Smart City Handbook:
Thailand

UK Government

depa

Background

This Handbook was commissioned by the UK Foreign, Commonwealth and Development Office (FCDO), as a complimentary research to the Prosperity Fund's Global Future Cities Programme (GFCP). The Prosperity Fund is a major UK government initiative announced in 2015. It contributes significantly to the United Nations Sustainable Development Goals (SDGs) and implementation of the New Urban Agenda. It is guided by the UK Aid Strategy objective of helping promote growth and prosperity in developing middle-income countries. The countries in which the Prosperity Fund operates offer great opportunities for creation of mutually beneficial partnerships, and for the growth of businesses and trade relationships.

THE UK PROSPERITY FUND & GLOBAL FUTURE CITIES PROGRAMME

The Global Future Cities Programme is a three year official development assistance programme.

The programme will support inclusive and sustainable urban economic growth and increase global prosperity through targeted interventions on transportation, urban planning and urban resilience in ten countries worldwide (Brazil, Indonesia, Malaysia, Myanmar, Nigeria, Philippines, South Africa, Thailand, Turkey and Vietnam).

GFCP in Thailand is being implemented in partnership with the Bangkok Metropolitan Administration (BMA). The activities will support existing objectives and projects in the city, while building the capacity of BMA teams and establishing models which can be replicated and up-scaled. Ongoing activities include:

Integrated Data Centre - Roadmap

Designing, and developing a road map for implementation, of a world-class data centre shaped to the specific requirements of Bangkok. The BMA data centre will inform and enable integrated, sustainable, future-focused and responsive city planning & management.

Decision Support System for Flood Management

Optimising the impact of the BMA's flood management strategy and related infrastructure investments, by supporting introduction of an effective and responsive decision-support system (DSS) and building the capacity of relevant teams to ensure that the DSS is effectively operationalised.

Transit-Oriented Development Plan (TODP) : Khlong Bang Luang and Bang Wa BTS station

Assisting BMA in the preparation of a TODP for Khlong Bang Luang and Bang Wa BTS station, which has been identified as a priority development area by BMA and other stakeholders. This TOD will help demonstrate how the government's investment in enhanced transport access and connectivity, can drive inclusive economic planning and sustainable development.


THAILAND

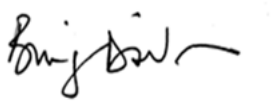
Foreword

Brian Davidson
HM Ambassador to Thailand

Cities are growing at an unprecedented pace. More than half of the world population already lives in urban areas. The proportion is forecast to increase to 66% in 2050. Within Asia alone, this is equivalent of adding an entire new city of 3 million people, more than half the size of Singapore, every month for the next 30 years. Unless cities are well planned and managed, urbanisation exacerbates poverty, overcrowding, congestion, pollution. Public services quickly become inadequate and inaccessible. With two thirds of the world's population due to live in cities by 2050, the UK Government believes resolving the challenges of our cities is critical to resolving the issues of our future including climate change, health, resource depletion, poverty and waste.

UK cities have been working for decades to tackle these new urban issues. While the journey is ongoing, we are keen to share our experiences and to learn from other countries. In Thailand, we are working in partnership with Bangkok Metropolitan Administration (BMA), under our Prosperity Fund's Global Future Cities Programme, to support projects on establishing the city's integrated data hub, using data to inform flood management policy and on Transit-Oriented Development Plan (TODP).

Urbanisation creates many challenges, but it also presents opportunities to improve people's lives. In addition to the work already underway in our Global Future Cities Programme, I believe there are other areas where we can work with Thailand. I hope this handbook will raise awareness of these opportunities and start conversations that lead to more collaboration between our two countries.



Brian Davidson
HM Ambassador to Thailand

Dr. Nattapon Nimmanpatcharin
President/CEO Digital Economy
Promotion Agency (depa)

In the Thailand 4.0 and Digital Economy Framework, 'Smart City' is the key umbrella both in promoting the innovation industry and supporting the rapidly changing society. In this context, the Digital Economy Promotion Agency (depa) is 'the hub' in the development of both digital manpower and technology, including standards, regulations and guidelines in materializing smart cities.

Smart cities are citizen-centric. Contrary to some popular perceptions, smart cities do not always have to be ultra-high-tech. Instead, smart cities prefer 'practical technology' that fosters people's wellbeing and livelihood. The key to a successful building of smart cities, therefore, is the understanding of the demands and needs of residents 'from within.'

As the hub, depa connects the central and local governments, private sectors including startups, academic and research institutions, and external partners in both the ASEAN region and beyond. Currently, more than 40 cities are being promoted by depa and we welcome the support of our partner the British Embassy of Bangkok in facilitating this fruitful dialogue among our partners through this Smart City Handbook: Thailand.

Dr. Nattapon Nimmanpatcharin
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Acknowledgments

Smart City Handbook: Thailand would not have been possible without the generous contributions from members across all sectors of Thai society, including stakeholders from both national and local government, private organisations and the research community.

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Thank you to the various public stakeholders that participated in expert interviews and online surveys, including representatives from the National Economic and Social Development Council (NESDC), the Office of Natural Resources and Environmental Policy Planning (ONEP), the Energy Policy and Planning Office (EPPO), Metropolitan Electricity Authority (MEA), the Office of Transport and Traffic Policy and Planning (OTP), the Department of Public Works and Town & Country Planning (DPT), the Office of National Higher Education Science Research and Innovation Policy Council (NXPO), the Office of the Education Council (ONEC), the National Innovation Agency (NIA), the National Science and Technology Development Agency (NSTDA), the Digital Government Development Agency (DGA), the Fiscal Policy Office (FPO), Thailand Board of Investment (BOI), and the Eastern Economic Corridor Office (EECO), as well as Chiang Mai Municipality, Chonburi Municipality, Rayong Municiplaity, Phuket Municipality, Chachoengsao Municipality, Khon Kaen Municipality and Khon Kaen Governor's Office.

Thank you also to the various representatives from Siam Commercial Bank, Federation of Thai Industries, TRUE Digital Park, Magnolia Quality Development Corporation, Life & Living Co., Rayong City Development, Phuket City Development, Khon Kaen Think Tank, and National Charter. Thank you to the researchers that contributed expert opinions from the Thai Green Building Institute, Thailand Development Research Institute, Thammasat University, Chulalongkorn University, Mahidol University, Chiang Mai University, and National Charter.

The project team expresses its sincere appreciation to everyone mentioned above for their invaluable contributions to the successful development of this Handbook.

Urban Studies Lab (USL) is a Bangkok-based independent research institute and consultancy founded in 2018 by a cross-disciplinary team of academics and practitioners.

USL draws on its broad range of experience and expertise in the fields of urban planning & development, architecture & design, community engagement, project management, communications, and the environmental and social sciences, to offer a unique and holistic approach to urban studies and consulting.

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URBAN STUDIES LAB

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Introduction

A Primer on Smart Cities

All around the world, governments and citizens are working towards making their cities ‘smarter’. In every one of these places, people are also asking the question, ‘What is a smart city?’ This chapter provides the basic knowledge about smart cities you need in order to start building cities of the future, especially in Thailand.

What is a Smart City?

Cities have evolved over time and will continue to do so in perpetuity. In this light, the smart city should not be considered an end state that is easily attained. In fact, building the smart cities of the future will take time. A lot of time. And just as our cities are always evolving, so too will the 'smart' aspects of our cities need constant updates and attention.

If there is one simple way of understanding the smart city, it is that becoming 'smart' is the next logical step for cities to take in the context of emerging technologies and what we can do with them.

Another important aspect of describing the smart city is that, in most parts of the world, smart city projects are very rarely happening at the complete city scale. You may be involved with the entire city, country or region, but more likely you will be working at the district, campus, neighbourhood, or even building level.

However, these projects should be guided by a holistic vision of the city, and that is where this handbook can help.

Just as every city is made up of its own unique, constituent parts, every city should have its own, unique way of defining the smart city. So, while you won't find a single definition put forth by this handbook, what you will find in this chapter are some important guiding principles and universal truths that should be considered when planning and developing the smart city.

DEFINITIONS OF A SMART CITY

Researchers and practitioners around the world that have been working on the smart city concept for years have come up with their own definitions.

Looking at how others define 'smart city' can be useful for understanding a basic pattern of thinking about it, and can serve as a good starting point for others to approach their own smart city development projects and strategies.

"[A city] that uses information and communications technology (ICT) to enhance livability, workability, and sustainability...[done by] collecting, communicating and 'crunching' [data]"

- Smart Cities Council -

"[A city] characterised by the integration of technology into a strategic approach to sustainability, citizen well-being, and economic development"

- Navigant Research -

"[A city that] leverages digital organisational principles, tools and innovations to...become more sustainable, inclusive, successful and creative."

- The New Digital Deal -

Notice that in all three cited definitions, the definition contains two common characteristics: (1) the application of technology or digital innovation, and (2) the expected benefits they bring to the city.

The specific ways in which technologies are applied in your city, region, country or community will differ from any other. This is necessary because the people, organisations and goals in each city are unique to that time and place.

Similarly, the benefits reaped from applying technology will differ, and should be tied to the specific needs in your city.

For those working to make their city smarter - whether you are a city leader, private citizen, government official, local entrepreneur, foreign investor, or a student or researcher - it's important to take the time to understand your city's priorities, existing assets, and, perhaps most importantly, your potential partners, in order to create your own definition and vision of the 'smart city'.

The Global Case for the Smart City

The motivations for cities to pursue their smart city vision are varied. Each city has its own set of issues that run the gamut from infrastructure to citizen needs that it needs to address. However, there are a number of powerful factors converging at this time that have compelled cities to make their cities smarter.

Rapid and increasing urbanisation It is old news that humankind is now living in the urban age. More than half of the world's population now live in cities, and driven by the economic and cultural opportunities our cities provide, that trend will only continue to grow. The United Nations projects that our cities will need to accommodate an additional 3 billion people by 2050, and that we'll need to create 40,000 new cities in the process.

Growing frequency of disruptions Progress also has a destabilising power. With each step made forward, systems such as cities that were in harmony are often thrown off balance and challenged to readjust themselves to return to the centre. These disruptions come in all forms – societal, environmental, economic, and more. The COVID-19 pandemic of 2020 is a prime example of a major disruption that cities need to prepare for and build resiliency.

Aging and inadequate infrastructure Cities are forever contending with aging infrastructure and meeting the demands of growing population. Underneath the veneer of attractive cities often lay crumbling and outdated utility systems that are not keeping up with developments. Municipalities need to deal with both the overtaxing of utility plants that could lead to outages and as well as leaky systems that are incurring unnecessary additional costs. Cities need smart city solutions to address these existing issues.

Citizen needs and expectations People want to live in places that make them happy, that offer them opportunity, and that allow them to get from home to work without sitting in traffic for two hours. They also have never before seen access to information that lets them see how other cities compare to their own. Simply put, citizens are demanding more from their cities and city government, and part of that is being smart.

Improving capabilities and decreasing cost of technology Fortunately, recent years have seen both the cost of smart technologies decline and their capabilities to make a positive impact in our cities improve. It has now become more feasible than ever before to apply smart solutions to address existing challenges, learn to anticipate future issues, and preempt them with a variety of tactics in order to provide better outcomes for everyone in our cities.

The global market continues to mature As the technologies themselves have become cheaper and easier to use, so has the number of examples of good practices and pool of experienced professionals in smart city services grown and expanded. While the market is still far from full maturity when compared to more traditional markets around the world, cities looking to enact their own smart city strategies and projects now have more support than ever before.

Technavio stated that the smart cities market – interrelated domains that impact urban living – was projected to reach $1.2 trillion USD as of 2019. This represents a massive opportunity for countries like Thailand to build smart cities and usher in a new marketplace that its citizens can partake in. This could stimulate innovation in its citizens. Once the market reaches a certain state of maturity, the quality of life for citizens and the city's economic competitiveness and attractiveness will increase as a result.

Pillars of Success for the Smart City

Though every city's journey towards becoming 'smart' is different, there are some 'universal truths' that have surfaced from the many smart city initiatives and efforts around the world.

Entire books have been written describing how a city can set themselves up for success, regardless of location, culture, or size, rather than elaborating on every detail, this section distills these factors of success down to four essential pillars that provide practical guidance to anyone involved in making a smart city.

SMART INFRASTRUCTURE

Regardless of your smart city needs and goals, successful smart cities must make the necessary investments in open and flexible ICT infrastructures. Smart infrastructure lays the foundations from which service innovation at scale is built upon, and without it, citywide benefits will not be possible. This starts with hard infrastructure, the circulatory system of high-speed internet services, data centres and connected devices (sensors, measuring devices) that allow for the collection and communication of data. Second is the soft infrastructure, or the intelligent operations centres and cloud computing platforms needed to analyse, predict, and present information and deliver services. This is essentially the brain.

Before becoming 'smart', cities must advance a strategy for the development of an integrated smart infrastructure system that allows for interoperability and open access. What this means is that cities must avoid being 'locked in' to proprietary suppliers, and instead develop standards that allow any project to plug in, whether developed by government, business, or citizens. This allows cities to build projects over time while having confidence the pieces will all work together in the end.

OPEN DATA & SECURITY

If infrastructure is the circulatory system, data represents the red blood cells of any smart city travelling through it. The effective use of reliable, secure data from a wide range of sources and systems is what leads to real innovation in service provision. By collecting and analysing data across large numbers of sensors and devices, cities can gain insights that lead to better management of city systems, further enhancing competitiveness, and driving citizen-centric solutions.

In every part of the world, successful smart cities are the ones driven by a focus on transparency and open data, enabling citizens to understand and devise their own solutions, acquire new skills through online learning, and improve their interaction and accountability with public authorities. Cities must work across departments and reach out to businesses and citizens to develop clear expectations and rules around data sharing, privacy and security, allowing information to move seamlessly throughout the city to those that need it.

URBAN GOVERNANCE

Deploying digital transformation on any scale, in particular one as large as a city, requires a new way of thinking about urban planning, management and administration. Successful smart cities move to adapt traditional organisational models, breaking down siloes to focus on improved, shared outcomes for citizens. Technologies themselves are only as effective as the leaders and coordinating entities that put them to work. Strategic vision, cross-institutional partnerships, and new service delivery models are all required to drive a successful smart city.

This new governance structure must include not only members of the city or government apparatus, but also an ecosystem of businesses, academia, citizens, local initiatives, and more. Citizen participation, public-private partnerships, R&D projects, and other innovative partnership models are key to smart cities. Perhaps most importantly, those in charge of coordinating smart city efforts must have at least the basic knowledge of technology choices, funding options, legal and regulatory needs, and should be allowed to operate with a certain level of autonomy to work outside of existing governance structures and bring about change on their terms.

SMART CITIZENS

Though all of these other pillars are critical to the success of smart cities, it all starts and ends with people. Without a citizenry that understands how they may benefit from smart solutions, and that is capable of engaging in the process of building a smart city, there will never be adequate demand for the smart city to be realised.

Considering the degree of complexity involved in introducing advanced technologies to our cities, it can be followed that without the necessary skills and know-how within, not only government, but also the general public, it will be impossible for smart cities to thrive. Because of this, programmes must be put in place to educate and train the critical competencies of data sciences, IT leadership, cybersecurity, enterprise architecture, and others. Fortunately, the smart city sector has a large number of experienced global, regional and local consultants and service providers, especially in less-developed markets like Thailand, there is a critical opportunity to develop partnerships with those that have come before to seek mutually beneficial relationships for building skills and opening up new commercial markets.

A New Marketplace of Opportunity

UNDERSTANDING THE SMART CITY ECOSYSTEM

The smart city is a new frontier for most cities. Even in more mature markets, supply and demand dynamics are still developing. Few cities have progressed beyond pilots or proof of concepts to a fully scaled and integrated smart city system. In cities and countries that are just beginning their smart city journeys, where few standards exist and there are very few, if any, entrenched market players, the path forward often feels risky and unknown. One thing that is clear, however, is the importance of leveraging partnerships and establishing new market mechanisms.

The nature of smart cities requires that many different societal stakeholders be involved, all with their different and evolving roles to play. The following section provides a general overview of the typical stakeholders involved in the smart city ecosystem, and the groups that must be involved in the emerging smart city marketplace.

CITIZENS

For most smart city services and solutions, the citizen is the end user, meaning they create the demand in the smart city market. For smart city projects to be successful, citizens must be involved early and often in the process, and they can often be the source of innovation themselves.

GOVERNMENT

Though government does not need to be the strongest player in the smart city market, their role as facilitator is critical to success. Government is best situated to articulate vision, provide open platforms for collaboration, set regulations, help create standards, and manage data. Government can often be a customer instead of provider for many smart city solutions.

LARGE TECHNOLOGY COMPANIES

With proven technologies and a large-pool of resources, large technology companies are an important player to support the scaling of solutions and to help establish industry standards.

SMALL TECHNOLOGY COMPANIES

Whereas larger companies are less likely to provide disruptive innovation to the market, truly novel inventions most often come from smaller companies, startups and even individuals. A successful smart city marketplace ensures these innovations are magnified, scaled and given market opportunity.

TELECOMMUNICATIONS SERVICE PROVIDERS

Telcos are key to providing connectivity in the system through their national networks of ICT infrastructures.

UTILITIES

Utilities and other providers of essential city services, like water, electricity, waste management and mobility, are central role players in leveraging smart technologies for improved service provision and collection and analysis of data.

DOMAIN-SPECIFIC VENDORS AND ORGANISATIONS

Schools, universities, police, hospitals, transport departments and other domain specific players will need specialised vendors that bring the necessary expertise, data know-how, and solutions to a particular sector.

INVESTORS

Investors of all kinds are needed to support the new business ventures required for the smart city. From startups to long-term infrastructure, it is crucial that investment opportunities are made visible and matched with the right investors.

REGULATORS

Regulators play a critical role in the smart city, and whether a regulating body is fast to reform or stuck in the past can make or break a smart city initiative. Those involved in the smart city must know their regulators.

ACADEMIA & NGOs

Around the world, higher education and research institutions, as well as local and international NGOs, play a key role in inventing, improving, measuring, benchmarking and validating the smart city. These entities often fill the role of mediator, bridging the gap between citizens and government or private stakeholders, and are key to a successful smart city marketplace.

BUILDING THE MARKETPLACE

Smart city projects can be capital intensive and require specialised skillsets that may not be present in the market today. This requires governments to explore new funding models and partnership opportunities, as they cannot go it alone. However, this drastically oversimplifies what it takes to build a robust and mature smart city market.

Building the smart city marketplace requires active facilitation and support, and it requires moving away from government as the primary customer or provider. A mature smart city market will see all of the stakeholders listed on the previous page working together to shape standards, encourage demand, and nurture innovations to prove their value and scale to market.

Most cities are not there, yet, and the learning curve can be steep. However, an important first step is to understand the basic process of fostering the smart city market. For this, we look to a simple model developed by Bas Boorsma in his book *A New Digital Deal: Beyond Smart Cities. How to Best Leverage Digitalization for the Benefit of our Communities*, which shows three interconnected methods needed for market creation: Create, Validate, and Scale.

Fostering a Market, Facilitating Value Creation

The process of building a smart city market is almost never linear, but it should almost always start with identifying community and citizen needs, and designing service innovations based on those needs. In this process of value creation, a particular innovation is given the chance to mature, prove its value, be validated in addressing a presumed market need, and is able to scale.

THE TECHNOLOGIES THAT ENABLE THE SMART CITY

The previous diagram shows how successful smart cities put service design based on citizen needs at the centre of the smart city. This is a point you will find repeated throughout this handbook.

However, 'smart' technologies are a key enabling tool that new services and applications utilise to improve our lives and the world around us. They enable citizens to access and make sense of new information, support the learning of new skills, and improve our communication with authorities and each other. Many uses of technology may not even be visible to us, but they will help connect citizens to a seamless provision of services that make our lives easier, healthier, and more enjoyable.

And just as the nature of every smart city may differ, with varying needs and goals, there are a wide range of technologies and standards, all with unique features and specifications, that can be applied in the smart city. As someone involved in the smart city, t is important to understand the spectrum of technologies and devices you may be using.

The table to the right provides a overview of the common categories of technology used in any smart city.

The actors in the system, Data Analytics & AI, Automation and Blockchain, analyse and act upon the information from the city.	**DATA ANALYTICS & AI** The vast amount of data that sensors other IoT connected devices generate will require data analytics and AI to process it.	**AUTOMATION** Automation allows smart systems to analyse inputs from sensors and the Internet of Things and then take action, sometimes on its own	**BLOCKCHAIN** Though still in its infancy as a technology, blockchain addresses one of the biggest issues affecting smart cities, the security of data flow
The receivers of the data, sensors and the Internet of Things, collect and distribute the data that a smart city needs to operate.	**SENSORS** Sensors are the often hidden but critical components of a smart city. Sensors monitor things like weather, air quality, traffic, and water levels, and can be used to automatically inform services	**INTERNET OF THINGS** The Internet of Things (IoT) is a system of interrelated computing devices, objects, and even people, that are connected to each other so that they can communicate and can take decisions for themselves.	
Location is the unique common denominator upon which each individual or technology is identified.	**GEOSPATIAL TECHNOLOGY** Mapping the city helps make better decisions, and gives meaning to information that would otherwise be difficult to understand. Geospatial technology uses satellite applications and Geographic Information System (GIS) to create, capture, and store geospatial data that can to create collaborative maps that allow citizens, planners, city leaders, and service providers to make more informed decisions.		
The foundation of the smart city, infrastructure, ensures data can move around the city and is securely stored for future use.	**ICT INFRAS-TRUCTURE** The wired and wireless networks that connect all of our devices. Think 5G, WiFi, mobile networks, fibre-optic, and data centres. The fundamentals of the smart city, ICT infrastructure provides the foundation on which all smart city applications are built and enables the fast and secure movement and storage of data of all types. ICT infrastructure ensures that data can move between users and smart city applications and between users themselves.		

Realities of Building A Smart City

A new frontier
While some countries are ahead of others in developing their urban centres, none can claim title as having the perfect smart city. The truth is all cities are constantly experimenting with smart city solutions, reacting to pre-existing problems while anticipating future ones that are entirely dependent on their singular context. Smart city is a new frontier, where actors sometimes travel on the same path and in other moments on parallel ones. The only certainty is that everyone is heading in the same direction towards a broadly defined concept. As such, there is no universal roadmap.

A long road ahead
Before embarking on the smart city journey, cities must take time to do due diligence on themselves. Those who work and reside in them must understand their own state, from resources to capabilities to will. These will impact on how initiation, execution, and maintenance of a smart city will play out. The more well-positioned each piece is, the smoother the journey. Even then, each project that is but a small part of the smart city holistic plan may take years to realise. And by then, pivots will be needed to address relentless changes, be it in technological, political, environmental, societal, and more. To future proof themselves, cities must make sure their plans are neither too rigid nor too nebulous.

Risks of inequality
Ideally, smart city solutions should benefit the entire spectrum of society. However, this will be hard to achieve. Technology tends to only be accessible to those who can afford it at the beginning and thus may exacerbate inequality. Nonetheless, this should not stop cities from pursuing a smart state. Solutions should be designed to be as equitable as possible. The user persona, or rather the full variety of it, must be fully embraced and equalized. This may mean preparing citizens with digital literacy and increasing access to technology required for the usage. Smart city solutions should not be costly for the majority of citizens.

A transient state
A smart city is not an end state. It will not materialise fully formed at the flick of a switch. It is a constantly transient state that is morphed by changes in technology and demands of the times. Cities should not see it as a final evolution, where the job is done once things are implemented. The finish line is always being pushed further out. To take on smart city development is to accept an almost endless stream of projects, each building upon one another and requiring maintenance and updates, and sometimes retirement to make room for a new one.

Inner workings over the veneer
Smart cities are presented as technological utopia with a clean and efficient lifestyle for its residents. This could not be further from reality. Smart city development are more about the inner workings of urban centres and what is unseen to users of solutions. Hard and soft infrastructure on the backend will need to be robust, well-designed, and efficient to be of good use to those on the frontend. A city can remain physically the same, but yet be smarter. Projects should focus on improving both processes and infrastructure that make the cities smart, rather than reaching for an image makeover.

How to Use This Handbook

WHO IS THIS HANDBOOK FOR?

This Handbook is for anyone who is learning to better understand how to approach smart city development in Thailand. Any actor in the smart ecosystem mentioned previously on page 12 would do well by simply using it as a starting point. For **city leaders, planners**, it can augment their decision-making process for digital transformations in cities. For **private companies and service providers**, it can help identify opportunities by anticipating future needs of city users. For **citizens**, it can reveal what is possible, shape demands, and inspire ideas. For **UK companies and organisations**, it can lead to local partnerships that require know-how in the Thailand smart city sector.

WHAT INFORMATION WILL BE FOUND IN THIS HANDBOOK?

This primer on smart city provides the lens by which the rest of the Handbook should be viewed. First, an overview of the UK's own smart city journey and strengths reveal how they can support Thailand's smart city ambitions. Second, a summary of the current state of smart city development in Thailand, the major stakeholders, and mechanisms for building towards smarter cities lay the groundwork for readers. Finally, a look at major smart city initiatives that are ongoing or upcoming in Thailand, in particular Bangkok, identifies commercial and partnership opportunities between Thai and UK stakeholders.

READER INSIGHTS

The light bulb icon highlights key insights into the content on the respective page for readers to take away and refer to in the future.

UK CITY INSIGHTS

The "UK city" icon identifies UK-specific lessons learned, case studies, and partnership opportunities that Thai smart city actors can look into.

THIS HANDBOOK **DOES NOT**

Give the be-all and end-all knowledge

This Handbook does not provide a finality in smart city concepts or developments. It shows the most current and applicable information that can help the reader support smart cities in Thailand. But smart cities move fast, and when compounded by current events, what was once relevant can quickly become outdated.

Prescribe rigid steps and instructions

As stated before, there is no universal definition of a smart city, and therefore there is no universal set of steps or criteria for a city to follow. Each city must identify their own bespoke needs and create a smart city vision and roadmap to meet them. The hope is this Handbook helps inspire you to do that.

Contain an exhaustive list of contacts

While specific entities are highlighted in this Handbook, they are not meant to be exhaustive. This is but the tip of the iceberg of all the actors involved in smart city development in both Thailand and the UK. Readers are highly encouraged to seek further information for entities that would be relevant to their prospective projects.

THIS HANDBOOK **DOES**

Provide foundational understanding

While smart city concepts and developments evolve, the pillars on which they are built will most likely withstand the test of time. The four introduced on pages 10-11 provide the reader with a solid base to reach from and build a robust and value adding smart city plan for their home cities, helping to deal with winds of change.

Encourage critical thinking in planning

This Handbook provides fundamental knowledge base that is meant to support critical thinking in the process of strategising and planning. Readers should use the information provided to reflect themselves and their city's status quo. From there, they can derive the path forward and build a flexible roadmap that is each unique to them.

Urge exploring connections

Almost every entity mentioned in this Handbook is open to exploring potential partnership opportunities. The reader is encouraged to use this Handbook as a resource to build the vital relationships needed to build the smart city. The conclusion of this book provides some next steps and recommendations for building towards collaboration.

Chapter 1

Lessons from the UK

The historic and growing emphasis on smart city development in the UK has made it home to world-leading expertise in the sector, which has brought increased opportunities for investment and export of established knowledge and services around the globe. This chapter summarises how the UK has successfully fostered a mature smart city market, and highlights some of the ways Thailand could benefit from a partner like the UK.

Building the Pillars of Success in the UK

Since the late 1990s, the UK has been at the forefront of digitising government services and promoting the transparency and open use of data at both the national and local level.

This puts the UK two or three decades ahead of most countries in the world in its progress towards smart city development. To be clear, the last decade in the UK has mostly been characterised by pilot projects and a select group of model cities, and it still has much to do in truly achieving its goals.

However, the way in which the government enables innovation in the market, and the active role of cities and the private sector, serves as an excellent model to learn from for Thailand and other countries in the region.

A major part of their success comes from having an integrated approach to infrastructure development, open data and transparency, and coordination amongst the many stakeholders in the smart city sector.

To the right is a summary of how the UK has been a leader in building its pillars of success for smart cities.

SMART INFRASTRUCTURE

Smart cities rely on infrastructure investment and the UK Government is committed to creating the conditions that encourage investment. The establishment of the Technology Strategy Board (TSB) in 2007 (now Innovate UK) helped focus investment and support for cities and businesses to integrate technologies for improved city operations and service delivery.

In 2016 the Government announced a new £400 million Digital Infrastructure Investment Fund, matched by private finance, that will invest in new fibre networks up to 2020. The roll-out of 5G networks was scheduled to start in 2019 with widespread coverage by 2022.

OPEN DATA & SECURITY

In 2010, an emphasis was placed on the improved access to public data, and the Public Sector Transparency Board was established to help drive the Government's transparency agenda, making open data and transparency a core part of all government operations.

In 2012, the Open Data White Paper was published to set out a vision for a truly transparent society, with an emphasis on developing and promoting open data applications that meet citizen needs. Out of this came the launch of the Open Data Institute (ODI), an independent, non-profit partially funded by a £2 million TSB investment.

URBAN GOVERNANCE

City Deals continue the move towards the devolution of power and responsibility from central government to cities and regions, and is one of the most important influences shaping UK smart city agendas. However, UK Government still plays a key role in development of smarter cities. The Government Digital Service (GDS) was established in 2011 to provide support, advice and technical expertise to departments at all levels as new digital delivery models developed.

The Future Cities Catapult (now Connected Places Catapult), established in 2013, facilitated work between businesses, universities and city workers to develop solutions to the future needs of UK cities.

SMART CITIZENS

The UK is committed to developing the skilled workforce and digital competencies in their citizens to see their future cities thrive. 19 universities currently offer postgraduate degrees in Smart Cities and nine universities offer PhD scholarships.

Universities are not only providing research support, but are also often active players in defining projects, securing funding, defining strategies, and contributing to or providing leadership of programmes.

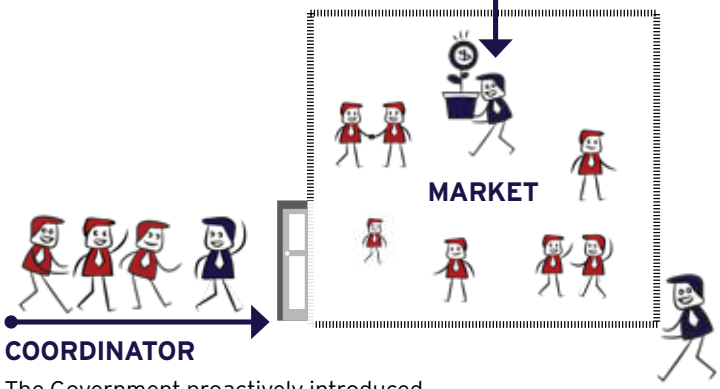
Partnerships with universities prove to be a win-win relationship as universities gain access to real-world big datasets, and build closer bonds with local communities and decision makers.

The UK's Market Making Approach

The UK Government recognised early on that businesses and cities cannot, on their own, overcome the many obstacles facing the establishment and growth of the smart city market. The market was too underdeveloped. It needed major investment in appropriate infrastructure, new regulations, and clear standards to push it forward.

The series of actions seen in the previous section are evidence of an intentional 'market making approach' - one that adheres closely to the principles described in the previous chapter.

On closer inspection, we can observe the UK Government playing three important roles right from the start: coordinator, funder, and regulator.



FUNDER

The UK Government funded testing and piloting of smart city projects and invested in ICT infrastructures that supports them. This moved smart cities projects from ideas to execution quickly without having to wait for private sector investment.

COORDINATOR

The Government proactively introduced organisations to one another and encouraged collaboration where mutual benefits of smart city development were to be found. Cross-sector network building fostered relationships needed to bring smart cities projects to life.

REGULATOR

The UK established one of the strongest regulatory environments for smart city development in the world. With structure and definitions provided, key players can speak the same technical language while operating within well-defined rules.

HOW THE UK GREW THEIR SMART CITY MARKET

Coordinator

In 2013, the government launched Future Cities Catapult (now Connected Places Catapult) with the mission of helping cities, both in the UK and globally, identify their challenges and explore how new technologies could be used to address them. The Catapult improves coordination between cities and the private sector by matching businesses with city employees. Together, they identify the value and potential use of data and collaborate on testing and development of scalable business models to help cities meet their goals and improve the lives of citizens.

Research Councils UK (now UK Research and Innovation (UKRI)), established in 2002, supports the development of new research centres.

Funder

In 2012, the Technology Strategy Board (TSB; now Innovate UK) ran Future Cities Demonstrator, offering £24m to the best proposal, as well as funding for 30 other cities to conduct feasibility studies. And in 2017, the £400m Digital Infrastructure Investment Fund (DIIF) added to a previously invested £1.7 billion to spur industry to develop nationwide superfast broadband.

Regulator

British Standards Institute (BSI) has worked with regulators and other partners to help develop a flexible, clear set of guidelines to look to when developing their own smart city initiatives. These standards have aided cities and businesses in their efforts to access funding, guided public policy and investment strategies, and provided stability to an often uncertain and unstructured sector.

CITIES ARE SET UP TO WIN - FUTURE CITY GLASGOW

Through the purposeful orchestration by UK Government, UK cities have been setup for success. Several have even been recognised in global rankings as some of the most innovative smart cities in the world.

Glasgow, recipient of the £24m *Future Cities Demonstrator* award from TSB (now Innovate UK) in 2013, has since implemented its *Future Cities Glasgow* programme, including a central city management system, and many of the ideas developed in the feasibility studies have been carried forward. The award has been used to fund a series of projects across the city that aim to improve the lives of Glasgow citizens and to establish the city as a centre of urban innovation.

While the *Demonstrator* projects were completed at the end of 2015, Glasgow's smart city development has expanded through the Scottish Cities Alliance, for which Glasgow is leading the Smart Cities Scotland workstream.

Glasgow City Council continues to drive efforts to improve smart city services. Below are just two of the projects that are built off of the momentum with *Future City Glasgow*:

Glasgow Operations Centre is a state-of-the-art integrated traffic and public safety management system. The 'beating heart of the city', the new centre has the capability to provide a co-ordinated, real-time, intelligence-led, response to incidents large and small across the city, placing Glasgow at the leading edge of smart city management.

MyGlasgow is a new and improved citizen app that is opening up data about the city, looking at innovative ways to harness it, and making it discoverable for everyone's use. This two-way communication channel will connect city government with citizens to empower individuals and communities, improve customer service and enhance service efficiency.

Key Players in UK Smart City

Government Digital Service

The Government Digital Service is a unit of the Government of the United Kingdom's Cabinet Office tasked with transforming the provision of online public services and helping government work better for everyone by leading digital transformation.

Ofcom

Ofcom is the regulator for the communications services in the UK. This includes many of the fundamental technologies of smart cities such as broadband, wireless networks and the future roll-out of 5G networks.

ice Institution of Civil Engineers

The Institute of Civil Engineers (ICE) is a professional membership body that works with government and industry to develop skills within the built environment. ICE includes a number of expert panels and knowledge panels who conduct a range of activities from best practice guidance to commenting on government infrastructure policy.

CATAPULT Connected Places

The Connected Places Catapult operates at the intersection between public and private sectors. They convene the disparate parts of the market to help innovators navigate the complexity of doing business, creating new commercial opportunities and improving productivity, socio-economic and environmental benefits for places. Their portfolio of work includes international, non-UK projects, as well.

Department for Business, Energy & Industrial Strategy

The Department for Business, Energy and Industrial Strategy (BEIS) was created in July 2016. The department is at the heart of the government's commitment to deliver an ambitious industrial strategy. It works to maximise the investment opportunities for the UK, promote competitive markets, and ensure the UK has a reliable, low cost and clean energy system.

techUK representing the future

techUK represents the companies and technologies that are defining today the world that we will live in tomorrow. More than 900 companies are members of techUK. Collectively they employ approximately 700,000 people, about half of all tech sector jobs in the UK. Their SmarterUK Programme is the champion for smart infrastructure deployment in the UK and for companies operating in that supply chain. It has been designed to help members develop networks and markets and reduce business costs and risks.

bsi.

The British Standards Institute (BSI) was first established in 1901 and produces technical standards on a wide range of products and services and supplies certification and standards-related services to businesses. BSI enables people and organisations to perform better. They share knowledge, innovation and best practices to make excellence a habit – all over the world, every day.

Innovate UK

Innovate UK is part of UK Research and Innovation, a non-departmental public body funded by a grant-in-aid from the UK government. They connect businesses to the partners, customers and investors that can help them turn ideas into commercially successful products and services and business growth.

BSI for Smart Cities

The British Standards Institute (BSI) was first established in 1901 as the Engineering Standards Committee. Over the previous century, it has extended its work to produce technical standards on a wide range of products and services and supplies certification and standards-related services to businesses. Their mission is to share knowledge, innovation, and best practice to help people and organisations make excellence a habit nationwide. As of 2014, the BSI portfolio now includes a dedicated Smart Cities section.

The UK Department for Business, Innovation and Skills (BIS) commissioned BSI to develop a standards strategy for smart cities in the UK with the intention to accelerate implementation of smart cities projects and provide quality assurance. Subsequently, the Cities Standards Institute was launched: a joint initiative between BSI and the Future Cities Catapult. Inclusive stakeholder engagement processes within the initiative helped identify the challenges, provide solutions, and define the future of smart city standards in the UK.

Since then, a rich body of publicly available standards and guidance documents have been rolled out. Though not legally binding, these unified guidance documents have helped provide a clear starting point that city leaders, citizens and suppliers needed to navigate a then-nascent market. Some have been developed into binding policy documents and integrated into funding instruments.

The BSI standards are widely regarded as an international example of best practice, and have been used to guide international standards and other countrywide documents throughout the world.

BSI SMART CITIES BODY OF KNOWLEDGE

As of 2020, BSI has developed eight guidance and standards documents for smart cities. *PAS 181, Smart City Framework - Guide to establishing strategies for smart cities and communities* details a comprehensive approach to building a smart city, and it has been utilised by many cities and communities throughout the UK and the world.

The overview of this framework can be seen on the following page.

SMART CITIES DEFINED IN THE BSI SMART CITY FRAMEWORK (SCF)

As previously discussed, smart cities have countless facets and one universal definition would be too simplistic and reductive to do them justice. The BSI SCF provides a definition (below), but also includes two important caveats for readers to consider:

"A smart city is an effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens."

"This definition is deliberately presented as a working definition rather than intended as a definitive definition which all cities are to follow. While there is a strong degree of commonality among the smart city strategies that are being developed around the UK, there is also significant diversity. All cities embarking on development of a smart city strategy can define their own reasons for doing so, in their own language [...]."

"This definition deliberately avoids describing a perfect end-state [...]. All cities are different: the historical, cultural, political, economic, social and demographic context for each city is different [...]. So the SCF is not a one size fits-all prescription for what a city might look like in future, but focuses on the enabling processes by which new technologies coupled with organizational change can help deliver the diverse visions for future UK cities."

PAS 181 Smart City Framework - Guide to establishing strategies for smart cities and communities | British Standards Institute (BSI) 2014

PAS 181 focuses on four components as building blocks upon which cities can use to customise their own plans. BSI believes that stakeholders and partners should develop these enabling processes together, namely guiding principles, key cross-city governance and delivery processes, benefit realisation strategy, and critical success factors, all of which can help jumpstart and deliver the diverse visions for future UK cities in more efficient, effective, and sustainable ways.

The robust framework offers depth and breadth in application for smart cities. The universal and flexible nature of it means that any city in the world can learn much from the framework and adopt it partially or wholly as a springboard for their own smart city endeavors.

