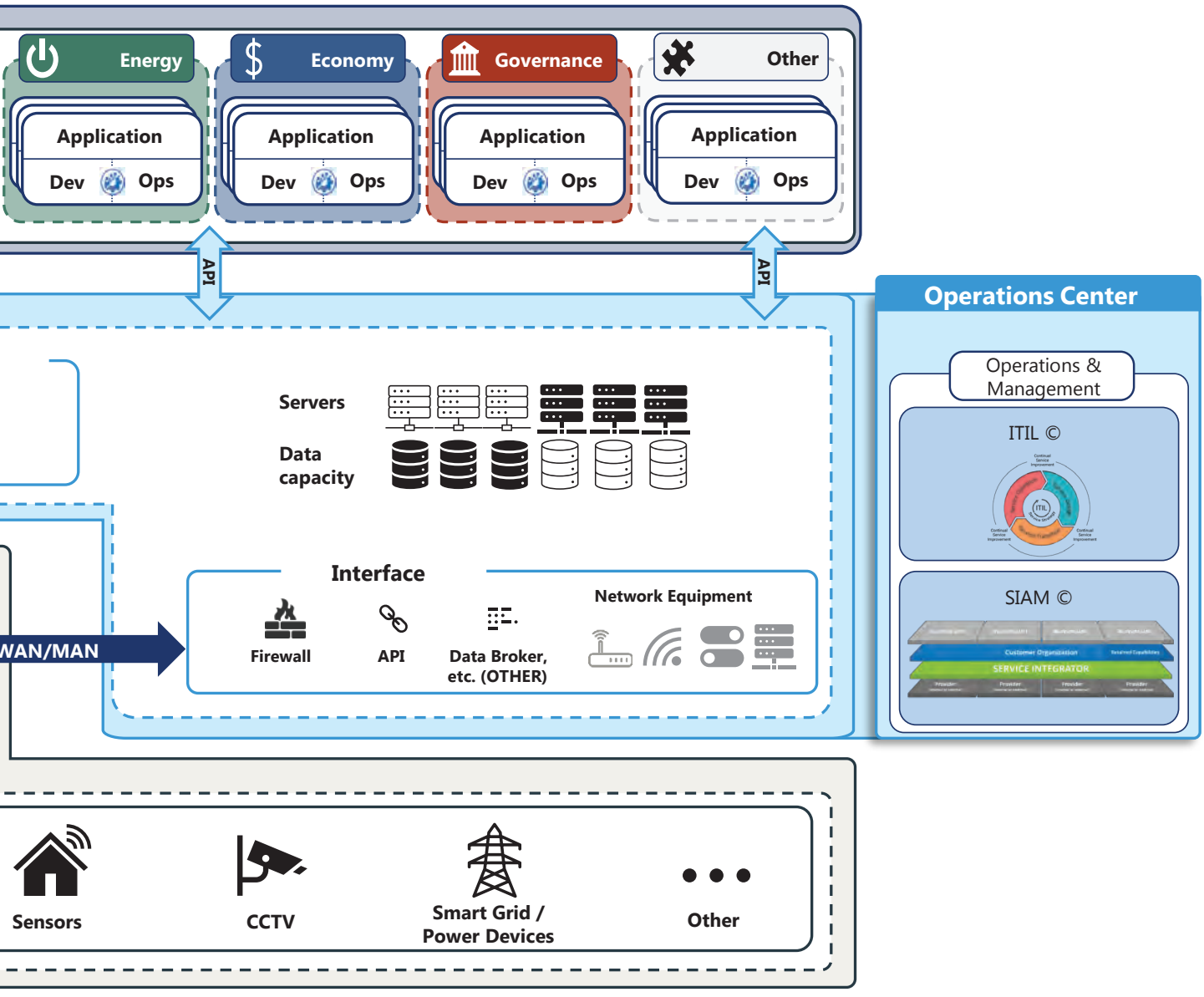
An alternative to the above is that either (i) the government provides IT Infrastructure and sells the access to this on an *X* year period to be the competition for public tendering (CSP), or (ii) the government is the CSP. Both require upfront payment. Note that CSPs and Sponsors can differ (e.g., the Asian Development Bank to finance investment based on CF-model).

If EEC is to manage this relationship, it is key that EEC understands its role as a service operator, and remembers that EEC must:

- Establish requirements must enable competition, inclusivity, and sensible pricing.
- Start with specifying outcomes not the technologies.
- Ensure openness of systems.
- Consider vendor lock-in vs. attractiveness (e.g., through fair take over values).

APPENDIX 7: VISUALIZATION OF SMART CITY LAYERS





Source: Authors.

APPENDIX 8: ITIL© PRACTICES FOR VENDORS

ITIL© categories and practices for ITSM	Describe compliance with the ITIL® practices and solution (Vendor)
Service Management Practices	
Release Management	
Problem Management	
Monitoring & Event Management	
IT Asset Management	
Incident Management	
Change Enablement	
Capacity & Performance Management	
Business Analysis	
Availability Management	
Service Catalog Management	
Service Configuration Management	
Service Continuity Management	
Service Design	
Service Desk	
Service Level Management	
Service Request Management	
Service Validation & Testing	

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Table continued

ITIL© categories and practices for ITSM	Describe compliance with the ITIL® practices and solution (Vendor)
Technical Management Practices	
Deploy Management	
Infrastructure & Platform Management	
Software Development & Management	
General Management Practices	
Architecture Management	
Continual Improvement	
Information Security Management	
Knowledge Management	
Measurement & Reporting	
Organizational Change Management	
Portfolio Management	
Project Management	
Relationship Management	
Risk Management	
Service Financial Management	
Strategy Management	
Supplier Management	
Workforce & Talent Management	

Photo: Envato Elements

APPENDIX 9: DIGITAL SOLUTIONS CATALOG

Smart Mobility & Transport					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
AI for optimizing road maintenance work	Scanning of roads with high resolution while driving at high speed. New equipment quickly and efficiently collects large amounts of data and is a major step forward when it comes to big data analysis and AI. This makes it possible to assess the state of the road network and optimize the maintenance regime.	Road maintenance	Analytics Sensors and controls		No
Logistics consolidation center	Construction of a central hub for consolidation of goods from commercial delivery vehicles to maximize truck load, and timed operation of trucks to minimize impact to traffic. Enabled by smart mobility technologies such as ITS, real-time road navigation, etc.	Traffic management	Cloud Data management Sensors and controls		No
Multimodal public transit to book end-to-end trips across all available modes of transportation	Digital platform that allows seamless end-to-end trip planning, booking, ticketing, and payment services across all available modes of transportation.	Traffic management	Broadband access Cloud Data management Privacy Security		Yes
Predictive maintenance using sensors to identify failure points of public transit	Use of sensor-based monitoring of the condition and potential failure points of public transit and related infrastructure (such as rails, roads, and bridges) so that predictive maintenance can be performed before breakdowns and disruptions occur.	Traffic management	Analytics Data management Cloud Sensors and controls		Yes
Public transit information and management	Collection and dissemination of real-time information about price, arrival and departure times, and availability of transportation options across many modes such as APIs, mobile applications, and in-person signboards. Open access to data through APIs will also enable private-sector innovation.	Traffic management	Cloud Data management Privacy Security Sensors and controls	Sweden – Skåne TomTom GPS data analytics	Yes
Traffic command and control center	Implementation of a central facility for cities or districts that integrates and displays multiple sources of real-time information to provide effective monitoring of traffic quality and service levels. Sources can include real-time GPS tracking systems, CCTV surveillance, vehicle monitoring systems, and more.	Traffic management	Analytics Cloud Data management Privacy Security Sensors and controls		No
Bike sharing scheme for public use bikes and e-scooters	Availability of public-use bicycles, either in docking hubs or free-floating, to provide an alternative to driving, public transit, and private bike ownership. This option can bridge the first mile/last-mile segment when public transit does not take a commuter door-to-door.	Soft user traffic management Mobility sharing schemes	Analytics Broadband access Cloud Data management Sensors and controls	Indonesia – Bandung Garuda Bike Indonesia – Semarang GOWES for e-bikes and e-scooter	Yes

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Table continued

Smart Mobility & Transport					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Car sharing scheme for public use cars	Access to short-term car use without a driver or full ownership. Can be round-trip (station-based), one-way (free-floating), peer-to-peer, or fractional.	Mobility sharing schemes	Broadband access Cloud Data management Privacy Security		Yes
Demand-based micro transit for ride-sharing services	Development of ride-sharing services with fixed routes, fixed stops, or both, often supplementing existing public transit routes. Algorithms use historical demand to determine routes, vehicle size, and trip frequency. May include options to reserve seats.	Mobility as a service	Analytics Broadband access Cloud Data management Privacy Security		Yes
Driverless trains	Implementation of International Association of Public Transport Grade of Automation 4 trains capable of operating automatically, including door closing, obstacle detection, and emergency situations.	Trains safety management	Analytics Cloud Computing resources onsite Data management Sensors and controls Security		No
Drone transportation	Availability of autonomous door-to-door transport using an unmanned aerial-only vehicle.	Package delivery	5G Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Dynamic smart parking for parking availability	Installation of IoT-based system for consolidation of parking availability across multiple locations, publishing of live status of individual spaces, and provision of parking reservations. A dynamic smart parking system can also be integrated with payment systems to implement dynamic pricing.	Parking services	Analytics Cloud Data management Sensors and controls Privacy Security		Yes
Smart Mobile Parking	Private companies can often create parking solutions based on apps. Thus, requiring limited or no IoT.	Parking services	Analytics Cloud Data management Applications dev and ops		Yes

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Table continued

Smart Mobility & Transport					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
E-hailing for point-to-point transportation	Availability of real-time, on-demand ordering of point-to-point transportation through a mobile device. Can also include pooled e-hailing where separate ride requests with compatible routes are matched dynamically to increase vehicle utilization.	Mobility as a service	Analytics Broadband access Cloud Data management Privacy Security		No
Intelligent traffic lights	Installation or retrofit of traffic lights with sensors and controls to implement dynamic optimization of timing, leading to higher average speeds on roads and less frequent stop-and-go conditions. Includes traffic light pre-emption technology, which gives priority to emergency vehicles, public buses, or both.	Traffic safety Mobility optimization Emergency mobility optimization	Analytics Cloud Computing resources onsite Data management Sensors and controls Security		Yes
Public and autonomous trains	Operating automatically, including door closing, obstacle detection, and emergency situations.	Safety	5G Analytics Cloud Computing resources onsite Data management Sensors and controls Security		Yes
Real-time road navigation	Development of real-time navigation tools that can be made available to individuals and companies for choosing driving routes, with alerts for construction, detours, congestion, and accidents. These tools will allow users to choose the most time-efficient routes or bicycle routes with best air quality.	Traffic management	Analytics Broadband access Cloud Data management Privacy Security		No
Self-driving trucks	Availability of trucks for the transport of goods with the capability of sensing the environment and navigating without human input through use of technology such as GPS, radar, and LIDAR.	Traffic management	Analytics Cloud Data management Sensors and controls		Yes