A. GUIDING PRINCIPLES

At the outset of projects, BSI recommends that the wide range of stakeholders and delivery partners are united by crafting an enduring statement of values. These can serve as steadying force to steer decision-making over the long term. In the process of creating guiding principles with one another, buy-in from all parties is achieved and expectations are aligned.

Four key traits of the guiding principles are:

- Visionary
- Citizen-centric
- Digital
- Open and collaborative

B. KEY CROSS-CITY GOVERNANCE AND DELIVERY PROCESSES

This is a set of practical guidance notes on how to deliver Guiding Principles in practice. City silos are a major obstacle in smart cities development. These notes focus on addressing city-wide challenges of joining-up across city silos in three areas:

- Business management and governance that should be managed at whole-of-city level.
- Citizen-centric service management
- Technology and digital asset management

C. BENEFIT REALISATION STRATEGY

To avoid wasting resources on programmes that does not or cannot deliver what has been promised, BSI recommends proactive benefits management. This documented strategy ensures that the intended benefits of a smart city project are clearly articulated, measured, managed, delivered, and evaluated in practice. Three pillars of this strategy are:

- Benefit mapping, where intended outcomes and clear line-of-sight from activity and investment output flow through to outcomes are set
- Benefit tracking, where current performance by the city is set against target output and outcomes and progress is tracked against success criteria of future vision
- Benefit delivery, where governance arrangements are set for clear accountabilities in delivery and outcome

D. CRITICAL SUCCESS FACTORS

Smart Cities projects face significant risks in delivery. By creating a checklist of critical success factors which a city should regularly monitor, risks can be proactively managed and mitigated effectively, thus increase the probability of project success.

- Strategic clarity
- Stakeholder engagement
- Achievable delivery
- Leadership
- User focus
- Future proofing
- Skills
- Supplier partnerships
- Benefits

Smart Cities in the UK Today

After more than two decades of progress and support towards smart cities, the movement is firmly established in the UK. Recent research suggests that almost a third of the UK's urban areas with populations over 100,000 currently have clear ambitions or substantial programmes labeled as 'smart'. Significant support from the UK Government, and clear policy directives and standards have enabled cities to take the lead.

However, just as no two cities are the same, UK smart cities are developing at their own speeds. Some are international leaders, achieving high ranks in global indexes and providing valuable case studies for others to learn from. Others are still in the nascent stages of forging a vision and engaging the relevant stakeholders to build towards their version of 'smart'.

UK MAKES THE RANKS

IESE Cities in Motion Index 2019	**London #1** **Edinburgh #46** **Glasgow #64**
Roland Berger Smart City Index 2019	**London #2** **Edinburgh #7**

Smart City Leaders These cities are leading the way not just in the UK, but around the world. They have differentiated themselves through the clarity, breadth, and inclusiveness of their smart city vision and planning. These cities have established the advanced infrastructure that can offer testbeds for commercialising new technology, and they are leading the way in implementing significant projects at both the pilot, and increasingly cityscale.

Developing Smart Cities
While these cities have laid down a vision for their smart city endeavours and begun to deploy projects, at least in some areas, execution still trails the vision outlined by a significant margin. These cities may still have major infrastructure needs or planned upgrades, and though they may have shown strong initiative in a few key areas, they are lacking in the broader smart city execution.

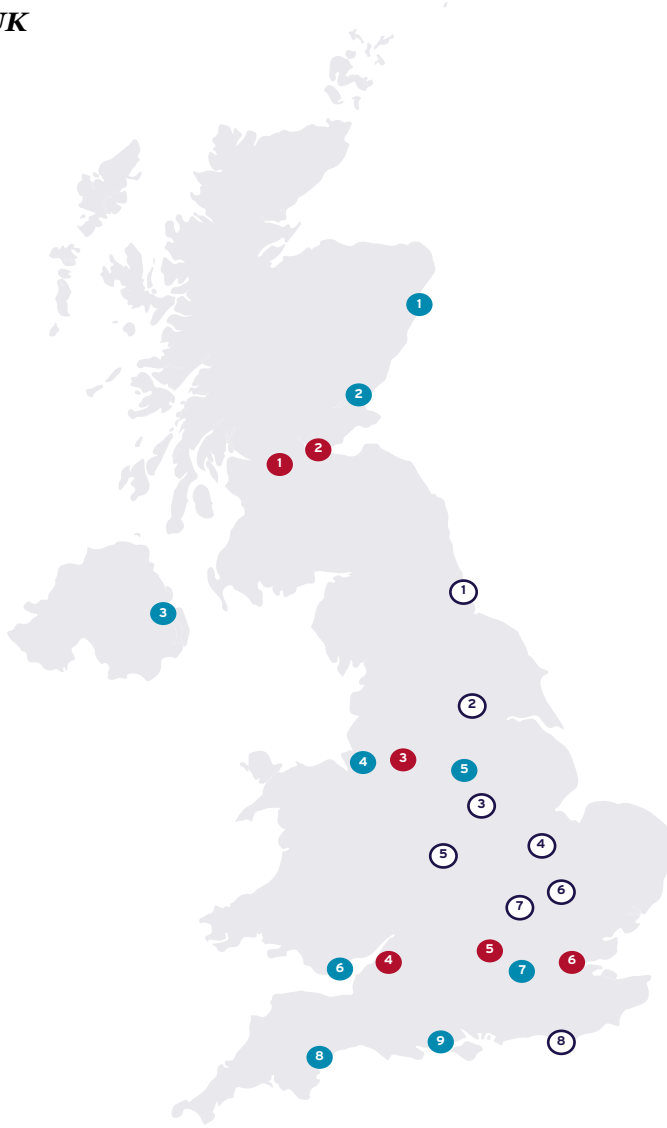
Emerging Smart Cities These cities have expressed initial statements of intent and may have developed limited pilot projects within specific service silos. However, there is still considerable work to be done in terms of developing a strategic programme and building the extensive ecosystem required for more holistic smart city developments.

Smart Cities in the UK

Smart City Leaders
1. Glasgow
2. Edinburgh
3. Manchester
4. Bristol
5. Oxford
6. London

Developing Smart Cities
1. Newcastle
2. Leeds
3. Notthingham
4. Peterborough
5. Birmingham
6. Cambridge
7. Milton Keynes
8. Brighton

Emerging Smart Cities
1. Aberdeen
2. Dundee
3. Belfast
4. Liverpool
5. Sheffield
6. Cardiff
7. Reading
8. Exeter
9. Bournemouth



LEADER

LONDON – THE GLOBAL LEADER

Strategy & Leadership – A renewed commitment from the London mayor in 2016 has reinvigorated London's smart city initiatives throughout its 33 boroughs. The focus in London is now on the quality and use of data to improve services and to achieve priority outcomes.

Governance & Management – A new Chief Data Officer (CDO) appointed in 2016 has driven greater collaboration across all parties involved in London's smart city development. The Smart London Board, refreshed under new leadership in 2017, advises the mayor and CDO with members from across the public sector, academia, and industry.

Infrastructure & Data – London was an early proponent of open data for urban innovation and Transport for London is a global leader in smart mobility and open data, and City of London is now 90% enabled for ultrafast broadband.

Stakeholder Engagement - Conference hosting, hackathons and the Tech City UK initiative have helped drive engagement with the smart city concept.

DEVELOPING

MILTON KEYNES - MOBILITY MASTER

Strategy & Leadership – The MK:Smart programme serves as the foundation of Milton Keynes development as a smart city. Transport and urban mobility is the key focus area for Milton Keynes', being the site for the first AV demonstration in Europe in October 2016.

Governance & Management – MK:Smart is a collaborative initiative that was partly funded by the Higher Education Funding Council for England and led by The Open University, the Milton Keynes Council, and BT, with support technology partners including BT, Huawei, and Tech Mahindra.

Infrastructure & Data – Milton Keynes was one of the first urban regions to implement a network based on IoT technology.

Stakeholder Engagement - An Innovation and Incubation Centre at University Campus Milton Keynes is designed to integrate training and support

EMERGING

LIVERPOOL - NEW SENSOR CITY

Strategy & Leadership – Liverpool has developed several smart city initiatives without establishing a formal overarching programme or leadership board. Initial smart city projects have emphasised the city's economic growth with a particular focus on the central research and education hub Knowledge Quarter.

Governance & Management – The Knowledge Quarter (KQ), the location of Liverpool's most ambitious smart city initiatives, is lead by a board of partners consisting of Liverpool City Council and a number of local higher education institutions, including University of Liverpool and Liverpool John Moores University.

Infrastructure & Data – In 2017, Sensor City was launched in the KQ to support the development of a hi-tech sensor hub and is developing a low powered network.

Stakeholder Engagement - KQ aims to bridge the knowledge gap between new disruptive technologies and local enterprise.

UK Smart City Systems & Expertise

The historic and growing emphasis on smart city development in the UK has made it home to world-leading expertise in the sector. This has brought increased opportunities for investment and export of established knowledge and services around the globe.

The following section outlines the major UK expertise in the smart city sector, and highlights some notable case studies providing an example of how it benefits their citizens.

Smart Citizens

The citizen is at the centre of the smart city ecosystem in the UK, and it is a general rule that any investment opportunity, both domestically and abroad, should be able to demonstrate the positive impact it will have on how citizens interact with their environment.

This stems from an understanding that the only way to achieve broad acceptance of new, disruptive technologies is by engaging citizens in understanding how they may improve their lives. This is why the UK has been such a champion of open data and transparency. Such initiatives enable citizens to access information and devise solutions, support the acquisition of new skills, and improve interaction with public authorities. By making smart city solutions citizen-, or user-focused, it in turn will drive the demand needed to build a successful smart city ecosystem.

UK Smart City Systems

The UK is home to expertise in smart city development that is proving valuable to cities across the world. UK companies and Government can provide support and know-how in fields ranging from urban planning, public engagement, and transportation, to data, software and analytics, advanced infrastructure engineering & construction, and project management and finance.

Smart Energy

UK companies have wide-ranging expertise encompassing everything from research into innovation, manufacturing, construction and deployment of energy efficient buildings, renewable energy technologies and electric vehicles, as well as the policy and regulatory expertise required to support these.

Significant energy sector expertise exists in offshore wind, smart grids, waste to energy, solar, electric & hybrid vehicles, carbon capture, utilisation and storage, hydrogen & fuel cells, bioenergy & biofuels, green finance.

Smart Buildings & Housing

The UK is home to some of the world's leading engineering and architectural firms, such as Foster + Partners and Arup, which have been involved in many of the world's most high-profile low-carbon, energy efficient projects.

UK companies and policy experts can offer services ranging from engineering and architectural services for efficient design, modelling and software tools for more effective project design, lighting solutions and supply of HVAC equipment, project management and logistics for the construction process, and products and services related to postoccupancy.

Smart Infrastructure

Developing smart, resilient and integrated infrastructure is a priority across the UK. It is the backbone that enables the successful provision of smart city solutions.

UK strengths in the smart infrastructure sector range from managed networked IT and communications services, systems integration, design and consulting, data management & analytics, data centres, cloud computing, artificial intelligence (AI), semiconductor design, and intelligent sensor networks.

Smart Governance

The UK is widely regarded as a world-leader in eGovernance, open data, and urban planning, utilising the intelligent use of technology to improve decision-making through better collaboration among different stakeholders, including government and citizens.

The Government Digital Service (GDS) works with governments around the world to help them tackle issues ranging from corruption, data systems, and citizen engagement, and leading UK management and consulting firms specialise in helping cities develop integrated data platforms to make services more efficient, support better urban planning, and streamline business registration and citizen payments.

Smart Mobility

The UK is home to some of the most advanced transport networks in the world and is at the forefront of smart mobility testing and applications. Transport for London (TfL) is a world leader in integrated transport innovation and many aspects of the TfL model have been adopted by other cities around the world.

Smart mobility companies and organisations offer intelligent transport solutions including smart parking and traffic management, on-demand and autonomous mobility solutions, smart ticketing, mobility-as-a-service (MaaS), and integrated payment systems.

Smart Health

UK companies and the National Health Service (NHS) are combining the power of data analytics and AI to analyse health data and extract valuable new insights about patients and the overall health of the city.

The UK is a frontrunner in the use of primary care electronic health records and an early adopter of several key parts of the digital health market, particularly digital imaging, telecare, mHealth and wearables, and is a world leader in innovative assisted living services for the elderly.

Smart Security

The rise of increased data sharing and new business models within smart cities creates significant vulnerabilities and security issues. This has created opportunities in the cyber security sector for IoT devices and networks.

UK universities are at the leading edge of this new IoT cybersecurity market. Aside from cyber security, security in the Smart City can relate to the intelligent use of surveillance equipment and biometric technologies.

Urban Planning & Project Delivery

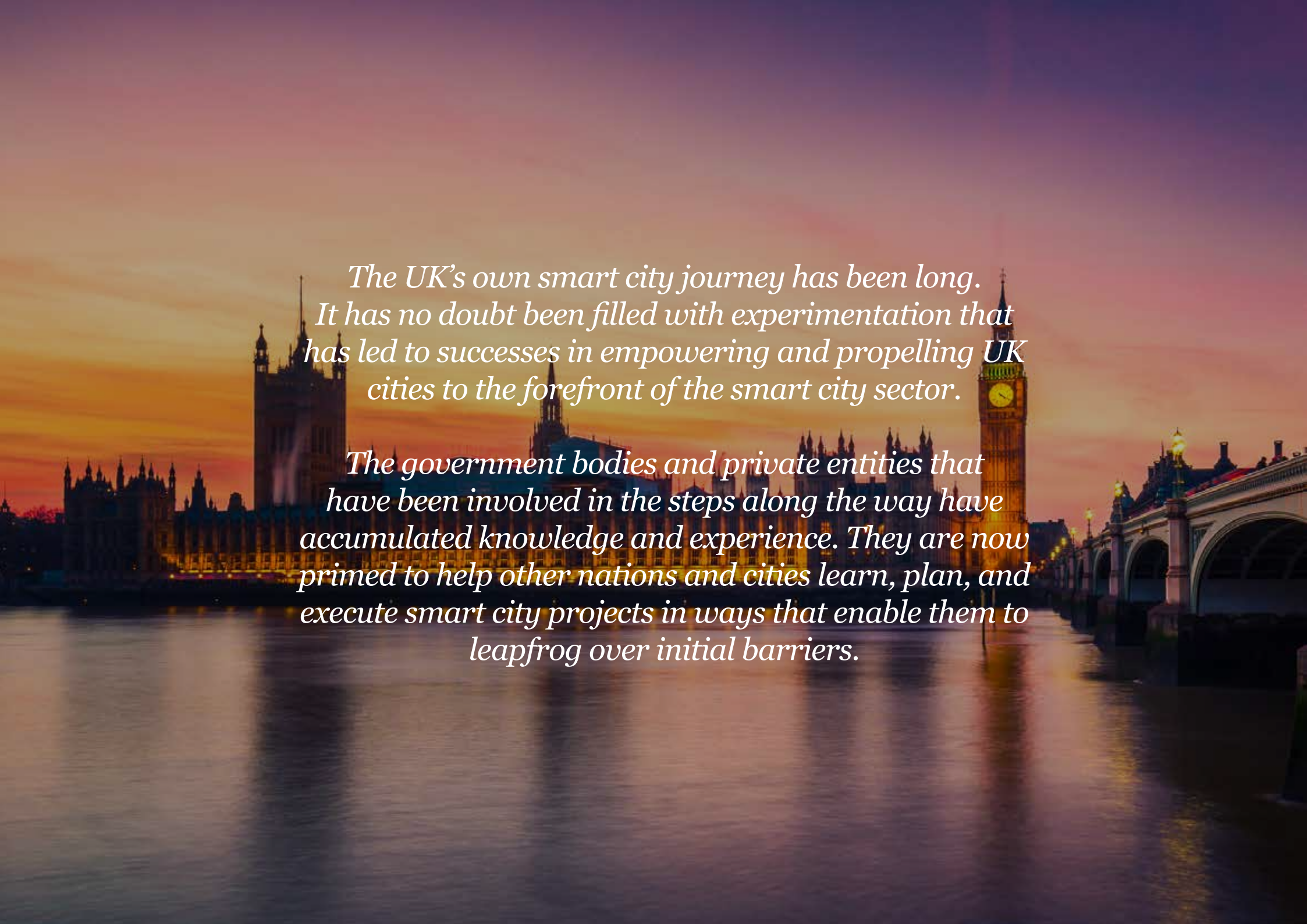
Due to the vast nature of smart city technology and projects, urban planners and consultancies are playing an ever more prominent role in the design, creation and delivery of Smart Cities.

The UK has over 17,000 architecture and planning firms that specialise in bringing together technology, skills and experience into a package to deliver positive change to an area, including BREEAM green building standards and Building Information Management (BIM) software used internationally.

Data Analytics

Data analytics allows computers to quantify the millions of digital elements of urban life that are created by sensors and the IoT. To realise the benefits of data analytics it is essential that data is shared throughout the smart city.

Open data projects collect either full data sets or metadata from existing databases, often from multiple sources, into huge, searchable databases or archives of different types of machine-readable media.



The UK's own smart city journey has been long. It has no doubt been filled with experimentation that has led to successes in empowering and propelling UK cities to the forefront of the smart city sector.

The government bodies and private entities that have been involved in the steps along the way have accumulated knowledge and experience. They are now primed to help other nations and cities learn, plan, and execute smart city projects in ways that enable them to leapfrog over initial barriers.

Chapter 2

Smart Cities in Thailand

Thailand has pinned its future development to the digital economy. Leaders have laid out ambitious plans to address the nation's challenges and improve its people's prosperity through 'smart' principles, and the smart city will be a key driver for Thailand to achieve its goals. This chapter explains the state of smart cities in Thailand, as well as the major stakeholders and policy frameworks driving this future industry.

A National Agenda for Smart Cities

A new concept
The concept of 'smart city' was first introduced in Thailand in 2003 by the then Ministry of Information and Communication Technology (MICT), however, it wasn't until the launch of the Thailand 4.0 policy in 2016, and the 20-year National Strategy (2017-2036) and 12th National Economic and Social Development Plan (2017-2021) when 'smart city' was firmly established as an important strategy for national development. In this light, 'smart city' in Thailand is still a new concept.

Thailand 4.0 & the 20-year National Strategy
Thailand 4.0 is a national agenda and economic development model launched by the Office of the Prime Minister of Thailand which provides a countrywide focus on the use of advanced technology to push the country towards national 'security, prosperity, and sustainability'.

Heavily influenced by Klaus Schwab's, "The Fourth Industrial Revolution", Thailand 4.0 looks to move the country out of the middle-income trap by establishing new hotbeds for 'S-curve' industries like robotics, artificial intelligence, and biotechnology, with a particular emphasis on developing Thailand's eastern seaboard, or the Eastern Economic Corridor (EEC) special economic zone.

Propelled by the Thailand 4.0 policy, nearly all ministries and government departments have moved to incorporate strategies and plans for the digitalisation of its workforce and services.

Under this broad framework, the smart city has been identified as a crucial agent for achieving national development goals. The 20-year National Strategy (2017-2036), the long-term strategic framework steering Thailand towards achieving the UN Sustainable Development Goals (SDGs), lays out a roadmap for implementation of Thailand 4.0 that includes a focus on livable cities and improved public administration. The subsequent 12th National Economic and Social Development Plan (2017-2021), National Master Plan #6 (2017-2036), and National Digital Economy Master Plan (2017-2036) firmly establish smart city concepts as a driving force for the future of Thailand's prosperity.

The birth of Smart City Thailand
At this same time, the MICT was reorganised into the Ministry of Digital Economy and Society (MDES), further emphasising the increasingly important role of digital technology in the national development agenda. As the ministry responsible for implementation of both the National Master Plan #6 and Digital Economy Master Plan, MDES is now the primary ministry responsible for driving smart city implementation in Thailand.

In this role, MDES established the smart city pilot city programme, highlighting Phuket as the first official smart city project in Thailand, followed closely by Chiang Mai.

It was at this time that a new form of government agency was formed under MDES in the Digital Economy Promotion Agency (depa) with a mission to create a strategic plan to promote digital economy, research policy, indexes, monitoring, and to follow the progress of emerging digital technologies and innovations into the future.

depa became the agency within MDES responsible for carrying forward the smart city torch and began coordination of a national Smart City Thailand framework in early-2019.

With this guiding body firmly established, the Smart City Thailand Office was launched within depa to execute the Smart City Master Plan, coordinate incentives, laws and regulations, measure impact of interventions, develop the necessary ecosystems and mechanisms for Public-Private Partnerships and infrastructure deployment, support city data platforms, and promote smart city research, development and innovation.

Key Players in Smart City Thailand

The creation of a thriving and robust smart city ecosystem requires collaboration amongst many different stakeholders.

This section summarises the key players involved in Smart City Thailand. Further details for specific sector-based stakeholders will be outlined in the following chapter.

KEY MINISTRIES, AGENCIES AND STATE-RUN ENTERPRISES

Three ministries have the responsibility of co-secretariat of the Smart City Thailand Steering Committee, and are leading the charge for smart city programmes under the supervision of the Deputy Prime Minister. Affiliated policy and planning departments within each ministry help shape the regulations, service priorities and funding for smart city initiatives.

State-run enterprises (denoted with *) operate important services throughout the country, in particular, energy generation and distribution, water, waste, transportation, and telecommunications. Details for each can be found in the next chapter.

OFFICE OF THE PRIME MINISTER OF THAILAND

The Office of the Prime Minister of Thailand launched the Thailand 4.0 national development policy, spurring the move towards the digital economy and bolstering smart city efforts.

The Prime Minister and Deputy Prime Minister chair the National Economic & Social Development Council (NESDC), which is charged with national policy development, and the **National Digital Economy & Society Committee**.

Key government ministries and agencies involved in smart city development report directly to the Committee, which manages the **National Digital Economy & Society Fund** that finances smart city related projects and other national digital transformation related projects.

The board of the National Digital Economy & Society Fund consists of the Deputy Prime Minister, Minister of MDES, Permanent Secretary of MDES, Director of the Office of National Digital Economy & Society (ONDE), the Minister of Finance, Budget Bureau Director, and three experts.

MINISTRY OF DIGITAL ECONOMY AND SOCIETY

MDES, formed in 2017, develops and promotes digital economy policy and is the primary ministry responsible for driving smart city implementation in Thailand. Key offices and agencies include:

- Office of the National Digital Economy and Society Commission (ONDE)
- Digital Economy Promotion Agency (depa)
- Smart City Thailand Office

MINISTRY OF ENERGY

MOE is in charge of national energy planning and generation, and alternative energy promotion to achieve sustainability and efficiency goals. Key offices and agencies include:

- Energy Policy and Planning Office (EPPO)
- Department of Alternative Energy Development & Efficiency (DEDE)
- Electricity Generating Authority of Thailand (EGAT)*

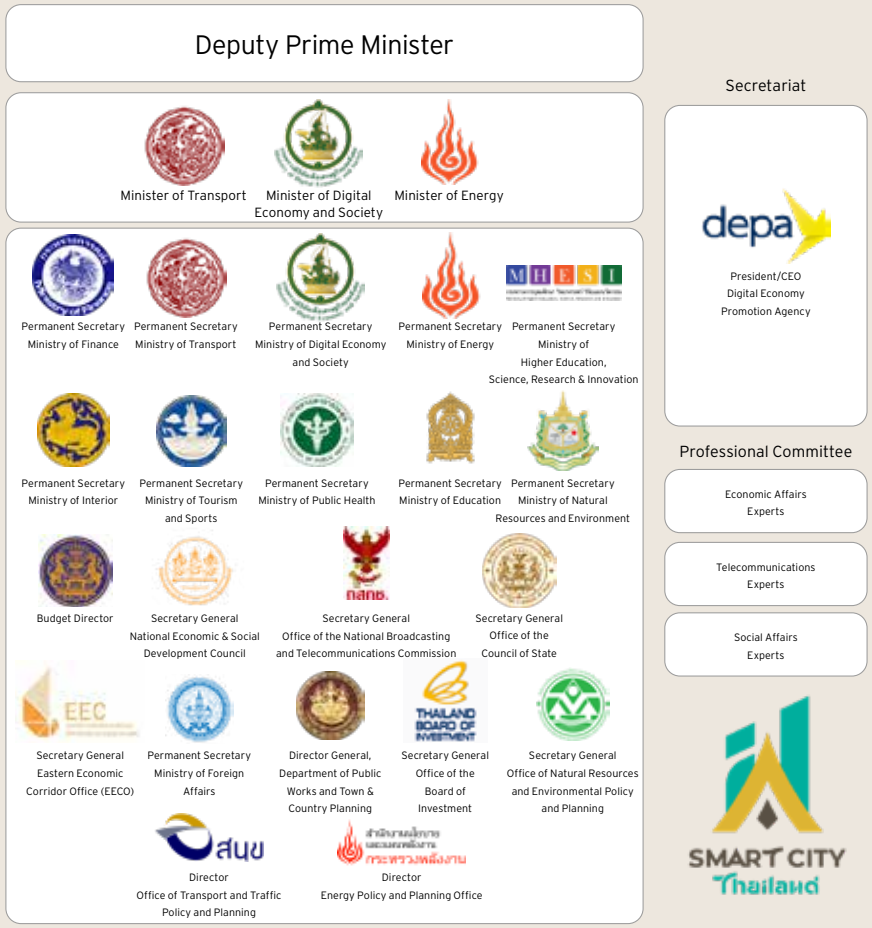
MINISTRY OF TRANSPORT

MOT is in charge of national transportation policy and planning with the mission of developing an integrated transport system for Bangkok and the nation. Key offices and agencies include:

- Office of Transport and Traffic Policy and Planning (OTP)
- State Railway of Thailand (SRT)*
- Mass Rapid Transit Authority of Thailand (MRTA)*
- Expressway Authority of Thailand (EXAT)*
- Bangkok Mass Transit Authority (BMTA)*

SMART CITY THAILAND STEERING COMMITTEE

Established in 2018 and chaired by the Deputy Prime Minister, the Ministers of Transport, Energy, and Digital Economy and Society, with broad representation from all other national ministries, as well as Eastern Economic Corridor Office (EECO).



*National committee members subject to change. Please refer to smartcitythailand.or.th for most recent updates.

TELECOMMUNICATIONS OPERATORS

There are three major, privately run telecommunications operators, AIS, True Corp, and DTAC, with the lion's share of the mobile market. CAT Telecom and Telecom of Thailand (TOT) are state-owned operators responsible for international infrastructure and fixed-line telephone, respectively.

- CAT Telecom Public Company Ltd.
- TOT Public Company Ltd.
- Advanced Info Service Public Company Ltd.
- True Corporation Public Company Ltd.
- Total Access Communication Plc

TRADE ASSOCIATIONS

A number of trade association and business groups play an important role in the Thai smart city ecosystem, leading the charge on local market growth, standards development, and working closely with regulators and state-run operators.

- Federation of Thai Industries
- Thai Chamber of Commerce
- Digital Council of Thailand
- Electric Vehicle Association of Thailand
- Thai IoT Association

The Challenges of the Thai City

Progress is being made to bolster smart city efforts In Thailand, however, there is still work to be done to ensure pioneering smart city projects align national level goals and actions with local needs.

As stated in the introduction to this handbook, the most successful smart cities in the world focus their smart city programmes around local level needs and home-grown initiatives. These are made possible through support and collaboration with national level government, but top-down initiation must be met with strong bottom-up capacity.

Though important reforms are underway, Thailand must continue to address major challenges in this regard.

These challenges can be boiled down to a few key, interrelated points of tension in the central-local government relationship that often preclude cities being an effective partner in service delivery and smart city development:

Centralised bureaucracy
Central government maintains a high-level of control over planning, budgeting and procurement at the local level. However, recent reforms have been made to better empower local authorities, and as implementation progresses, cities will find new opportunities in the smart city space.

Coordination difficulties
A lack of coordination between and within some government departments can slow implementation of national level policy reforms at the local level. Smart city principles can lead to improved coordination and more effective and positive outcomes at the city, and even provincial level.

Limited local capacity
Bangkok's position as the major economic and cultural hub of the country has concentrated know-how in the nation's capital, and overall capacity for urban planning and administration, as well as digital skill sets, are limited in some cities.

NATIONAL CHARTER FOR CITY DEVELOPMENT

In order for Thailand to achieve its national level development targets and smart city goals, city authorities and local actors can be further empowered through increased budgetary autonomy and improved know-how.

This is not lost on smart city leaders as stated by depa Senior Executive Vice President, Dr. Passakon Prathombutr:

"Local agents of transformation in each city are needed to play a critical role in moving the cities toward becoming 'smarter.'"

Fortunately, many local actors and private sector partners have been working to better plan and prepare for the smart cities of the future.

City Development Corporations (CDC) are a new model of development partnership that has emerged in recent years, and is supported by national legislation allowing local authorities to partner with private enterprise in a new form of public-private partnership.

CDCs can serve as a source of funding for projects, and help supplement local budgets. Nearly 20 such CDCs have been established throughout the country, most notably in Khon Kaen, Phuket and Chonburi, and are serving as a good entry point for those seeking to get involved in the smart city effort.

NATIONAL Charter

Another important movement helping to organise smart city efforts is the National Charter. A recognised partner of depa, this group of urban planners, development professionals and design experts are working together with CDCs and local leaders to support better planning and partnerships for smart cities though public participation and best practice support, development of standards and indexing.

The National Charter operates on an MOU model, meaning it does not hold jurisdictional authority or directly influence budgetary decisions. However, the Charter is involved in an increasing number of studies and pilots throughout the country.

Thailand's Smart City Pillars

As discussed in our primer for smart city, every city should ideally have these four foundational pillars in place: smart infrastructure, open and secure data, sound urban governance, and strategies for supporting smart citizens.

Smart City Thailand is one of the newest initiatives in the country, and thus the movement is still emerging. Thai Government is aware of the need to build out the necessary elements to form a comprehensive platform on which smart cities can be built. There has been progress in Thailand's digital development, but much of it is just beginning to emerge.

SMART INFRASTRUCTURE

Thailand's performance on numerous digital economy-related indices shows that the country still has a way to go in terms of meeting its infrastructure goals, but there are some approaching milestones on the horizon in terms of infrastructure development.

In 2016, the government declared it was investing THB 56bn (£1.44bn) to fund the expansion of broadband throughout the country, and MDES has plans to invest THB 3.76bn (£97.2m) in ICT related programmes over the next 20 years. The national broadband policy sets precise targets to have 95% of the population connected by 2020, with cities and major centres linked with 100 Mbps-minimum connections within 2020. 10 Initial 5G auctions (700 MHz) and regulatory sandbox projects were launched in 2019, with additional national and area specific licenses being auctioned in early 2020.

Recent years have also seen substantial investment into domestic data centres in preparation of the increased data demand for IoT connected devices and other cloud based services. By some estimates, it is believed Thailand will have 400m connected devices in 2020, with IoT spending approaching THB 32.43bn (£840.7m).

OPEN DATA & SECURITY

Data access and data quality are major challenges in Thailand for both the public and private sectors. Within government, a lack of inter-departmental cooperation and data sharing has historically led to inefficiencies, redundancies, and poor coordination in working towards holistic development outcomes. The Digital Government Development Agency (DGA) is taking aggressive steps to address this, and Bangkok and other cities have begun to pursue tangible measures towards establishing much-needed data platforms that support the smart city.

The rise of increased data sharing and new business models within smart cities creates significant vulnerabilities and security issues, the risk of which has slowed growth in the smart city market.

The Private Data Protection Act (PDPA) was recently enacted as a national effort to improve data security and data transparency, and the ongoing implementation of the PDPA moves to significantly reduce the risks associated with data protection and sharing. Enacted in late-2019, the Private Data Protection Commission is drafting guidelines and regulations to be ready for implementation in 2021 and 2022.

URBAN GOVERNANCE

Thailand's well documented organisational silos and tensions between central-local administrative units can have a markedly halting effect on the country's smart city market. Corruption in government also remains a major issue for smart city development.

In the Corruptions Perceptions Index 2019, Thailand ranked 101 out of 180 countries with a score of 36, where 0 is highly corrupt and 100 is very clean. Decision-making for new projects are influenced by longstanding procurement models which have documented cases of graft and bribery. An overhaul to the procurement process, including e-procurement models that encourage transparency and quality, can help encourage the growth of the smart city market.

The Decentralization Act of 1999 was enacted to grant greater autonomy to local authorities and allow the central government to divest itself of many roles and responsibilities. While decentralisation was officially enacted since, actual reforms have yet to be fully realised. Responsibility of local service delivery, a major area of focus in the smart city, is not always clearly demarcated, and many services are still controlled by the central government. This dynamic leads to difficulties for central government officers who are often overburdened with broad administrative duties and disconnected from local needs. Local authorities may have service responsibilities, but often lack capacity or resources to effectively deliver or improve processes.

Last year, the New Urban Planning Act 2019 was enacted by the Ministry of Interior. This Act more formally transfers authority of local planning to local and provincial authorities and encourages more public participation in the planning process. Instead of province-wide comprehensive planning, the focus is shifted into the specific town planning at the neighbourhood and district scale. The implementation of this Act represents an important step in the right direction, and though the progress of decentralisation has been slow, the policies are in place to support better governance for smart city development.

SMART CITIZENS

The use of the Internet has steadily increased in recent years, and according to Statista, the number of Internet users in Thailand reached approximately 40.7 million people in 2018; and it is likely to grow to about 57.4 million people in 2023. Moreover, the Global Digital Report 2019, conducted by Hootsuite and global agency WeAreSocial, reported that there are 92 million mobile subscribers (of around 69 million population) accounting for 133% penetration, and 55 million active mobile internet users. Among those users, 49 million people are mobile social media users, accounted for 71% penetration.

Thais are connected, and increasingly so. However, according to the International Telecommunication Union (ITU), the major problem faced by many Thai households is not poor Internet accessibility, but rather access to computers and other hardware at home. Compared to countries around the world, only 21% of Thai households have computers, which is lower than the global average of 49% and the developing countries' average of 38%.

The digital divide in Thailand is a problem that has detrimentally impacted poor households for a long time, and addressing this issues can help Thailand on its quest to truly become 'smart' in the years to come.

Digital Economy Promotion Agency

The establishment of the Smart City Thailand office places depa at the centre of the smart city space in Thailand. However, as is shown by the broad representation in the Smart City Steering Committee, there are many players involved in the sector.

Recognising this, depa is working hard to play the role of connector and facilitator amongst these many actors.

How they are doing this, and how depa may aid you in developing the future of smart cities in Thailand is explored here.

WHAT DO THEY DO?

Development and promotion of the smart city sector is one of many responsibilities of depa, as it is the government agency responsible for the overall promotion of digital economy in Thailand. Officially, the broad mission of depa can be divided into the 4 pillars below.

In a practical sense, this means depa has a national agenda to build the digital capacity of the country through trainings, business matching, startup and business support, and ecosystem development.

Develop digital workforce through literacy and skill development.

Develop digital community through inclusiveness and inclusive technology accessibility.

Develop digital economy through the ability to use technology to enhance economic activities.

Generate digital ecosystem for aforementioned pillars to work sustainably.

depa throughout the nation

The Smart City Thailand Office is located at the depa central office, located in Bangkok, and is responsible for setting the national policy framework and providing support to cities and businesses around the country.

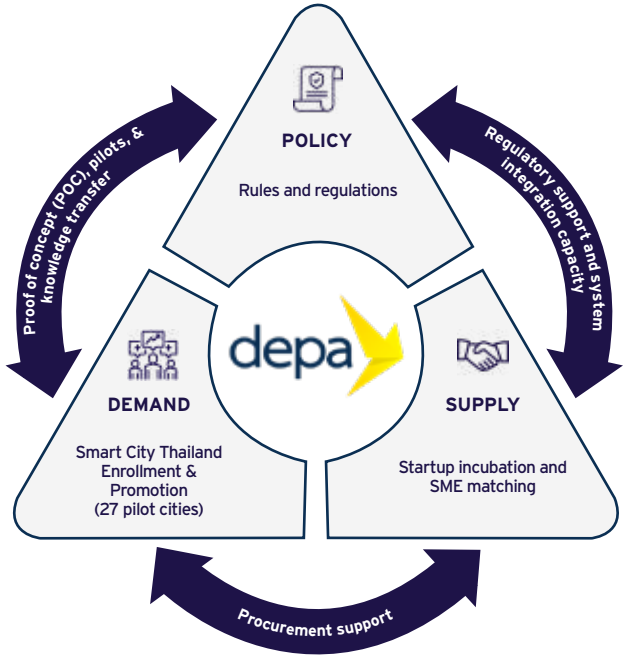
At the provincial level, depa regional offices are responsible for setting up a provincial working committee, which includes stakeholders such as the vice governor, depa officials, local academia and businesses, and citizens. Regional offices also develop strategic plans at the provincial level and collaborate with local stakeholders to implement their smart city initiatives.

DEPA AND THE SMART CITY

As the leader of Smart City Thailand, depa takes a three-pronged approach to building and supporting a burgeoning smart city marketplace.

It does this through three primary activities:

- Policy, regulations and incentives development
- Demand generation through city enrollment in its Smart City Thailand promotion programme
- Supply matching through startup incubation and SME support.

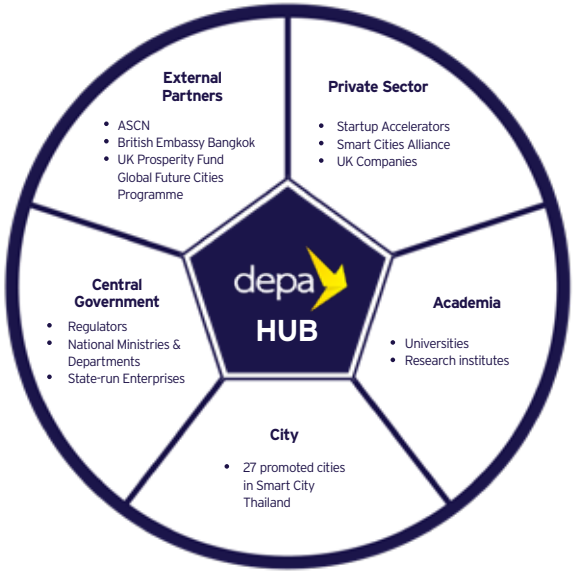


DEPA AS THE CONNECTOR

depa has positioned itself to be the connecting hub between the many stakeholders involved in smart city development.

In a more mature smart city market, connections between various stakeholders will happen more organically, building off of an active ecosystem and strategic plan to drive forward service delivery and user-focused solutions.

However, in Thailand where the smart city sector is still in its early state, depa aims to orchestrate these connections more deliberately and overtly in order to facilitate the growth of the Thailand market.



YOUNG & EMERGING

Having only been founded in 2017, and the Smart City Thailand office itself being just over a year into its existence, depa and its mission are both young.

As the primary government sector agency charged with facilitating development of the smart city market in Thailand, depa is still seeking out new and innovative ways to engage with stakeholders, just as the market itself is still taking shape.

With a growing sphere of influence and expertise related to smart cities, depa represents the one-stop-shop for both international and local partnerships.

depa provides an active entry point into the market and can act as a first point of contact for any foreign companies and government organisations looking to explore market opportunities or engage in business in Thailand's emerging smart city market.

Get in touch: doss@depa.or.th

Smart City Thailand

In the lead up to the launch of the Smart City Thailand office in early-2019, and as part of its mission since, depa has consolidated best practices and expert advice to create a national framework and investment promotion programme for smart cities throughout the country.

Smart City Thailand works with other national ministries and departments to coordinate incentives, laws and regulations impacting the deployment of smart city solutions, develop the necessary ecosystems and mechanisms for service innovation, testing, piloting and scalability, and supports smart city infrastructure development, with a major emphasis on open city data platforms.

SMART CITY ACCORDING TO DEPA

SMART CITY Thailand

"A city that leverages technology, innovation, and good design to increase efficiency, cut costs, and innovate in relation to city management and service provision, with participation from all relevant stakeholders, in order to achieve citizen's quality of life and happiness as well as sustainability."

Types of Thai Smart Cities

depa recognises that each city has its own unique context, which is influenced by existing infrastructure, environment, social services, housing, recreational areas, and commercial resources. Additionally, each might be seeking to preserve and advance its existing culture, traditions, and identity. With this in mind, Smart City Thailand categorises Thai cities into two types:

SMART LIVABLE CITY

Smart Livable City is an existing city with long-term residents. To be developed into Smart Livable City, it needs to incorporate and integrate technology and innovation as needed by its residents according to its own context. Bangkok, Chiangmai, and Phuket are prime examples.

SMART NEW CITY

Smart New City is a newly designated urban area with zero to sparse population to be developed into Smart New City with the use of technology and innovation as needed by its own contexts. Future cities named in the Eastern Economic Corridor (EEC) project are prime examples.

7 SMART CITY DOMAINS

Smart city initiatives run the gamut and identifying which ones to begin with can be daunting. depa has categorised potential initiatives into seven smart city domains, each highlighting particular goals, objectives and example solutions for cities to consider while defining their vision and strategies.

Determining which domains to focus on and how technology is to be deployed within each city or project scope is upto each programme applicant, though depa provides the following advice when crafting each city vision and roadmap:

"Smart City Thailand considers citizen participation as the most vital element of smart city promotion. We believe that a smart city is a collaborative task. In fact, when the public and private sectors work together, we can benefit from the accountability of the public sector and the incentive structure that drives the private sector to make smart city grow exponentially."

- Dr. Non A., depa Senior Expert in Smart City Promotion

SMART CITY Thailand
SMART ENVIRONMENT
SMART MOBILITY
SMART ENERGY
SMART PEOPLE
SMART GOVERNANCE
SMART LIVING
SMART ECONOMY

Smart Environment

The Smart Environment domain aims to maintain the balance of nature and sustainable natural resource consumption through efficient administration and environmental management. Smart Environment is considered co-dependent on all other domains, which is why it is required for inclusion in any project enrolled in the Smart City Thailand programme.

Objectives and solutions include: Community waste management, compatible land usage, standardised water supply, smart waste management systems, primary water treatment systems and other related smart environment innovations.

Leadership: Ministry of Natural Resources and Environment

Smart Energy

Smart Energy includes a focus on energy consumption, energy generation, energy distribution, greenhouse gas reduction and smart grid system that decreases reliance on the traditional channels of energy distribution.

Objectives and possible solutions include: renewable energy, district cooling or district heating systems, smart metering systems, micro-grid systems and smart home/smart building systems.

Leadership: Ministry of Energy

Smart Mobility

This domain places attention on the accessibility to transportation networks and public transport systems, convenient use of public utilities and facilities of transportation including public transportation, efficient public transportation management, transportation safety and green mobility.

Objectives and solutions include: be the electric vehicle (EV) and charging station, smart parking system, traffic management and public transport application.

Leadership: Ministry of Transport

Smart Living

Smart living encompasses 3 guiding principles:

1. Smart Health - Healthy people and promoting people's hygiene, achieved through comprehensive healthcare services

2. Public Safety & Security - Safety from crime, accidents and disaster by using surveillance systems, disaster prevention plans and proper design of physical urban development for disaster prevention

3. Smart Built Environment - Smart living facilities, including hotel and tourism development, inclusive & universal urban design, and smart building management systems.

Leadership: Ministry of Interior

Smart People

This domain emphasises the knowledgeable and digital citizen, and an inclusive society and culture through the reduction of social inequality and creating an environment that is conducive to coexistence in society.

Objectives and solutions include: the dissemination of knowledge for life-long learning, access to digital technology and systems, digital libraries and digital encyclopedias, provision of creative space, maker space, urban living labs, co-working space and learning centres.

Leadership: Ministry of Digital Economy and Society

Smart Governance

Smart governance focuses on government services efficiency and accessibility, stakeholder participation and transparency, and verifiable government policy and plans.

Objectives and solutions include: eGovernment, open government data, promotional plan for public participation, efficient and high-quality public services and concrete action plan.

Leadership: Office of the Prime Minister

Smart Economy

This domain aims to promote the growth/ expansion of new businesses through digital systems that support business agility, business connectivity, business ecosystem development, and business innovation.

Objectives and solutions include: the development of digital infrastructure, local economic development, value-added creation from data storage and data analytics, and big data resulting from doing business in the area. Start-up support through incubation/innovation centres and test beds or 'sandbox' areas.

Leadership: Ministry of Finance

ENROLLING IN SMART CITY THAILAND: SMART CITY THAILAND EVALUATION CRITERIA & PROCEDURES

To access incentives and support services, cities and projects must apply and enroll in the Smart City Thailand programme.

The application and evaluation process was determined by the Smart City Thailand Steering Committee. Five general criteria are considered when applying for the programme, and certain requirements must be met to be considered for enrollment

Requirements:

1. Must be a public organisation;
2. Or, must be a partnership between a public and private organisation registered in Thailand; and,
3. Or, must be a private organisation registered in Thailand with a document of rights in the area with the project's having been approved by a public hearing process.

1 DEFINE VISION OF THE AREA

Identify geographical boundary, Smart City type (Livable or New), and Smart City goals by Domain (Smart Economy, Smart Mobility, Smart Energy, Smart Environment, Smart Living, Smart Governance and Smart People). Applicants must include at least two Domains -- but **MUST** include Smart Environment.

2 INFRASTRUCTURE DEVELOPMENT

Formulate an infrastructural development and investment plan for both digital and basic infrastructure such as transportation, energy, and public services.

3 DATA PLATFORM/ SECURITY

Design a data storing and management strategy (i.e., City Data Platform), as well as cybersecurity strategy for the city and its residents

4 SOLUTIONS

Build urban systems, activities and projects, strategies and guidelines in accordance with the proposed type of Smart City, encompassing both the mandatory and other services as appropriate.

5 SUSTAINABILITY MODEL

Creating a management model and process of public participation incubation for a sustainable operation.

Application Process:

1. Register through the Smart City Thailand Office website (https://smartcitythailand.or.th/)
2. Smart City Thailand Office screens proposals and verifies qualifications
3. Smart City Sub-Commitee evaluates project feasibility and assigns to domain specific committees
4. 7 Smart Domain Committees evaluate proposals
5. Smart City Sub-Committee forwards results to Smart City Steering Committee
6. Smart City Steering Committee responds to applicant with response; Applicant recieves access to Smart City Thailand logo
7. Project owners submit progress reports every 6 months for evaluation by Smart City Thailand Office
8. Project owners apply for benefits including: legal and regulatory benefits, infrastructural fast-tracking, and financial support.

Board of Investment Smart City Incentives

SMART CITY BENEFITS

Cities and projects that are approved through the Smart City Thailand Office gain access to several benefits and funding instruments available through MDES and BOI (outlined to the right).

Legal and Regulatory Benefits:

- Access to regulatory sandbox environments offered through relevant agencies and partners
- Smart Visa availability for foreign investors or experts

Infrastructural Benefits:

- Fast-track benefits in basic infrastructural development in digital technology, transport and energy

Financial Support Mechanisms:

- Digital Transformation Fund
- Digital Manpower Fund
- Digital Startup Fund
- Digital Smart City Research Fund
- Smart City Infrastructure Fund
- Tax exemptions

The Office of the Board of Investment (BOI) offers various tax incentives and investment support mechanisms to parties interested in investing in Smart City Thailand approved projects.

It has the investment promotion policies to:

- Promote investment that helps enhance national competitiveness by encouraging R&D, innovation, value creation in the agricultural, industrial and services sectors, SMEs, fair competition, and reduce social and economic disparity.
- Promote activities that are environmently-friendly, save energy or use alternative energy to drive balanced and sustainable growth.

If these incentives are fully utilised, these incentives have the potential to simultaneously provide significant environmental protections and economic benefit, nudging Thailand towards becoming even more environmentally sustainable.

SMART CITY PROMOTION

1. Project must develop, install, and provide any one or more proper aspects of smart city system services as stipulated by the Board, for example, Smart Mobility, Smart People, Smart Living, Smart Economy, Smart Governance, Smart Energy, and Smart Environment, etc.
2. Project must be a part of Smart City Development Project approved by the Board or agencies responsible for the smart city development only.
3. Rights and Privileges:
4. In case the project is a part of Smart City Area Development Project that provides all 7 smart systems. **Incentives A2**
5. In case the project is a part of Smart City Area Development Project that provides some of the 7 smart systems. **Incentives A3**
6. If the project is located in EEC area, it is eligible for a 50 percent corporate income tax deduction for 5 years from the date on which the corporate income tax exemption period expires.

Incentive A2: Infrastructure activities for the country's development, activities using advanced technology to create value-added, with no or very few existing investments in Thailand.

Incentives: Exemption of corporate income tax for 8 years, Exemption of import duties on machinery, Exemption of import duties on raw materials used in production for export and Non-Tax Incentive.

Incentive A3: High technology activities which are important to the development of the country, with a few investments.

Incentives: Exemption of corporate income tax for 5 years, Exemption of import duties on machinery, Exemption of import duties on raw materials used in production for export already existing in Thailand. Exemption of corporate income tax for 8 years, Exemption of import duties on machinery, Exemption of import duties on raw materials used in production for export and Non-Tax Incentive.

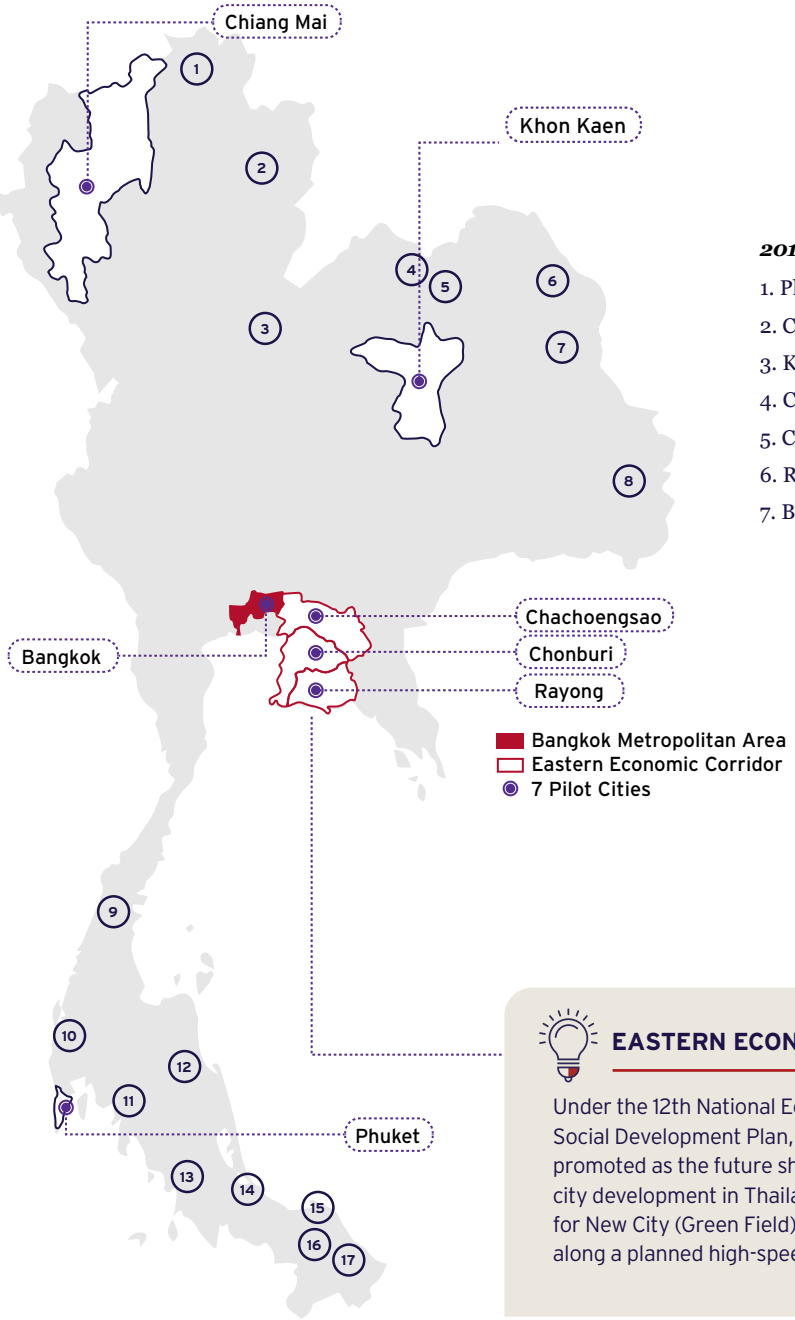
Smart City Thailand Roadmap

In late-2018, the first batch of Smart City Thailand pilot cities were introduced into the programme - Phuket, Chiang Mai, Khon Kaen, Chachoengsao, Chonburi, Rayong and Bangkok - which are shown on the map to the right. The ongoing activities in these cities will be covered in greater detail throughout the remainder the handbook, with a special emphasis on Bangkok.

However, these seven cities were just the beginning of the Smart City Thailand roadmap. The national Smart City Master Plan has set targets for additional enrollment in the programme and both national and international goals for service deployments and achievements.

In 2019-2020, they aim to enroll 24+ designated provinces and 30+ areas, and during the period of 2020-2022 they hope to expand the scope of Thailand Smart City Development Plan through the application channel to encompass Smart City services and City Data Platforms in all 76 provinces and Bangkok, and to have at least three globally-recognised smart cities.

As of October 2020, forty Thai cities, municipalities, areas and industrial estates have been accepted into Smart City Thailand with proposals including public and private sector stakeholders, private citizens, and local academic institutions.



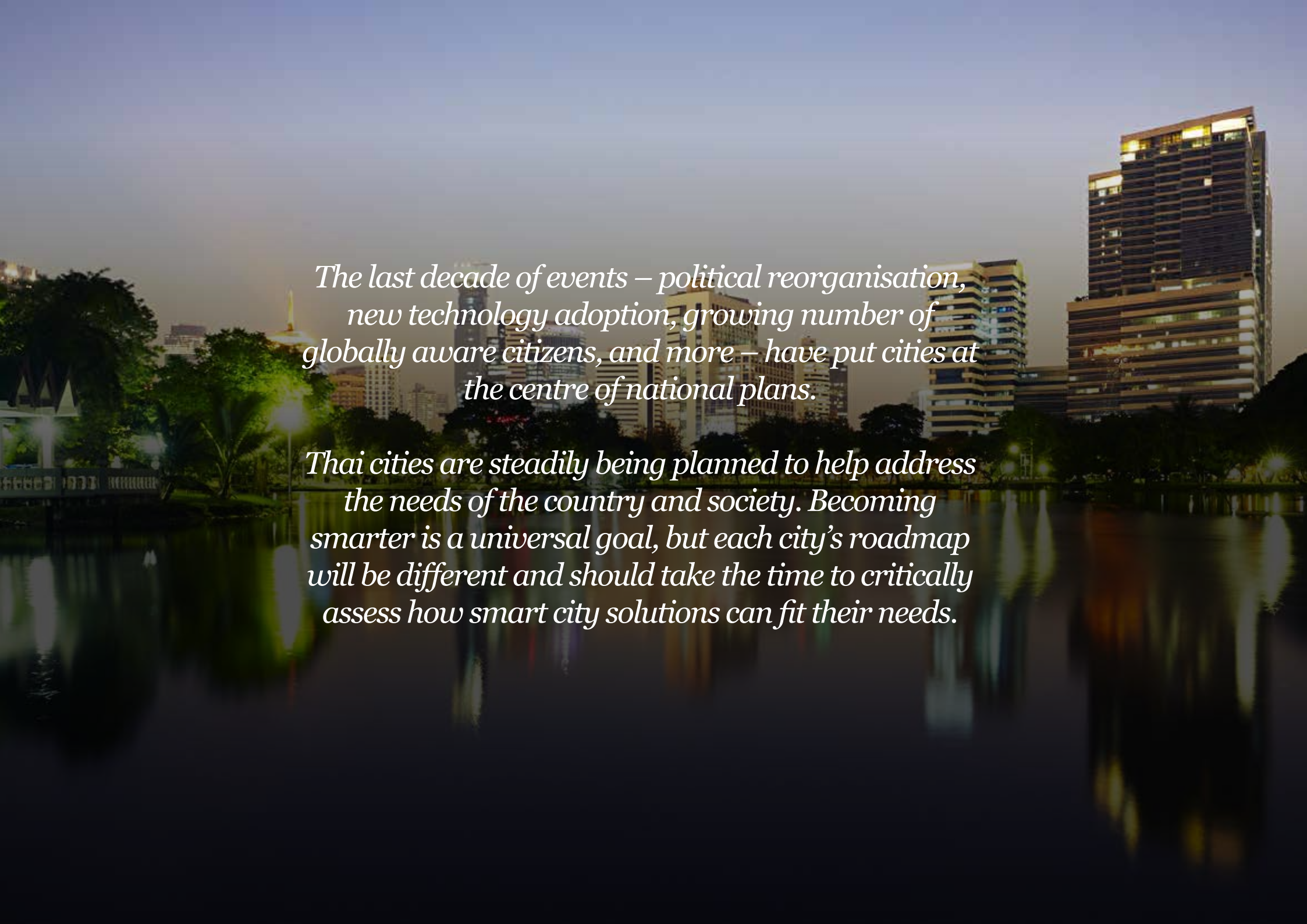
Smart City Thailand Pilot Cities & Targets

2018	***2019***	***2020***
1. Phuket	1. Chiang Rai	60 cities in 30 provinces
2. Chiang Mai	2. Nan	
3. Khon Kaen	3. Pitsanulok	***2022***
4. Chachoengsao	4. Nong Khai	100 cities in 76 provinces
5. Chonburi	5. Udon Thani	+ Bangkok
6. Rayong	6. Nakhon Phanom	
7. Bangkok	7. Mukdahan	
	8. Ubon Ratchathani	
	9. Ranong	
	10. Phang-Nga	
	11. Krabi	
	12. Nakhon Si Thammarat	
	13. Satun	
	14. Songkhla	
	15. Pattani	
	16. Yala	
	17. Narathiwat	

EASTERN ECONOMIC CORRIDOR (EEC) - THE FLAGSHIP

Under the 12th National Economic and Social Development Plan, the EEC is promoted as the future showcase of smart city development in Thailand , particularly for New City (Green Field) development along a planned high-speed rail.

The EEC Office offers special investment incentives within promoted industrial zones and future designated transit-oriented development (TOD) areas. For an overview of ongoing and planned projects in EEC, please refer to page 152 in the handbook.



The last decade of events – political reorganisation, new technology adoption, growing number of globally aware citizens, and more – have put cities at the centre of national plans.

Thai cities are steadily being planned to help address the needs of the country and society. Becoming smarter is a universal goal, but each city's roadmap will be different and should take the time to critically assess how smart city solutions can fit their needs.

Chapter 3

Bangkok Smart City Deep Dive

The previous chapters discussed the theories behind smart cities and showed how both the UK and Thailand approach the sector. This chapter shows what is happening on the ground, using Bangkok as a case study to understand the major challenges facing the nation's capital, and how smart city solutions can bring about a more sustainable, prosperous and livable place for the many that call this city home.

Bangkok, Thailand

Bangkok is Thailand's capital, and by far the largest city in the country, with a population of more than 10 million people. While the city is equipped with an expanding, modern network of infrastructure, Bangkok is nowhere near the level of advancement of Tokyo, Singapore, or Seoul in terms of ICT and public services. The regional hub of Southeast Asia, Bangkok is a magnet for tourists and foreign expats, and is home to a growing technology sector. Its vibrant and attractive urban centre is well plugged-in to global networks, and is full of immense opportunities for the smart city sector.

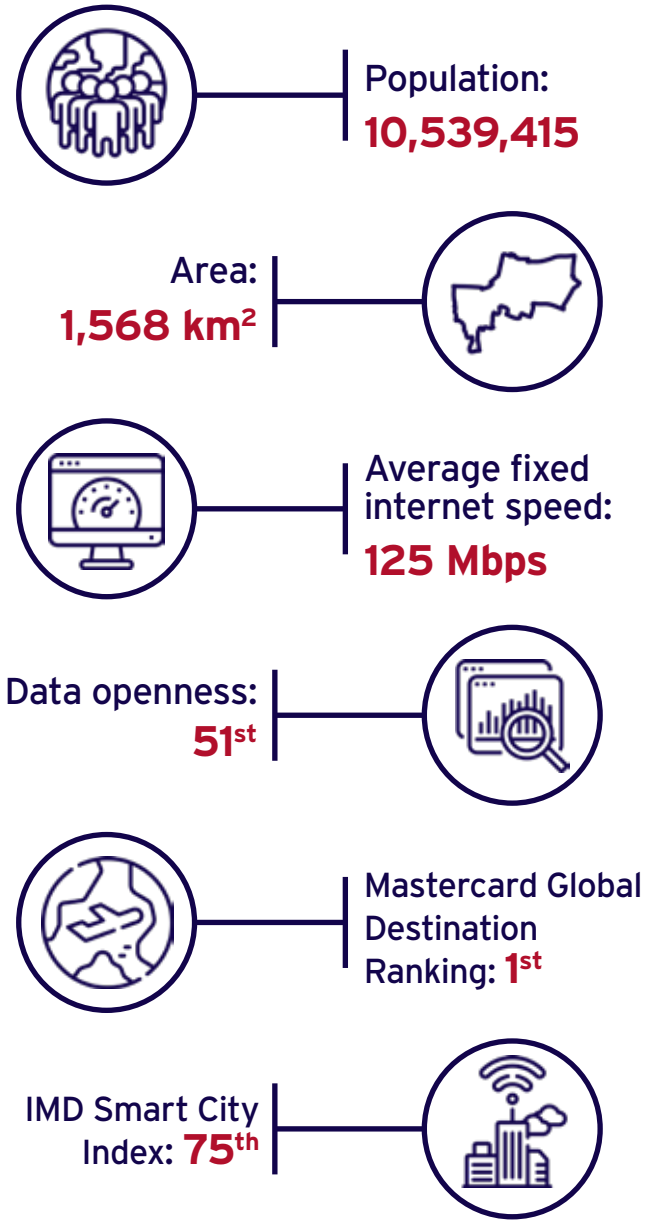
World's most primate city

Bangkok has earned the double-edged distinction of the world's most primate city, as it is disproportionately the largest city in the urban hierarchy of Thailand, and an estimated thirty-five times larger than the second largest city in the country, Nakhon Ratchasima (Korat).

For decades, Bangkok's unique position as the national capital and economic engine of Thailand has drawn people from around the country and region. This is a trend that continues to this day.

This urban primacy means Bangkok receives an over abundance of attention from the central government, and a higher resource allocation than any other Thai city. However, like in other rapidly urbanised megacities around the world, inadequate urban planning has led to haphazard development outcomes, a unstainable patterns of expansion, and many service provision challenges.

These longstanding issues have led many in the Thai development community to look to smart city solutions for an answer.



People of Bangkok

Bangkokians account for 15% of the country's population, and the city contains most of Thai society's upper and middle class. The city's education system is the most robust in the nation. Digital penetration statistics of Thailand offers a conservative view on how plugged in Bangkokians might be. The Global Digital Report 2020 approximates 75% of Thais having access to the internet and 95% using smartphones to go online. Thais spend a whopping average of 9 hours per day on the internet (5th in the world). Thais increasingly use the internet to consume, with 82% of users stating they bought something online in January 2020.

While this may seem impressive, it does not necessarily reflect usage quality. Bangkok ranks low on the KPMG's Technology Innovation Hub Survey 2020, indicating that Bangkokians are not fully taking advantage of digital accessibility to create products and services.

ICT infrastructure and data in Bangkok

Living in Bangkok is convenient, with basic needs being met and augmented by modern infrastructure. In particular, digital infrastructure is improving – the national average fixed internet connection speed stands at 125 Mbps (10th in the world). 100% of mobile connections are broadband (2G, 4G and 5G). However, there is much room for improvement. Mobile download speed is at an average of 26 Mbps (34th in the world). 5G implementation is underway and should further improve mobile internet access. For data, Thailand is ranked 51st by the Global Open Data Index (GODI), an independent assessment of open government data publication from a civic perspective. More work is to be done in delivering quality data to the general public.

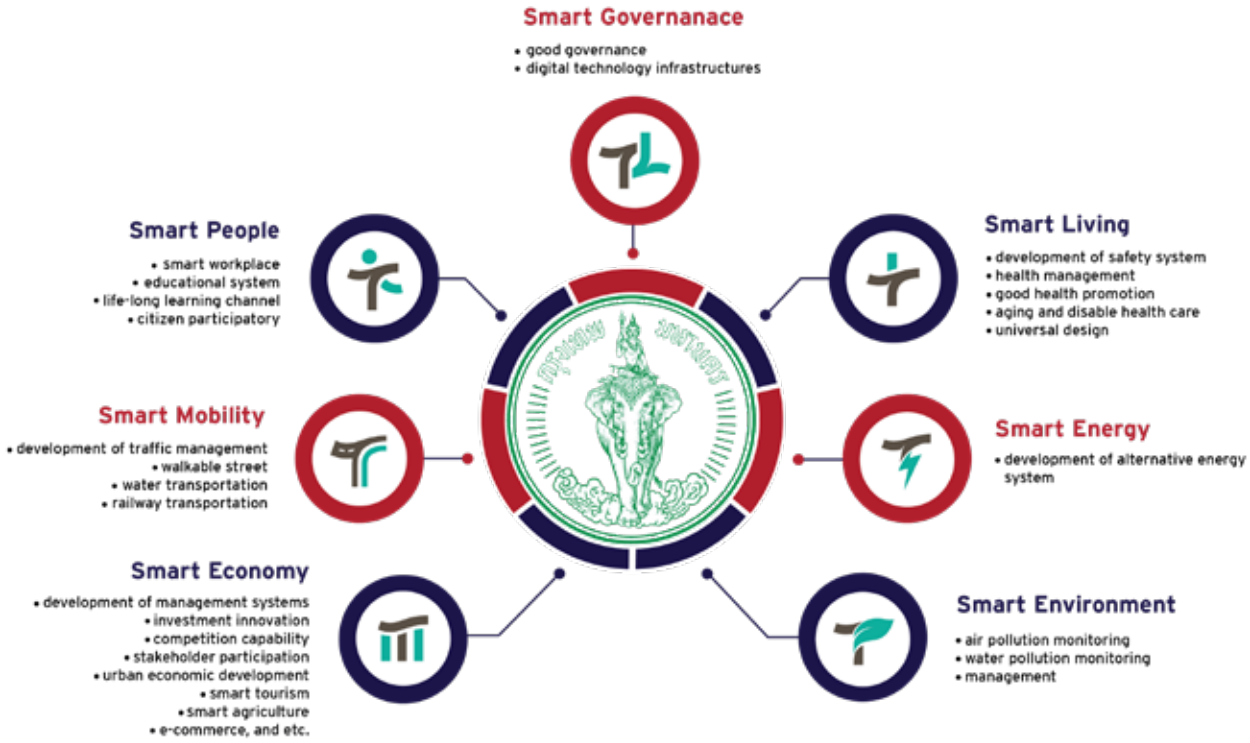
Bangkok Metropolitan Administration (BMA)

AMBITIONS TO BECOME A SMART CITY

The local authority responsible for city management in Bangkok is the Bangkok Metropolitan Administration (BMA). Though there are a wide range of stakeholders involved in service provision and asset management (more on this in the following sections), as the local authority, BMA is best suited to act as facilitator for citywide smart city programmes, and is the key stakeholder involved in the city's strategic planning.

Currently, Bangkok does not have a comprehensive smart city strategy, though the BMA has declared its ambitions of Bangkok becoming a smart city by 2032, and it is expected to develop a formal Smart City Masterplan in the near future. At present, the BMA has taken the important first step of tying its broader city development goals to the smart city concept by integrating its current 20-year development plan (2013-2032) with the Smart City Thailand framework, as seen to the right.

BMA 20-year Development Plan (2013-2032) mapped to the Smart City Thailand Domains



BMA AS SMART CITY ADMINISTRATOR

The BMA is a special administrative area led by an elected Governor who serves a four-year term, and the elected Bangkok Metropolitan Council. The Governor and his team are responsible for policy formulation, supervision and control of all functions undertaken by the permanent government officers headed by the centrally appointed Permanent Secretary for the BMA. The Council is the local legislative body responsible for making local laws, ordinances and regulations, as well as approving and allocating the BMA's annual budget.

The BMA is divided into 16 Departments and 50 district offices. Departments are responsible for planning management, supervision, monitoring and evaluation, whereas the District Offices operate field work and some local service provision.

AREA-BASED OPPORTUNITY

Though currently lacking a comprehensive strategy to drive its smart city projects, the BMA has partnered on a number of projects and initiatives with the hope of further stimulating investment into smart districts and area-based development in Bangkok.

Smart City Thailand

There are two projects in Bangkok currently seeking approval into the Smart City Thailand programme. Most notable is the area surrounding a new national transport hub called Bang Sue Grand Station (see pg. 140 for more information), which is, at present, the most substantial public infrastructure development project in Bangkok.

The adjacent **Phahon Yothin Smart District** is a transit-oriented development (TOD) project with support from BMA. The Thai government will spend THB 40 billion to develop a 'smart city' in the Phahon Yothin district of Bangkok that is slated to be completed within three years.

Another project receiving substantial attention from BMA, and support from Smart City Thailand, is the **Rama IV Smart District** (see pg. 143 for more information).

Together with a coalition that includes some of the most prominent private property developers in Thailand, as well as Chulalongkorn University and the Mass Rapit Transit Authority of Thailand (MRTA), the BMA plans to invest THB 15 billion to enhance the approximately 9km stretch of the Rama IV corridor.

The improvements will stretch from the historic Hua Lamphong Train Station to the Kluay Nam Thai area of Khlong Toei. This investment focuses on improving mobility and walkability along the corridor, connecting some of the central city's most high-profile private developments.

National Innovation Agency Innovation Districts

The BMA has partnered with the National Innovation Agency (NIA) to designate pilot areas for **eight "Innovation Districts" throughout Bangkok**.

Each district aims to leverage existing assets and technology to create new value and economic opportunity through research, knowledge exchange, and innovation acceleration (locations and details can be found on the next page).

Bangkok Charter

BMA has partnered with the National Charter Network, led by the Thai Town Planning Association and the Science Promotion Board for Research and Innovation, to draft a Bangkok Charter.

The Charter itself is divided into five area-based sub-charters, including the **Asoke-Rama IX Charter, Rattanakosin Charter, Bang Wa Charter, Tao Pun - Bang Po Charter and Bang Khun Thian Charter** (locations can be found on the next page).

Similar to their work around the country, these National Charter-led projects aim to bring together relevant stakeholders throughout the city to establish shared goals, action plans and investment promotion for city management, green growth, mobility, housing and applications of smart city solutions.

In late 2020, Rattanakosin Charter will be joining a national initiative called **Smart City Charter** that will involve 14 locations around the country making streetscape improvements and installing smart street poles.

PROSPERITY FUND FUTURE CITIES & THE BMA

The BMA has partnered with the UK Foreign, Commonwealth and Development Office's Prosperity Fund Global Future Cities Programme (GFCP) on three activities: **(1) an Integrated Data Hub, (2) a Decision Support System (DSS) for Flood Management, and (3) a Transit-oriented Development (TOD) Plan for Khlong Bang Luang.**

This ongoing collaboration has connected UK companies with expertise in urban management and smart city development to aid BMA in meeting their development goals, and the strategic partnership seeks to promote further cooperation with companies and organisations from the UK offering smart city consultancies, knowledge transfer, and technical assistance.

LEARN MORE

Website: www.gov.uk/world/organisations/british-embassy-bangkok

Contact: Info.Bangkok@fcdo.gov.uk

SMART CITY Thailand

1. Phahon Yothin Smart District - Bang Sue Grand Station
2. Rama IV Smart District

NATIONAL Charter

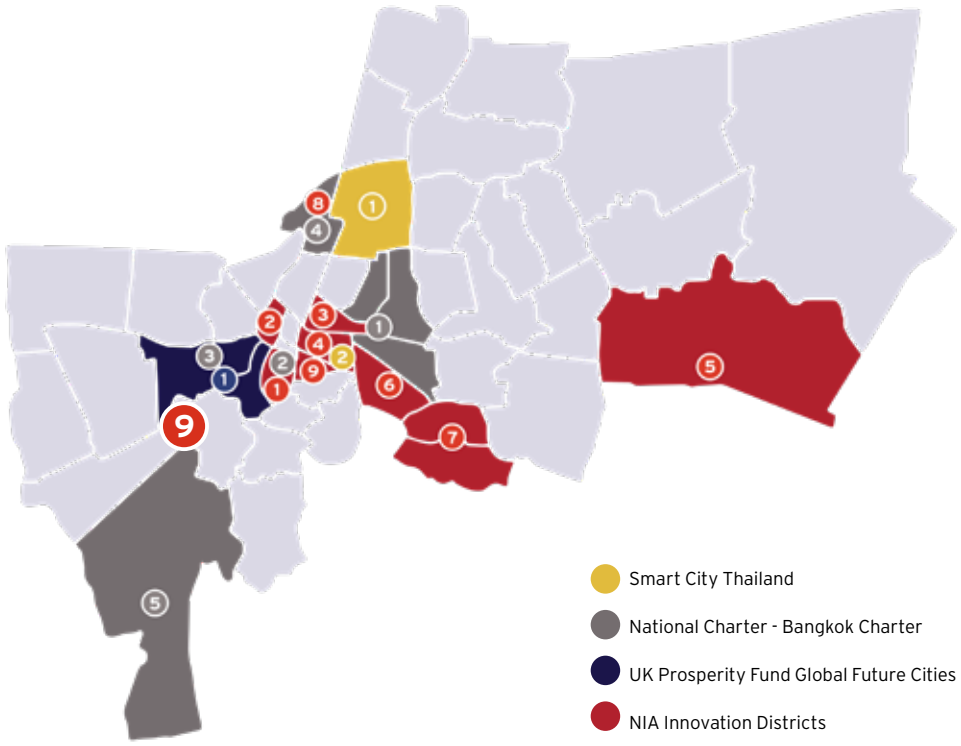
1. Asoke - Rama IX Charter
2. Rattanakosin Charter
3. Bang Wa Charter
4. Tao Pun - Bang Po Charter
5. Bang Khun Thian Charter

HM Government Prosperity Fund

1. Khlong Bang Luang - Bang Wa TOD Plan

1. Khlong San Innovation District:
   - Food & Tech
2. Rattanakosin Innovation District:
   - Creative Cultural District & Green City
3. Yothi Medical Innovation District:
   - Medical & Government Research
4. Pathumwan-Siam Central Innovation District:
   - Fintech, Food & Lifestyle
5. Lat Krabang Innovation District:
   - Culture, Logistics & Transportation
6. Kluaynamthai Innovation District:
   - New Media, Logistics & Industry
7. Punnawithi Innovation District:
   - Robotics & Cloud Technology
8. Bang Sue Transportation Innovation District:
   - Intelligent Transporation Systems

BMA Involved Smart City Area-based Projects



Barriers to Becoming Smart

Though Bangkok is making progress, recent studies show that Bangkok is well behind world leaders when it comes to common smart city indicators.

The 2019 Cities in Motion Index (CIMI), conducted by IESE Business School, grades **Bangkok close to last in governance, environment, mobility and human capital.**

This is supported by the most recent Smart City Index (SCI) conducted by IMD and Singapore University for Technology and Design, in which **city residents stated that air pollution, road congestion, corruption, security and public transport were their top five most urgent priorities for the city**, respectively. Waste management and a growing demand for electricity are also major challenges facing the city.

Faced with addressing these challenges, those working in Bangkok have a difficult task ahead of them. More details on these challenges will be shared in the remaining pages, as well as some of the possible smart city solutions.

Despite these setbacks, Bangkok remains a city with vast potential, and there is a growing awareness that smart technologies have an important role to play in supporting the city in overcoming its challenges, as well as helping Bangkokians achieve a higher quality of life.

Large scale investments into mass transit aim to curb congestion and air pollution issues, and a robust business and academic sector is driving research and development in related fields. Regulatory sandboxes are promoting new pilots in energy and mobility, and many new built projects rival international buildings in terms of green design and energy efficiency.

While Bangkok faces a number of major challenges in building a truly mature smart city market, there are a wide variety of opportunities that can be taken advantage of in the short term to help move Thailand towards a stronger foundation of success.

Subject matter experts or organisations from the UK will find that there is much appetite for assistance in work that will prime Thai cities for advancement.

INTEGRATED DATA AS A GOAL

Thailand has declared its aim to promote open-data in government to provide better services to citizens and businesses. Before providing effective open-data to citizens, inter-governmental data sharing standards and practice need to be instilled.

World leaders in the smart city sector are finding innovative ways to integrate public (and sometimes private) data residing in different sources that can significantly improve decision-making processes and outcomes. In the process, they are also building a culture of trust through transparency and accountability.

Thailand can learn from these cities, many of which reside in the UK, by making a concerted effort to improve data outcomes, initiating open data policies and organisations, and placing and developing people with data management capabilities within every department of government.

THE BMA'S INTEGRATED DATA HUB

BMA's partnership with the Global Future Cities Programme to develop an Integrated Data Hub (IDH) is a major step towards addressing the lack of cross-departmental cooperation and enhancing integrated planning and responses to urban challenges.

CONSULTATION AND ADVISORY TO GOVERNMENT

Bangkok represents a hotbed of opportunities for consultation and advisory work with both central and local government, from policy and strategic advising, to procurement and regulatory reform, to technology system design and integration, that can help Thailand develop the local skills and expertise needed to drive the smart city of the future.

One such example is transit oriented development (TOD) - a holistic approach to area-based planning that links transport to the wider-issues of land use, housing, green space, and local economic development - has the potential to ease traffic congestion, enhance connectivity in the city, and drive a more inclusive and sustainable model of development.

KHLONG BANG LUANG TRANSIT ORIENTED DEV

The Prosperity Fund's Global Future Cities Programme, who is currently assisting the BMA in a TOD planning project in Khlong Bang Luang, provides a model for other areas of Bangkok and Thai cities to learn from.

INDEPENDENT PRIVATE PROJECTS

The private sector, in particular many of the private real estate development companies, have invested in innovations in construction management, building information modeling (BIM) and urban data analytics.

Numerous research centres have been established in Bangkok and elsewhere to push forward development of technologies and initiatives that would support better urban management practices. There are major investments being made within the private sector that include smart city related technologies and programmes. These area-based projects are highlighted in a later section of the Handbook (see pg. 139).

Partnering directly with these private companies is likely the easiest way to enter Thailand's smart city market today.

PAVEGEN STEPS INTO TRUE DIGITAL PARK

PaveGen, a UK-based developer of an off-grid technology that converts the kinetic energy from footsteps into electricity, had its first installation in Thailand in a partnership with True Digital Park.

Bangkok Smart City Service Priorities

The remainder of this chapter will lay out in greater detail the major challenges facing Thailand's capital within each of the seven Smart City Thailand domains, and some key service priorities to address them, highlighting examples of ongoing projects where they exist.

The chapter will also provide highlights of how UK companies and public organisations have assisted cities around the world to achieve their smart city development goals.