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Table continued

Smart Mobility & Transport					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Shared and autonomous driving	Availability of a shared car fleet capable of sensing the environment and navigating without human input. Transportation via these cars can be ordered through a mobile device or other digital touchpoint.	Mobility sharing schemes Autonomous mobility	Analytics Broadband access Cloud Data management Sensors and controls Privacy Security	Australia – Canberra Philippines – New Clark City New Zealand - Christchurch	Yes
Smart parcel lockers for package deliveries	Installation of onsite drop boxes at locations where packages can be picked up using individual access codes sent to mobile devices or another personal authentication method.	Package delivery	Broadband access Privacy Security		Yes
Smart crossing for pedestrians.	Road safety is important as accidents, whether by driving or crossing the streets, can sometimes be fatal. Smart crossing for pedestrians can include illuminated signage on each side of the road and flashing LED lights in the roadway, which will be activated automatically as pedestrians' approach to cross.	Soft road user's safety	Computing resources onsite Sensors and controls Security	New Zealand - Dunedin	Yes
Safety road assessment	Digital tools make it possible to utilize objective calculation methods, which places children on an equal footing by configuring the dangers of their school routes into a mathematically measurable form. These tools can be used to determine the need for school transportation.	Soft road user's safety	Analytics Data management	Finland – ViaSmart road safety assessment tool	Yes
Electrical Vehicles Charging Infrastructure	As more vehicles become electric, there is a need for a large Electrical Vehicles charging infrastructure. The main considerations are based on location, parking, shared infrastructures (no vendor lock-in), integration with energy system (peak times, pricing, etc.), payments and much more. A shared infrastructure is needed to support different stakeholders, which should be included in the Traffic management -and energy system.	Electrical Vehicles Charging	Electrical Vehicles chargers IT platforms and energy management platforms	Copenhagen	Yes
Digital public transit payment with touchless payment of public transport	Implementation of digital and touchless payment systems in public transportation that allow for prepayment and faster boarding. Includes smart cards and mobile payments.	Digital payments	Broadband access Cloud Data management Privacy Security		No

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Table continued

Smart Mobility & Transport					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Dynamic congestion pricing	Charging of fees for private car usage in certain areas, during times of peak demand, or both, adjusted dynamically according to prevailing road conditions based on ideal average road speeds. Uses a system of transponders, automated gates, and digital payment systems in conjunction with a charge-determining algorithm.	Digital payments	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Energy Storage	Most energy is consumed in cities, but cities have, due to economy of scale, the potential for an efficient energy infrastructure, including electricity, Gas, district heating (hot water) and district cooling (cold water). Due to the conversion technologies and the integrated networks, it is possible to e.g., store electric energy not as electricity, but as hot water, cold water or gas in case this is the end-use demand. Thereby, a city with this infrastructure can react on the electricity market and use a lot of electricity at low prices and even generate electricity at peak prices.	Energy management	Analytics Cloud Computing resources onsite Data management Sensors and controls Security		No
CO2 conversion to useful products	Use of technologies to capture carbon dioxide, CO2, from low-concentration emission sources in the industrial and power sectors to convert the CO2 into useful products such as building materials, reclamation sand and synthetic fuels	Emission reduction	Analytics	New Zealand - Dunedin	Yes
Low-carbon energy	Low-carbon energy technologies such as hydrogen, carbon capture, utilization and storage can help cities to achieve long-term emission reduction goals.	Emission reduction	Analytics	Singapore	Yes
Smart Building management systems for transparent consumptions	Deployment of smart systems that optimize energy and water use in commercial and public buildings by leveraging sensors, meters, and analytics to monitor and manually or remotely/automatically eliminate inefficiencies.	Building energy monitoring Building water monitoring	Analytics Cloud Data management Sensors and controls		Yes
Home energy consumption tracking	Installation of smart meters and other sensors to track residential electricity consumption with feedback delivered to the user via mobile app, email, or text to increase user awareness and encourage conservation.	Building energy monitoring	Analytics Cloud Data management Sensors and controls		Yes

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Table continued

Digital Smart City Solutions	Short Description	Key Priorities / Challenges	Enabling ICT & Digital	Use cases	Possible Modular Implementation
Smart Mobility & Transport					
Geothermal energy	Opportunities for exploiting geothermal energy depend on the local geological structures and the temperature of the underground reservoirs. Once built and commissioned, a geothermal energy plant is able to provide base load with quite high efficiency and low operational costs, independently of weather and climate.	Energy management	Computing resources onsite Sensors and controls		
Digital engagement platform with AI energy-use insights	Use of digital platform to engage costumers via digital self-service, tracking, comparing of their energy usage. Leveraged by artificial intelligence and machine learning to inform costumers to create saving programs	Civic engagement	Analytics Cloud Data management Sensors and controls		Yes
Smart Environment					
Disaster early warning systems	Deployment of sensors, cameras, and monitoring systems with data collection and analytics designed to predict and mitigate the effects of natural disasters such as hurricanes, earthquakes, floods, and wildfires	Disaster resilience	Analytics Cloud Computing resources onsite Data management Sensors and controls Security	Philippines – Geo Risk Philippines GIS	No
Flood early warning systems using IoT, crowd-sourcing and remote sensing	Disasters brought about by climate change and extreme weather events such as flooding continue to challenge the resilience of cities. It is imperative that local governments strengthen their early warning systems in order to protect their communities and avoid overwhelming their disaster management capabilities. Fortunately, recent advances in remote sensing, artificial intelligence, and information technologies, in combination with crowdsourced information from social media are leading to significant changes in the mechanisms of flood early warning systems (FEWS).	Disaster resilience Flood management	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		No
Real-time air quality information	Installation of sensors to detect and monitor the presence of air pollution (outdoor, indoor, or both) in real time. Individuals can view the information online or on a personal device and choose to modify their behavior accordingly. Further, a city operations center can monitor air quality and take actions accordingly. By making the air visible, governments can identify land-use, traffic, and clean air zone policies that can improve the air and measure their effectiveness – being more responsive and transparent to constituent needs with sustainability planning.	Air quality	Analytics Data management Sensors and controls	America – Richmond Shair app	Yes