Most importantly, it will outline critical opportunities for partnerships to deploy smart technologies for the betterment of Bangkok citizens and visitors. The following table provides is a summary of the deep-dive into Bangkok's smart city service priorities.

Following the overview of each Smart City Domain will be a high-level look at some of the privately driven mega development projects utilising smart city concepts within the city.

SMART CITY SERVICE PRIORITY	SERVICE OVERVIEW
SMART ENVIRONMENT	
 Smart Water Metering & Monitoring	Real-time water consumption tracking and wastewater discharge monitoring
 Smart Waste Management	Real-time waste level monitoring and smart routing for improved waste collection
SMART ENERGY	
 Smart Electricity Metering	Real-time electricity consumption tracking for consumption management
 Electric Vehicle Charging Networks	EV charging network design and management
 Peer-to-Peer Energy Trading	Distributed energy trading platform design and management
SMART MOBILITY	
 Intelligent Traffic Control Systems	Integrated traffic data collection and analysis for real-time traffic management
 Smart Public Transport	Integrated public transportation platform with single-payment system and trip management
SMART LIVING	
 Smart Disaster Management System	Integrated network of environmental sensors to monitor and predict disaster events

SMART CITY SERVICE PRIORITY	SERVICE OVERVIEW
SMART LIVING	
Smart Building Design	Integration of technology and sustainable design techniques to optimise building performance
Integrated Health Information System	Standardised system for coordination and sharing of information between patients and healthcare providers
SMART PEOPLE	
Education Technology (EdTech)	Digital education platforms for course development and life long learning support
Higher Education Partnerships	Research and educational partnerships for digital skill development and smart city innovation
SMART GOVERNANCE	
Integrated Data Hub	Government data centre for cross-departmental coordination and improved decision making
Open Data Platform	Citywide open data centre for citizen services and improved government transparency
SMART ECONOMY	
Smart City Innovation Hub	Business ecosystem development for smart city innovation and solution commercialisation support
High Skill Worker Development	Technical training and workforce development programmes for digital economy related skills

Smart Environment

The following section focuses on three essential environmental services in our cities: air quality, water management, and waste management. It identifies a number of the key technologies needed to better manage and monitor these vital resources and services and explains the ecosystem of stakeholders involved in the domain.

The Pillars of Smart Environment

If the world is going to mitigate climate change and meet the long list of environmental challenges we are currently facing, we are going to need the smart city. Cities use two-thirds of the world's energy and generate three-fourths of the world's CO2 emissions, and due to rapid urbanisation and aging infrastructure, cities are struggling to manage the needs of their residents when it comes to air, water, and waste.

Smart environment is about utilising smart technologies to manage our resources more economically and sustainably, and care for the environment we all depend on to live healthy, resilient lives.

SMART INFRASTRUCTURE

Improving smart environment outcomes starts with installing sensors and other monitoring devices to collect the information needed to map, measure, and understand the current situation. We can install household water meters to track our water use and help customers improve their habits. Leak detection sensors help identify water loss in the system and lead to more effective repairs. Water and air quality monitors collect valuable information to support better decision making and alert residents to hazards in real-time. By connecting our solid waste collection systems, sensors can measure waste levels in collection areas and alert collectors for more efficient route planning, improving waste pick-up rates while also saving on fuel costs and reducing carbon emissions in our neighborhoods.

OPEN DATA & SECURITY

Addressing environmental issues requires collective understanding and action, which is why data about the air, water and waste in our cities is most effective when presented through an integrated citywide data management platform. A central geographic information system (GIS) is key in this regard, as it helps coordinate route planning, infrastructure locations, and track current and future problems. Expanding this central hub to include weather data allows for planning agencies, businesses and citizens to achieve near full situational awareness in their dealings with the environment. Though in some cases water utilities and waste management are operated by private entities, data sharing and transparency is critical in enabling cities and their residents to understand, plan and act on resource management strategies.

URBAN GOVERNANCE

When we discuss the issues of water, waste, wastewater, and air quality, we are discussing environmental services essential to our everyday lives. They touch on every sector of society. Planning improvements to our infrastructure and management systems for environmental services are heavily influenced by government policies and regulations, as they often dictate how we use water, who collects our waste, and the level of pollutants that are allowed to enter our air. The private sector has an important role to play in smart environment, and can be innovators to legacy systems through new business models like software-as-a-service (SaaS) or risk-sharing contracts, but this requires the traditional players in government to pursue new partners with the necessary ICT know-how to help them meet the challenges of the future.

SMART CITIZENS

People in our cities interact with environmental services each and every day, which means they must be engaged and involved members of any solution that attempts to change the existing systems. Waste management programs may include the adoption of new technologies for collecting and treating our garbage, but if the general public doesn't understand or care about sorting garbage in their homes, the whole system may breakdown. The same can be said about water and air pollution. This means that while know-how of the smart technologies involved in smart environment are crucial, just as important are knowledge and skills about the environmental sciences and how our cities relate to the critical ecosystems they rely on.

Smart Environment in Bangkok

Thailand has set some ambitious environmental targets under its current Environmental Quality Management Plan (2017-2021). By virtue of being Thailand's biggest city, Bangkok is also the biggest producer of pollutants and waste, and biggest consumer of water. Tackling these issues has been given critical importance at the national level, but implementation of any smart, sustainable solutions within Bangkok are still at their early stages.

AIR QUALITY

Though many Bangkok residents would be surprised to hear it, air quality in Bangkok has improved by some measures over the past two decades. Due to improved fuel standards, some harmful pollutants such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) are now at safe levels.

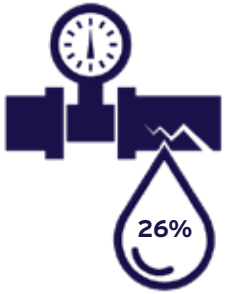
However, recent years have seen increasingly high concentrations of particulate matter, both PM10 and PM2.5, and air pollution remains the number one concern of many Bangkokians (SCI, 2019).

According to the latest data available for the city, the transport sector accounts for around 50% of the city's particulate related emissions, and this is one reason the expansion of Bangkok's public transport has been made a priority.

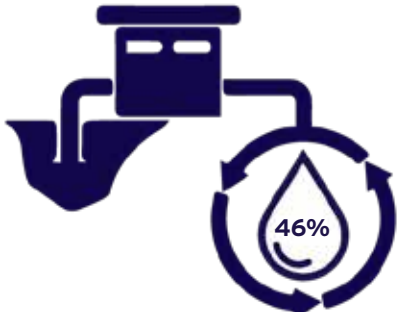
More advanced air quality monitoring together with data analytics would be beneficial to the city, though pollution sources are already well understood. Solutions to Bangkok's air quality have more to do with reducing auto emissions through improving standards and alternative mobility options.

68% of Bangkokians say air pollution is their number one concern

26% of water in Bangkok is lost due to water leaks and improper metering



Only 46% of wastewater in Bangkok is treated



WATER

Water is a major issue in cities all around Thailand, and Bangkok is no different. The two main sources of water supply in Bangkok are the Chao Phraya River and the Tha Chin River, and according to the Metropolitan Waterworks Authority (MWA), all registered residents of Bangkok have access to clean water, though many unregistered households still lack proper access to the metropolitan water supply. Overall water consumption is relatively high compared to other cities in the region, at around 440 litres per day (ADB, 2013), and water tariffs are in major need of reform, having remained unchanged since 1999.

The issues in water cover various dimensions, though of particular challenge in Bangkok are non-revenue water (NRW) and wastewater management.

Though numbers have decreased from around 40% in 2000, it is still estimated that more than 26% of water in the Bangkok system is lost due to water leaks and improper metering (BMA, 2014). This leads to significant losses for MWA, and unnecessary depletion of freshwater sources. Wastewater management is an even more significant problem, however. According to recent figures from the BMA, 2.48 million m^3 of wastewater are generated every

day in the city, but only 1.136 million m^3 are treated. This means only 46% of wastewater generated in Bangkok is treated, with large amounts of untreated wastewater being discharged into grounds, rivers, canals or the sea.

The BMA's Department of Drainage and Sewerage is in charge of wastewater treatment, and has implemented a monitoring system to measure flooding, flow, canal and river levels, and precipitation. However, wastewater treatment is currently provided at no charge, and substantial reform in the way wastewater is measured and treated is a major opportunity within the smart environment.

WASTE

Solid waste management is an issue plaguing every city in Thailand, and is a focus of every city's smart city strategies. In 2016, the government adopted the Solid Waste Management Master Plan which aims to promote more sustainable waste management and power generation from waste-to-energy technologies. It set the target of 75% of municipal solid waste to be properly managed, and 100% of hazardous industrial and infectious waste.

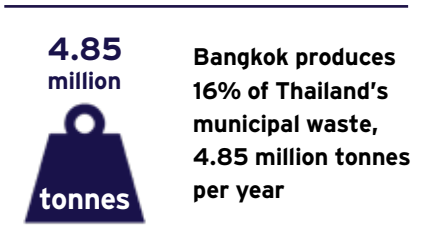
The Plastic Waste Management Roadmap 2030 calls for 100% of plastic waste to be recycled by 2027, and government, together with private sector partners, have begun to take aggressive action in reducing plastics use in the nation's capital.

However, this will be no easy task. In 2016, around 27 million tonnes of municipal waste, or around 74,000 tonnes per day, were generated nationwide, an approximate 80% increase since 2010 (PCD, 2017). Of that, Bangkok accounts for nearly 16% of the country's municipal waste, producing more than 10,000 tonnes a day. Much of the nation's solid waste is not collected, and even less is treated properly. Waste is a major challenge in Thailand.

Of the 4.85 million tonnes of solid waste produced by Bangkok every year, less than 1 million tonnes are recycled (2018), though these numbers are hard to measure as they are not part of the municipal collection process.

There is vast potential for investment into waste-to-energy, plastic waste recycling and reuse, and overall waste reduction and management strategies. However, in order to realise this potential, there must be better sorting at source, as well as increased public awareness and education around solid waste management.

10,000 tonnes - The amount of municipal waste Bangkokians produce each day



Bangkok produces 16% of Thailand's municipal waste, 4.85 million tonnes per year

Approximately 21% of Bangkok's waste is recycled or composted

Key Players in Smart Environment

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

Thailand's environmental policies and regulations are made by the **Ministry of Natural Resources and Environment (MNRE)**, including for air and water pollution, as well as solid waste management.

When it comes to implementation, much is left to local authorities, which often leads to issues of coordination among the many government agencies and private sector.

The **Office of Natural Resources and Environmental Policy and Planning (ONEP)** is responsible for creating the Environmental Quality Management Plan, which is approved by the National Environmental Board.

The **Pollution Control Department (PCD)** sets emission and effluent standards, and oversees the control and monitoring of pollution.

MINISTRY OF INTERIOR

The Ministry of Interior's (MOI) Department of Public Works & Town Planning regulates areas used for waste disposal and administers finances to local authorities responsible for service delivery. MOI also manages two state-run enterprises responsible for operating Bangkok's water and wastewater treatment services.

The **Metropolitan Waterworks Authority (MWA)** is a state-run enterprise responsible for the distribution, treatment and sale of potable water throughout much of the Bangkok Metropolitan Region.

The **Wastewater Management Authority (WMA)** is responsible for organising wastewater treatment in the Bangkok Metropolitan Region.

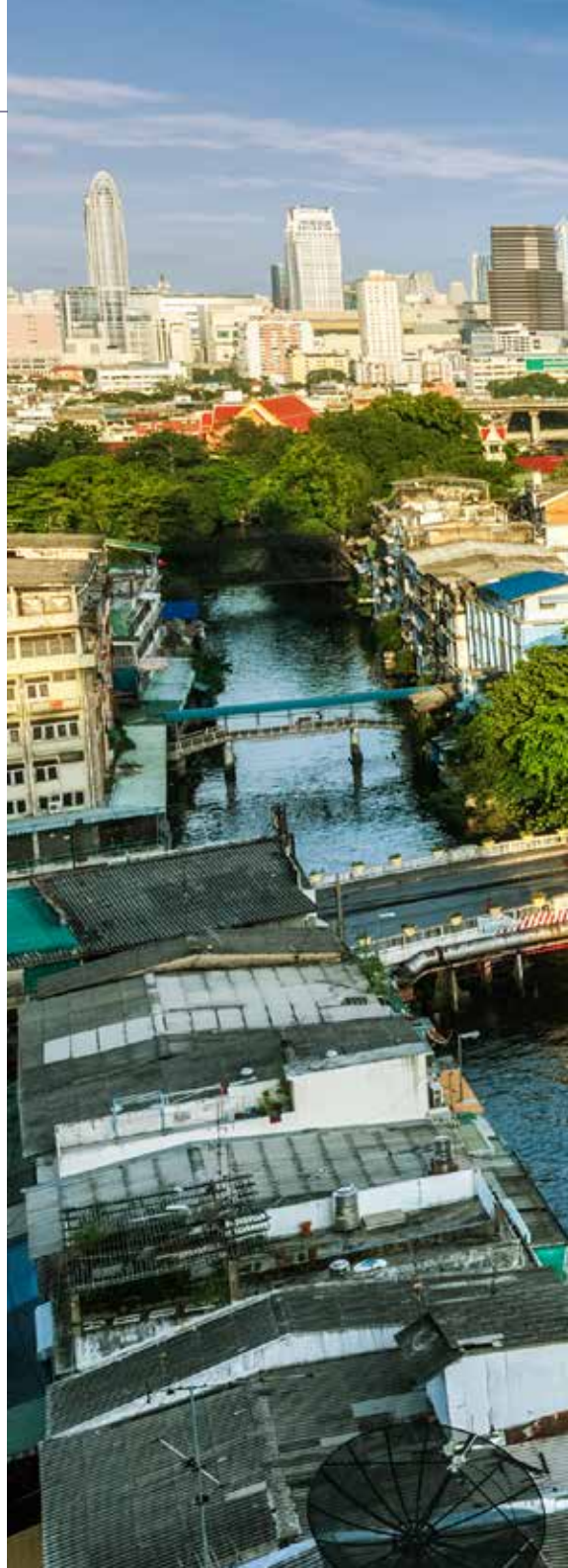
MINISTRY OF PUBLIC HEALTH

Though MNRE regulates municipal waste management, the **Ministry of Public Health** sets the collection fee ceiling that dictates how much the local municipality can charge for waste collection.

BANGKOK METROPOLITAN ADMINISTRATION

As the local authority in charge of municipal waste management, BMA contracts out collection and disposal services to third-party companies. Bangkok District offices, under the Environment Department, are responsible for collecting waste disposal fees, and hold district level data. The BMA Department of Drainage and Sewerage also play an important role in wastewater treatment.

Krungthep Thanakom is BMA's public holding company, and determines public investment or concessions into waste and wastewater treatment facilities, including waste-to-energy plants.



SMART CITY SERVICE PRIORITY

Smart Water Metering & Monitoring

Smart metering for both drinking water and wastewater in households is a key opportunity for improving water use and treatment in Bangkok. Smart water metering and monitoring provides both households and service providers information in real-time about water consumption, water discharge, and any potentially harmful pollutants entering municipal water treatment facilities.

BENEFITS

Online, real-time water quality monitoring helps measure current levels of pollution, as well as alerting citizens to health risks, while water consumption metering is critical to enhance Bangkok's ability to improve resource efficiency and provide cost savings both to consumers and the Municipal Waterworks Authority (MWA).

RELEVANCE

Bangkok's water bodies are some of the most polluted in the world, attributed to inadequate facilities for water treatment and monitoring. Water shortages and salinity are also increasing challenges during the summer months.

The complete lack of wastewater discharge tariffs, and the low charges for water distribution, has been attributed to the lack of financial capacity for the city to upgrade its water infrastructure. Smart metering and monitoring can help in both counts by enabling accurate counts on the amount of water being used and discharged, which can lead to more accurate tariff reform.

ONGOING INITIATIVE

A number of suppliers exist in Thailand selling smart water metering technology, though no planned or ongoing initiatives exist for smart water metering in Bangkok.

SERVICE ECOSYSTEM

Smart meters record water consumption at regular intervals and then transmit information to a cloud platform for monitoring and analysis by the Metropolitan Waterworks Authority (MWA). Smart sensors measure the amount of wastewater discharged.

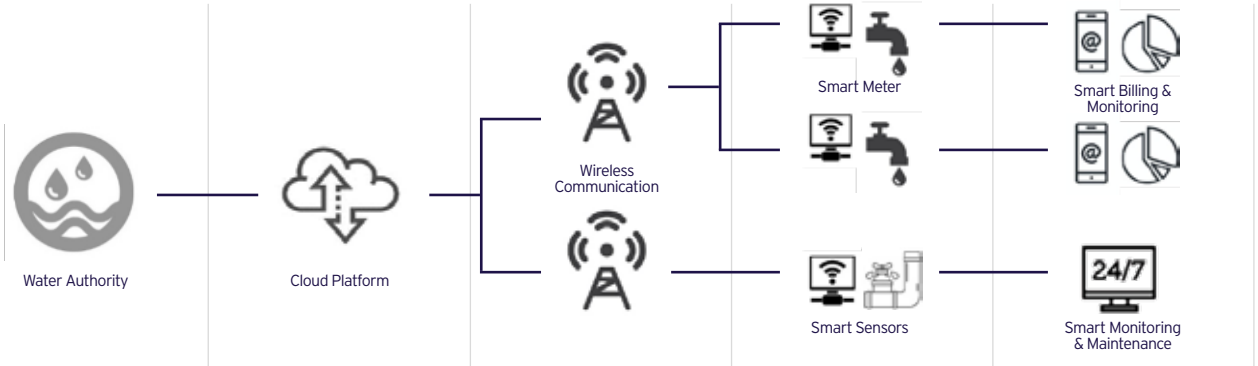
Consumption and discharge information is then transmitted back to consumers through a mobile device or home monitoring system, allowing for consumption and discharge monitoring to support more efficient water use practices.

The Metropolitan Waterworks Authority (MWA) and Wastewater Management Authority (WMA), together with the BMA Drainage and Sewerage Department, will be responsible for meter and sensor selection, procurement, installation and monitoring. They are also responsible for reporting and billing with their customers. Pollution levels and will be monitored and evaluated by the Pollution Control Department (PCD)

COMMERCIAL OPPORTUNITIES

UK based solution providers and water authorities can support the MWA, WMA and BMA in designing and delivering the smart metering and monitoring system, as well as provide data analytics solutions for better response and improvements to the distribution and treatment networks of Bangkok.

While actual meter and sensor technology is likely to be sourced locally or from other global brands, the UK should focus on data analytics support and solutions.



ROLE	Water Authority	Cloud Platform	Wireless Communications	Smart Meter & Sensors	Smart Billing & Monitoring
THAI STAKEHOLDERS	MWA WMA PCD BMA	Solution Provider	true AIS dtac CAT	Solution Provider	MWA WMA Smart Meter Provider
DESCRIPTION	The water supply authority (MWA) and wastewater management authority (WMA, BMA Drainage and Sewerage) select and integrate meters	Cloud solutions and data analytics are provided by the smart meter provider	National, wireless telecommunications networks will enable data to pass from meters to water authorities	Smart meters solutions provider for water consumption monitoring, and smart sensors for discharge monitoring	Consumer facing consumption monitoring solutions, provided by MWA or solution provider, and water quality monitoring by the WMA
UK OPPORTUNITY	Smart metering system development, meter selection & procurement support	Cloud platform solutions and data analytics services & consultancy	-	Smart meter or sensor provider together with data analytics services	-

WHY THE UK?

UK-based companies are supporting the transformation of water utilities by using smart, data-based technology. Using leading-edge modelling and analytics tools, UK firms are helping utilities turn asset and operational data into actionable insights, and improve customer service and efficiency.

The UK is also a pioneer in wastewater treatment as British wastewater companies provide a full range of services to their international clients, including upgrading and renovating existing systems.

What can the UK offer?

- Water management system design
- Water system modelling and data analytics
- Predictive control and automation tools
- Wastewater recycling and treatment

Aquamatix (www.aquamatix.net)

Developed WaterWorX™, a completely different approach to the way real-time network management solutions are designed and delivered which is a lot faster, lower cost and based on open standards.

Costain (www.costain.com)

Costain helps to improve people's lives through smart infrastructure solutions to meet urgent national needs across the UK's energy, water and transportation.

Kingspan Water & Energy (www.kingspanwaterandenergy.com)

Kingspan Water & Energy has been manufacturing sustainable solutions that preserve and protect water and energy for over 50 years. Our portfolio of Water, Energy and Service Management Solutions coupled with intelligent monitoring, utilising the Internet of Things, provide our customers with enhanced insight and greater control over their water and energy assets.

Metasphere (www.metasphere.co.uk)

Metasphere provides robust asset monitoring of time critical remote operations for operators to gain competitive advantage and meet regulatory compliance. Applications in the water and energy infrastructure sectors. IoT devices for real time monitoring.

Rezatec (www.rezatec.com)

Rezatec provides Big Data GeoAnalytics using proprietary algorithms and advanced machine learning techniques to customers spread across the water utilities, agribusiness, energy, urban infrastructure and forestry sectors.

SMART WATER UK SUCCESS STORY: YORKSHIRE WATER*

OVERVIEW

Yorkshire Water's Hadfield smart water network pilot is a game-changing pilot project developed with significant investment from Yorkshire Water Services (YWS).

The utility is running a proof of concept, smart networks pilot in Hadfield and Loxley over the next 12 months, with the aim to revolutionise their approach to leak management and supply interruption reduction.

This urban area, with a population of around 20,000, was selected as YWS has already deployed a wide range of sensors and meters (~3,800), including smart digital meters, acoustic and hydrophone loggers, temperature, pressure and water quality sensors.

KEY STAKEHOLDERS

- Yorkshire Water Services
- Xylem
- View

TIMELINE

- Ongoing

APPROXIMATE PROJECT VALUE

- N/A

OUTCOMES

The disruptive and innovative pilot will present rich data from new and existing sources in an integrated, single visualisation platform. The platform uses machine learning and AI to cluster data sets and remove false positives to accurately inform asset and operational decision making.

The cloud-based system will help meet YWS Outcome Delivery Incentives (ODI's), mainly leakage, per capita consumption (PCC), supply interruptions, and customer measure of experience.

*Source: WWTonline

SMART CITY SERVICE PRIORITY

Smart Waste Management

Thailand's ambitious targets for waste management apply heavily to Bangkok. Waste management reforms present vast potential for reuse and recycling, as well as waste-to-energy. However, none of this will be possible at scale without proper sorting and collection practices. Enter Smart Waste Management.

Smart Waste Management uses simple sensor technology to detect waste levels in public and community bins, and utilises data analytics to improve waste collection routes, leading to improved recovery of waste, and reduced costs for collection agencies.

BENEFITS

Smart waste management practices can benefit citizens by improving waste pick-up rates, reducing waste bin overflow, and reducing potential contact to harmful pollutants. It benefits waste collection agencies by reducing fuel and other operational costs through smart routing that optimises the waste collection truck time on the road.

RELEVANCE

Bangkok produces the highest amount of waste, by far, in Thailand, and more than half of the city's waste is dumped openly. The installation of smart bins and smart route planning can make the most out of insufficient waste treatment infrastructure and capabilities.

If coupled with waste collection fee reforms that incentivise waste reduction, Bangkok's waste management can be drastically improved.

ONGOING INITIATIVE

D-Kids Phuket

In 2017, the mayor of Phuket's busiest tourist destination, Patong Beach, partnered with local waste management SME D-Kids to develop a smart waste management application to combat the overwhelming amount of rubbish piling up in the town.

A mobile application was developed by D-Kids for locals to take photos and report where waste pileups were occurring. D-Kids would then collect waste for disposal.

The service has since expanded to include smart bins equipped with sensors to measure the amount of waste, as well as temperature and humidity. Untreated waste has been reduced by an estimated 30%.

D-Kids was awarded a THB 42 million contract from the local municipality, and is seeking THB 10 million in loans to procure seven additional garbage trucks.

SERVICE ECOSYSTEM

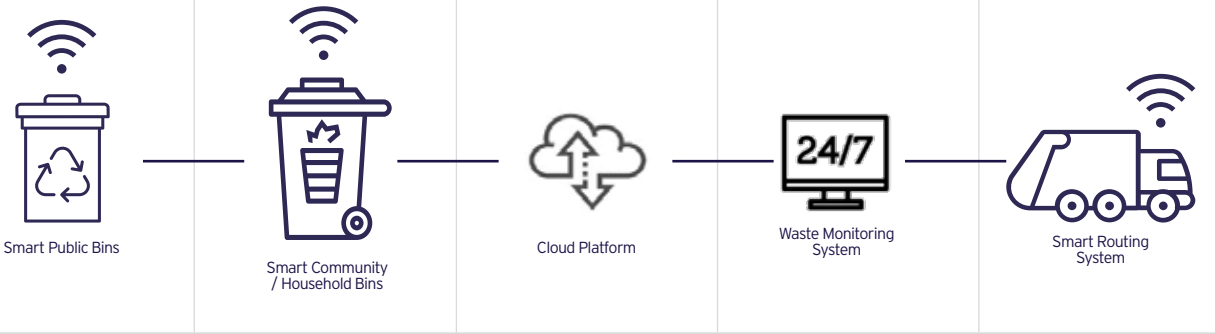
Waste collection and disposal in Bangkok is provided by third-party contractors under the supervision of BMA. They are responsible for public waste collection, and also contract separately with private property developers and managers to provide waste collection to private residences and commercial buildings.

The BMA and property owners will either directly install smart bin sensor technology within their respective jurisdiction, or contract out to one of the waste collection companies to own and operate the bins. Waste levels are then recorded by the smart bins and stored on a cloud platform, which is then analysed through a central waste monitoring system. Artificial intelligence and data analytics are then utilised to optimise route planning and waste collection for collection operators.

COMMERCIAL OPPORTUNITIES

While the largest impact for waste management in Bangkok would be to implement smart management practices at the city or district scale, this will require significant reform from the BMA and third-party contractors, limiting commercial opportunities in the short-term.

However, many private property developers and large commercial developments are exploring ways to reduce and manage waste within their property, and there are opportunities throughout the service chain to partner directly with these private entities. Opportunities also exist for construction waste management and waste-to-energy.



ROLE	Smart Public Bins	Smart Community / Household Bins	Cloud Platform	Waste Monitoring System	Smart Routing System
THAI STAKEHOLDERS	**BMA** **Contracted Waste Collectors**	**Real Estate Developers or Property Managers** **Neighbourhood Developments**	**Solution Provider**	**BMA** **Contracted Waste Collectors** **Solution Provider**	**BMA** **Contracted Waste Collectors** **Solution Provider**
DESCRIPTION	BMA and their contracted collection and disposal companies will select and install smart bin technology at optimally placed locations for public waste collection	Private property developers and managers, as well as large neighbourhood developments install smart bin technology in their developments	Waste levels of bins will be recorded and stored on a cloud platform	BMA and waste collection companies will operate a waste monitoring system to track waste in the system; Can also be contracted to a solution provider	BMA and waste collection companies utilise smart routing analytics to optimise garbage truck routes; Can also be contracted to a solution provider
UK OPPORTUNITY	Waste bin location system design and consulting, and technology provider	Waste bin location and system design and consulting, and technology provider	Cloud platform solution provider	Waste monitoring system and data analytics solution provider	Smart routing system solution provider

WHY THE UK?

The waste industry in the UK is extensive, and the country has numerous experts working within the consulting, operational and engineering sectors. These experts work on national and international projects providing innovative and groundbreaking services.

UK consultancies are highly regarded internationally and are well placed to help bridge the gap between research and industry, enabling faster development and implementation of ideas.

What can the UK offer?

- Waste management strategy consulting
- Innovative waste collection and sorting technologies
- Waste incineration systems
- Anaerobic digestion technologies
- Plastic recycling & reuse
- Waste-to-Energy
- Processing of construction, demolition and excavation waste

All Waste Matters Ltd (www.allwastematters.co.uk)

Professional collection and disposal of chemical waste.

Biffa (www.biffa.co.uk)

Biffa is a waste management company in the UK. It provides collection, landfill, recycling an special waste services to local authorities and industrial and commercial clients in the UK.

Cheaper Waste (www.cheaperwaste.co.uk)

The UK's fastest-growing waste management service provider.

Denniss Eagle (www.dennis-eagle.com)

Providing the global waste and recycling industry with robust, reliable efficient and innovative ECO-technology.

Egbert Taylor (www.egberttaylor.com)

Egbert Taylor is the UK's leading provider of waste management solutions through their innovative and forward thinking product range.

FCC Environment (www.fccenvironment.co.uk)

FCC Environment is one of the UK's leading waste and resource management companies with a range of services, from collecting business and municipal waste to recycling and processing and the generation of green energy from waste.

Grundon (www.grundon.com)

Grundon Waste Management provide a service for reduction, reuse, recycling, recovery and disposal of waste.

Highlander International (www.highlanderinternational.co.uk)

Highlander International recycling offers a wide range of products and services relating to recovered paper recycling.

Hillend Engineering (www.hillendeng.com)

Hillend Engineering develops waste and recycling products with specific missions in mind.

MVV Environment (www.mvv.de)

MVV Environment provides flexible solutions for waste disposal, producing environmentally sustainable energy.

Recycling UK Ltd (www.recycleduklimited.com)

Recycled UK Ltd's Waste Management Company and has evolved into one of the country's leading providers of total waste management solutions.

Straight (www.straight.co.uk)

Straight Ltd (Waste & Recycling Container Specialists) is the UK's leading manufacturer of high-quality waste and recycling solutions.

The Waste Company (www.thewastecompany.co.uk)

The Waste Company is the UK leading Waste Management Solution Specialists, Commercial Waste, Construction waste and Recycling waste solutions.

Viridor (www.viridor.co.uk)

Viridor is one of the UK's leading recycling, resource and waste management companies helping businesses and local authorities across the UK.

Wyllie Recycling Ltd (www.wyllierecycling.co.uk)

Wyllie Recycling Ltd is committed to real recycling and to achieve "Zero waste to landfill".

WASTE MANAGEMENT UK SUCCESS STORY: BIFFA SEAHAM

OVERVIEW

In January 2020, Biffa, a UK leader in recycling and waste management, opened a new state of the art PET plastic bottle recycling facility in Seaham, County Durham, UK. The facility is capable of processing 57,000 tonnes of PET plastic per year, or the equivalent to 1.3bn plastic bottles.

PET, or polyethylene terephthalate, is a commonly used material to package soft drinks, popular as it is lightweight, durable, and highly recyclable, producing significantly lower carbon emissions

The Biffa plant will convert PET back into plastic pellets to be sold and used for a range of recycled products, ranging from food and beverage packaging, to clothing.

KEY STAKEHOLDERS

- Biffa
- Northern Powerhouse Partnership

TIMELINE

- Ongoing

APPROXIMATE PROJECT VALUE

- £27.5 million

OUTCOME

The new facility is expected to generate £40m in revenues per year, and will provide 100 full time jobs in the region.

The plant will capitalise on the access to plastic waste that Biffa has through its collections and sorting activities, including the 4.1m tonnes of waste and recycling the Group collects from UK households and businesses every year.

Biffa believes the plant will play an important role in reducing plastic pollution in the UK by improving the country's ability to recycle through sustainable closed loop systems.

*Source: British Plastics and Rubber Magazine

Smart Energy

The following section describes the current state of energy in Thailand and Bangkok. It identifies some of the key technologies needed to develop a smart energy system in the city, highlights the primary stakeholders involved in smart energy, and suggests some important steps needed to further implement smart energy in Thailand's capital.

The Pillars of Smart Energy

Simply put, our cities cannot work without energy. It lights our streets, pumps our water, cools our homes, and fuels our cars, trains and buses. Energy is integral to nearly every facet of the city, and therefore it plays a critical role in the smart city, too.

Smart energy refers to creating and supporting a smart energy system, meaning a system that connects our energy production, distribution and consumption so we can understand how to balance supply and demand in real-time. A smart energy system helps to reduce waste in our networks, decrease the frequency of power outages, and empowers residents and utilities to monitor and control their energy use so we can save on our bills.

SMART INFRASTRUCTURE

Smart energy powers the technologies at the foundation of the smart city. Energy utilities will need to transform their infrastructure systems to enable consumer participation, accommodate new forms of generation and storage, and optimise grid operations. They will need to leverage information and communications technologies (ICT) to enable two-way communications between consumers and service providers.

Smart meters on every home and building, and sensors and measuring devices throughout the energy grid, will provide valuable information that helps control energy consumption and improve the reslience of the network.

URBAN GOVERNANCE

Creating a smart energy system will not occur without understanding dependencies between energy and other city systems and services. The installation of new distribution lines will require cooperation with the operators of roads and owners of other parts of the built environment. As distributed generation from solar, wind and other related technologies continues to grow, utilities, city governments, and other service providers will need to form new, closer relationships to ensure effective energy delivery. Prioritising the development of clearly defined interconnection standards is an important step in making it easier for residents and building owners to plug solar and wind into the grid and ensure interoperability over the long-term.

OPEN DATA & SECURITY

The information produced by smart energy technologies enable people to understand their consumption patterns and control their monthly utility bills. However, there are several data privacy issues related to smart metering that could prevent or slow smart energy initiatives, and it is imperative utilities are transparent and public about how they use their customers' data.

Given the dependence of other city systems and key infrastructures on the energy system, the security of a smart energy grid must also be a major priority. Because of this, it is critical to create a comprehensive security framework at the early stage of developing the smart energy system.

SMART CITIZENS

In every smart domain involving the use of advanced digital technologies and the development of new markets, the question of manpower and capacity becomes a challenge. This is no different in smart energy.

There is a need for those trained in installation of renewable energy and distributed generation infrastructures, as well as the software know-how for energy trade, management and operation of smart grids. However, markets can also be major job producers, as renewable energy jobs like solar installations typically produce more local jobs than large centralised plants that are often operated outside the region.

Smart Energy in Bangkok

Smart energy encompasses all forms of energy – electricity, gas, coal, renewables, and others. However, electricity is the most ubiquitous form of energy in our cities and is therefore the priority of most smart energy initiatives.

Electric utilities serve as the key infrastructure for energy consumption in Bangkok, bringing energy access to nearly every household and business in the city.

In 2019, Bangkok consumption amounted to 28% of the national total, or around 53,345 GWh, and consumption is growing at a rate of 3.3%, annually.

RECENT DEVELOPMENTS

In the last couple of decades, the sector has begun to employ more decentralised forms of energy generation and distribution as a range of innovation has been introduced in the form of rooftop solar and other renewables, electric vehicles, and high-performance batteries.

PAIN POINTS

Peer-to-peer energy trading is the most common type of non-public energy trading in Thailand, however, a number of technical and legal hurdles remain. Intermittent generation from solar and wind means an overdependence on renewables could lead to rolling blackouts. An unclear regulatory environment to enable individual producers of electricity to sell power back to the grid is also slowing the growth of this market.

OPPORTUNITIES

At this stage, efforts to transform the energy system through smart technologies have been limited to a small number of pilots and the introduction of regulatory sandbox policies.

However, there is a demand for advancement in energy storage capacity in Thailand that has the potential to reduce the impact of variable renewable energy generation.

Know-how related to energy trading platforms, distributed ledger (blockchain) technology, and the related software is also in high demand, as is the expertise around demand side response (DSR) management and operations.

Bangkokians consumed **53,345** GWh of electricity in 2019

53,345 GWh

Bangkok consumes **28%** of Thailand's energy

Bangkok electricity consumption is growing by **3.3%** every year

Renewable energy supplied **15%** of Thailand's energy in 2018

Key Players in Smart Energy

To truly understand the state of smart energy in Bangkok, we need to understand the landscape of the Thai domestic electricity market.

THAILAND'S STATE-RUN ENERGY ENTERPRISES

In Thailand, the electricity market is dominated by three main state-owned utilities: the Electricity Generating Authority of Thailand (EGAT) under the Ministry of Energy, and the Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA) under the Ministry of Interior.

Each state-owned utility has their own authorities and jurisdictions, appointed by the central government. EGAT is responsible for national power generation and transmission, while the other two, MEA and PEA, are responsible for power distribution in metropolitan areas and provincial areas, respectively.

In sum, EGAT has responsibility for electric power generation and transmission to MEA and PEA. EGAT owns and operates the national transmission network which includes transmission lines and substations of various voltage levels across the country, while MEA and PEA are the principal distributors.

MINISTRY OF ENERGY

The Energy Policy and Planning Office (EPPO), under the Ministry of Energy, is responsible for the strategic planning and development of the Thailand energy system.

The current Power Development Plan (2018-2037) places a major emphasis on expanding renewable energy production in the country, as well as working with the three state-run enterprises to develop and test the needed smart grid technologies to accommodate the shift to the energy "prosumer".

EPPO has initiated a number of smart grid pilots around the country, most notably in Bangkok and Pattaya, and is also working on projects related to EV-charging stations and networks.

Electricity Generating Authority of Thailand (EGAT)
Responsible for national power generation and transmission.

MINISTRY OF INTERIOR

Electricity producers and distributors must obtain electricity distribution licenses from the **Energy Regulatory Commission (ERC).** Connection to the transmission grid requires the execution of a power purchase agreement (PPA) with MEA, PEA or EGAT, and it is through this process that specific requirements concerning grid connectivity, safety standards and metering, are detailed.

Metropolitan Electricity Authority (MEA)
Responsible for power distribution in metropolitan areas.

Provincial Electricity Authority (PEA)
Responsible for power distribution in provincial and rural areas.

PTT PUBLIC COMPANY LTD.

PTT, formerly the Petroleum Authority of Thailand, is a state-owned, Stock Exchange of Thailand (SET) listed company. It's primary business is in oil and gas, but is also in electricity generation and petrochemical products.

PTT also has many subsidiaries that are working to produce more renewable or alternative forms of energy.

INDEPENDENT POWER PRODUCERS

Various independent power producers (IPPs) supply power in Thailand, the largest of which are Banpu Public Company Ltd. and Bangchak Corporation Public Company Ltd. (BCP).

SMART CITY SERVICE PRIORITY

Smart Electricity Metering

Smart metering technologies are the first step on the road to a smart electrical grid, and is a key service priority for MEA within its Bangkok service area.

As Bangkok prepares to make the jump to a national smart electrical grid, widespread application of smart metering is necessary in order to analyse and ensure network stabilty in the transition.

BENEFITS

Installation of smart metering devices at the household or building level enables real-time monitoring and analysis of energy consumption (and potentially generation), helping consumers control their consumption habits and reduce their bills.

Suppliers gain real-time notifications of potential outages and save on costs associated with manual meter readings. Data produced by smart meters can lead to policy innovations and network optimisation.

RELEVANCE

Energy consumption in Bangkok has increased steadily by 3.3%, annually, a key indicator that smart metering is needed to help slow overall consumption.

Thailand's overall reliance on imported energy sources is also driving the demand of distributed generation and peer-to-peer energy trading, both requiring smart meters to fully deploy.

ONGOING INITIATIVE

In 2020, the Metropolitan Electricity Authority (MEA) launched an initiative called the "Smart Metro Grid" project. The project is aligned with the government's smart city initiative, with a budget of Bt1.149 billion. In collaboration with FORTH and Yip In Tsoi (YIT), the project aims to install smart meters for some 33,000 households for selected areas of Bangkok.

FORTH is a Thai-tech listed company providing electronic and digital-based solutions for businesses and consumers. In this project, FORTH provides smart meters with wireless communication, while YIT, a total IT solution provider, is providing a data management platform, based on Omnimesh technologies by CyanConnode.

By 2022, smart meters and two-way communication devices will be installed which would enable MEA to monitor electricity usage in real-time and locate positions where malfunctions occur for corrective measures and quick responses. On top of that, the project will assist consumers in managing their consumption more efficiently. Data from meters will also enhance MEA's capability in developing innovative modern services for people going forward.

SERVICE ECOSYSTEM

Smart meters record electricity usage at regular intervals (typically 30 minutes or an hour) and then transmit information to a cloud platform for monitoring and analysis by the electricity authority.

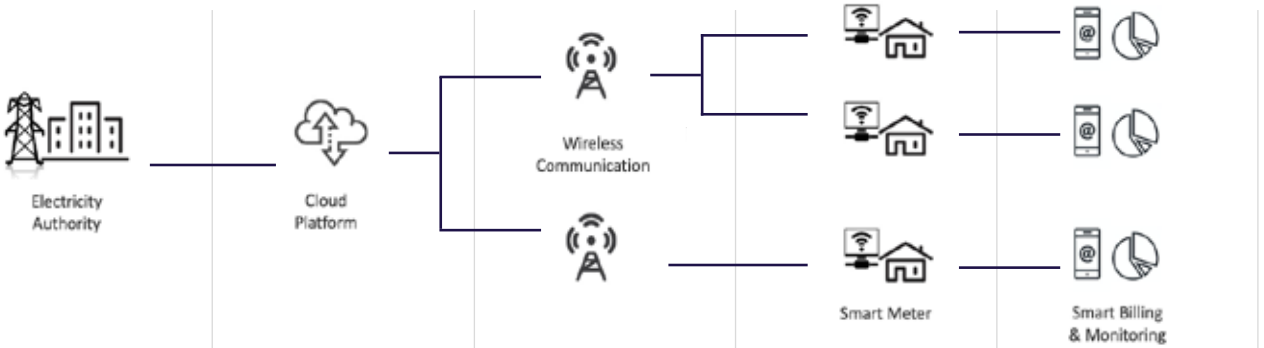
Consumption information is then transmitted back to consumers through a mobile device or home monitoring system, allowing for consumption monitoring, which can lead to more predictable and lower utility expenses.

As the electricity authority in Bangkok, Metropolitan Electricity Authority (MEA) will be responsible for meter selection, procurement, installation and monitoring. They are also responsible for reporting and billing with their customers.

COMMERCIAL OPPORTUNITIES

A solution provider will supply the smart meters themselves, while cloud platforms used to process the data collected by the smart meters will be provided by another third party. These providers are often one and the same, though that is not always the case.

UK companies have an opportunity to offer consultancy services throughout the value chain, with particular focus on data analytics with an eye towards broader network applications.



ROLE	Electricity Authority	Cloud Platform	Wireless Communications	Smart Meter	Smart Billing & Monitoring
THAI STAKEHOLDERS	**Metropolitan Electricity Authority (MEA)**	**Solution Provider**	true AIS dtac CAT	**Solution Provider**	**OR Smart Meter Provider**
DESCRIPTION	MEA is the primary service operator in Bangkok, and will be responsible for meter selection and integration	Cloud solutions and data analytics are typically provided by the smart meter provider	National, wireless telecommunications networks will enable data to pass from meters to MEA	Smart meters typically provided by company offering data analytics and cloud integration	MEA responsible for billing and consumption monitoring. May also provide installation and maintenance, though solution providers may also offer this service
UK OPPORTUNITY	Smart metering solution development, meter selection & procurement consultancy	Cloud platform solutions and data analytics services & consultancy		Smart meter provider	

WHY THE UK?

The UK has one of the most mature and sophisticated national grid systems in the world and, through its long-term evolution, the UK has developed a wealth of expertise in the design, delivery, operation and maintenance of grid systems.

The UK's regulatory framework, which emphasises and incentivises innovation, competition and transparency, has led to the growth and deployment of a wide range of smart technologies and services, all with applications that can be scaled and applied globally. Whatever the scale of project, the UK has expertise and suppliers that can deliver.

What can the UK offer?

- Policy, regulation and incentive design;
- Whole system design and implementation;
- Technical innovations (e.g. new storage
- Remote system monitoring and control systems.

Advizzo (www.advizzo.com)

Advizzo has developed a software which monitors and analyses the utility consumption patterns of consumers and provides tips and insights on how to reduce it.

CyanConnode (www.cyanconnode.com)

IoT (secure Narrowband RF mesh networks) used to save costs and energy, enabling governments, metropolitan authorities and businesses to monitor and manage services such as utilities and street lighting with optimum efficiency.

Fabriq (www.fabriq.space)

A platform that enables the management of energy and building performance data across all kinds of assets.

Germserv (www.germserv.com)

Smart metering regulatory and consultancy advice.

Green Energy Options (www.geotogether.com)

Efficient collection of raw data from meters or solar panels, delivery onto cloud servers, and the processing of information for analysis and presentation.

Steama (www.steama.co)

The world's most data-efficient energy management system.

Informetis (www.informetis.com)

Robust IoT system platform designed and developed inhouse, that collects and stores data from our own energy sensor as well as various third party IoT sensors, for energy disaggregation and other analysis.

Kingspan Water and Energy Ltd (www.kingspanwaterandenergy.com)

Kingspan Water & Energy has been manufacturing sustainable solutions that preserve and protect water and energy for over 50 years. Our portfolio of Water, Energy and Service Management Solutions coupled with intelligent monitoring, utilising the Internet of Things, provide our customers with enhanced insight and greater control over their water and energy assets.

Open Energi (www.openenergi.com)

Open Energi (formerly known as "RLtec") has developed grid management technology that once installed in electrical devices (e.g. fridges and air conditioners) aims to enable a carbon-free balancing of energy supply and demand across the national grid.

OVO (www.ovoenergy.com)

OVO is the UK's largest independent energy technology company and supplier, serving nearly one million customers with intelligent energy services and other home services.

SMART ELECTRICITY UK SUCCESS STORY: MOMBASA, KENYA

OVERVIEW

In partnership with Kenya Power (KPLC), UK-based supplier Lucy Electric installed Kenya's first 11kV distribution automation system (DAS) to help improve power supply in Mombasa - Kenya's second largest city.

It covered 1,661 square kilometres and was part of the country's wider infrastructure development programme.

Support for the development of this scheme was provided by UK Export Finance.

The turnkey solution developed by Lucy Electric also included the end-to-end design, manufacture, delivery and installation of all the contract-specified equipment.

KEY STAKEHOLDERS

- Kenya Power (KPLC)
- Lucy Electric
- UK Export Finance

TIMELINE

- Phase 1 2010-2012
- Phase 2 2015-2017

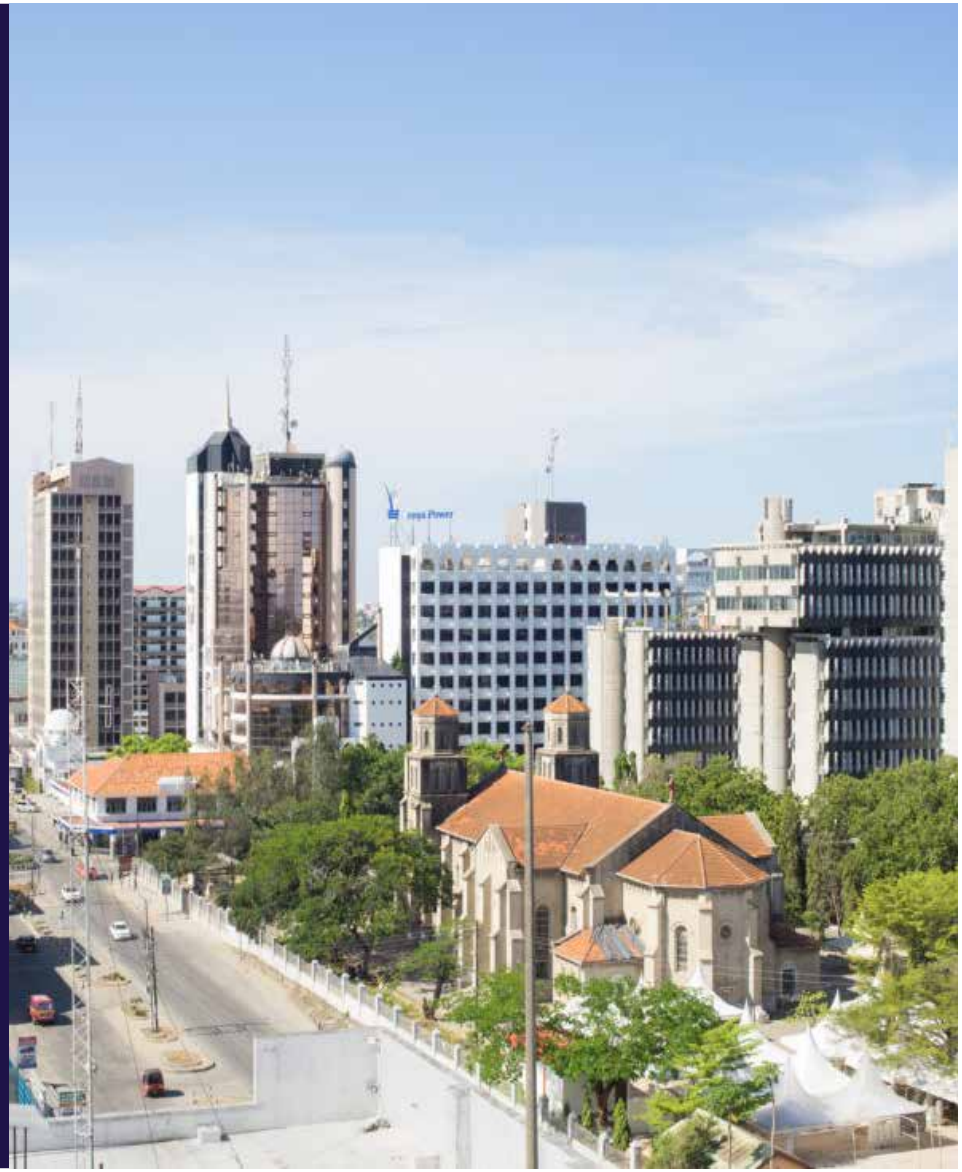
APPROXIMATE PROJECT VALUE

- £4.5m (THB 178.2m)

OUTCOMES

As a result of the project, average power interruptions have been reduced from 2 hours to just 20 seconds.

Eng. Samuel Ndirangu of Kenya Power said: "Lucy Electric's determination to provide excellent customer support both locally and remotely, through the automation design team, far exceeded the levels of value and customer service that Kenya Power has had in the past. Their automation system has given us greater control and awareness of our network which has meant that we will be able to offer a more reliable service to customers."



SMART CITY SERVICE PRIORITY

Electric Vehicle Charging Networks

The number of electric vehicles (EV) on the road in Thailand is steadily increasing, the result of government policies to promote and support EV production, and part of its push to reduce energy use in the transportation sector. The need for EV charging stations and networks, both in the home and commercial market, will continue to grow in the years to come, driving demand for charging technology itself, as well as understanding of network stability and smart demand management.

BENEFITS

Electric vehicles are one of the best long-term solutions to reducing air pollution in our cities. EVs also help to improve energy efficiency in the transportation sector, decreasing reliance on fossil fuels. EVs can even save vehicle owners money in the long-run.

RELEVANCE

According to the Land Transport Department, as of December 2019, there were more than 150,000 registered EVs in Thailand, though less than 1,500 of these were 100% battery EVs, and most of those were motorbikes. Consumer uptake of EVs is still low, though widespread market penetration is seen as inevitable in the next 5-10 years.

Thailand is the first country in Southeast Asia to offer incentives for EV manufacturers and tax reductions on sales of their cars. By 2036, the Thai government aims to have 1.2 million electric vehicles nationwide, and 690 public charging stations.

ONGOING INITIATIVES

The Electric Vehicle Association of Thailand (EVAT), together with the Energy Regulatory Commission (ERC) and Energy Policy and Planning Office (EPPO) of the Ministry of Energy, has organised the EVAT Charging Consortium, an effort to coordinate relevant stakeholders to prepare the country for servicing electric vehicle users.

It is a collaboration of government agencies and the private sector, consisting of charging service providers, automobile companies and capacitor companies.

In 2017, the Ministry of Energy, in collaboration with EVAT, began the first round of investment promotion into 100 electric vehicle charging stations in Bangkok. Both public and private sector actors were invited to submit applications to receive funds from the Energy Conservation Promotion Fund.

100% subsidies were offered to public sector partners, whereas subsidies for the private sector, which included hotels and resorts, department store operators, office and housing developments, were offered 30-70% subsidy. Both normal charging stations and quick-charge stations were included in the programme.

SERVICE ECOSYSTEM

Two major markets exist for EV charging stations: home and commercial. As the price of EVs drops in coming years, demand for privately owned EVs and home charging stations will grow. Private owners of EVs will need to install charging stations at home, which are purchased from a supplier and connected directly to the grid.

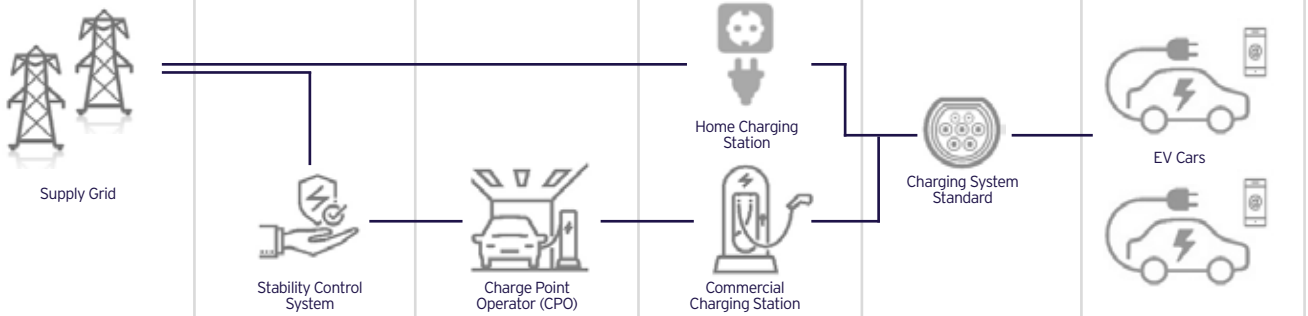
Commercial charging points are mostly operated by department store operators like Central Group and The Mall Group, operators of petrol stations like PTT and Bangchak, and large office or housing complexes. These charging points will be purchased from third-party suppliers, as well.

MEA and EGAT are responsible for ensuring stability to the electrical grid. They will work together with solution providers to develop charge management solutions that meet the needs of the supply grid.

COMMERCIAL OPPORTUNITIES

Aside from the price of EVs, the major obstacles holding back the market in Thailand today are a lack of set standards for charging networks and unknowns related to grid stability.

UK solution providers have an opportunity to enter into the growing EV market with their expertise in system design and stability control management, packaging charging station technology together with stability control system design and management solutions.



	Supply Grid	Stability Control System	Charge Point Operator (CPO)	Charging Station	Charging System Standard	EV Cars
ROLE						
THAI STAKEHOLDERS	**MEA** **EGAT**	**Solution Provider**	**Public or Private Sector Owners** (i.e., department store operators, housing developers, office parks)	**Solution Provider** (local and global providers exist in the market)	**Thai Industrial Standards Institute (TISI)**	**Car Manufacturer**
DESCRIPTION	As electricity generators and distributors, EGAT and MEA are responsible for ensuring network stability	Charge management solutions to manage frequency and improve stability in the system	The operator of commercial charging stations providing the charge point for EV owners	Both home and commercial charging stations provided by third-party manufacturer or supplier	Standards of EV charging system, electromagnetic compatibility, battery for EV and DC meter for billing system	19 major auto manufacturers exist in Thailand, most of which are already producing EVs for purchase
UK OPPORTUNITY	Consultancy for system design and management	Consultancy and technology provider for stability control system design and management solutions		Home and/ or commercial charging station provider	Standard consultancy	

WHY THE UK?

In 2017 the UK was the second largest market for Ultra-Low Emissions Vehicles (ULEVs) in Europe, and it is a global leader in their development and manufacture. In the first half of 2018 , 1 in 5 battery electric cars sold in Europe was made in the UK. The UK has long been a pioneer of automotive innovation and is increasingly a leading manufacturer of electric vehicles and charging systems.

What can the UK offer?

- Manufacture of core automotive component
- Manufacture of lighter body structures
- Provision of maintenance and repair services for E&HVs
- R&D for battery cell components
- Charging station installation and maintenance
- Development of mobile apps/ information management systems

Chargemaster (www.bpchargemaster.com)

UKs largest supplier of charging infrastructure for electric vehicles. It provides charging units for home, business and public use, and operates its own electric vehicle public charging network, called POLAR.

Connected Kerb (www.connectedkerb.com)

Connected Kerb manufactures and installs EV (electric vehicle) charging points in urban environments.

CrowdCharge (www.crowd-charge.com)

CrowdCharge is developing a digital platform to manage multiple electric vehicle chargers to provide EV owners with cheaper and greener electricity, while at the same time reducing the impact from EV charging on the electricity grid – in the UK and globally.

EA Technology (www.eatechnology.com)

Global leaders in electricity network engineering and smart charging solutions to mitigate EV impact on electrical grids. Their Network Assessment Tool represents the state-of-the-art in electric vehicle infrastructure planning and impact assessment.

EO Charging (www.eocharging.com)

EO Charging develops and manufactures smart charging technology for electric vehicles.

GreenFlux (www.greenflux.com)

GreenFlux helps its customers in the EV industry to optimally manage their charging networks to accelerate the adoption of electric vehicles.

Ovon (www.ovon.io)

Smart charging industrial designers.

Pod Point (www.pod-point.com)

The UK's leading provider of electric vehicle charging.

Spark EV Technology (www.sparkevtechnology.com)

Software solution for electric vehicles in multiple market sectors, addressing their key challenges and driving greater adoption and increased driver trust.

ELECTRIC VEHICLE UK SUCCESS STORY: ELECTRIC NATION

OVERVIEW

When launched, Electric Nation was the world's largest home smart charging trial with nearly 700 Electric Vehicle (EV) owners taking part in the 18-month trial in Midlands and Wales. Between them, trial participants provided data for more than 2 million hours of car charging. Importantly this also gave first-hand feedback on what it is like living with an EV in the real world and how they found the smart charging experience.

The lessons from this project greatly assist local electricity networks in accommodating home EV charging whilst ensuring that drivers always have the ability to charge when they need to.

KEY STAKEHOLDERS

- Western Power Distribution
- EA Technology
- CrowdCharge
- DriveElectric

TIMELINE

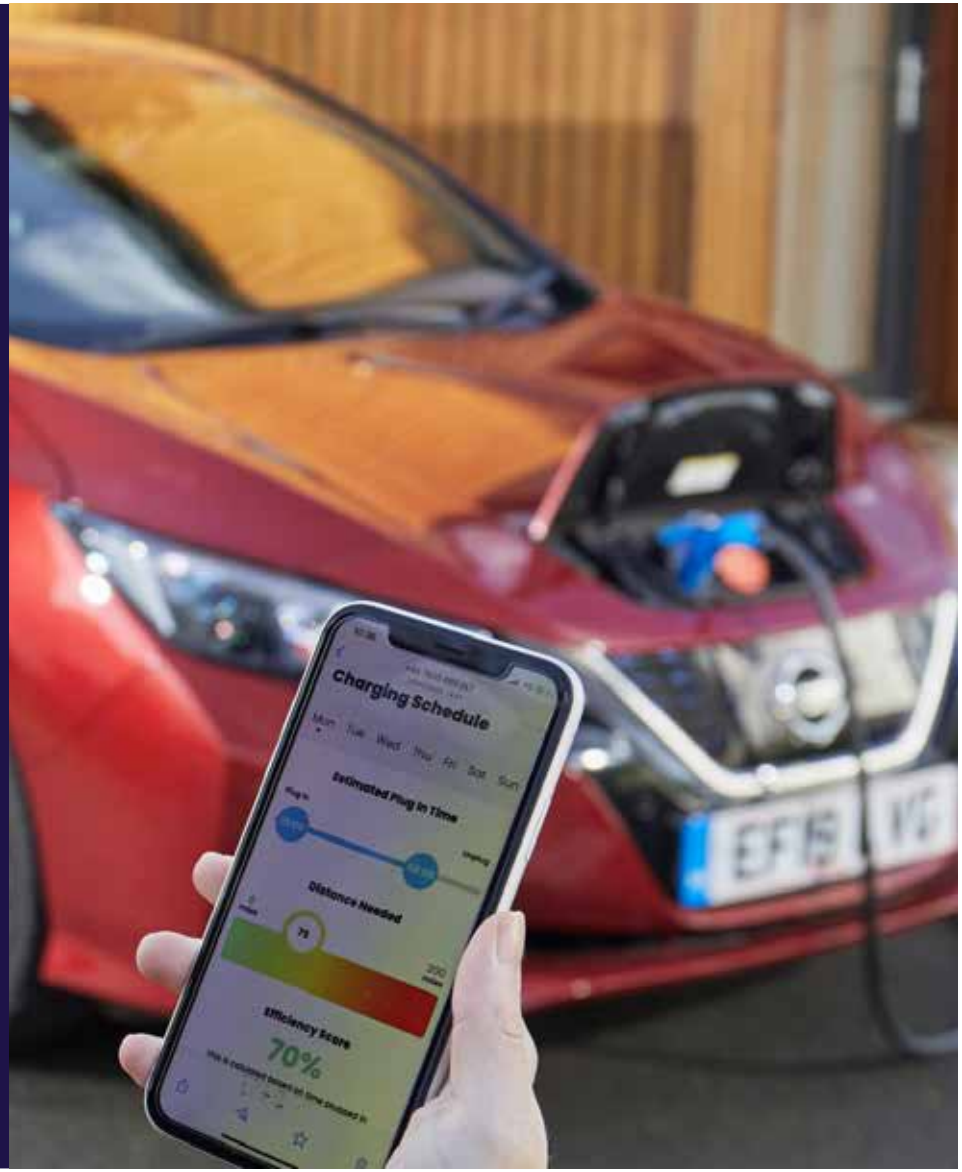
- Phase 1 2015-2016
- Phase 2 Ongoing

APPROXIMATE PROJECT VALUE

- £2.3m (THB 91.2m)

OUTCOMES

Smart charging, as trialed by the original Electric Nation project, uncovered ways to move demand away from peak times by managing charge times through charging technology. However, vehicle to grid (V2G) charging offers a lot more than just smart charging: it offers the ability for potentially millions of EVs to smart charge using renewable energy and act as battery storage facilities, and then put energy back into the grid if needed. This means that rather than EVs being seen as a problem in relation to grid capacity, they can be an important solution to help balance the grid.



SMART CITY SERVICE PRIORITY

Peer-to-Peer Energy Trading

Peer-to-peer (P2P) energy trading is the buying and selling of electricity, often excess energy from rooftop solar, between two or more grid-connected entities.

EGAT and ERC have already started to test regulatory reforms that allow for P2P energy trade from solar rooftops onto the grid, and the MEA and PEA have also launched pilots to explore the impact of distributed renewable energy production on their systems.

BENEFITS

P2P energy trading expands the availability of renewables, reduces the cost of energy, and provides choice in the market for consumers.

By distributing power generation, you also reduce the strain (or need) for expensive electricity transportation networks, and the network can become more resilient to disruption. With the use of blockchain, trading can also be done with full transparency.

RELEVANCE

Thai energy is heavily dependent on imports and fossil fuels, and the Ministry of Energy has already stated the goal of moving towards distributed power generation and domestic renewable energy.

Opening the energy market to P2P trading through a producer-consumers, or 'prosumer', model drives the demand for renewable energy generation, quickening the transition to distributed energy, while reducing the cost to government and public utilities.

ONGOING INITIATIVE

In 2018, Power Ledger, an Australian-based software company developing solutions for the energy industry, partnered with BCPG, the Bangchak subsidiary and renewable energy industry leader, to pilot a peer-to-peer energy trading platform in Bangkok.

The Power Ledger Platform utilises an ecosystem of blockchain applications to allow households and other renewable energy producers to trade electricity with each other.

Power Ledger and BCPG partnered with MEA and Thai real estate developer Sansiri to install a total capacity of 635 kW of solar power generation at its T77 development. The trial includes four large energy consumers: a shopping centre, a high school, an apartment building, and a dental hospital.

By utilising a blockchain token system, excess energy produced by these four entities can be sold to the others, rather than letting it spill back into the network. In this pilot, BCPG acts as a middle-man in buying and selling the excess energy. In a commercialised deployment, participants could receive an even higher return.

This project marked the first P2P renewable energy trade in Asia.

Power Ledger bcpg SANSIRI

SERVICE ECOSYSTEM

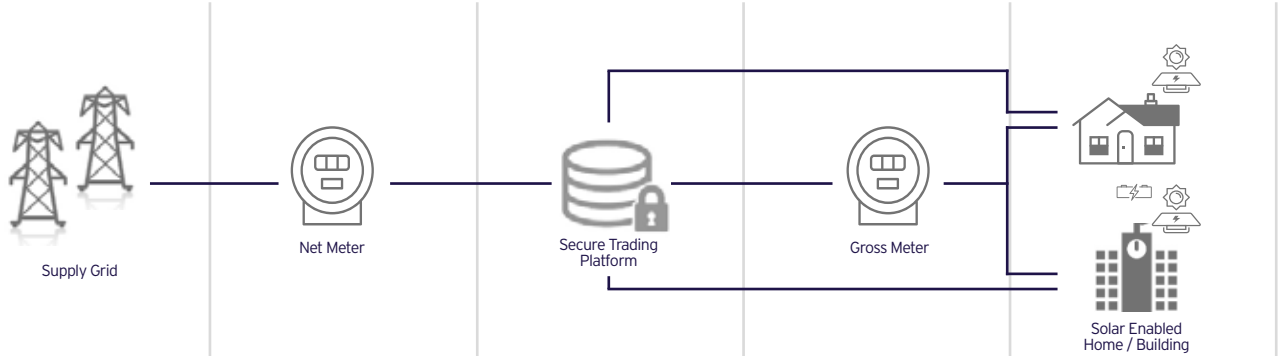
The simplified ecosystem to the right shows the basic form of a P2P energy trading platform. Solar panels are installed at homes and/or commercial buildings for energy generation. Excess energy can then be transmitted and sold to other users through user-friendly apps or online platforms which allow consumers to see how much energy they use, need, or have stored, and then enable them to trade it instantly with other local users at the click of a button (or through automation).

In this model, energy trading is done completely 'behind the meter', meaning energy is not traded back onto the broader grid, though traditional electricity suppliers and retailers, in this case MEA, may still charge a fee for the use of their distribution network. Early pilots are being trialed where MEA or EGAT may also purchase unused energy generated by solar panels for a feed-in tariff as it is brought back into the larger grid.

COMMERCIAL OPPORTUNITIES

P2P energy trading is still in the very early stages in Thailand, and there is demand for the expertise throughout the value chain. In particular, overall network and tariff structure consultancy is in need, as is the platform solutions to facilitate secure trading transactions, including blockchain.

Though solar panels are already well supplied in the Thai market, there is an opportunity in battery technology to increase storage capacity.



ROLE	Supply Grid	Net Meter	Secure Trading Platform	Gross Meter	Solar enabled home / building
THAI STAKEHOLDERS	**MEA** **EGAT**	-	**MEA or Solution Provider**	-	**Solar Panel Supplier & Home Owner / Building Operator**
DESCRIPTION	As the current electricity retailer in Bangkok, MEA will buy excess energy through a feed-in tariff and monitor network stability	Net meter measures unused energy AFTER private use or P2P trading for purchase through the grid	Energy trading occurs through a unified, secure platform, provided by technology company or the energy retailer themselves (can utilise blockchain technology)	Gross meter records ALL of the electricity generated by solar panels	Solar panels supplied and installed at home or building site - connected to P2P network; May include battery technology for energy storage for later use/trade
UK OPPORTUNITY	Network design and tariff structure consultancy	Smart meter provider, data analytics and communication	Trading Platform supplier, data analytics, and blockchain consultancy	Smart meter provider, data analytics and communication	Battery technology provider

WHY THE UK?

Some of the UK's biggest energy firms are implementing groundbreaking trials of peer-to-peer energy trading within the domestic grid, and they are standing by, ready to export their knowledge abroad.

These UK firms can help support the development of new, sustainable business models for energy utilities and providers, and help in the transition to a cleaner and more efficient energy system.

What can the UK offer?

- Electrical networks and storage consultancy
- Original equipment manufacturing
- Aggregation intermediaries (demand side response)
- P2P system development & project management
- Blockchain system design
- Co-location and Renewables

Anesco (www.anesco.co.uk)

Anesco is the UK's leading renewable energy company that develops, constructs, operates and maintains high performing grid scale renewable energy projects.

Bowers Electricals (www.bowerselec.co.uk)

Bowers Electricals is a UK-based designer and are Electrical Transformer Manufacturer of Industrial transformers.

Cumulus Energy Storage (www.cumulusenergystorage.com)

Cumulus Energy Storage (Cumulus) aims to be the leading manufacturer and developer of grid-level energy storage batteries with the lowest levelised cost of storage (LCOS) globally.

EA Technology (www.eatechnology.com)

EA technology is a world leader in products and services which enhance th performance, reliability, safety and cost-effective of power networks.

Greenhedge (www.green-hedge.com)

Green Hedge develops, realises and operates large grid-connected energy storage projects across Britain.

Highview Power (www.highviewpower.com)

Highview Power's CRYOBattery delivers, clean, reliable and cost-efficient long-duration energy storage to enable a 100% renewable energy future.

Kiwi Power (www.kiwipowered.com)

Kiwi Power is a leading global energy technology company that is simplifying distributed energy. Kiwi Power's vision is to simplify distributed energy for global sustainability impact.

Limejump (www.limejump.com)

Limejump provides distributed energy generators in the UK with smart, simple and transparent access to energy markets.

Origami Energy (www.origamienergy.com)

Origami Energy is a technology company with the vision to build a real-time marketplace for the distributed energy world.

Ormazable UK (www.ormazabal.com)

The company specialised in the electric sector focused on innovation and encourage the development of the electric sector to solve future energy needs.

Powervault (www.powervault.co.uk)

Powervault make intelligent, future-proof home battery storage solutions.

Piclo (www.piclo.energy)

Piclo is a software company on a mission to make electricity cheap, clean and abundant. Piclo Engage gives generators and consumers control over their energy by showing where electricity is generated and sold, what it costs and how those costs change over time.

Swan Barton (www.swanbarton.com)

Swanbarton is the original energy storage consultancy in the UK.

TNEI (www.tneigroup.com)

TNEI is an independent specialist energy consultancy providing technical, strategic, environmental and conventional and renewable energy sectors.

Upside Energy (www.upside.energy)

Upside Energy is helping to shape the energy transformation through pioneering digital solutions that support the smart energy management systems of the future.

Verv (verv.energy)

Verv has developed a cutting-edge peer-to-peer renewable energy trading platform utilising AI technology blockchain for trading.

P2P ENERGY TRADING UK SUCCESS STORY: VERV ENERGY

OVERVIEW

In 2015, Verv received funding from Innovate UK to develop a cutting-edge peer-to-peer renewable energy trading platform, spearheading the first blockchain enabled P2P energy trading in the UK.

They based their innovation on high-speed data acquisition and AI technology for understanding the consumption and production of energy, teamed with blockchain for trading.

It enables households with solar panels to sell the excess energy that they generate directly to their neighbours, improving their ROI and incentivising uptake, improving access to cheaper, green energy for those that cannot afford renewables.

KEY STAKEHOLDERS

- Verv
- Innovate UK
- Ofgem

TIMELINE

- 2015-2018

APPROXIMATE PROJECT VALUE

- N/A

OUTCOME

In 2015, Verv were selected to be part of UK regulator Ofgem's sandbox for new and disruptive technologies, providing regulatory flexibility to test their platform.

With funding from Innovate UK, they set out to power a social housing community with sunshine using their energy trading platform in a Hackney estate with solar panels installed by Repowering, a social enterprise set up to facilitate community owned energy.

In April 2018, Verv conducted the UK's first peer-to-peer trade of energy on blockchain technology, and results have shown a potential to reduce energy bills and carbon emissions by 20%.

*Photo: Verv

Smart Mobility

The following section discusses the incredibly important transportation networks and movement of people, goods and services in the Thai capital. It describes how smart technology can play an important role in reshaping mobility in Bangkok, who is involved in the sector, and some of the intelligent solutions being proposed to address current mobility challenges.

The Pillars of Smart Mobility

In a nutshell, Smart Mobility is about the integration of different modes of transportation and infrastructures in order to optimise the way we move around our cities.

As a result, a range of benefits can be provided, from time-saving on commutes to pollution reduction. From the commuters' view point, Smart Mobility allows the public easier access to a greater number of transportation options in more efficient, safer and cleaner ways. Smart Mobility plays a critial role in determinig our quality of life in cities, and if done right, it can help to reduce CO_2 emissions, alleviate traffic congestion and improve business efficiency and productivity.

SMART INFRASTRUCTURE

Smart Mobility will intensively rely on the use of the Internet of Things (IoT) to facilitate communication between modes of transportation and user interfaces, via a wireless network. For example, GPS trackers in every bus or train, the strategic placement of roadway sensors so we can track the movement of vehicles throughout the city, and even the sourcing of information directly from our smart phones so we can monitor pedestrian and bicycle movements.

Loads of data from connected smart devices will be collected and interchanged, through the city's communications network, and then analysed to enhance traveler experience.

URBAN GOVERNANCE

Smart mobility is an interconnection between digital technologies, urban design and city transportation policy. It is also the interplay of many different actors in the transportation network, from bus service operators, to taxi drivers, to the pedestrians crossing the street.

Especially in the reform of legacy transportation systems, this interplay of actors and technologies inevitably leads to challenges and conflict. In this case, the right governance structure is critical to the success of smart mobility. It is necessary to have strong leadership and vision on the future mobility of the city, and clear communication to those involved so they can understand how to use and benefit from it.

OPEN DATA & SECURITY

Our cities rely on vast transportation networks, and understanding how to manage, improve and navigate them requires a lot of data.

Smart mobility is about collecting, analysing and communicating real-time information about how we move through our cities so we can better understand how to reduce congestion and improve service quality.

As our transportation networks become ever more interconnected, relying on universal payment platforms and the constant flow of data, protection of personal data and the security of our communication networks become keys to success in the smart city.

SMART CITIZENS

Smart mobility empowers citizens to make better transportation decisions so they can move through the city faster, safer and more easily.

This is done by giving people more mobility options, and giving them control over those options. For example, integrated payment platforms or fare cards that can be used to pay for and use all forms of transportation or parking in the city makes the lives of citizens easier.

By opening up and sharing transportation data, citizens can take control over their mobility not just through choice, but through creating innovative new solutions to mobility challenges, creating new business opportunities in the process.

Smart Mobility in Bangkok

Bangkok is a city well known for its traffic congestion problems. With more than 10 million people living in the city, and an auto-oriented mobility network, it can be quite a challenge getting around the city, especially during rush hour.

Historically, Bangkok had a robust streetcar network, as well as a vast web of canals used for water transport. However, as the city expanded, both streetcars, and many canals, were removed or paved over in favor of the automobile.

Today, as is fitting for a city of such variety, there are many different forms of urban mobility. There is 159 km of fixed-rail mass transit, currently in operation under three different service providers, the BTS (skytrain), MRT (underground) and Airport Rail Link. However, more than 40% of trips in Bangkok are made by private car, which is nearly double the use of public transportation (25%), and another nearly 25% is by private motorbike. Bus, controlled by Bangkok Mass Transit Authority (BMTA), is the most commonly used form of public transport, at 18% of total trips. The bus, however, is largely seen as a mode of travel for those that cannot afford other means, and the service quality is in major need of an upgrade.

Privately operated van transport is also common for commuters, as is riverboat ferry for those that need to traverse the Chao Phraya River. On the few canals that still exist, a small number of commuters still use canal boat taxis for their daily needs, and in the historical parts of the city, the quintessentially Thai *tuk tuk* is a common form of travel for short trips.

PAIN POINTS

Aside from traffic congestion, which is the biggest issue plaguing Bangkok's transportation system, the lack of integration amongst its many forms of transport is a major drawback to urban mobility in the city. For most people, other forms of transportation are needed to reach public transport, such as a taxi and or motorcycle taxi, requiring payment for the first and last mile. This lack of a robust feeder system is one of the main reasons why driving cars is the preferred option for many in Bangkok.

RECENT DEVELOPMENTS

Bangkok's mass transit is undergoing a massive expansion, with 10 additional lines, and nearly 400 km of new train lines expected to be in operation by 2029.

29% of Bangkok households own a private automobile

23% of Bangkokians do not own any vehicle

25% of trips in Bangkok are on public transit

Bangkok mass transit will expand by nearly 400km by 2029

Key Players in Smart Mobility

OPPORTUNITIES

Efforts to better manage traffic and to improve efficiency, convenience, and safety of transportation are underway, and the use of smart technology is considered as a key enabler.

Consequently, the Ministry of Transport's Office of Transport and Traffic Policy and Planning (OTP) has developed an Intelligent Transport System (ITS) Development Master Plan for Bangkok, in which it lays out a roadmap for various smart transport solutions, including integrated traffic data and control, integrated public transport service, and eventually enhanced Mobility-as-a-Service (MaaS).

ITS development is still in the early stages, and OTP and other key players in the smart mobility ecosystem are still exploring the optimal mix of solutions. Expertise and consultancy in intelligent transport system design and data integration and analysis are in need, and there are opportunities to introduce new business models and incentive schemes to develop the integrated public transport and MaaS platforms envisioned for the future of Bangkok.

MINISTRY OF TRANSPORT

MOT is the key ministry in charge of national transportation policy and planning, and it plays a major role in the planning and development of Bangkok's transportation system, both through its policy office, and as service operator through its various state-run enterprises.

The **Office of Transport and Traffic Policy and Planning (OTP)** is responsible for creating transport and traffic policy. OTP overseas mass transit planning in Bangkok through the Mass Rapid Transit Master Plan, as well as the Intelligent Transport System (ITS) Development Master Plan.

The **Mass Rapid Transit Authority of Thailand (MRTA)** is the state-run enterprise responsible for mass transit operation in Bangkok and other provinces. It currently operates the **MRT**'s two underground and elevated lines in the BMR, with ongoing construction and planned development of four additional lines.

The **Bangkok Mass Transit Authority (BMTA)** is the state-run enterprise responsible for bus operation in Bangkok.

The **State Railway of Thailand (SRT)** is the state-owned enterprise responsible for national rail operation, which includes operation of the Airport Rail Link, an express commuter rail connecting Suvarnabhumi Airport to the central city.

The **Expressway Authority of Thailand (EXAT)** is the state-run enterprise responsible for operating Thailand's controlled-access highways.

BANGKOK METROPOLITAN ADMINISTRATION

As a city government, the **Transportation and Traffic Department of BMA** has a responsibility in traffic supervision and development. BMA also grants concessions to transport service operators.

BANGKOK MASS TRANSIT SYSTEM

The Bangkok Mass Transit System, or BTS, is a privately held company which operates the elevated mass transit system in Bangkok under a concession granted by BMA. The BTS currently operates two lines, the Sukhumvit and Silom lines, with planned extensions on both.

ROYAL THAI POLICE (RTP)

The Royal Thai Police (RTP) Public Police Division also plays a major role in traffic-related policing duties and traffic control, including road safety and traffic violation enforcement, as well as traffic flow monitoring.