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Smart Environment					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Noise Control Systems	Installation of sensors to detect and monitor the noise in real time. A city operations center can monitor noise pollution and noise levels and take actions accordingly – being more responsive and transparent to constituent needs with sustainability planning.	Noise control	Analytics Data management Sensors and controls		Yes
Groundwater mapping	Using an airborne electromagnetic method with the purpose of offering a cost-effective way of mapping the sub-surface while preserving a precision which is equal to or better than ground-based systems. Obtaining information on aquifers and hydrogeological properties, e.g., groundwater recharge or saltwater encroachment.	Ground water	Ground water		No
Water quality monitoring of mains, rivers, oceans, etc.	Monitoring of water quality in real time (in mains, rivers, oceans, etc.) in an online database with e.g., alerts delivered to the public via channels such as mobile app, email, text, or website. The knowledge base will prove invaluable to stakeholders in effective water management. Reliable, real-time water quality data from multi-parameter low-cost sensors can be equipped on 'smart' boats which could be called 'floating labs'.	Water resources Water quality	Analytics Cloud Data management Sensors and controls	Singapore - SWAN	No
Chemical leakage detection	Detect in real-time leakages and waste in rivers and in the sea derived from e.g., factories	Water, Air, Soil quality	Analytics Cloud Data management Sensors and controls		No
... Other monitoring systems; soil quality, water leakage, sewage system monitoring, radiation level, ozone monitoring, etc.					
IoT sensor technologies for reporting of environmental data	Using IoT sensor technologies to automatically report and report tractability of performance of assets by obtaining environmental data. Sensor data can also be combined with cloud-based analytics to evaluate performance of sustainable management techniques e.g., for storm water or water quality.	Water quality	Analytics Cloud Data management Sensors and controls		No
Big data analytics and AI for business intelligence and environmental data	Big data analytics and artificial intelligence for visualizations of business intelligence and insights, operational efficiency, identification of low-cost options, and to report tractability of performance of assets by obtaining environmental data on water quality.	Water quality	Analytics Cloud Data management Sensors and controls		Yes

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Table continued

Smart Water					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Behavior-based transparent water consumption tracking	Provides feedback (via mobile app, email, text, etc.) on a resident's water consumption to increase awareness and reduce consumption.	Civic engagement Water consumption	Analytics Broadband access Cloud Data management Sensors and controls Privacy Security		Yes
Intelligent water management systems using AI and IoT	Sustainable water management in urban areas requires an integrated approach to ensure that the management, development and utilization of water resources, water infrastructure and water/wastewater treatment satisfies socio-economic, environmental, sustainability and multi-sectoral water demands. Intelligent water management systems are using sensors to track e.g., water levels and rainfall to predict flooding events, which can automatically control sluice gates, etc.	Water consumption Water management	Analytics Cloud Computing resources onsite Data management Sensors and controls	Australia – Sydney Water Australia – Melbourne Water	Yes
Agent-based modeling for water management	Agent-based modeling coupled with tangible interface to aid in the decision-making process of water management in an area. Explore water irrigation systems with hydrological modeling and agent-based modeling.	Water management	Analytics Data management	Vietnam – Red River Delta	Yes
Biogas sludge and waste system	Digestion of wastewater treatment sludge to biogas. System can be further developed to include co-digestion of organic waste, e.g., from kitchens, restaurants, food markets, etc.	Wastewater utilization	Analytics	China – Beijing	Yes
Eco-digesters for convert solid organic waste to reusable water	Installation of a wholly self-contained disposal system able to convert solid organic waste to reusable water.	Solid waste management	Analytics	Phnom Penh	Yes
Smart drainage to detect blockage or clogging	Installation of sensors to detect blockage or clogging inside underground drainage channels, indicating the exact area and place of problem. Sensors also allow monitoring of water flow data, so that the control center can open, and close drainage channels as needed.	Water management	Analytics Cloud Computing resources onsite Data management Sensors and controls		Yes
Leakage detection and control of water pipes	Monitoring of pipe conditions from a remote location using sensors, and control of pump pressure to reduce or prevent water leakage. The early identification of leaks can prompt follow-up actions from relevant city departments and utility companies.	Water management	Analytics Cloud Computing resources onsite Data management Sensors and controls		No