SMART CITY SERVICE PRIORITY

Intelligent Traffic Control

Bangkok is infamous for its traffic congestion, a problem that has plagued the city for years. While investments into public transportation will likely alleviate some congestion, Bangkok requires comprehensive solutions to its traffic problems, which includes intelligent traffic control.

Intelligent traffic control integrates various technologies - communication technology, automated data collection technology, computing technology and data analysis - to first collect information in order to understand and manage traffic flow, and utilising the collected data to adjust and automate traffic control mechanisms, improving traffic flow and improving comfort and safety of travelers.

BENEFITS

Intelligent traffic control can help alleviate congestion problems on the road, reducing the amount of time travelers spend on the road and stuck idling in traffic. This reduced idle time will also help improve air quality, as idling cars or those moving at low speeds are major sources of carbon emissions.

RELEVANCE

Bangkok's traffic management is split amongst numerous actors, and traffic data is not integrated or acted upon in a coordinated manner. The integration and central control of Bangkok traffic is a major priority for the Ministry of Transport, with initial studies underway, and expected implementation over the next 2-7 years.

ONGOING INITIATIVE

Intelligent Traffic Sign for Introducing Alternate Route

OTP recently implemented an Intelligent Traffic Sign programme around Bangkok to provide real-time traffic information to drivers by installing electronic dashboards along main streets that display colored lines to inform the different level of traffic condition.

In addition, CCTVs were installed near the intelligent traffic signs to monitor the traffic from both upstream and downstream directions, and to identify level of traffic congestion. Together with traffic information from Google Map Server, alternate faster routes will be recommended through the Variable Message Sign (VMS).

SERVICE ECOSYSTEM

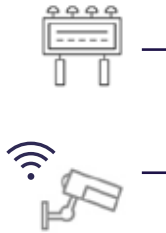
The traffic control authorities in Bangkok, which are Bangkok Metropolitan Authority (BMA) and Royal Thai Police (RTP), as well as Office of Transport and Traffic Policy and Planning (OTP), who assist in piloting intelligent transportation solutions, will collect data through existing or newly installed sensors and CCTV devices throughout the transportation network that detect and record vehicle movements.

This data is then integrated through a central cloud platform and analysed in a traffic monitoring and control system for traffic flow insights. This central traffic monitoring and control centre will utilise data analytics and automation to assist in traffic management decision, adjusting to the traffic situation in real-time, and helping to optimise traffic signal timings to improve the flow of traffic.

COMMERCIAL OPPORTUNITIES

One of the UK's strengths is in intelligent transport solutions and integrated transport system design. Intelligent traffic control systems are still in the early stages in Bangkok, and full integration is still difficult to achieve.

UK organisations and companies have an opportunity to assist OTP and other Bangkok traffic authorities at the system design phase, assisting in technology procurement as well as data analytics and automation system architecture, bringing in suppliers throughout the service value chain.



ROLE	Traffic Data Collection	Wireless Communications	Cloud Platform	Traffic Monitoring & Control System	Traffic Control Authority
THAI STAKEHOLDERS	BMA RTP OTP	true AIS dtac CAT	Solution Provider	BMA RTP OTP Solution Provider	BMA RTP
DESCRIPTION	Traffic control authority responsible for installing the traffic data collection devices (sensors and CCTV) in strategic locations throughout the transportation network	National, wireless telecommunications networks will enable data to pass from data collection to cloud platform	Traffic data from multiple sources is collected and integrated on a central cloud platform	Traffic data is analysed in real-timeusing advanced analytics and AI, and some traffic management decisions are automated	Traffic authorities utilise outputs from the traffic control system to monitor and control traffic signal timings for more efficient traffic flow
UK OPPORTUNITY	Traffic control system design and consulting, technology provider or procurement support	-	Cloud platform solution provider for dedicated traffic control system	Data analytics and automation system design and operation	Data utilisation capacity building and technical assistance

WHY THE UK?

The UK is home to some of the most advanced transport networks in the world and is at the forefront of smart mobility testing and applications.

UK mobility companies and organisations offer services around the world, helping cities and transportation operators innovate and transform their cities into more sustainable, livable and economically prosperous places to live.

What can the UK offer?

- Intelligent traffic management
- Advanced traffic data analytics and insights
- CCTV data integration
- Automation and AI technology and support
- Signal control optimisation
- Transportation operations management and customer experience design

AGD Systems (www.agd-systems.com)

AGD Systems develops intelligent traffic systems that aim to improve the safety, efficiency, and the carbon footprint of transport environments.

Chipside (www.chipside.com)

Chipside is a leader in the world of parking and traffic management IT.

Global Reach (www.globalreachtech.com)

Wi-Fi software, service and analytics for the world's leading service providers and their customers across multiple markets including travel & transport. The platform supports billions of authentications and concurrent users, using hundreds of devices and networks. Currently in use on TfL.

FlowX (www.flowx.tech)

FlowX develops technology that filters the footage from existing CCTV cameras to provide cities with traffic information.

Goodvision (www.goodvisionlive.com)

Goodvision develops technology which utilises AI to provide analysis on vehicle traffic data.

Immense Simulations (www.immense.ai)

Immense Simulations develops city simulation software for the transport industry, aiming to improve decision making, and provide insight into the moving of goods and people.

Resonate (www.resonate.tech)

A powerful digital platform combined with a highly skilled team delivering the best solutions for signalling control, traffic management, operations management and customer experience.

Tracsis (www.tracsistraffic.com)

Leading international provider of transport surveys, passenger analytics, event traffic management and GIS location data.

Transport for London (tfl.gov.uk)

Transport for London (TfL) is a world leader in integrated transport innovation and many aspects of the TfL model have been adopted by other cities around the world. TfL partners with cities, regions, consultancies and transport operators around the world to deploy our unique, specialist expertise and develop sustainable answers to transport challenges.

SMART CITY SERVICE PRIORITY

Smart Public Transport

As noted above, Bangkok has many different forms of public transport, such as the urban rail transit system, public bus, boats, serviced motorcycles, taxis, as well as shared mobility like Grab. These services are run by multiple operators and there is no current integration of fares or data for digital payments or trip planning. This causes invonvenience to commuters as people must carry multiple cards, and cash, and it is often not clear what the most efficient method of public transport is to get from one point to another, which in turn discourages public transport use.

Smart public transport is part of a broader ecosystem referred to as Mobility-as-a-Service (MaaS), which ties together all mobility options in the city, often on a single platform, to provide real-time information for trip planning, unified fare payment, and integrated commuter information for further insights into service operation and improvements.

BENEFITS

Smart public transport makes mobility in the city more convenient, improving quality of life for citizens. It encourages transit ridership, incentivising less reliance on private vehicles, helping to reduce traffic congestion. By unifying all forms of transport, insights on mobility demand can also be gained for better optimisation of transport networks.

RELEVANCE

Smart public transport is one of the best ways to combat traffic congestion in a city, which is why it has been given high priority by the Ministry of Transport's Intelligent Transport System (ITS) Master Plan.

ONGOING INITIATIVE

Real-time Public Transport Tracking and Navigation System

ViaBus is a mobile application which was developed by a startup from Chulalongkorn University, in cooperation with Bangkok Mass Transit Authority (BMTA).

The app provides real-time information of public transportation, specifically the bus system. The app will enable you to gain information of bus routes, bus lines and bus stops. In addition, the location information of buses with a GPS device will be integrated which would allow you to learn about estimated waiting times and also the traffic status. Currently, the app has only partial coverage of the bus system, and does not include any payment or trip planning capabilities.

Bangkok's Spider Card

OTP announced a common ticketing initiative in 2016 called the *Mangmoom* (Spider) Card, and both BTS and MRT signed an MOU in 2007 to implement the system. Since then, other transportation operators, such as BMTA buses, and Expressway Authority of Thailand (EXAT), and public boat taxis have expressed a desire to join the unified ticketing system.

However, delays have kept the service from coming to fruition for close to a decade, as fare sharing agreements have met roadblocks again and again.

SERVICE ECOSYSTEM

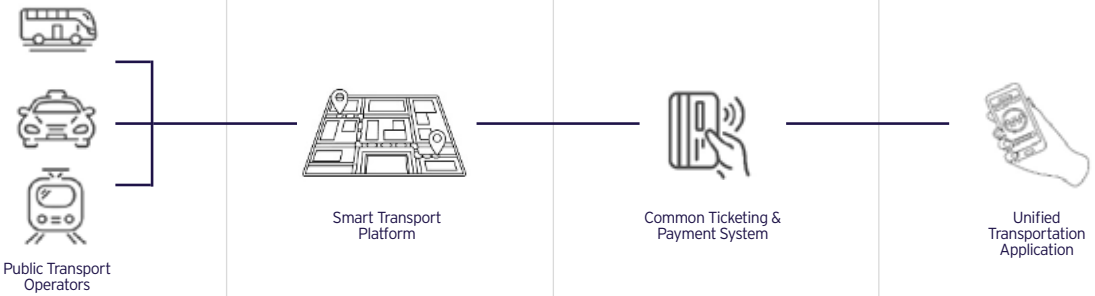
The smart public transport ecosystem depends on the cooperation and interconnection of various parties, including public transport operators, as well as commuters, platform developers, and data scientists.

In Bangkok, OTP will host a platform that unifies services for all public transport operators in Bangkok, including BTS, MRT, BMTA, Airport Rail Link, EXAT and potentially other mobility service providers like Grab, boat taxis, motorcycle taxies, etc. All operators must share relevant data with a platform developer to create a unified smart public transport platform that includes geographic information system (GIS) tracking and real-time operations insights.

This platform is then tied to a unified ticketing system, which requires buy-in from all operators to a common fare structure for all (or a package of) services. Commuters are then able to access information from the smart public transport platform through a single application that includes journey planning and payment.

COMMERCIAL OPPORTUNITIES

London has one of the most well known smart transportation platforms and common ticketing systems in the world, in the Oyster Card. Transport for London (TfL) and other UK service providers are well positioned to assist OTP and Bangkok transport operators in designing a mutually beneficial smart public transportation system, including platform design and development, as well as common ticketing standards and fare setting.



ROLE	Public Transport Operators	Smart Public Transport Platform	Common Ticketing & Payment System	Unified Transportation Application
THAI STAKEHOLDERS	BMTA, ARL, Grab	**OTP** **Service Provider**	**Transport Operators** **Service Provider**	**Commuters** **Service Provider**
DESCRIPTION	All relevant public transport operators in Bangkok, including BTS, MRT, BMTA, Airport Rail Link, Expressway Authority, and other mobility service providers like Grab, boat taxis, motorcycle taxis utilise smart technology to track their services	Data on service operation, like schedule, location, delays, and costs are unified on a single smart transport platform	Common ticketing system is arranged in which a single, progressive fare system is used based on length of trip and choice of service operator; Revenue is shared accordingly	Commuters access the smart public transport system through a unified application or card that allow seamless trip planning and journeys through any of the transport operators in the system
UK OPPORTUNITY	System design consultation	Platform design and development, geographic information system and data analytics service provider	Common ticketing standards and fare settings consultation	Application design

WHY THE UK?

UK transport operators are at the forefront of smart public transport operations and Mobility-as-a-Service (MaaS) innovation.

The robust public transport systems in the UK have bred expertise across the transportation ecosystem, and UK organisations and companies have assisted cities and service operators around the world with upgrades to their existing transport systems.

What can the UK offer?

- Integrated payment systems
- Smart ticketing
- Mobility-as-a-Service (MaaS)
- Smart parking and traffic management
- On-demand and autonomous mobility solutions
- Geographic information systems (GIS) for transport

Conigital (www.conigital.com)

Conigital are transport infrastructure integrators developing Mobility-as-a-Service, IoT sensors and Artificial Intelligence solutions for the next generation of zero emission driverless vehicles.

Globalreach Technologies (www.globalreachtech.com)

Wi-Fi software, service and analytics for the world's leading service providers and their customers across multiple markets including travel & transport. The platform supports billions of authentications and concurrent users, using hundreds of devices and networks. Currently in use on TfL.

Masabi (www.masabi.com)

Justride is a Software-as-a-Service (SaaS) ticketing platform developed by Masabi. Suitable for mobile ticketing systems and to enable Mobility as a Service (MaaS) or for an account-based full fare collection solution using a contactless bank card, mobile device or smartcard.

Restrata (www.restrata.com)

Principal provider of innovative security and technology consulting solutions.

Stage Intelligence (www.stageintelligence.co.uk)

Ground- breaking artificial intelligence solutions to solve some of the most complex challenges within the shared mobility ecosystem such as bike share schemes.

TBS Mobility (www.tbsmobility.com)

Using IoT, AI and mobile, TBS helps choose the right route to improve passenger experience and journey times, keep services running smoothly and ensure employees are productive, engaged and empowered.

Transport for London (tfl.gov.uk)

Transport for London (TfL) is a world leader in integrated transport innovation and many aspects of the TfL model have been adopted by other cities around the world. TfL partners with cities, regions, consultancies and transport operators around the world to deploy our unique, specialist expertise and develop sustainable answers to transport challenges.

SMART PUBLIC TRANSPORT UK SUCCESS STORY: HO CHI MINH CITY, VIETNAM

OVERVIEW

Starting in early 2019, the UK FCDO Global Future Cities Programme partnered with Ho Chi Minh City to provide technical assistance and implementation of a pilot project to a develop a Smart Ticketing System (STS) in Ho Chi Minh City.

The project is expected to have a long-term impact on public transportation development of Ho Chi Minh City by increasing the ridership of public transportation, ensuring the integration of different modes of public transport such as MRT, BRT, Buses and Ferry Boats in the near future and enhancing the level of services.

KEY STAKEHOLDERS

- Ho Chi Minh City
- UK FCDO Global Future Cities Programme
- UN-Habitat

TIMELINE

- Ongoing

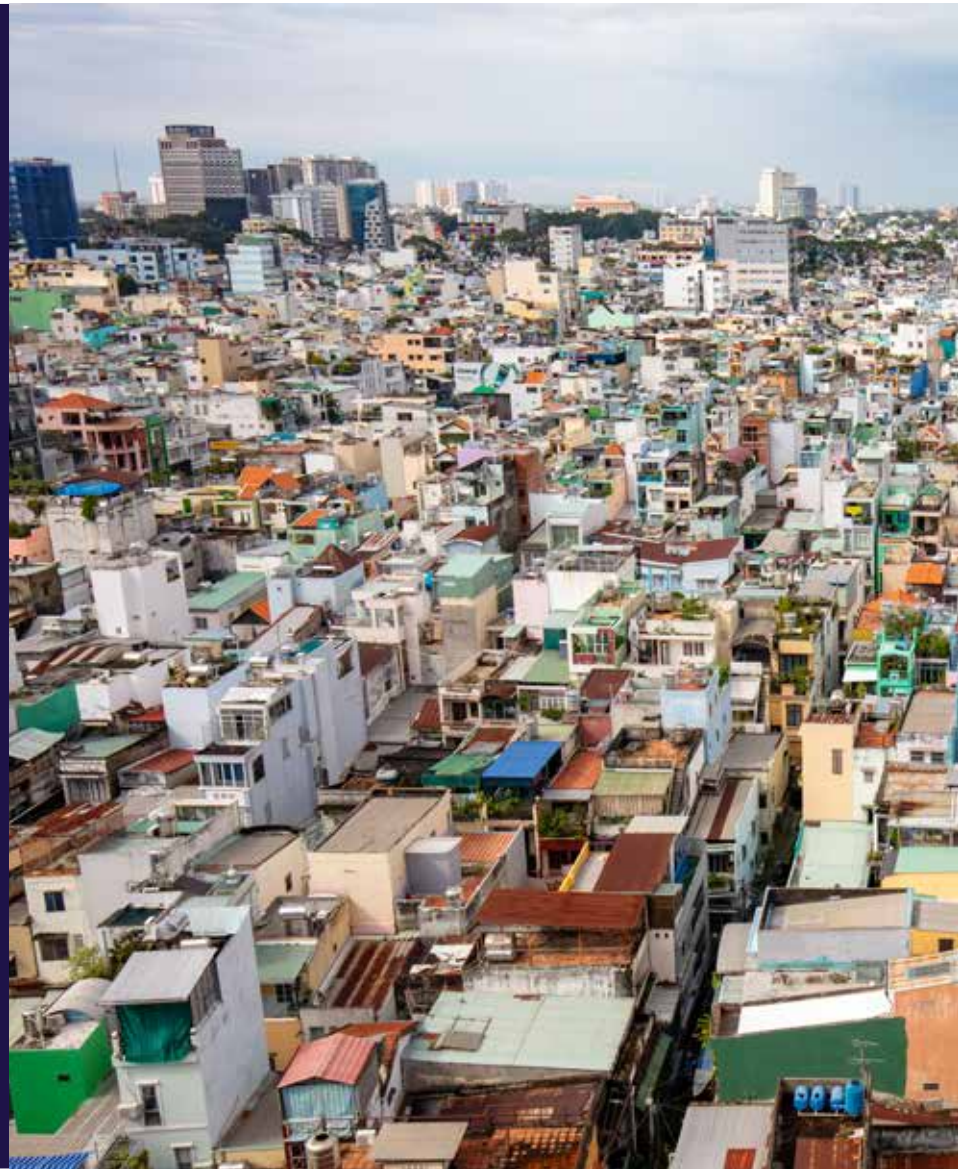
APPROXIMATE PROJECT VALUE

- N/A

EXPECTED OUTCOMES

The project is designed to achieve the following sub-objectives, as a result of creating STS in Ho Chi Minh City:

- Improve the quality of public transport
- Increase the ridership of public transport
- Provide comprehensive data to support decision-making process of government and stakeholders in related-issues
- Improve the capacity of city authorities in delivering and managing public transport



Smart Living

The following section describes how smart technologies can positively influence the way Bangkokians live their lives through three fundamental avenues: better public health practices and access to healthcare, improved public safety and security, and smarter ways of interacting with our built environment to encourage healthier more sustainable lifestyles.

The Pillars of Smart Living

Living in a metropolis is being transformed significantly due to lifestyle changes and technology advancements. In consequence, Smart Living is a new trend highlighting opportunities and benefits from new ways of living in the city.

Smart living solutions highlight ways to improve people's health and access to healthcare through the power of technology. It is about providing modern systems to monitor and alert us to criminal activities or impending natural disasters like floods and fires.

Smart living is also about improving the facilities we spend most of our time, our homes and workplaces, through automation and cutting edge design practices.

SMART INFRASTRUCTURE

In essence, smart living is the innovation of using technology to link together everything from our personal health to the indoor environments of our homes and offices, to our healthcare providers, and even to our urban infrastructure. Smart living innovations help us understand how to live healthier lives, and gives us important information about impending security crises or emergencies in the city.

This interconnectedness requires immensely powerful and stable communications networks to ensure the steady flow of data from nearly every facet of our urban lives.

OPEN DATA & SECURITY

Smart living solutions are all about the power of the Internet of Things (IoT) connecting data flows from our bodies, homes and urban systems.

While these data can provide incredible insights into our daily lives, helping us lead healthier and more sustainably, it also brings up important questions about personal data privacy and security.

Cyber attacks have already become a threat in our modern world, and with the increasing interconnectedness of our urban systems, cybersecurity protocols and regulations will be vital in ensuring the success of the smart city.

URBAN GOVERNANCE

Smart living principles are built upon the cooperation of many different stakeholders, as we move to connect our own bodies with the built environment and our urban institutions in new and powerful ways.

For example, moving healthcare into the digital world requires the cooperation of all healthcare provider in the system, if it is to be truly impactful. Another example are early warning systems for environmental conditions and disaster event, requiring the coordination of many state run agencies and institutions responsible for getting people information.

These solutions demand stable and transparent governance to ensure buy-in across the city.

SMART CITIZENS

Citizens stand to benefit greatly from advances in smart living solutions. Personal health monitoring devices can help people track their own health and provide automated alerts to their doctors in the case of an emergency, saving lives. Smart building management technology can save on energy costs, improve indoor air quality, and make our lives more convenient and comfortable. Security and disaster alerts can ensure we are aware of risks to our safety, and help us feel more secure.

At the same time, if the data and technologies that control the smart city are not made accessible to all citizens, these benefits will not be felt by many.

Smart Living in Bangkok

The concepts of Smart Living have been gaining momentum in both the public and private sectors due to the unmitigated urban growth in Thailand. As the largest urban area in Thailand, Bangkok is still undergoing further expansion, bringing about various transformative changes that have had influential impacts on citizens' lives and health.

In the face of unpredictable events, like the 2011 floods, or the 2020 global pandemic, emphasis has been placed on improving disaster preparedness and community resilience, which requires new solutions for monitoring and alerting us to potential risks, like early disaster warning systems and integrated citywide CCTV networks.

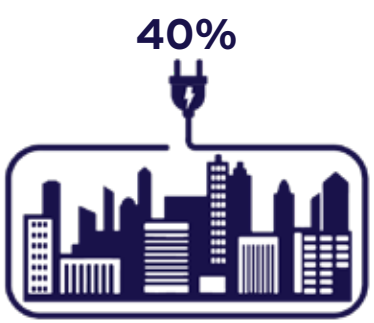
The growth of intelligent building management systems and high performance buildings has also been steady in recent years, partially brought about by government policies and public institutions that have advocated for improved building standards, but also due to demand in the market for technologically driven, modern housing and office space, leading to many of Thailand's top property developers leading the charge in terms of green building practices.

HEALTH

Thailand is home to Southeast Asia's second largest healthcare market, and already houses some of the most advanced healthcare facilities in the region. However, healthcare services are not equitablly distributed throughout the country, or even within Bangkok. Though Thailand has public healthcare for its citizens, services at most local public hospitals are not comparable to the most well-funded national hospitals, or to private hospitals. This has brought about demand for more varied healthcare options through the use of telehealth technology, as well as support for personal healthcare devices that can assist populations with monitoring their own health and preventative medicine.

One of the largest challenges plaguing Thailand's public health system is the lack of integrated health information system, making it difficult for patients to access health services at different hospitals, and causing delays or repetition in healthcare provision.

Thailand is Southeast Asia's second largest healthcare market



Commercial buildings account for nearly 40% of Thailand's energy consumption

SAFETY AND SECURITY

Thailand is no stranger to catastrophic natural disasters, or public security emergencies. Though Bangkok is a regular victim to flooding events, the 2011 floods were in a class of their own. Though more than £6.2 billion was spent on repairs and rehabilitation in the city, the fallout from these floods was much more than economic.

The governments preparedness and response to the floods raised much ire in the general public and the disaster mitigation and response sector, and a perceived lack of transparency and incompetent decision making was seen throughout.

Though natural disasters themselves cannot be entirely blamed on the government, there has been a renewed emphasis on improving disaster preparedness in the nation's capital, and resources are being put towards the development of a disaster decision support system to help monitor weather, predict potential flood events, and better alert the public to personal safety and security risks.

Another element of the push to improve public safety and security outcomes is the investment into integrated surveillance systems, as more than 50,000 CCTVs have been installed around Bangkok by various stakeholders.

£6.2 billion

was spent on repairs and rehabilitation following the 2011 floods in Bangkok

BUILT ENVIRONMENT

In 2018, Thailand put in place a new building energy code (BEC) that required new construction to meet much more rigorous energy efficiency standards, and mandated new design and management techniques for commercial buildings over a certain size.

The Ministry of Energy has also partnered with the Thai Green Building Institute (TGBI), an independent body pushing for green building standardisation in Thailand's development sector, to start the Smart Cities-Clean Energy Award, given to projects the meet certain standards of energy efficient building design.

These two developments represent a move towards more advanced building construction and management in the sector that is also being met by high-end demand for homes and offices that include smart, connected appliances and building management systems. This represents a growing opportunity for companies with cutting edge construction management and building design expertise, in particular with building information management (BIM), IoT connected housing appliances and devices, and high-performance building design, more generally.

Key Players in Smart Living

MINISTRY OF INTERIOR

Included in the broad range of responsibilities of the **Ministry of Interior (MOI)** and its related departments are local administration, internal security, land management, public works, and disaster management. Because of this, policies and actions of MOI impact nearly all decisions involving the built environment.

The **Department of Public Works and Town & Country Planning (DPT)** is responsible for building design and construction controls and compliance, as well as supporting local administrative authorities with formulating and supervising land use policy, infrastructure development, and land readjustment.

The **Department of Disaster Prevention and Mitigation (DDPM)** is the central agency responsible for disaster management and prevention, including policy formulation and information technology development.

MINISTRY OF PUBLIC HEALTH

The **Ministry of Public Health (MoPH)** is responsible for overseeing the development of the national health system, including health innovation in both the public and private sector. In 2017, MPH deployed the National eHealth Strategy to reform and improve data use for medical records access and collaboration between healthcare providers and patients.

MINISTRY OF SOCIAL DEVELOPMENT & HUMAN SECURITY

The **Ministry of Social Development & Human Security (MSDHS)** is responsible for social welfare programmes that include public housing and community development, through the National Housing Authority (NHA) and Community Organizations Development Institute (CODI).

MINISTRY OF ENERGY

The **Ministry of Energy (MOE)** has developed numerous programmes promoting energy efficiency in the built environment that involve standards and technology promotion for smarter building management and advanced building design.

The **Department of Alternative Energy Development and Efficiency (DEDE)** partnered with the Architect Council of Thailand and the Engineering Institute of Thailand to develop the new Building Energy Code (BEC), which requires new construction to meet requirements for building materials, HVAC, lighting, hot water, and renewable energy.

THAI GREEN BUILDING INSTITUTE

The Thai Green Building Institute (TGBI) is an independent industry group working together with MOE to develop green building standards and smart city development initiatives.

BANGKOK METROPOLITAN ADMINISTRATION

The BMA departments most involved in Smart Living are the City Planning Department, Social Development Department, Fire and Rescue Department, Public Works Department, Medical Service Department, Health Department, and Department of Drainage and Sewerage.

ROYAL THAI POLICE (RTP)

The Royal Thai Police (RTP) is responsible for safety and security related to crime prevention in Bangkok, and are in the process of developing an extensive, citywide integrated CCTV network.

SMART CITY SERVICE PRIORITY

Smart Disaster Management System

Natural disasters, particularly flooding, are a regular threat and annual occurrence in Bangkok. Around the world, cities have implemented early warning systems based on real-time data monitoring and communication, alerting residents sooner when a disaster event occurs, and aiding emergency responders with swift and accurate information.

A smart disaster management system involves networks of environmental sensors to monitor and predict disaster events, and uses emerging technology to help improve flood management decisions during the preparedness, forecasting and monitoring stages.

BENEFITS

The biggest benefit of implementing a smart disaster management system is the reduction of mortality during disaster events. By providing earlier and more accurate alerts, people are able to react more effectively, saving lives as well as property. By collecting more extensive information on environmental conditions, local authorities are also able to make better, evidence-based decisions.

RELEVANCE

The BMA has already invested into and established a Flood Control Centre under the Department of Drainage and Sewerage. By developing a smart disaster management system, the BMA will be able to better utilise this centre for improved decision-making based on more accurate data and transparency.

ONGOING INITIATIVE

Decision Support System (DSS) for Flood Management

In 2019, the BMA partnered with the UK Prosperity Fund Global Future Cities Programme to develop an improved decision support system (DSS) for flood management. BMA recognises that the introduction of a new flood management Decision-Support System (DSS) will improve its ability to identify solutions to flood adaptation and mitigation, facilitate objective and evidence-based decision-making, and justify flood management decisions based on logical and transparent approaches.

DSS will take advantage of newly emerging technologies in remote sensing, open-source mapping, geographic information systems (GIS) and hydrological models. These technologies will further supplement the BMA's investments by adding productive value to its existing meteorological gauges, weather prediction services and extensive network of water pumps. Finally, the DSS will serve to institutionalise flood management practices led by the BMA, ensuring knowledge and expertise is transferred within and across the organisation.

This two-year project aims to achieve four 'proof of concepts' in the development of flood hazard maps, improved rainfall forecasting, evaluation of water retention strategies, and citizen communication strategies for disaster preparedness and response.

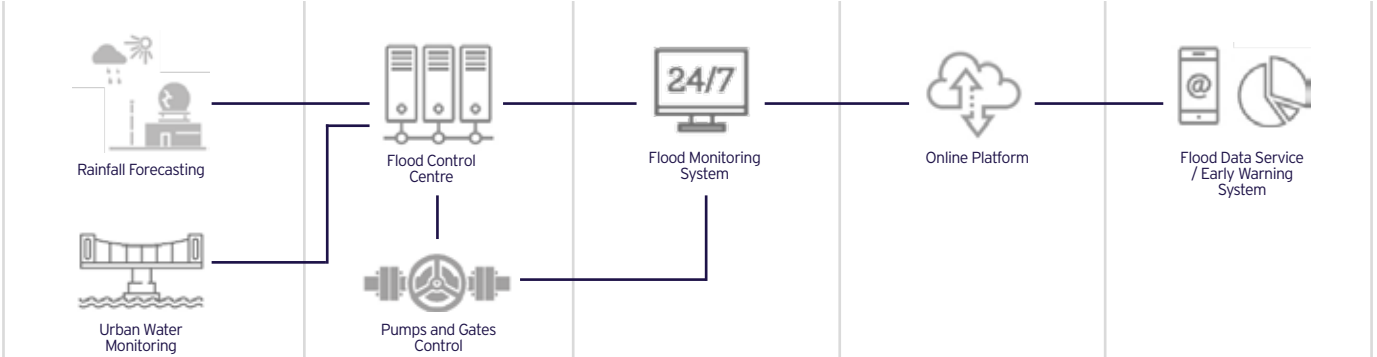
SERVICE ECOSYSTEM

For this example, the BMA is focused on a flood management disaster management system. The BMA works with meteorological and hydrological systems experts to collect and track relevant information related to rainfall and urban water levels. This data is then processed through a central flood control centre for 24 hour monitoring and assistance in water pump and gate control decisions. Data is then communicated to and hosted on a cloud-based open data platform for further use and analysis within both BMA and the general public, supporting solution development for flood response and future mitigation. This data also helps inform the public through early warning alerts and other relevant information before, during and after flood events.

COMMERCIAL OPPORTUNITIES

While BMA has already invested heavily into flood management systems, and has extensive experience dealing with its local flood networks, UK companies can and are assisting with expertise in environmental systems management and integrated data-driven decision support systems.

Flooding is also a problem in many other provinces and municipalities throughout Thailand. Technical assistance and IT solution providers may find other willing partners with other local authorities, as well as national agencies like the Department of Disaster Prevention and Mitigation (DDPM).



	Rainfall Forecasting / Urban Water Monitoring	Flood Control Centre / Pumps and Gates Control	Flood Monitoring System	Online Platform	Flood Data Service
ROLE					
THAI STAKEHOLDERS	**BMA** **Thai Meteorological Department (TMD)** **Hydro Informatics Institute (HII)**	**BMA Department of Drainage and Sewerage**	**BMA** **Hydro Informatics Institute (HII)** **Service Provider**	**BMA** **Hydro Informatics Institute (HII)** **Service Provider**	**Public and Private Sectors** • **Decision Making** • **Early Warning and Monitoring** • **Responders**
DESCRIPTION	Through the use of remote sensing, geographic information systems (GIS) and hydrological models, BMA and its partners collect more accurate environmental data	Data is collected and processed through a Flood Control Centre before being communicated to the Flood Monitoring System which helps adjust water pumps and gates accordingly	An interactive and automated flood monitoring system will display real-time conditions and support improved risk-informed decision making	Relevant data will be hosted on a cloud-based open data platform for further analysis and transparency	Both public and private sector stakeholders will benefit from early warning alerts and access to accurate data to aid in preparedness, response and relief efforts
UK OPPORTUNITY	System Monitoring and Data Collection Consulting and Technical Assistance	Solution Provider and Technical Assistance	Solution Provider	Solution Provider	-

SMART CITY SERVICE PRIORITY

Smart Building Design

Modern housing and building design goes far beyond merely a physical structure, and has expanded to include the supply of products, services and solutions to improve spaces for living, working and community health.

Smart building design starts at the early stages of development, integrating technology and sustainable design techniques to optimise building performance and operations. A smart building connects home and office appliances with building management systems to generate a tremendous amount of data that is collected, integrated and analysed for automated control of building systems and equipment, including access, lighting, energy, air conditioning and air quality, security, hygiene, and more.

BENEFITS

Smart buildings can significantly increase energy efficiency in a building, simultaneously reducing a building's operation costs and carbon footprint. Owners and tenants can also attain newfound insights into how they interact with their homes and offices, helping to self-regulate energy and water use, and control indoor air quality for a more comfortable and healthy environment.

RELEVANCE

Newly instated regulations have placed requirements on new construction to integrate smart building techniques for energy efficiency, and demand for smart building design is strong, particularly amongst private property developers that are increasingly integrating smart and green building techniques in their projects.

ONGOING INITIATIVE

Sansiri Smart Home

Sansiri is one of Thailand's property developers who has embraced emerging trends and technologies in their properties. Recognising the role of digital technologies, like Internet of Things (IoT), WiFi network communication, and touch-point smart devices, in changing the way of living, Sansiri has developed and introduced its own smart home devices, Siri LifeTech, to residents.

The Siri LifeTech suite includes a range of state-of-the-art technologies, from mobile app with AI to smart gadgets, and let them work together seamlessly to enhance living experiences of residents. Applications include:

- Sansiri Home Service Application - the application provides residents properties-related information, such as notifications from the property management, payment statuses, utility bills and repair status reports, which allow them to manage their properties efficiently. Also it allows residents to be able to control in-property facilities, such as lighting and air conditioning remotely.
- Sansiri AI Box – the box is an AI personal assistant, based on the technology from Amazon Web Services. It allows residents to control in-property facilities and home appliances by using voice commands in Thai, and be integrated as part of the Home Service Application.

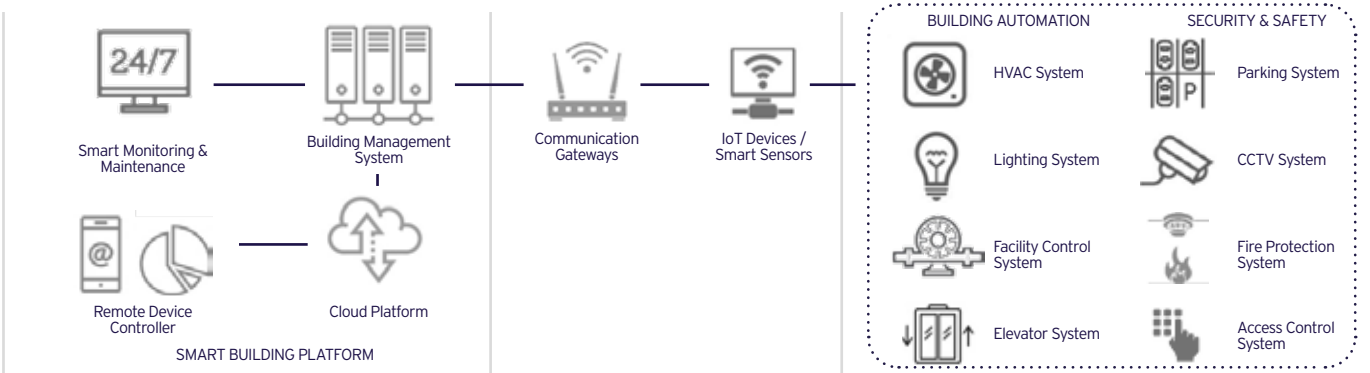
SERVICE ECOSYSTEM

Smart building design involves integration of the many different systems of building operation. The simplified model to the right emphasises the two major elements of smart buildings: building automation, and security & safety system control. Through the integration of smart IoT devices, the various equipment and operations involved in these systems can be tracked and monitored through a centralised building management system. Residents and building operators can then access this information to monitor and control building operations through cloud-based remote control applications.

COMMERCIAL OPPORTUNITIES

Leading UK architecture and engineering firms are already assisting private property developers in Thailand with smart building design services, ranging from sustainable building design, building system design, equipment sourcing, building information management (BIM) consulting, and more.

The market for these types of design services will continue to grow in years to come, as high performance buildings become more of the norm with increasing regulatory requirements for energy efficiency and environmental quality in buildings, as well as strong demand within the real estate market for smart living and work spaces that promote sustainability and comfort.



ROLE	Smart Building Platform	Communication Gateways & Smart Sensors	Building Automation System	Security & Safety
THAI STAKEHOLDERS	**Property Developers / Owners** **Solution Providers**	**Property Developers / Owners** **Solution Providers**	**Solution / Technology Providers**	**Solution / Technology Providers**
DESCRIPTION	Some private property developers have developed their own smart building platforms, including proprietary technology that enables residents and building operators to remotely control building performance through a central, cloud-based management system. In other cases, third-parties provide comprehensive solution platforms.	Communication gateways tied to remote sensing devices allow for real-time analysis and control of building automation and security systems. These devices are often proprietary to the smart building platform provider.	Specialist technology providers for building automation systems for HVAC, lighting, facility control, elevators and more	Specialist technology providers for security and safety systems for parking, CCTV, fire protection, access control and more
UK OPPORTUNITY	Platform provider or developer Smart building design services (including: energy efficiency design, building information management (BIM), automation, etc.)	Solution Provider	Solution Provider	Solution Provider

WHY THE UK?

The UK is home to some of the world's leading engineering and architectural firms, such as Foster + Partners and Arup, which have been involved in many of the world's most high-profile low-carbon design and construction projects. UK companies can help ensure that buildings are energy efficient, not only through construction but the entirety of their operation, reducing an asset's carbon footprint and in turn its impact on climate change.

What can the UK offer?

- Engineering and architectural services for efficient design
- Modeling and software tools for more effective project design
- Lighting solutions and supply of HVAC equipment
- Project management and logistics for the construction process and site laser scanning
- Design and consultancy services related to district heating
- Products and services related to post occupancy

Aedas (www.aedas.com)

Architectural design firm specialising in urban design and masterplanning, architecture, interiors and landscapes.

Arup (www.arup.com)

Arup operates a design and engineering firm that works on a range of creative projects across the built environment sector.

Ash Projects (www.ashprojects.com)

Real-time occupancy monitoring to manage dynamically climate control and integrate with existing Building Management Systems and utilise historic data to better plan energy consumption.

Atamate (www.atamate.com)

IoT platform which reduces energy, maintenance and management in buildings while increasing the occupants security and comfort.

Atelier Ten (www.atelierten.com)

Atelier Ten are award-winning consultants offering environmental design consulting, masterplan sustainability consulting, health and wellness design, energy analysis, façade optimisation, benchmarking (WELL, TREES, LEED, Green Mark, Fitwel, Smart City Thailand, TRUE, EDGE, and others), carbon strategic management and corporate sustainability report including Global Reporting Initiative (GRI).

Bead Technology (www.enbead.com)

An AI-based system that analyzes, optimises and operates your building's energy management, marketing strategies and operations by measuring real-time occupancy data.

Benoy (www.benoy.com)

Specialise principally in master planning, architecture and interiors, focusing on 'creative commerciality' to solve problems and unlock potential.

Beringar (www.beringar.co.uk)

Beringar develops sensors that utilise machine learning technology to provide users with metrics on how they use their space at home, such as typical number of people and temperature.

Broadway Malyan (www.broadwaymalyan.com)

Global architecture, urbanism and design practice dedicated to creating cities, buildings and places that will provide a lasting legacy.

BuroHappold (www.burohappold.com)

International, multidisciplinary engineering consultancy delivering creative, value-led building and city solutions.

Centrica (www.centrica.com)

Centrica is a market leader in Connected Home products, and our Hive smart thermostat and other services help our customers manage their energy use.

Chapman Taylor (www.chapmantaylor.com)

Global architects, masterplanners, interior designers and smart city consultants.

Energenie (www. energenie4u.co.uk)

Energenie develops, designs and manufactures energy-efficient smart homes products.

Foster + Partners (www.fosterandpartners.com)

Foster + Partners Thailand is the Bangkok-based entity of Foster + Partners' London-headquartered global studio, renowned for architecture, urbanism and design, rooted in sustainability.

Mott MacDonald (www.mottmac.com)

A global engineering, management and development consultancy

Restrata (www.restrata.com)

Principal provider of innovative security and technology consulting solutions.

SMART BUILDING DESIGN UK SUCCESS STORY: MEXICO CITY NEW INTERNATIONAL AIRPORT

OVERVIEW

In 2017, Arup was appointed as head engineering company responsible for developing a sustainability plan for the Mexico City New International Airport (NAICM).

The terminal design was conducted in collaboration with Foster + Partners (UK based) and FR-EE (Mexico based).

The goal was for the NAICM to be environmentally sustainable and to be the first airport in the world to obtain LEED Platinum certification v4 at its main terminal.

At 743,000 square metres, it will be one of the world's largest airports and will revolutionise airport design.

KEY STAKEHOLDERS

- Arup
- Foster + Partners
- FR-EE

TIMELINE

- 2014-2018

APPROXIMATE PROJECT VALUE

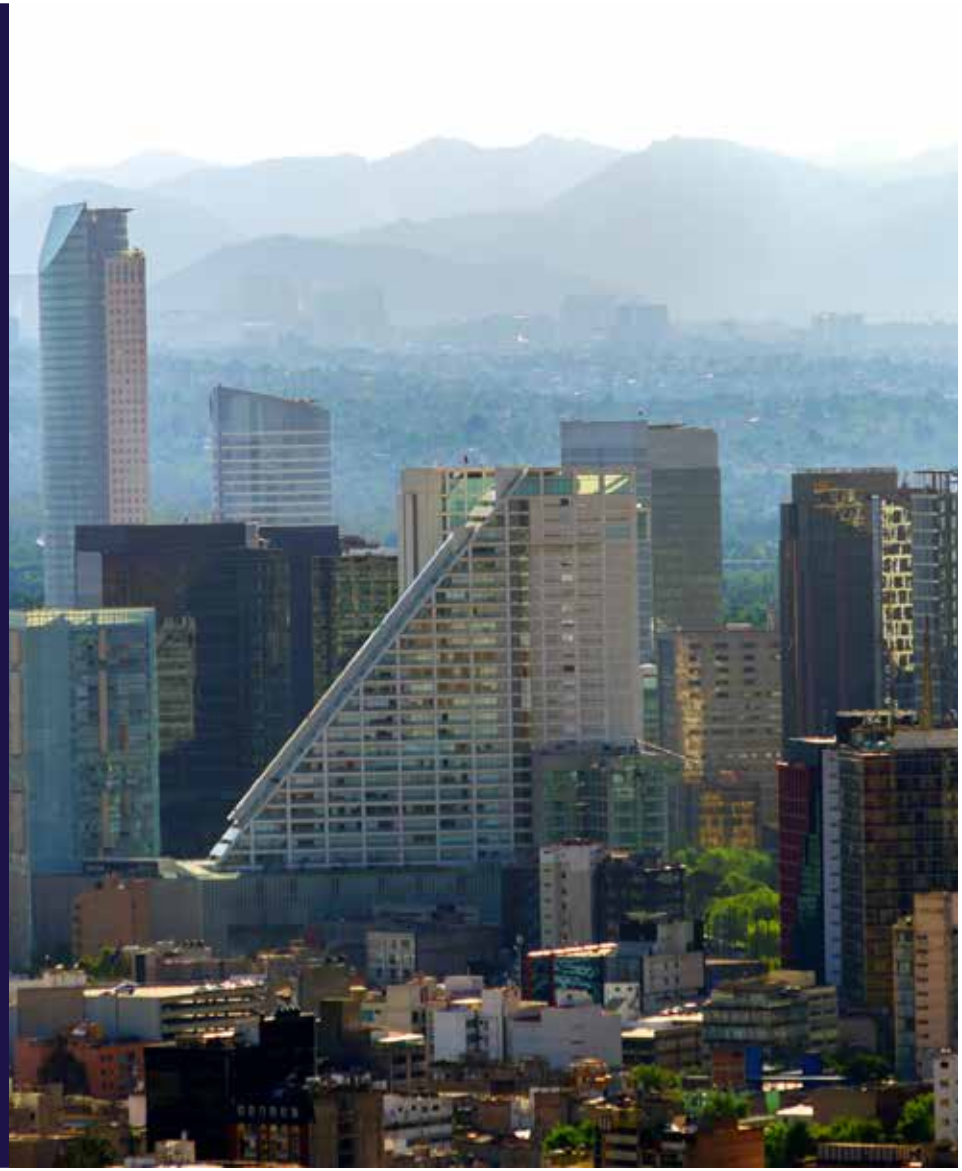
- N/A

OUTCOMES

This hardworking structure harnesses the power of the sun, collects rainwater, provides shading, directs daylight and enables views – all while achieving a high performance envelope that meets high thermal and acoustic standards.

The LEED Platinum design works with Mexico City's temperate, dry climate to fill the terminal spaces with fresh air using displacement ventilation principles. For a large part of the year, comfortable temperatures will be maintained by almost 100% outside air, with little or no additional heating or cooling required.

*Source: Foster + Partners



SMART CITY SERVICE PRIORITY

Integrated Health Information System

A well-designed health information system (iHIS) is one of the essential components of an effective, modern healthcare system, as it helps ensure that reliable and timely information on health determinants will be produced, analysed, dispatched and acted on.

An iHIS involves the development of uniform data standards to ensure interoperability and two-way communication between both patients and healthcare providers. With an iHIS, healthcare services can be linked through digital technology without separating public and private sectors, helping to provide the best possible benefits and continuous services to the public.

BENEFITS

An iHIS allows for more streamlined coordination and sharing of information, reducing administrative overhead for healthcare providers, and making it easier for patients to access the healthcare they need. Patient records can be shared between healthcare providers in real-time, making medical referrals seamless. Remote health monitoring can also be linked to an iHIS, enabling better preventative medicine and timely emergency response.

RELEVANCE

The MoPH has stated in its eHealth Strategy that one of the major challenges for Thailand is developing effective health information systems which would interoperate with other different health information systems.

ONGOING INITIATIVE

Bangkok Digitalisation of Healthcare Services

The BMA has launched a pilot to introduce electronic patient records in 10 public hospitals. This is a crucial platform required for the city's public health system to use more advanced technologies like analytics and artificial intelligence in the future.

In particular, the BMA is using technology to enhance elderly care, making it more convenient to access healthcare. The Home Ward Referral Center, a new BMA unit, has been set up to provide home care for the elderly, improving the utilisation of digital technology in public hospitals, and working around unpleasant traffic conditions.

This innovative health-care service shares patient medical records and personal data to enhance the capability of the Center to provide healthcare staff and healthcare volunteers the information they need to check on elderly/disabled patients in their homes.

Additionally, the updated data of the visits is being being shared to public hospitals so that doctors and nurses can better coordinate care for the elderly/disabled during visits, improving the patients' experience, as they no longer have to repeatedly provide the same information to doctors – whether at home visits or at hospitals.

SERVICE ECOSYSTEM

For a Bangkok iHIS, the Thai Health Information Standards Development Center (THIS), an affiliated organisation with Health System Research Institute (HSRI), under the Ministry of Public Health (MoPH), was established to research and develop health information standards toward the aim of achieving interoperability across health information systems in Thailand. THIS has proposed the health data standards development plan that aims to support and enable both administrative (insurance reimbursement and population health report) and clinical (healthcare services) information exchange. These standards will support the exchange of uniform information between both public and private healthcare service providers, patients, insurance providers, emergency responders, and researchers.

COMMERCIAL OPPORTUNITIES

The development and implementation of iHIS in Bangkok has been difficult due to a lack of agreement on standardisation throughout the health system, and a gap in technical capacity between policy makers and healthcare providers.

There is an opportunity for UK companies that work with NHS and/or other international entities on health IT solutions, electronic health records, and health data analytics to support MoPH in achieving its eHealth Strategy.

WHY THE UK?

The UK is a frontrunner in the use of primary care electronic health records and an early adopter of several key parts of the digital health market, particularly digital imaging, telecare, mHealth and wearables.

The UK has internationally recognised companies that are active in the Digital Health sector, and having been intimately involved in the digital transition of the UK's National Health Service (NHS). Whilst this list is not exhaustive, it provides a perspective on the depth and breadth of the sector.

What can the UK offer?

- Health IT Solutions
- Electronic Health Records management
- Real-time health analytics
- Telemedicine and Teletriage
- Education and technical training
- Patient engagement and self management
- Services management

Ampersand + Ampersand (www.3amp.co)

Co-create digital platforms with innovators in healthcare who share their mission: to generate practical benefit for patients, clinicians and society through technology. Have created solutions in conjunction with multiple NHS trusts and hospitals.

Aparito (www.aparito.com)

Aparito's next generation monitoring allows for remote patient monitoring for routine care and decentralised / hybrid / remote clinical trials to be conducted anytime / anywhere. Reducing data collection burden while providing in built data analytics.

EMIS (www.emishealth.com)

EMIS have a suite of related products to allow for interoperability and community access. They also work for bespoke solutions. Have approximately 50% market share of coverage for NHS primary care providers.

medCrowd (www.medCrowd.com)

The instant messaging technology for health and care that keeps everyone in touch while protecting confidential information to the required standards.

medDigital (www.medDigital.com)

Develop and manage the approval of scientific content for healthcare websites and social media. Produce health websites, product information, training modules and can then run digital advisory boards that help discover insights in real-time.

Sitekit (www.sitekit.net)

Sitekit develops software and technology to connect patients and caregivers. The company has partnerships with the NHS, universities and industry. Has recently digitised the Children's National RedBook Care Record.

TPP (www.tpp-uk.com)

Through its SystemInsight database it can provide vital clinical and administrative data for analytics. Approximately 50% market share of coverage for NHS primary care providers. Holds 44 million patient records across the UK for 6000 organisations.

Transforming Systems (www.transformingsystems.co.uk)

Takes capacity and demand info from all services and shows availability through app technology, web portal or on phone – automatically escalates if there is a problem. Allows operational redirection and rearrangement of services real time.

Smart People

The following section discusses the most important aspect of the smart city - people. In order to create the ICT enabled cities of the future, people throughout all of society must be able to understand and engage with these technologies. In Bangkok and all of Thailand, that will require innovations in how we learn, think about and interact with our cities.

The Pillars of Smart People

Most perceptions of the smart city concentrate on the use of technologies and data. However, as has been stated throughout this Handbook, technology is just the tool we use to improve the well-being, sustainability and prosperity of our cities.

A technologically-enabled city will thrive only if its people are 'smart'. This applies to the ability of everyday citizens to engage with and shape the vision for digital transformation in our cities. This is also vitally important in our elected officials, policy makers, business leaders, and city officers as they make the decisions shaping the smart city.

SMART INFRASTRUCTURE

Access to digital technology and ICT infrastructure is one of the most important factors in supporting the smart people our cities need. This requires comprehensive smart city planning that accounts for ease of access and relevant digital programming.

Finding ways to share infrastructure, both within city departments and other public agencies, as well as with the private sector, can improve overall access. This is especially important when it comes to broadband and wireless connectivity, and it is often private sector operators that are best suited to deploy and maintain these networks.

OPEN DATA & SECURITY

Reliable information and robust two-way communication between cities and its people is the only way to achieve much of what makes a smart city desirable. Those involved in creating the smart city should take every opportunity to inform and educate people on the ways new technologies or investments could benefit them. People that are educated about smart waste bins or electricity meters are more likely to adopt and utilise them.

Being transparent about data security protocols and addressing privacy concerns will also instill confidence in people for the direction and vision of the smart city.

URBAN GOVERNANCE

The best chance for a successful smart city is to gain the support of the people that live, work and travel through your city on a daily basis. The Smart Governance section of this chapter goes into greater detail on the ways in which smart city actors can create a unified and effective decision-making model for the city, but it is reiterated here that citizen engagement to increase public involvement and support in the smart city is a vital part of the process.

Public support and engagement brings in broader perspectives, and builds trust in current and future investments. It can also help rally support and financing from the private sector.

SMART CITIZENS

The interaction and education of citizens is critical to smart city success. Interaction refers to the way that people in a city interact with their public and private services. The smart citizen requires an ability to find, communicate, create, and use information and communication technologies that are integrated across the city. This requires a sufficient level of digital literacy.

It would follow that education in the smart city must facilitate people, in their various age groups and demographics, to pursue lifelong learning opportunities that ensure their place in a changing labor market, and contribute as innovators, entrepreneurs and decision-makers.

Smart People in Bangkok

Digital penetration in Bangkok, especially when accounting for mobile internet use, is very nearly ubiquitous. However, as was noted earlier in this chapter, Bangkok ranks low on KPMG's latest Technology Innovation Hub survey, indicating that Bangkokians are not fully taking advantage of their digital access.

The digital divide in Thailand mostly refers to the urban-rural disparity, however, even in Bangkok there are large gaps present between demographics in terms of digital access and literacy.

For Bangkok to become 'smart', all of its residents, from urban youth to government officials to corporate CEOs, must gain access to the know-how and skills needed to participate in the smart city and future workforce.

RECENT DEVELOPMENTS

Since the adoption of Thailand 4.0, government has set ambitious goals to provide universal access to broadband internet as a basic utilty, and to ensure all Thais are digitally literate.

In practice, this means MDES has started to invest in the creation of more than 100 digital community centres throughout the country, and has doubled down on the promotion of digital education opportunities, especially in the face of the global pandemic, which has made distance learning a higher priority, even for urban Thais.

Depa has made modest investments through their Digital Manpower Fund to provide digital literacy training for government workers, as well as local communities and youth.

There is a strong local presence of co-working and creative space that has grown in Bangkok over the past decade, adding vital spaces for digital skill development and incubation.

PAIN POINTS

While the majority of Thais do have access to the internet, it is estimated that only 21% of Thai households have computers, which is lower than the global average of 49%.

On the 2018 Global Competitiveness Index, conducted by the World Economic Forum, Thailand actually lost ground in 'Digital Skills among Active Population' rankings, moving from 57th to 61st when compared to the 2017 Index.

This lack of digital skills is not just an issue for everyday citizens, but within government departments throughout Bangkok and the country. A major pain point identified by stakeholders throughout the smart city ecosystem is the lack of digital know-how in government workers, causing a severe disconnect between central policy and local implementation.

OPPORTUNITIES

Government policy supports the move towards lifelong learning as a key to future workforce development and overall prosperity. Lifelong learning refers to not only the development of new professional skills, but also critical, creative and systematic thinking, which are important skills in need of development in Thailand, as well as the language skills, especially English.

There is demand for new digital content that supports lifelong learning and digital skill development, as well as innovation in education technology.

Bangkok is home to most of the country's top higher education institutions, and there are opportunities for creating research and development partnerships for specific workforce development intitiatives, or general knowledge exchange between international research institutions and smart city related organisations in the UK.

Approximately 75%

of Thais have access to the internet

Thailand ranked 61st (of 140) for Digital Skills Among Active Population in the 2018 Global Competitiveness Index

Only 21% of Thai households have computers within the home

21%

Key Players in Smart People

MINISTRY OF DIGITAL ECONOMY AND SOCIETY

Depa, under MDES, operates the **Digital Manpower Office** which controls a Digital Manpower Fund focused on digital skills development. They also offer a Digital CEO programme, Coding Thailand events and courses, and certify third-party courses for digital manpower development.

MINISTRY OF EDUCATION

The **Office of Private Education Commission (OPEC)**, under MoEd, developed an online learning platform, its Digital Learning Centre, to provide education via internet connections to the general public and all elementary and secondary students nationwide during the COVID-19 outbreak.

MINISTRY OF HIGHER EDUCATION, SCIENCE, RESEARCH & INNOVATION

The Office of National Higher Education Science Research and Innovation Policy Council (NXPO) is an autonomous public agency affiliated to the Ministry of Higher Education, Science, Research and Innovation. NXPO serves as the secretariat of the National Higher Education, Science, Research and Innovation Policy Council (Policy Council) and is, therefore, responsible for facilitating the Policy Council in formulating, deploying and monitoring national policy addressing higher education, science, research and innovation under the guidance and instruction of the Policy Council.

The **National Reseach Council of Thailand (NRCT)**, under MHESI, provides grants and oversees research and innovation research for Thailand, and develops the database and index for science, research, and innovation. NRCT also provides support and capacity development for Thai researcher and research institution as well.

Thailand Science Research and Innovation formulate policies, strategies, and plans on science, research, and innovation (SRI plans) and develop human resources and knowledge institutions. National Charter was one of the researches that has been initiated by TSRI. They also have a unit which focus on smart city and area-based development

The **National Science and Technology Development Agency (NSTDA)**, under MHESI, funds research partnerships between international education and research institutions, as well as domestic research projects. Future cities is part of their agenda, and they also have a Manpower Development Division.

THAI UNIVERSITIES

Thai universities are leading the charge for smart city research. Many agencies and organisations are relying on them to provide the insight to the technology, innovation, and research to develop smart city. Though it is impossible to list them all, top Bangkok-based universities like **Chulalongkorn University (CU), Thammasat University (TU), Kasetsart University (KU), King Mongkut's Intitute of Technology Ladkrabang (KMITL), King Mongkut's University of Technology Thonburi (KMUTT), and National Institute of Development Administration (NIDA)** support various Centres of Excellence (CoE) or Research Units (RU) under professors who are doing research to offer the expertise on urban analytic, data science, built tech, etc.

Nevertheless, compared to UK or other developed countries, Thailand has yet to produce the robust research centre or think-tank in the particular field of smart city. UK partners have an opportunity to provide the lesson-learned, establish partnership or even help develop this kind of entity. In the long run, this will help develop the manpower needed for smart city development and business model.

PRIVATE SECTOR

The Thailand Development Research Institute (TDRI) is a private non-profit foundation. It provides technical analysis (mostly but not entirely in economic areas) to various public agencies to help formulate policies to support long-term economic and social development in Thailand.

SMART CITY SERVICE PRIORITY

Education Technology (EdTech)

Education technology, or EdTech, is a sector that has recently emerged in response to the rapid growth of digital technologies and startup communities, and garnered even more attention in the context of the global pandemic. It can be a powerful tool to create new smart city champions.

EdTech refers to the utilisation of technologies to provide new forms of education in various aspects, from accessibility, delivery, participation, content development, or modes of learning. It can play a key role in the positive transformation of education, including making classroom time more collaborative and integrated, teacher assessment more transparent and seamless, and improving accessibility through remote learning and online research.

BENEFITS

EdTech has the potential to enable lifelong learning across all age groups and demographics. It can provide high standards of educational content to those without access in traditional schools, it can empower teachers to reach a greater number of students, and it provides new business opportunities for content creators.

RELEVANCE

The market trend shows that the EdTech sector is soaring, with 17% growth annually, especially in the Asia-Pacific region which is expected to represent 54% of the EdTech market by 2020. In Thailand, several EdTech startups have emerged, reflecting the long-recognised need for the digitalisation and transformation of education.

ONGOING INITIATIVE

InsKru

'Ins' from 'inspire' and 'Kru' meaning 'teachers'– InsKru is a local startup providing a platform for teachers to share teaching methods, pedagogical ideas, and techniques of engagement with students from primary school through high school. InsKru founders' desire to connect educators from across the nation through EdTech reflects their general philosophy of teachers as crucial components of education development in Thailand. Educators can view articles posted by other teachers about ideas ranging from engaging and educational games or note-taking techniques, and they can post specific questions for other teachers to respond with their own experiences and solutions.

OpenDurian

OpenDurian is an education technology platform utilising artificial intelligence to develop educational content based on Thai education data. The EdTech company develops free test preparation materials and premium video courses for three target groups: K-12 students, college students, and first-time jobseekers. The online courses cover subjects such as biology and mathematics and prepare users for English language tests, general aptitude tests, and doctor aptitude tests. OpenDurian provides users with exam preparation courses specifically for advanced standardised tests, such as the PAT, the SAT, Smart-I, and the CU-AAT.

SERVICE ECOSYSTEM

EdTech services link together the many stakeholders involved in the education ecosystem. Educators or schools seeking to provide online content to their students can create content themselves, or seek third-party providers to augment their educational offerings.

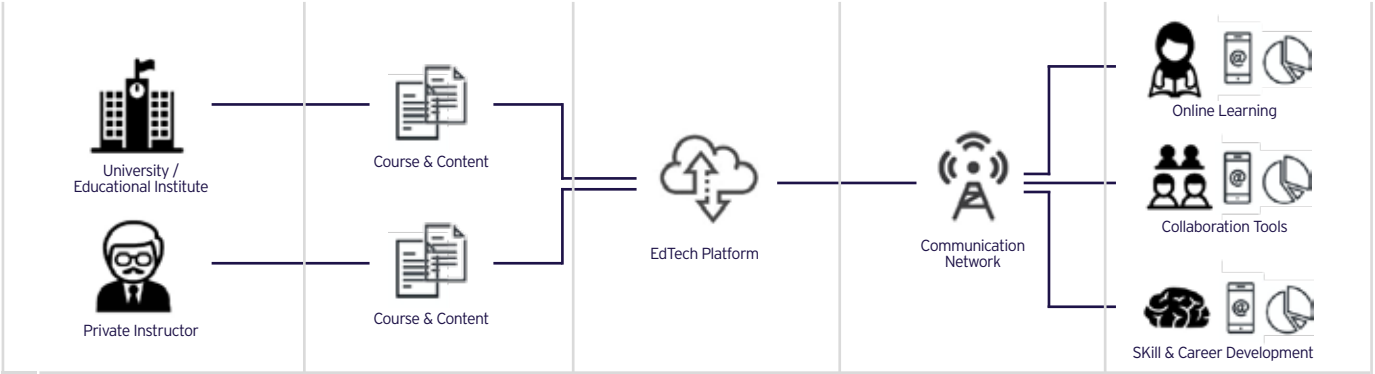
Courses and content are hosted on an online platform, typically provided by a third-party software provider or EdTech startup. Content is then transmitted via network communication to interested students, typically via a webcam and monitor, speakers, and sometimes interactive features.

Platform providers may also be the content creators, or may offer content creation tools.

COMMERCIAL OPPORTUNITIES

There is growing demand for digital content to augment Thailand's current educational system. UK EdTech companies should explore translating and importing their existing content and expanding their online platforms to the Thai market.

Demand for smart city and digital skills related content is high. Content creators and hosts like Open University should consider forging a partnership with those involved in digital manpower development, for example depa or NSTDA, for the dissemination of their content into the Thai market.



ROLE	Educators and Schools	Courses & Content Providers	EdTech Platform	Communication Network	Students
THAI STAKEHOLDERS	**Universities, Schools, Teachers**	**Universities, Teachers, EdTech Companies**	**Software Provider, EdTech Startup**	true AIS dtac CAT	**K-12, University, Post-grad, Professional Certifications, Skills Training**
DESCRIPTION	Universities and educators responsible for providing digital content to their students; Schools also responsible for administration / enrollment management. Front end users	Educational content and curriculum creators. May be schools or teachers themselves, or third-party content creators	Integrated platform providing service to both content creators/providers and students - Resonsible for content hosting, content creation tools, account management, etc.	-	Students are the end users of created content. May be seeking general online education, collaboration tools, or targeted skill or career development
UK OPPORTUNITY	Administration management and/or institutional partnerships	Course & content provider	Platform supplier and manager	-	-

WHY THE UK?

The UK is world-renowned for the quality of its education system, and it has become an established and fast-growing hub for emerging EdTech. Over half of the European EdTech Top 20 list are from the UK, and the UK has more than 1,000 EdTech companies covering the full educational landscape, with expertise in infrastructure, connectivity, hardware, software and content.

With a culture of innovation and wide array of competitive Edtech companies, the UK EdTech sector is well placed to help international organisations achieve better educational outcomes.

What can the UK offer?

- Expertise in infrastructure, connectivity, hardware, software and content
- New learning methods and technology to teach essential skills from coding to the access and understanding of data

RM Results (www.rmresults.co.uk)

RM is an e-marking platform that works with awarding organisations who need to process up to tens of millions of exam scripts. Their RM Assessor software is the world's most widely used and innovative e-marking solution.

GL Education (www.gl-education.com)

GL Education (GLE) is the UK's largest provider of formative assessments for schools. It provides digital assessments, reporting analytics and support services for over 3 million students each year, across more than 100 countries. GLE has developed over 120 rigorous and high quality assessments for children's education, mental health and well-being. Their belief is that schools should take a 'whole pupil view' approach.

Maths-Whizz (www.whizz.com)

Maths-Whizz is a personalised tutoring platform that has been catering to the individual learning needs of students, making it ideal for a wide range of abilities including gifted and talented students.

EDTECH UK SUCCESS STORY: MATHS-WHIZZ AGUASCALIENTES, MEXICO

OVERVIEW

The Mexican state of Aguascalientes is using Maths-Whizz, presented in Spanish, to improve student performance and educational outcomes across maths and associated subjects.

There is typically a four year gap in maths ability between the highest and lowest achieving students. To bridge this gap, the Maths-Whizz Tutor takes each child on an individual learning journey that continually adapts to their performance. It also provides teachers with detailed information about each child's usage and progress through the Maths-Whizz curriculum.

OUTCOMES

The project was successfully piloted in 10 schools. Over 1,600 students have been assessed and are actively using Maths-Whizz. Teachers received certified training in how to implement both the adaptive tutoring technology and the digital tools for whole class teaching to raise standards in maths.

SMART CITY SERVICE PRIORITY

Higher Ed Partnerships

A KEY ROLE IN SMART CITY RESEARCH

The UK's Newton Fund has already established the Newton UK - Thailand Research and Innovation Partnership Fund, a partnership with NSTDA. It aims to strengthen science and innovation capacity and unlock further funding to support poverty alleviation through the cooperation between Thai and British institutes. The fund addresses priority in the following areas: health and life sciences, improving environmental resilience and energy security, future cities, agritech, and digital, innovation and creativity.

Further partnerships between Thai higher education and research institutions with UK counterparts would strengthen smart city efforts in both countries, and provide opportunities to gain much needed expertise in smart city related fields like computer science, information and technology, urban planning and management, digital change management, and more.

Explore opportunities with UK Research & Innovation, the organisation that directs research and innovation funding in the UK.

UK Research & Innovation (www.ukri.org)

UK RESEARCH CENTRES FOR SMART CITIES

UK universities play a key role in developing future smart cities through education, research and partnership. Universities in the UK are assessed on their ability to transform research into practical application and this incentivises them to work with new investors.

Thai partners in smart cities can take advantage of:

- Almost 115,000 graduates each year in engineering & technology, architecture, building & planning, mathematical studies, and computer science.
- 19 universities currently offer postgraduate degrees in Smart Cities and nine universities offer PhD scholarships in Smart Cities.
- Interdisciplinary research centres in universities that connect leading edge research in different departments with public and private partners.
- International research collaborations on smart cities bring new ideas into the UK research environment.

Institute for Future Cities (www.ifuturecities.com)

The Institute is based at the University of Strathclyde's £89 million state-of-the-art Technology & Innovation Centre, a custom-built City Observatory facility to dynamically visualise cities and city systems in new ways.

Censis (www.censis.org.uk)

An industry-led Innovation Centre for Sensor and Imaging Systems (SIS) and Internet of Things (IoT) technologies and their applications.

Newcastle Helix (www.ncl.ac.uk/helix/urban)

Opened in September 2017, the £58m Urban Sciences Building and its surrounding city area is a living laboratory underpinning research to make urban centres more sustainable for future generations.

Leeds Institute for Data Analytics (www.lida.leeds.ac.uk)

Home to state of the art physical and IT infrastructures supporting £50m in research projects. Working with Alan Turing Institute on Urban Analytics Research programme.

Sensor City (www.sensorcity.co.uk)

Driving sensor technology development enabling industry and academic partners to translate their innovative sensor products into commercially viable products.

Cambridge Centre for Smart Infrastructure and Construction

(www-smartinfrastructure.eng.cam.ac.uk)

Develops cutting edge sensing and data analysis models to provide a platform for delivering data for smarter whole-life asset management decisions.

Oxford Programme for the Future of Cities (www.futureofcities.ox.ac.uk)

Re-thinking the city as a flexible and evolving space that better responds to contemporary urban challenges. Uses AI in fields of urban studies, real estate, climate change, transportation, migration and ageing.

Urban Innovation Centre (www.futurecities.catapult.org.uk/urban-innovation-centre/about)

A collaborative hub for businesses, academics, city leaders and entrepreneurs to connect, develop and create smart city solutions.

Smart Governance

Thailand and Bangkok have declared a commitment to improving its governance structures, and 'smart' technology has an important role to play in meeting this goal. The following section describes how technology can augment the decision making processes in our cities through the better integration and sharing of information, and by instilling a culture of transparency and accountability in our government institutions.

The Pillars of Smart Governance

Fundamentally, Smart Governance encompasses the use of information and communication technology to improve to way government actors interact with themselves, as well as making it easier for citizens to participate in the processes of the city.

The use of the word "governance" instead of "government" is to emphasise the change in decision and policy making processes.

Practically, smart governance is about integrating government data and digital government services to support better coordination amongst government actors, as well as increase citizen satisfaction while holding government more accountable in the process.

SMART INFRASTRUCTURE

If smart governance is about digitally transforming the way government delivers services and interacts with its citizens, then it should go without saying that this transformation requires citywide connectivity to broadband and wireless networks.

Government delivers a wide-range of services that impact nearly every facet of life in the city. This complexity often makes managing and delivering services costly and ineffective. The key to smart governance is leveraging ICT infrastructures to integrate these services through interoperable devices and communications networks.

URBAN GOVERNANCE

Reshaping the way government works can be a long and difficult task. It requires the commitment and cooperation of many different stakeholders. Government departments may be at odds with each other, or existing systems or incentive structures may preclude a desire to change.

This is why the move towards smart governance is unlikely to succeed without a true champion of the cause. This is typically a city mayor or manager, but can also come from the private sector, local universities, or general public.

Either way, the most important part of smart governance is strong and accountable leadership.

OPEN DATA & SECURITY

One of the biggest challenges around the world to delivering smart digital government services is a lack of standardised and accurate data.

Therefore, the first step towards smart governance is creating a citywide data management, transparency and sharing policy that ensures data is collected and stored uniformly and securely, and that data is made available to other government departments, as well as the public (when applicable).

This can be a difficult transformation, but ultimately it leads to a more agile and accountable form of government that saves money and improves citizen satisfaction.

SMART CITIZENS

Aside from providing more effective and convenient government services to citizens, smart governance is all about engaging citizens in the process of the smart city.

Being proactive about sourcing ideas from citizens and informing and educating them about the ways the smart city can benefit their lives will lead to better outcomes, more trust in government, and faster and greater uptake of new service solutions.

The methods of engaging citizens should also become smarter, moving away from traditional public meetings that typically draw a small number of the same engaged citizens, and looking to innovate through technology to engage people in more interesting and genuine ways.

Smart Governance in Bangkok

The vision of Thailand Smart Governance is under the direct supervision of the Office of the Prime Minister, as it is seen as a major priority for the future of the country. In 2017, the Five-Year Digital Government Development Plan (2017-2021) was put into effect, declaring the aim to develop digital capabilities in all government sectors, and integrate digital technologies into public services.

This was followed by the establishment of the Digital Government Development Agency (DGA) in 2018, the agency charged with implementation of the Five-Year Plan, and supporting all other state-level partners in the digitalisation process through data optimisation and integration, cloud platform support, and digital skills capacity building.

PAIN POINTS

Thailand's move towards digital government has been slow, as most government departments, at the state, provincial and local level, lack the internal capacity for digital transformation, both from an ICT infrastructure and skills perspective.

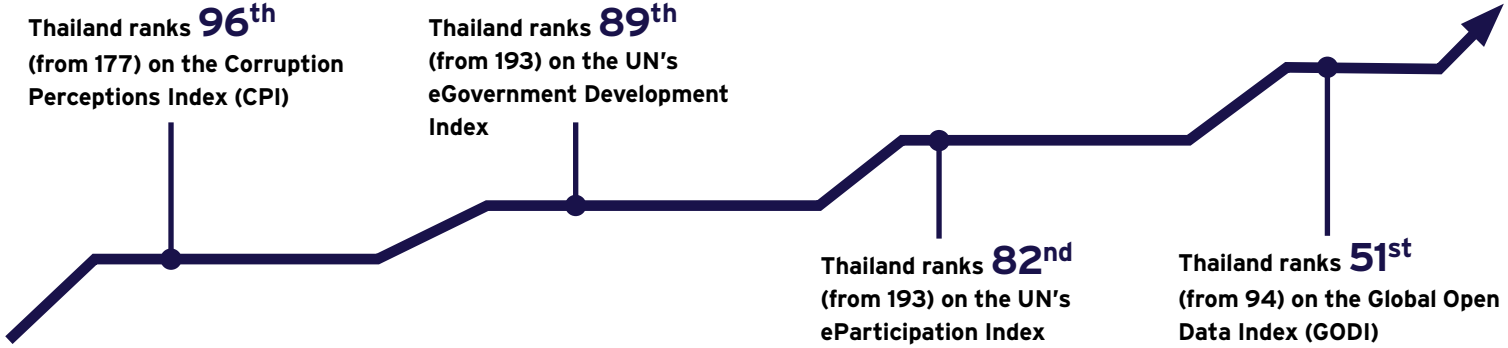
In Bangkok, where similar goals have been stated to make the transition to digital government, there is resistence to integrate data sources at a cross-departmental level, and few understand the benefit of sharing government data with the public. Similar challenges are present throughout the country.

These challenges are supported by recent global indexes, which rank Thailand far behind world leaders on eGovernment, eParticipation, open data, and government corruption (see below for 2019 indexes).

RECENT DEVELOPMENTS

In May 2019, the Digital Governance Services Act was enacted, establishing the **Government Information Network (GIN)** under the supervision of DGA, together with MDES. The GIN requires more than 100,000 state agencies, government hospitals, schools and subdistrict administrations to integrate their data and services into a single government platform. This service will include, among others, e-Procurement, e-Budgeting, and a Digital Citizen ID programme to allow citizens to access public records. It is expected that at least 120 citizen services and 300 business-related lincenses will be available through the portal within five years.

At the city level, depa is working closely with its Smart City Thailand partner



cities to develop City Data Platforms for the integration of city data and services. To date, Phuket is leading the way in integrated government data, with Khon Kaen and Chiang Mai not far behind.

Bangkok's ongoing work with the Prosperity Fund's Global Future Cities Programme (GFCP) to develop the integrated data hub for cross-departmental data sharing and optimisation is also a model of how government can make the transition to digital government.

OPPORTUNITIES

The emphasis from the very top of Thai government presents significant opportunity for companies and organisations with expertise in digital government transformation. Though major challenges still exist related to the culture of data sharing and transparency within Thai government, mandates from the Office of the Prime Minister, and substantial resources being put towards the development of integrated government services, means that every government department must eventually make the transition.

Companies with platform solutions with proven results will be in high-demand, and insitutional partnerships for system design and internal capacity building like the ongoing collaboration with GFCP and BMA present other opportunities for cities around the country.

Key Players in Smart Governance

OFFICE OF THE PRIME MINISTER

The central executive office responsible for assisting the Prime Minister in administering the Thai government, the Office of the Prime Minister has set the national agenda for digitalising government services. The **Office of Public Sector Development Commission (OPDC)** supports the development of Thailand's bureaucracy, budgeting system, personnel system, and other public sector duties in the effort of achieving good governance. The **Office of Civil Service Commission (OCSC)** advises on human resource management in the public sector and development of human resource and workforce planning.

The **Digital Government Development Agency (DGA)** is the government agency responsible for implementation of the Digital Government Development Plan. DGA supports other government actors through trainings and technical support for data integration, cloud platform development, and other digital transformation programmes.

MINISTRY OF DIGITAL ECONOMY AND SOCIETY

MDES is responsible for the overall transformation of digital infrastructure and practices in Thai society. Upon creation of MDES in 2016, the **National Statistical Office (NSO)** was placed under its supervision. The NSO is responsible for the national decennial census, containing the largest and most comprehensive publicly held datasets in Thailand.

A core mission of the Smart City Thailand Office under depa is to help cities develop city data platforms, offering training programmes and technical assistance to city departments.

The **Electronic Transactions Development Agency (ETDA)** is responsible for regulating and supporting electronic transactions, in both the public and private sector. This includes any financial transaction, or trade of information for services. ETDA has partnered with DGA on the GIN project to ensure safe and secure transfer of information and payments.

BANGKOK METROPOLITAN ADMINISTRATION

The BMA is currently undergoing the process of developing an integrated data hub (IDH), under the supervision of the Deputy Governor and with cooperation of all BMA departments, together with the UK FCDO Global Future Cities Programme. BMA is also currently upgrading the existing data centre, improving network speed and security within the organisation, and improving it computing facilities.

SMART CITY SERVICE PRIORITY

Integrated Data Hub (IDH)

An Integrated Data Hub (IDH) is mix of ICT solutions and personnel involved in a centralised repository of city data. It is used to enhance decision making and lead to better quality analysis, considered critical to strengthening data monitoring systems.

IDH helps address issues of coordination amongst government departments, and includes practices for improving data consistency and reliability, leading to better quality data in the longrun, and more informed policy making, more effective service provision and reform, and speedier crisis response.

BENEFITS

IDH allows a city like Bangkok - a large metropolitan area that is constantly needing to respond to environmental and societal demands - to deliver better services, respond more rapidly to crises, improve accountability amongst government departments, and improve data accuracy and timeliness, eventually leading to an improved culture of data sharing and a more informed public.

RELEVANCE

The BMA, and Thai government, more generally, is renowned for a lack of coordination in terms of planning and data sharing between the different departments. The lack of data sharing and unharmonised analysis make the deployment of projects and strategies within the city more difficult and inefficient.

ONGOING INITIATIVE

Phuket Smart City Data Platform

The Phuket Smart City Data Platform (CDP) Development Project is a first of its kind prototype project in Thailand for integrated information at the city level for use in planning, management and solving urban challenges, and is seen as a model for other cities pursuing smart city data platforms across the country.

Initiated by City Data Analytics, a subsidiary of Phuket City Development (PKCD), together with support from depa and Prince of Songkla University Hat Yai Campus, the platform is setup to collect, analyse and display data collected at more than 1,000 wi-fi hotspots.

The CDP brings together more than 60 city level data layers related to tourism, safety, environmental protection, and real estate, and though currently operational, further cooperation from all sectors are needed to optimise the platform.