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Smart Water					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Smart meters to monitor usage patterns of water, etc.	Installation of sensors to monitor usage patterns of water, including remote/ automated control in certain instances.	Water management	Analytics Cloud Computing resources onsite Data management Sensors and controls		Yes
Customer engagement with water usage and service through web-based costumer service.	Improving overall customer experience involves both transparent engagement and the delivery of cost-efficient, reliable services. Sharing data and data insights with customers could help to build trust even if the utilities share information not favorable to utility operations, such as water quality issues. Costumers will eventually start to become aware of the work and effort to provide clean water and start to value water as the life source of society.	Civic engagement Water management	Analytics Broadband access Cloud Data management Sensors and controls		No
Customer engagement with water usage and service through web-based costumer service.	Improving overall customer experience involves both transparent engagement and the delivery of cost-efficient, reliable services. Sharing data and data insights with customers could help to build trust even if the utilities share information not favorable to utility operations, such as water quality issues. Costumers will eventually start to become aware of the work and effort to provide clean water and start to value water as the life source of society.	Civic engagement Water management	Analytics Broadband access Cloud Data management Sensors and controls		No
Remote sensing using water metering and satellite imaging for leakage detection	Remote sensing using water-metering sensors for monitoring, smarter control and online simulation and/or using satellite imaging and drones for efficient leak detection to make informed and optimized decisions. A supervisory control and data acquisition (SCADA) control system can be used to enable a reliable online monitoring of leakages. A SCADA system combined with an online hydraulic modeling system can ensure a continuous real-time overview of the state of the distribution system for online monitoring, planning, design and optimization activities.	Water management	Analytics Cloud Computing resources onsite Data management Sensors and controls	Australia	No
Climate information portal	When designing infrastructure and buildings for the long-term, in many climatic zones it is necessary to take projected climate change effects into account when looking at weather statistics and storm return periods derived from historical weather records.	Climate resilience	Analytics Cloud Data management		No

Continued on next page

Table continued

Digital Smart City Solutions	Short Description	Key Priorities / Challenges	Enabling ICT & Digital	Use cases	Possible Modular Implementation
Smart Water					
Heat island management	A virtual 3D city model with sensor feeds and analytics for wind flow, temperature and solar radiation, to provide a detailed map of a city's climate over time. Allows to map and visualize the climate impact and heat patterns of an entire city and identify problematic areas, where the heat gets too intense and can cause heat stress. Visualize future scenarios to get detailed insights on where to focus efforts of mitigation, and on how intense the mitigation needs to be to make a real impact on the urban climate. Test different mitigation strategies and quantify the efficiency.	Climate resilience	Analytics Cloud Computing resources onsite Data management Sensors and controls	Philippines – GUHeat GIS tool Denmark - Copenhagen	Yes
AI powered monitoring platform to spot signs of erosion, contamination and hydrologic issues	Characterize the whole city or site with AI-powered platform to analyze health, growth, and distribution of vegetation from an aerial and satellite imagery to spot signs of erosion, contamination and hydrological issues. Reporting should show if, where and how the city site is deteriorating, including recommendations for what to do next.	Climate resilience	Analytics Cloud Computing resources onsite Data management		Yes
Digital twin for production insights	Use artificial intelligence with human interaction to enable a digital twin to accumulate farmer's real-time production knowledge and to provide intelligent, adaptive and dynamic facilities management and farming decision-making suggestions	Farming production transparency	Analytics Cloud Data management Sensors and controls		Yes
Smart Government					
Public engagement in city affairs using digital municipal apps	Use of digital apps to encourage public engagement in city affairs. May include reporting non-emergency nuisances and maintenance needs, e.g., reporting on trash via a municipal app, giving input on policy decisions, participating in digital city initiatives, such as open data hackathons, and interaction with city officials and departments on social networks.	Civic engagement	Analytics Broadband access Cloud Data managemen		Yes
Reimbursement system for welfare payments	Development of a digital solution, an algorithm, that calculates and transfers actual funding, and furthermore establishes a municipal framework for management information. A detailed script of how all legislative provisions must be translated into an IT system, including how all business rules, methods and information needs can be incorporated.	Welfare payments	Analytics Data management Security		No
Digital twin model of city with stored data feeds and cloud analytics for transparent city performance and operations	A digital city twin is a digital model of a city. It collects information (via sensors, drones or other IoT and Industrial IoT tools) and applies advanced analytics, machine-learning and artificial intelligence in order to receive real-time insights about the city's performance, operation or profitability.	Digital twins	Analytics Cloud Computing resources onsite Data management	Singapore – Virtual Singapore France – Rennes Metropole Finland – Helsinki Virtual tourism Denmark – Copenhagen city climate digital twin	Yes

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Smart Government					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Smart waste management platform for all city stakeholders	A flexible, process-oriented, internet-based tool that might serve as a platform for all involved stakeholders: the local authority, its staff members, residents, the business community, non-governmental organizations, waste management companies, etc.	Solid waste management	Analytics Broadband access Data management		Yes
Demand-based waste collection with smart bins	Installation of solar-powered smart bins for general waste and recyclables; incorporates sensors that alert waste collection operators when capacity limits are reached. This application keeps garbage trucks from traveling to trash bins with little waste volume.	Solid waste management	Analytics Cloud Data management Sensors and controls		Yes
Digital land-use and building permitting	Digitization and automation of the application process for land-use and construction permitting, reducing approval time and increasing transparency.	Digital government	Data management		Yes
Open cadastral database, and visual mapping	Provide a complete database of land parcels in the city, open to the public; enables a more efficient land market by creating transparency of available land and lowering the cost of land parcel registration	Digital planning	Data management		Yes
Open source geospatial data	Easily accessible GIS data to support for planning and design of rapidly developing towns, cities and regions, but also for universities and education institutes to do research.	Digital planning	Data management	Indonesia – KSP Geoportal Vietnam – Vmap India – Gram Manchitra Singapore - OneMap	Yes
Smart 3D visual city master planning	Smart 3D planning systems allow city planners to simulate, test, and validate multiple planning scenarios with only a few clicks. They have become an invaluable tool to create compelling new Masterplans, easing the workload of city planners by automatically flagging any local regulations or land use conditions that were not met during the design process. 3D visualizations of planned changes in the city landscape is also a powerful way to communicate and present solutions to stakeholders who stand to benefit from these proposed developments.	Digital planning	Analytics Computing resources onsite Data management		Yes
Customer service robots operating independently in people-facing situations	Deployment of robots equipped with natural language processing and capable of operating independently in people-facing situations at government bodies to increase productivity and improve experience.	Automated robot services	Computing resource onsite		Yes

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Smart Government					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Digital business licensing and permitting through online platform	Switch to digitized process, such as an online portal, for businesses to obtain operating licenses and permits.	Digital planning	Broadband access Cloud Data management		No
Digital citizen services via online platform	Digitization of citizen-facing government administrative services such as income tax filing, car registration, and applying for unemployment benefits. Includes digitization of the user journey as well as back-end support functions as needed.	Digital government	Broadband access Data management Privacy Security	Singapore - Singpass	No
E-Procurement through online platform	Business-to-business, business-to-consumer or business-to-government purchase and sales of supplies, work, and services through an online platform.	Digital government	Broadband access Cloud Data management Privacy Security		No
Digital business tax filing	Creation of channel for businesses to complete tax filing online.	Digital government	Broadband access Cloud Data management Privacy Security		No
Mobile Pay and cashless transaction for strengthened inclusion and digital economy	Hands-free ticketing through QR coding of ticketing and payment systems. Development of new methods for tariff restructuring for consumer payment of utilities such as solid waste, water and sewerage. Mobile Pay could be a strong solution to accelerate cashless payments. Many people, especially the poor and communities in rural and remote areas, are left out of the formal financial system. This means that they cannot access official banking services. Mobile Pay enables people to access services and pay bills through online platforms. Mobile Pay would also lead to creation of businesses in the field of digital economy and technology start-ups.	Digital payments	Broadband access Cloud Data management Privacy Security	Vietnam – Mobile money and cash-less transactions Malaysia – Cyberjaya Indonesia – QR-EDC New Zealand – Cashless parking meters	No
Robotic Process Automation to automate repetitive processes	Robotic Process Automation (RPA) is technology that allows anyone today to configure computer software, or a "robot" to emulate and integrate the actions of a human interacting within digital systems to execute business processes.	Automated digital government processes	Cloud Data management Privacy Security		Yes

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Table continued

Digital Smart City Solutions	Short Description	Key Priorities / Challenges	Enabling ICT & Digital	Use cases	Possible Modular Implementation
Smart Government					
Blockchain in waste disposal, recycling, etc.	Implementation for incentivization of waste disposal, recycling, etc. This can also be used to enable e-government, particularly in areas with high corruption.	Solid waste management	Cloud Data management Privacy Security		Yes
Digital tracking and payment for waste disposal	Installation of digitally enabled pay-as-you-throw systems. Such systems provide feedback to users which increases awareness and reduces waste.	Solid waste management	Broadband access Cloud Data management Privacy Security		Yes
Asset management using GIS combined with structured data	Having every asset recorded within a GIS system with structured and unstructured data from departments such as finance department for actionable insights to decrease costs and risks and strengthen interlinking of business planning functions.	Digital planning	Data management		Yes
Expanded Cost-Benefit Analysis tool to compare proposed Masterplans with investment plans etc.	A Cost-Benefit Analysis (CBA) tool can be an important tool in order to compare proposed Masterplans (e.g., blue-green Masterplans) with existing investment plans. Existing investment plans will constitute the baseline for the CBA.	Digital planning	Analytics Data management	New York City	No
Smart Economy & Job					
3D printing of low-cost housing	Assembly of components of a structure in a factory or other manufacturing site and transporting complete assemblies or subassemblies to the construction site for quick setup.	Construction optimization	Computing resources onsite		Yes
Augmented reality and virtual reality for effective maintenance and training	Augmented reality and virtual reality can be used at utilities for optimized maintenance and training of staff for specific repairs.	Construction optimization Construction safety	Computing resources onsite		Yes
Local e-career center online platform for job openings	Creation of online platforms for posting job openings and candidate profiles. May use algorithms to match compatible candidates with available jobs. Reduces job-hunting time and increases net new employment.	Digital labor market	Broadband access Cloud Data management Privacy Security	India – NCS portal	No
Online digital platform for young students and women with mentorships in start-ups	Providing mentorships through online platforms to upskill and empower young students and women to harness the full potential of digital platforms and tools to learn new ways of doing business and explore and connect with domestic and international markets.	Digital labor market	Broadband access Cloud Data management Privacy Security	India – GOAL program	No

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Digital Smart City Solutions	Short Description	Key Priorities / Challenges	Enabling ICT & Digital	Use cases	Possible Modular Implementation
Smart Economy & Job					
Peer-to-peer accommodation platforms for citizens to rent out homes	Creation of digital marketplaces where individual hosts can list and rent out short-term accommodations.	Tourism	Broadband access Cloud Data management Privacy Security		No
Smart Education					
Personalized education	Use of student data to identify individuals who need additional attention or resources; potential to tailor learning environments for individual students.	Digital education	Broadband access Cloud Data management Privacy Security		Yes
Gamification of education in disaster events	Visual education of behavior in disaster events like COVID-19, volcano outbreak, bush fires, cyclones, etc.	Disaster management	Broadband access Cloud Computing resources onsite Data management		Yes
E-Learning and virtual learning	Schools and universities demand settings that promote learning and attract students and staff. Online e-learning is an innovative way of engaging with students. The COVID-19 situation and future similar situations makes e-learning very relevant for all universities around the world.	Digital education	Broadband access Cloud Computing resources onsite Data management	Broadband access Cloud Computing resources onsite Data management	Yes
Gamification connecting labor market and students	E-learning modules using gamification can be an excellent way of simulating internships and teaching students' skills and behavior for better job matchings. This must always be based on the local context with research on university, job market and students' needs.	Digital education	Broadband access Cloud Computing resources onsite Data management		Yes
ICT & digital capacity of teachers through online training	Capacity building sessions such as webinars aim to help educators become familiar and comfortable using ICT & digital-enabled education services.	ICT & digital capacity building	Broadband access Cloud Computing resources onsite Data management	Philippines	Yes

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Digital Smart City Solutions	Short Description	Key Priorities / Challenges	Enabling ICT & Digital	Use cases	Possible Modular Implementation
Smart Education					
Interactive rooms	Rooms that facilitate effective exploration of the interactivity of teamwork with interactive white boards, virtual reality headsets, computers and other cutting-edge information and communication technologies.	Digital education	Broadband access Cloud Computing resources onsite Data management		Yes
Interactive workspaces	Online workspace designed for students to work, learn and play.	Digital education	Broadband access Cloud Computing resources onsite Data management		Yes
Online retraining programs	Delivery of lifelong learning opportunities through a digital format, especially to help individuals, who are unemployed or at risk of becoming unemployed, gain new skills.	Digital education	Broadband access Cloud Data management		Yes
Smart Health					
Data-based public health interventions for maternal and child health	Use of analytics to direct highly targeted health interventions for at-risk populations (in this case, identifying expectant and new mothers to drive educational campaigns about pre- and post-natal care).	Vulnerable groups of society	Analytics Data management		Yes
Data-based public health interventions for sanitation and hygiene	Use of analytics to direct highly targeted interventions, such as understanding where to increase rainfall absorption capacity or collecting crowdsourced data on gaps in sanitation systems.	Health care resilience	Analytics		Yes
Infectious disease surveillance	Implementation of data collection, analysis, and response to prevent spread of infectious and epidemic diseases. Includes awareness and vaccine campaigns (for example, for HIV/AIDS). Integrated patient flow management systems with real-time hardware and software solutions that provide visibility into where patients are in the system to improve hospital operations and coordinate utilization on a city or multiple-facility level.	Health care resilience	Analytics		Yes
Lifestyle wearables to collect data and promote healthy lifestyles	Public dissemination (free or subsidized) of wearable devices that collect data on lifestyle and activity metrics and inform the wearer; may promote exercise or other aspects of a healthy lifestyle.	Health care resilience	Analytics Cloud Data management Sensors and controls Privacy		Yes

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Smart Health					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Big data for disease & COVID-19 tracking	Governments must be able to observe and predict when, where, and how diseases are spreading to be able to set up efficient safety measures toward disease outbreaks. By using digital tools and technologies, governments have efficiently applied big data analytics and artificial intelligence (AI) to analyze spread patterns in the urban landscape. New data sources serve as timely indicators, and citizens' input has proven to be an efficient new way of collecting data through apps and websites.	Health care resilience	Analytics Cloud Data management Sensors and controls Privacy		No
Automated robotics for optimized operation of hospitals	Logistics play a vital role in smooth and efficient operation of a hospital. Automated Guided Vehicles (AVG) systems automate a lot of the logistic tasks at a hospital. AVG systems are combined with automated storage, washing functionality for transport trollies and for the transport of beds.	Hospital logistics	Computing onsite Sensors and controls	Denmark – Automated guided vehicle systems	Yes
First aid alerts and online CPR training	Deployment of technologies that alert bystanders trained in CPR so that cardiac arrest victims receive prompt and critical care, e.g., mobile applications.	Health care resilience	Analytics Broadband access Cloud Data management Sensors and controls Privacy		Yes
Online care search and scheduling	Deployment of digital tools that assist in selecting payees and providers with financial and clinical transparency, especially through online platforms.	Health care resilience	Analytics Broadband access Cloud Data management Privacy		No
Remote patient monitoring and telemedicine	Use of technology, including audiovisual communication, and devices to monitor vitals in order to receive healthcare and interact with physicians remotely, outside of a healthcare facility or in a different location from the healthcare professional. Includes medication adherence technologies that assist patients in taking medications as recommended by their healthcare provider.	Health care resilience	Analytics Broadband access Cloud Data management Privacy	Malaysia – My Seiahtera Thailand - TUH	No
Healthcare apps for citizens to input health status	Ministries and industries have been applying information technology in their daily operations and administrative procedure handling. New online applications are used by citizens to input their health status. Apart from collecting valuable data for the healthcare system to handle emergencies, it can be a useful channel to deliver all formal medical notices and announcements to citizens related to pandemics such as COVID-19.	Health care resilience	Analytics Broadband access Cloud Data management Privacy	Vietnam – Ncovi mobile app	No

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Smart Society & Culture					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Online citizens engagement platform for input to help the city prioritize which public services should be digitized	An online poll or survey to identify how citizens rank their priorities for the digital future of the city. The contributions from the online poll will act as a basis for the discussion and development of an inclusive and participatory digital strategy for the city.	Civic engagement	Broadband access Data management		Yes
Crowd management using sensors	Utilization of RFID, sensors, drones, and social media to monitor and direct crowds to ensure safety	Community safety	Analytics Cloud Data management Privacy Security		Yes
Connection and meetups with community mobile apps	Promotion of connection and potential meetups within a community through websites or mobile apps. Potentially used to find people with similar interests and hobbies, to connect with neighbors and social events, etc.	Social inclusion	Broadband access Cloud Privacy Security		Yes
Free public Wi-Fi	Offering free Wi-Fi to citizens and tourists makes the urban experience more enjoyable.	Tourism Digital maturity of citizens	Computing resources onsite Fiber		Yes
Multifunctional smart city poles	City poles with flexible LED light arms, provision to fit Wi-Fi antennae, environmental sensors and emergency announcement system, provision for surveillance cameras, provision for electrical vehicle charging, water resistant cabinet rack to support battery bank, power bank, base transceiver station, flexible to host multiple cellular operators, provision for billboard, etc.	Community safety	Computing resources onsite Data management Sensors and controls		Yes
Smart streetlights	Installation of sensor-equipped and connected energy-efficient streetlights (including LED) that optimize brightness and reduce maintenance needs. Smart streetlights can be equipped with speakers, gunshot detection sensors, and other features to enhance functionality.	Community safety	Computing resources onsite Data management Sensors and controls		Yes
Connection and meetups with community mobile apps	Promotion of connection and potential meetups within a community through websites or mobile apps. Potentially used to find people with similar interests and hobbies, to connect with neighbors and social events, etc.	Social inclusion	Broadband access Cloud Privacy Security		Yes

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Smart Safety					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Data-driven building inspections	Incorporation of data collection and data analytics in building inspections to focus on buildings with the greatest potential risks.	Safety	Analytics Computing resources onsite Data management		Analytics Computing resources onsite Data management
Emergency response optimization	Deployment of in-home/in-vehicle sensors, GPS, and other devices to collate data and use analytics and technology to optimize emergency response call processing and field operations, such as the strategic deployment of emergency vehicles.	Emergency response	Analytics Data management Sensors and controls Security		Yes
Predictive policing using big data analytics in police systems to predict crimes	Deployment of big data and analytics (including social media monitoring) in police stations and systems to predict where and when crimes are likely to happen with greater precision. These systems are used to deploy police patrols and target prevention efforts.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Real-time crime mapping to map, visualize and analyze crime incident patterns	Development and adoption of technology used by law enforcement agencies to map, visualize, and analyze crime incident patterns. Information and intelligence gathering serves as a management tool for allocating resources effectively and creating accountability among officers.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Smart surveillance to detect anomalies	Integration of intelligent monitoring to detect anomalies based on visual feeds including facial recognition, smart closed-circuit TVs, and license plate recognition.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security	Malaysia – Penang's facial recognition Singapore – high-tech robot guards	Yes
Drone-enabled construction surveys	Survey and inspection of difficult and inaccessible terrain by overlaying civil engineering plans with 3D models to track progress of civil works and to track movement of critical equipment, etc.	Construction safety	Analytics Sensors and controls		Yes

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Smart Safety					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
IoT-enabled construction site	Incorporation of a network of sensors into physical devices and equipment used in construction sites to allow connectivity and exchange of data. Equipment monitoring (predictive maintenance), smart structures (e.g., sensors to test strength and reliability of structure), GPS tracking (to track materials and trucks), electronic time logs, etc.	Construction safety	Analytics Cloud Computing resources onsite Data management Sensors and controls		Yes
Body-worn cameras by police officers to record incidents and police operations audit	Utilization of wearable audio, video, or photographic recording systems by police officers to record incidents and police operations for audit.	Police safety	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Gunshot detection with real-time acoustic surveillance technology	Implementation of acoustic surveillance technology that incorporates audio sensors to detect, locate, and alert police agencies to gunfire incidents in real time.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Personal alert services technologies for personal safety	Development of applications that respond to emergencies by alerting emergency response services, loved ones, or both. Devices (such as personal safety wearables, car crash detectors, and fall alert systems) may transmit location and voice data.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes
Safe spaces for women and children in urban landscape with transparent GIS-based apps	GIS based app with real time location service to provide information on local services, safe spaces and women's support services.	Emergency response	Analytics Cloud Computing resources onsite Data management Sensors and controls Privacy Security		Yes

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Smart Safety					
Digital Smart City Solutions	**Short Description**	**Key Priorities / Challenges**	**Enabling ICT & Digital**	**Use cases**	**Possible Modular Implementation**
Automated cleaning robotics	Robots can be applied in heavily crowded places in the urban landscape such as in trains to clean surfaces in more frequent intervals than with manual cleaning. By automatically spraying hydrogen peroxide solution that is atomized to a specific concentration, a Robot can ensure that disinfectants penetrate in the small gaps that are difficult to reach during normal cleaning work.	Safety	Computing resources onsite	Hong Kong – VHP Robot	Yes
Online support network with virtual chat for women to share ideas and experiences	An online support network to encourage women, local businesses, etc. via virtual chat to share ideas and experiences during the coronavirus pandemic, or other events.	Women inclusion Start-up	Broadband access Cloud Data management Privacy Security	Australia – Victoria COVID-19 online chat room for rural women	Yes

Source: ASEAN Australia Smart Cities Trust Fund (AASCTF).

Photo: Envato Elements

ABOUT THE ASEAN AUSTRALIA SMART CITIES TRUST FUND

The ASEAN Australia Smart Cities Trust Fund (AASCTF) assists ASEAN cities in enhancing their planning systems, service delivery, and financial management by developing and testing appropriate digital urban solutions and systems. By working with cities, AASCTF facilitates their transformation to become more livable, resilient, and inclusive, while in the process identifying scalable best and next practices to be replicated across cities in Asia and the Pacific. The Trust Fund is supported by the Australian Government through the Department of Foreign Affairs and Trade (DFAT), managed by the Asian Development Bank (ADB) and implemented by Ramboll.

ASEAN AUSTRALIA SMART CITIES TRUST FUND
Asian Development Bank

Australian Government
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ADB