บริษัท ภูเก็ตพัฒนาเมือง จำกัด
PKCD PHUKET CITY DEVELOPMENT CO., LTD.

depa

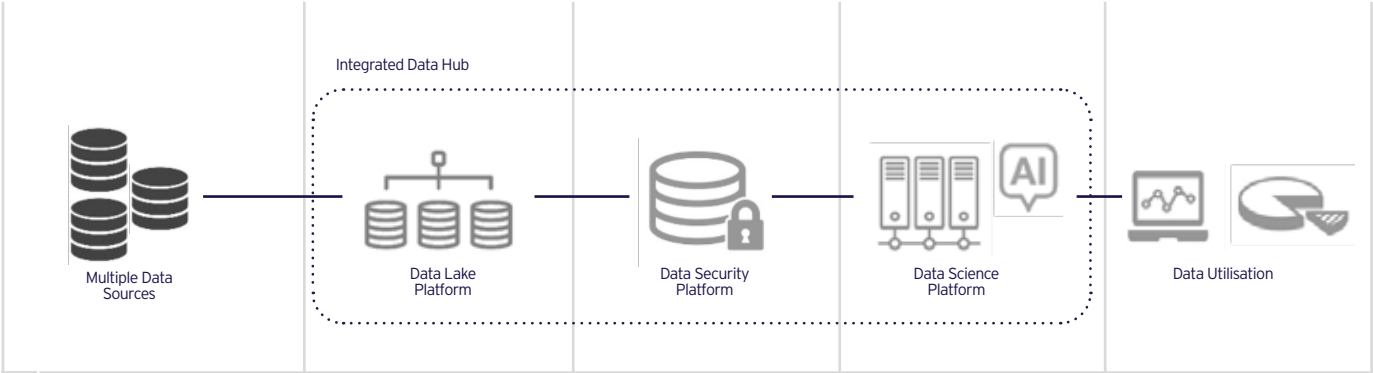
CDA

SERVICE ECOSYSTEM

In the case of a Bangkok city IDH, data is pulled from the various BMA departments, or in some cases, from outside sources that are relevant to BMA work. BMA is the host of the IDH, however a data architect, either third party or in-house, must design, create, deploy and manages the BMA's data architecture system, which includes standards and connectivity. Data is then stored in its raw form in a data lake platform, a repository for all data required for further application in the IDH. Data is made secure through a data security platform, and then is processed and analysed through a data science platform, which typically involves the use of AI, and is prepared for utilisation. Data is then communicated for display and utilisation within an integrated cloud for BMA and partners to use for decision making, planning, service development, and eventually open data.

COMMERCIAL OPPORTUNITIES

The development and implementation of IDH requires technical specialisation through the development stage all the way through operation and maintenance. UK specialists can be instrumental in the data architecture design phase, the platform development phase, and also in capacity building for in-house technicians to maintain and further develop the IDH once it is in operation.



ROLE	Data Sources	Data Lake Platform	Data Security Platform	Data Science Platform	Data Utilisation
THAI STAKEHOLDERS	**BMA** **Data Architect Specialist**	**Solution Provider: Developer / Data Management Specialist**	**Solution Provider: Developer / Data Security Specialist**	**Solution Provider: Developer / Data Analytics Specialist**	**BMA** Decision Making Strategic Planning Service Development Open Data
DESCRIPTION	Data from multiple BMA (host) departments and related organisations/ service providers are organised and managed by a data architect	Data is stored in a data lake repository designed by a developer with data management and data lake specialisation	A data security platform developer / specialist ensures data is secure within the IDH	Data is processed and analysed through a data science platform developed by a data science / AI specialist	Data is connected in an integrated space for BMA and partners to utilise
UK OPPORTUNITY	Data architect specialist and/or capacity building for in-house data architect	Solution Provider	Solution Provider	Solution Provider	Capacity building for data utilisation for planning and service development

WHY THE UK?

As well as being the second largest exporter of computer and information services globally, the UK has one of the world's strongest and most developed data analytics sectors. This is driven by the diversity of technology firms in the UK and the variety of areas where data management and analytics can help improve efficiency. If your organisation is looking to make full use of data, UK companies are the perfect partners to help in the processing, analysing and monetising.

What can the UK offer?

- Data architecture design and management
- Data management & analytics consulting
- Data security consulting and platform design
- Cloud computing platform design and management
- Artificial intelligence (AI) expertise

Analytics Engines (www.analyticsengines.com)

Provide data analytics solutions to organisations throughout industry and the public sector by reducing complexity, optimising performance and maximising the value of data.

Arup (www.arup.com)

Arup operates a design and engineering firm that works on a range of creative projects across the built environment sector.

Capita Software (www.capita.com/our-services/software)

Capita Software provides specialist enterprise software solutions which support the education sector, local government, the emergency services, the health sector, utilities and other private sector markets.

Chordant (www.chordant.io)

A platform allows cities to enable their own solutions by consolidating, exposing and monetising their data. Smart City deployments involve diverse types of devices, data and services. The platform supports standards-based architecture and APIs that hide complexity from application developers, so they can focus on creating amazing applications for cities, consumers and enterprises.

Connected Space (www.connected-space.co.uk)

Technology innovation company, building solutions across multiple sectors with a focus on smart cities, mobility, govtech and urbantech.

Future Cities Lab (www.futurecitieslab.com)

Future Cities Lab designs and develops city wide technology frameworks, aiming to integrate the lives of citizens with Big Data, including wellness mobile apps and healthcare software.

Giosprite Ltd (www.giosprite.com)

Provides smart network technologies expertise for local authorities to gain insights from IoT data to make better decisions on transport, social, environmental services.

KnowNow Information Ltd (www.kn-i.com)

KnowNow provides software and consultancy services to city planners, ranging over areas such as app development, sensor deployment and analytics, and flood modelling.

Mott MacDonald (www.mottmac.com)

Global engineering, management and development consultancy.

Open Data Institute (www.theodi.org)

The Open Data Institute works with companies and governments to build an open, trustworthy data ecosystem, where people can make better decisions using data and manage any harmful impacts.

Privitar (www.privitar.com)

Privitar is the global pioneer in data privacy engineering and creates software designed for enterprise-wide and Government privacy protection, enabling their customers to control, use and share data safely.

Urban Tide (www.urbantide.com)

UrbanTide use IoT and AI to identify and map assets helping cities and organisations to meet legislated targets and improve service delivery and citizen well being.

IDH UK SUCCESS STORY: BMA - BANGKOK, THAILAND

OVERVIEW

The overall aim of the IDH is to address the lack of inter-departmental cooperation and enhance integrated planning and the adoption of integrated approaches in responses towards urban challenges.

The IDH's first priority will be the development of a Data Science Platform (DSP) to enable BMA to develop solutions capable of more readily achieving its strategic, as well as development goals while ensuring coherence between departments.

This is especially relevant in a context like Bangkok where currently there is a need to increase coordination in terms of planning as well as data sharing between different departments.

KEY STAKEHOLDERS

- BMA
- UK FCDO Global Future Cities Programme
- Mott MacDonald

TIMELINE

- Phase 1 2019-2021
- Phase 2 TBD

APPROXIMATE PROJECT VALUE

- N/A

OUTCOMES

A centralised repository such as that enabled by an Integrated Data Hub (IDH) will enhance decision making and lead to better quality analysis, considered critical to strengthening data monitoring systems. Increasing the utilisation of real-time data and adoption of core data principles is expected to improve accountability among departments which will thereby help promote an environment more conducive to openness and sharing of data. Moreover, once data accuracy and timeliness can be more reliably assured, the availability of updated data to the public will also help raise the credibility of information published and push towards a better informed and more trusting society.

SMART CITY SERVICE PRIORITY

Open Data Platform

Whereas a IDH systems are about cross-departmental and inter-governmental coordination on government data, open data platforms are about data sharing, transparency, and two-way communication and engagement with the public.

Open data can be freely used, reused and redistributed by anyone. It includes government data, but a robust open data platform also includes citizen-generated data, where citizens are not just consumers of data, but also producers, users and intermediaries. Citizen-generated data can help improve city service delivery, and provide granular data for more evidence-based decisions.

BENEFITS

Open data has been shown to increase government transparency and accountability, improve innovation and economic development through greater access to information, and greater inclusion and citizen empowerment, leading to more trust in government, and improved overall city operations.

RELEVANCE

Bangkok is a city with major service shortfalls and public safety challenges that are made worse by a lack of evidence-based planning and service improvement. At the same time, most Bangkokians are connected to the internet. Open data can help optimise service delivery by providing more comprehensive access to information about urban challenges, and encouraging citizens and other societal actors to innovate and provide solutions.

ONGOING INITIATIVE

DGA Open Data Government of Thailand

The Digital Government Development Agency (DGA), together with the Office of the Prime Minister, has launched the Open Data Government of Thailand portal, data.go.th, to consolidate and provide access to government datasets sourced throughout the country.

There are currently more than 2,000 datasets available through the portal, and the portal is developed under the concept of being a centre for country information that allows people to access government information conveniently, quickly, and at all times.

The data can be displayed and visualised directly through the platform, as well as downloaded for offline use.

However, while availability of datasets on the platform continues to grow, the intended impacts of the platform are still unrealised, as partnerships and collaboration on data utilisation are still minimal, and open data policies and standards have yet to take hold, leading to unreliable data, and many gaps in the available information.

DGA

data.go.th

SERVICE ECOSYSTEM

The open data platform ecosystem is similar to the IDH in terms of ICT infrastructure and technical capacity. What differs is the source and availability of data.

A robust open data platform provides access to nonconfidential government data, and provides means for citizens to use, produce and control datasets. More important than the technology are effective partnerships and collaboration, the quality of public open data, clear open data policies and engagement and educational campaigns around the use and benefits of open data for society.

COMMERCIAL OPPORTUNITIES

The UK is a world leader in open data policy and platform development. As Thailand makes the transition towards open data, expertise will be in demand for open data policy and standardisation development, and open data architectures.

Though Thailand has begun to collect and host open data, the connection to service delivery, innovation and business ecosystems, and citizen-empowerment are still lacking. Beyond the platform development and operation, UK expertise in developing a culture and ecosystem around open data utilisation and citizen-engagement is another area that Thailand would greatly benefit from.

OPEN DATA PLATFORM UK SUCCESS STORY: RECIFE, BRAZIL URBAN GOVERNANCE DATA ECOSYSTEM

OVERVIEW

The UK FCDO Global Future Cities Programme, together with UN-Habitat and the government of Recife, Brazil, have begun the development of an Urban Governance Data Ecosystem (UGDE).

A UGDE is a system of interactions between municipal government and other stakeholders for exchanging, producing and consuming data for better understanding, planning, financing and managing a city.

The programme focuses not only on the technological side of open data, but also the need for cultural change in how government and citizens interact with and understand the power of data in their everyday lives.

KEY STAKEHOLDERS

- Recife
- UK FCDO Global Future Cities Programme
- UN-Habitat

TIMELINE

- Ongoing

APPROXIMATE PROJECT VALUE

- N/A

OUTCOMES

The programme focuses on three primary outputs for the UGDE intervention:

A **Municipality Data Governance Framework (DGF**) that consists of the processes, methods, tools and techniques to ensure that data is of high quality, reliable, and unique (not duplicated).

A **Urban Knowledge Hub (HUB)** , a central data hub to stimulating citizen participation and innovation and foster a data transformation to permeate local culture.

A **Data Engagement Action Plan (DEA)**, a series of initiatives with the aim of giving city residents the knowledge needed to verify and utilise city data.

Smart Economy

The following section highlights how Thailand has hinged its future prosperity on the digital economy and advanced industries, and how smart cities can harness smart technologies and innovations to ensure a supportive environment for entrepreneurship and business transformation while expanding economic opportunity for its residents to participate in the high-skilled workforce of the future.

The Pillars of Smart Economy

The Smart Economy places the needs of citizens at the centre of business ecosystems, and actively facilitates connections through technology and market building activities to encourage innovation and collaboration towards meeting the needs of city users.

As advanced industries emerge and grow in the 21st century economy, workforce management and development becomes vital for economic success, both in terms of market growth, as well as ensuring citizens are able to make a living.

In this sense, inclusivity is a prerequisite for the 'smart' economy.

SMART INFRASTRUCTURE

Ubiquitous broadband communications are a prerequisite for the smart economy. In today's economy, people and businesses expect fast and stable communications, requiring strategic and expansive investments into the telecommunications infrastructure of the city.

Cities are not solely responsible for building or operating this infrastructure, but the ICT infrastructure of the city must accommodate future growth and demand, and it must be made accessible to the full population to ensure economic activity can be optimised.

OPEN DATA & SECURITY

The flow of standardised, open data from the city promotes better economic decision making. Financial forecasting and business strategy is augmented by a strong regimen of city data, and also helps support businesses to shape their models around solving identified urban challenges and opportunities.

The smart economy relies on safe and secure payments, and clear and enforced data privacy rules. In general, trust in cybersecurity measures instills confidence in economic activity across the spectrum, and becomes even more important as the economy becomes ever reliant on the flow of data and interconnectivity of devices.

URBAN GOVERNANCE

The importance of proper governance cannot be understated in supporting economic success. Effective city management and leadership on smart city initiatives has a positive impact on economic performance. A strong vision and coordinated effort on policy development and implementation will encourage private sector partnerships and investment into the smart city. In many cases, this is the most important factor determining the success of the smart city.

The government procurement processes also have a major impact on project delivery, and therefore ease of doing business on smart city related projects. A move towards e-procurement is part of the smart economy.

SMART CITIZENS

It is one thing to invest in the infrastructure of a smart city, but finding the highly trained workers in both the public and private sector that smart cities will need to operate that infrastructure is a challenge.

All throughout the world, workers in the field of ICT, data science and computer engineering are in high demand. To build a smart economy in our cities, policies and programmes should be prioritised that develop a workforce with the necessary skills to manufacture, install, maintain and operate smart city technologies

Citizens should be able to find out which skills are required in the workforce, how to attain those skills, and have access to employers in need of them.

Smart Economy in Bangkok

Bangkok's position as Thailand's economic engine means it is home to the majority of the country's entrepreneurs and digital startups. Bangkok is pioneering the first 5G test bed in Southeast Asia, and investment into ICT infrastructures continue at a steady pace.

This all supports a healthy environment for the digital economy, as Bangkok has drawn in many new ventures and the move towards digital payments continues to increase. In the World Bank's 2019 Ease of Doing Business Index, Thailand ranked 27th, and it consistently ranks high in terms of foreign direct investment.

However, as Bangkok, and the nation as a whole move towards the Thailand 4.0 industries, there is growing risk that many in the Thai economy will be left behind.

RECENT DEVELOPMENTS

Advancements in cybersecurity and regulatory reforms for electronic transactions have led to growing consumer confidence in the ePayment sector, and growth in FinTech, in general. 46.5 million Thais are currently registered for the digital payment platform PromptPay, and other digital wallets have been brought to market in recent years.

A growing startup ecosystem has also emerged in the past decade, with a variety of homegrown co-working hubs working together with MDES and major technology companies to develop Thailand's 'first unicorn'. In recent years, some of these startups have begun to focus their attention on addressing urban challenges.

PAIN POINTS

Despite growing signs of the country's readiness and preparedness for the digital economy, the main challenge Thailand is facing on its path towards Smart Economy is the fact that digital skills are mostly confined to select middle to high-income demographics. It is estimated that low-skilled workers make up 57% of Thailand's total workforce, which is why high skill worker development is a major emphasis right now.

Another major challenge is access to venture capital for Thailand's startup community, and in general, the difficulty entrepreneurs face when trying to go to market with a product. Innovation ecosystems for smart city startups is especially lacking.

OPPORTUNITIES

With the noted shortage of high skilled workers, the country has set a number of measures to compete in attracting and retaining skilled groups by bypassing the typical four years residency application process for high skilled workers, investors, entrepreneurs, and start-up executives.

Also a digital park project (see more in the next chapter) which aims to attract more than 100,000 developers hopes to spur interest in the sector.

Moreover, there is an objective to roll out a more advanced innovation system to improve citizens quality in every aspect, including technological assistance, competitive income, and a better welfare system, in particular in the Eastern Economic Corridor special-economic zone.

Foreign companies looking to expand overseas will find a welcoming business environment in Thailand, especially if involved in the manufacture, design or operations of advanced technologies. In particular, groups that have experience building innovation ecosystems and are skilled at skills development and matching promising new ventures with real-world needs and investors are currently a critical need in Thailand's journey towards the smart economy.

Low skilled workers make up 57% of Thailand's total workforce is

57%

Thailand ranks 27th on the World Bank's Ease of Doing Business Index 2019

46.5 million Thais are registered for digital payment platform PromptPay

Key Players in Smart Economy

MINISTRY OF FINANCE

The Ministry of Finance (MOF) is tasked with overseeing the Smart Economy domain within Smart City Thailand. The Fiscal Policy Office is the central government body responsible for fiscal policy, and is the secretariat for Smart Economy.

MOF also holds responsibility overseeing many state-run enterprises, including a number of state-owned banks, like the Government Savings Bank, the Small Business Credit Guarantee Corporation (SBCG), and the Small and Medium Enterprise Development Bank of Thailand (SME Bank).

MINISTRY OF COMMERCE

The Ministry of Commerce (MOC) is responsible for trade, prices of important agricultural goods, consumer protection, entrepreneurship, insurance, intellectual property protection, and exports.

The MOC works deliberately in boosting local entrepreneurs and businesses in digitalization and e-commerce.

MINISTRY OF INDUSTRY

The Ministry of Industry (MOI) is responsible for the promotion and regulation of industry, and therefore plays a key role in shaping the regulatory environment and standards of the smart city sector.

In 2019, the **Industry Network** was created under the MOI to emphasise their commitment and cooperation in driving Thailand's mission in the digital age.

BOARD OF INVESTMENT

The Board of Investment (BOI) plays a pivotal role in promoting and providing financial support for investment on smart city related industries, and offers incentives to companies or investors looking to import or help develop high-skill workers in Thailand.

BANK OF THAILAND

The Bank of Thailand (BOT) is the central bank of Thailand, setting interest rates, helping to guard against economic crisis, and working to ensure transparency in the banking industry.

In February 2020, BOT approved a regulatory sandbox to allow banks to use cross-bank identity verification through a National Digital ID (NDID) platform for opening bank accounts.

MINISTRY OF DIGITAL ECONOMY AND SOCIETY

MDES, of course, plays a major role in the development of the digital economy, as a whole, and is the ministry most aligned with the mission of Smart Economy. In particular, depa's core mission is to promote competitiveness in accordance with Thailand 4.0, and coordinate development projects amongst other government agencies, and the private sector, to build a healthy digital innovation marketplace in Thailand.

COMMERCIAL BANKS

Commercial banks and other private financial institutions play a vital role in providing financial support, as well as incubator programs to FinTech and other startup platforms.

There are approximately 20-30 commercial banks in Thailand, the most prominent being Bangkok Bank (BBL), Kasikorn Bank (KBank), Siam Commercial Bank (SCB), and Krungsri Bank.

CREATIVE ECONOMY AGENCY

TCDC, under the Creative Economy Agency (CEA), was founded to integrate the ingenuity of Thai society and culture with modern knowledge and technology.

TELECOMMUNICATIONS COMPANIES

The major telecommunications companies, AIS, True Corp, dtac, and CAT Telecom, all support and provide incubation services for digital startups.

SMART CITY SERVICE PRIORITY

Smart City Innovation Hubs

Smart city innovation hubs proactively engage with tech startups, big tech, financial and research institutions, city government, and everyday citizens to develop the necessary business ecosystems that make the smart city thrive.

Thailand has taken steps to develop these ecosystems, but leaders in the startup community have said that there is still much work to do. Access to venture capital is difficult, and existing innovation hubs have not quite cracked the code on how to involve citizens and city government in the process of developing solutions to urban challenges.

BENEFITS

Mature smart city markets have established creative and innovation ecosystems that help new ideas come to market by matching entrepreneurs with city users and leaders, as well as involving investors to develop, test, and scale new products and solutions.

When innovation hubs are successful, markets grow organically, and government can play a smaller role in terms of financially supporting the the smart city market.

RELEVANCE

While R&D in Thailand is quite mature, the commercialisation process is still limited and hard to scale. There has yet to be a hybrid funding model that is kickstarted by the government sector but has more autonomy and flexibility, and Thailand has yet to develop the sharing economy act which will govern and help support new types of business models.

ONGOING INITIATIVE

depa Smart City Accelerator Program

depa Accelerator Program (ASEAN's First Smart City Accelerator) was developed to support and act as a catalyst for digital startups entering into the smart city space. Running from November 2019 to March 2020, this program was presented by depa Thailand in collaboration with HUBBA Thailand and Techsauce Media Co., Ltd.

The program aimed to develop potential digital startups where participants can grow through support system and maximise growth opportunities from the national scene to regional level.

The two month accelerator program in Bangkok hosted 5 practical sessions specially tailored to help expand and strengthen business knowledge.

It provided startups the opportunity to work with government agencies from 5 Smart Cities such as Bangkok, Khon Kaen, Chonburi, Chiangmai and Phuket so companies could get in touch with relevant stakeholders in order to develop solutions.

Teams were expected to develop a Proof of Concept (POC) to test out possibilities of solutions to the problem presented by teams along with relevant stakeholders under real environment testing for 3 days.

Through this process participants will be able to empathise and fully acknowledge the problems people are facing in different areas; where research and discovering will provide an in depth perspective in the making of a prototype.

SERVICE ECOSYSTEM

Innovation hubs bring together city and industry leaders, government workers, city users and smart city entrepreneurs to build common understanding around urban challenges, and learn innovation processes and how technology can be harnessed to address identified needs.

Once an established demand had been identified, then innovation hubs facilitators work to source relevant suppliers, either through development and incubation in a local ecosystem, or from outside markets where established suppliers meet the specified need, and match investors or funding.

COMMERCIAL OPPORTUNITIES

The UK has one of the best innovation support systems in the world, and has led the way in terms of building the bridges between smart city stakeholders to work together on developing smart city solutions.

Establishing and facilitating an innovation hubs, together with depa and other local stakeholders, could go a long way towards building the smart city marketplace in Thailand. In bringing UK innovation expertise to Thailand, UK supply chains can then be provided a direct entry point into the Thai market in real-time, as demand for smart city services is developed and grown.

INNOVATION HUB UK SUCCESS STORY: CONNECTED PLACES CATAPULT*

OVERVIEW

The Connected Places Catapult offers international Innovation Hub support providing a catalyst for creating world-class innovation ecosystems across and between smart cities.

The role of the Innovation Hub is two-fold:

- Bridge the gap between research findings and outputs
- Provide a single point of access for cities to engage with the supply side

Including city-to-city knowledge sharing, Connected Places Catapult runs capacity building workshops with city leaders specifically on innovation and technology-based city programmes to ensure cities' full preparedness to readily accept innovation and technology-based programmes.

These will cover areas such as:

- City standards for innovation
- Procuring innovation services
- City data analysis and sharing
- User centred design of smart city services
- Developing prioritised roadmaps for city innovation programmes

*Source: Connected Places Catapult

CASE STUDY: NEW TOWN, KOLKATA

Connected Places Catapult worked with key stakeholders in New Town to develop a proposal that is rooted in local needs and strategic priorities. Supported by the UK Foreign, Commonwealth and Development Office's Prosperity Fund, they provided independent, expert support to New Town's authorities, to help them realise their ambition and secure investment.

A roadmap that summarises the first stage of collaboration was produced. Intended both for New Town's leaders and for suppliers seeking new business, it articulates opportunity areas in the city and provides a starting point to help shape, guide and implement strategic priorities over the coming years.

LEARN MORE

Connected Places Catapult offers other international services, including city standards development, testbed demonstrations, technical training, and more.

Website: cp.catapult.org.uk/international

SMART CITY SERVICE PRIORITY

High Skill Worker Development

The lack of high skilled workers is a major challenge for Thailand smart city development, and the development of the digital economy, as a whole.

Recent estimates show that there are only 2.5% of the required workers with sufficient skill to fill 400,000 positions available in the fields of innovation and technology, and this trend is expected to rise over 475,000 by 2023.

Thai government has established a variety of programmes and partnerships to expand the country's capacity to train and match workers to in-demand sectors, though these programmes are limited in scope, and there are improvements that can be made in the information ecosystem so workers can clearly see how they could progress in their field, and what skills they will need to develop.

This presents an opportunity for institutions and companies with interest and capabilities in training high skilled workers, or designing and delivering government training programmes.

DEPA DIGITAL MANPOWER DEVELOPMENT

One of depa's core missions is to develop and support upskilling and reskilling programmes related to the digital economy. Current programmes include Digital CEO trainings, Coding for Youth, and digital skill training for small and medium enterprise. Through the Digital Manpower Fund, depa offers a limited number of grants to support digital skills development for high demand skills and sectors.

Depa has partnered with Kasetsart University (KU), to launch Digital Academy Thailand, a project located at KU, Sriracha Campus in EEC, that provides digital upskilling short-courses.

Depa also works with SCB Academy and Asia Institute of Technology (AIT) to support university students, fresh graduates, and vocational students with a Data Analytics for Upskilling Program that includes Data Analytics and Data Science Essentials, Exploratory Data Analysis with Critical Thinking, and Data Analytics Tools: Power BI, Data Visualization, Data Storytelling.

Together with VISTEC and AI Research Institute of Thailand, Depa has also established the Junior Digital Ambassador Program.

PRIVATE INDUSTRY SKILL DEVELOPMENT

Private associations such as **Federation of Thai Industries (FTI)** provide online courses and trainings on lean automation, production process improvement (Karakuri Kaisen), and leadership under their Human Capacity Building Institute (HCBI).

Digital Council of Thailand (DCT) likewise host a Digital Learning Portal that collects online courses from platforms like eDX and Coursera, while Thai corporations like True and SCG also host a digital academy of their own.

FOREIGN INVESTMENT IN THE THAI WORKFORCE

A number of established Japanese companies with longstanding ties to Thai industries like automotive and electronics manufacturing have invested in worker training programmes to bolster their own workforce, while also aiding in the longterm development of Thailand's workers.

For example, King Mongkut's Institute of Technology Ladkrabang (KMITL) has established the Kozen project, together with Japanese companies to develop the practical engineers to supply Japanese factories.

DENSO Corporation is also undertaking a demonstration project to train lean automation system integrators (LASIs) through the cooperation with Japan External Trade Organisation (JETRO) as part of the Project for Nurturing New Industries in ASEAN.

Delta Electronics Thailand (Taiwan) also worked with universities on the Delta Automation Academy 2018 to develop engineers for the automation industry through Smart IA Lab program, hosting automation and IA workshops for government officers of industry workers.

UK DIGITAL MANPOWER PARTNERSHIPS

UK higher education institutions offer several high-quality MOOCs and online programmes in relevant smart city fields (urban planning, computer engineer, geography, etc.). Finding a way to import and establish training and incubation programmes could provide great benefit for Thailand, while also providing a direct pipeline of specially trained workers for UK companies in Thailand and in the region. More advanced programmes can see the integration of advanced internships and training-for-trainer by UK companies and related academic programs.

Bangkok Area-Based Projects

Bangkok's megacity nature combined with the bureaucratic structure of governing bodies make it slow on the uptake and implementation of innovative ideas. It is happening but it cannot anticipate and overtake the needs and demands of private citizens yet. This is where the private sector has begun to step in and fill the gap.

Across Bangkok, private-led projects are in a race to develop parcels of land that would be considered more advanced than the rest of the city in asset products and services. Of note, these developments are incorporating smart city solutions that would in theory improve quality of life of people. However, these solutions would only benefit users that patronise these areas. Most likely the site specific solutions will not extend to the rest of the city.

These projects are not closed off to the government. Public agencies are in fact participating and becoming stakeholders of some of these area-based projects. Many are viewing these projects as testing ground for smart city solutions and waiting to see how successful and scalable they will be in the future. This section provides a quick look into some of these area-based projects.

1 Bang Sue Grand Station

Area: 3.7 sq.km **Status:** Ongoing
Investment: £12.3 Billion
Timeline: 2014 - 2032
Location: 336 Kamphaeng Phet 2 Alley, Chatuchak, Bangkok

2 Rattanakosin Innovation District

Area: N/A **Status:** Ongoing
Investment: N/A
Timeline: N/A
Location: Wat Ratchabophit, Phra Nakhon Bangkok

3 Chula Smart City

Area: 10.18 sq.km **Status:** Ongoing
Investment: N/A
Timeline: 2018 - 2037
Location: Soi Chulalongkorn 64, Wang Mai, Pathum Wan District, Bangkok

4 Rama 4 Model

Area: 10 sq.km **Status:** Ongoing
Investment: £375 Million
Timeline: 2019 - 2021
Location: Rama 4 Road, Bangkok

6 Dusit Central Park

Area: 36,800 sq.m **Status:** Ongoing
Investment: £892 Million
Timeline: 2017 - 2023
Location: 946 Rama IV Rd, Silom, Bang Rak, Bangkok

7 One Bangkok

Area: 0.17 sq.km **Status:** Ongoing
Investment: £2.9 Billion
Timeline: 2018 - 2026
Location: 1032 1-5 Rama IV Rd, Lumphini, Pathum Wan District, Bangkok

8 The PARQ

Area: 0.13 sq.km **Status:** Ongoing
Investment: £495 Million
Timeline: 2017 - 2020
Location: 102 Rama IV Rd, Khlong Toei, Bangkok

10 Yothi Medical Innovation District

Area: 1.7 sq.km **Status:** Ongoing
Investment: N/A
Timeline: N/A
Location: Thanon Rama VI, Thung Phaya Thai, Ratchathewi, Bangkok

11 Makkasan Complex

Area: 0.24 sq.km **Status:** Ongoing
Investment: £3.4 Billion
Timeline: 2016 - 2024
Location: Makkasan, Ratchathewi, Bangkok

13 NIDA Smart Compact City

Area: 0.18 sq.km **Status:** Ongoing
Investment: £247000*
Timeline: N/A
Location: 118 Seri Thai Rd, Khlong Chan, Bang Kapi District, Bangkok

14 The Forestias

Area: 0.63 sq.km **Status:** Ongoing
Investment: £3.09 Billion
Timeline: 2018 - 2022
Location: Bang Kaeo, Bang Phli District, Samut Prakan

5 Samyan Mitrtown

Area: 22,400 sq.m **Status:** Finished
Investment: £222 Million
Completed in: 2019
Location: 944 Rama IV Rd, Wang Mai, Pathum Wan District, Bangkok

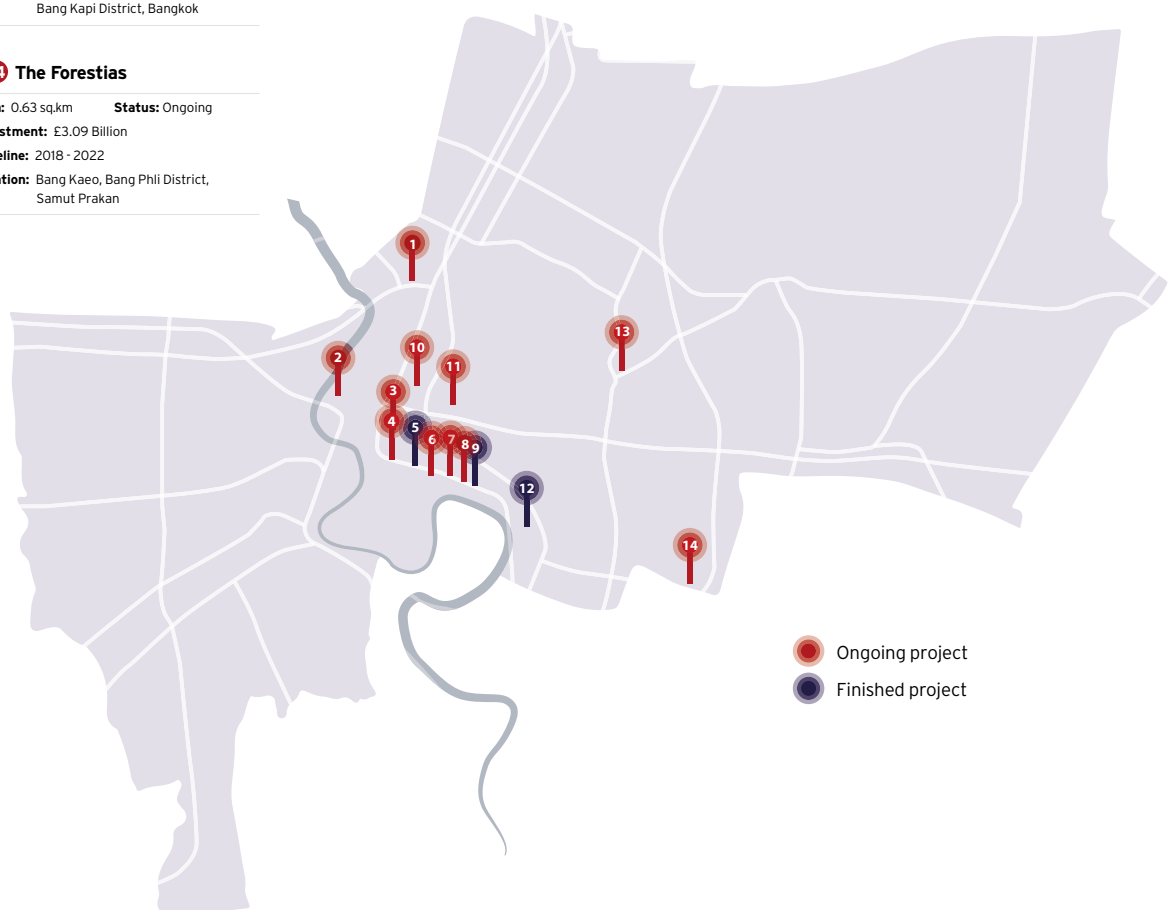
9 FYI Centre

Area: 14,400 sq.m **Status:** Finished
Investment: £123 Million
Completed in: 2016
Location: 2525 Rama IV Rd, Khlong Toei, Bangkok

12 True Digital Park

Area: 68,800 sq.m **Status:** Finished
Investment: £741 Million
Completed in: 2019
Location: 101 Sukhumvit Rd, Bang Chak, Phra Khanong, Bangkok

Ongoing and Finished Private Sector-led Area-based Smart City Projects in Bangkok



Bang Sue Grand Station

Project Overview

Bang Sue Grand Station is one of Thailand's ongoing mega projects. It aims to create a new transportation hub located in Chatuchak District. The station will serve as a node for intercity trains, including high-speed rail, and Bangkok Mass Rapid Transit lines. Future plans will also include opening up tracks for Airport Rail Link and commuter trains. Upon completion, it is expected to be the largest railway station in Southeast Asia.

Area: 3.7 sq.km
Cost: £12.3 Billion
Organisation: PPP
Implemented in: 2032

Relevant Stakeholders

State Railway of Thailand

Office of Transportation and Traffic Policy and Planning

Ministry of Transportation

Ministry of Land Infrastructure Transport and Tourism

Investors

Petroleum Authority of Thailand Group

Japan International Cooperation Agency

Expected Outcome

Smart Environment
- reduced noise pollution by using noise barrier
- expected to expand and connected green area

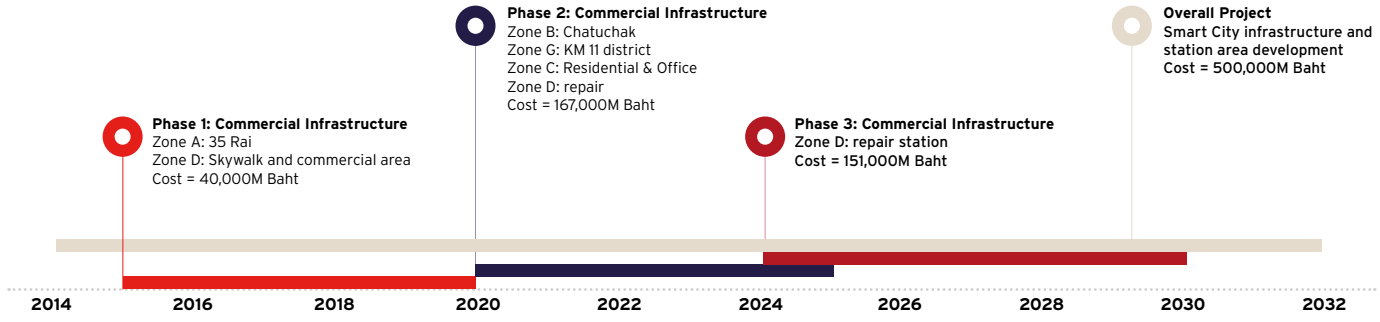
Smart Mobility
- able to support the increased traffic volume
- expected design to be flexible support, convenient, reliable at an affordable price
- 40% increase of traveling by rail system

Smart Energy
- expected to use solar power
- expected to install a co-generation system to generate District Cooling System
- expected to use AI to play a role in energy management

Smart City Domain

SMART ENVIRONMENT
SMART MOBILITY
SMART ENERGY

Timeline



KING'S CROSS STATION

King's Cross Station redevelopment in North London shows many parallels to the Bang Sue Grand Station project. More than 20 UK architects and designers helped bring King's Cross into reality, including 10% of all energy coming from onsite solar, a combined heat and power (CHP) plant, and an integrated payment and mobility platform.

One Bangkok

Project Overview

One Bangkok is the largest private sector property development initiative ever to be undertaken in Thailand. It has an estimated investment value of over £2.9 billion. The project is building a new global mixed-use landmark with its first components opening in 2022. The vision is to create a place that people want to spend time in and completely integrated into the city fabric.

Area: 0.17 sq.km
Cost: £2.9 Billion
Organisation: Private Sectors
Implemented in: 2026

Investors

TCC Assets (Thailand) Company Limited

Frasers Property (Thailand) Public Company Limited

Expected Outcome

Smart Environment
- clean, green, and safe sustainable greenery

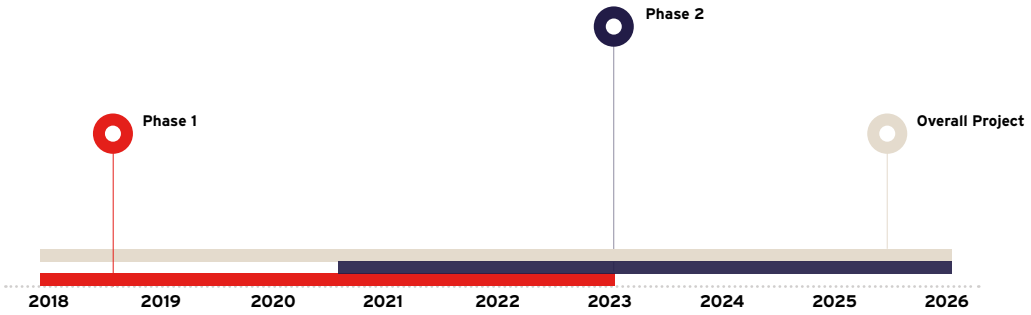
Smart People
- people centric principles
- accessible, inclusive, and inspire new forms of public participation
- pedestrian-friendly circulation

Smart Living
- integrates smart technologies into all aspects
- smart parking and traffic management to centralised security and safety
- district cooling and energy management systems

Smart City Domain

SMART PEOPLE
SMART ENVIRONMENT
SMART LIVING

Timeline



True Digital Park

Project Overview

True Digital Park aims to be the largest digital innovation hub in Southeast Asia and is the first and only one in Thailand where all digital lifestyle solutions needs, working and daily life have been fulfilled. Under the concept of "Digital Lifestyle – Connecting Possibilities", the complex is designed with open space, interconnected structures, and a fully integrated startup ecosystem to enhance imagination and creative innovation.

Area: 68,800 sq.m
Cost: £741 Million
Organisation: PPP
Implemented in: 2019

Relevant Stakeholders

- Electronic Transactions Development Agency
- Digital Economy Promotion Agency
- National Innovation Agency
- King Mongkut's Institute of Technology Ladkrabang
- Action Community for Entrepreneurship, Singapore
- Amazon Web Services
- Google
- Thailand E-Business Centre Company Limited
- Wongnai Media Company Limited
- Huawei Technologies Company Limited
- Cisco Systems
- Microsoft Corporation
- Ricoh Company Limited
- Epson Corporation
- True Corporation Public Company Limited
- Magnolia Quality Development Corporation Limited

Expected Outcome

Smart Environment
- pavegen is the floor yields 5 watt per step

Smart Mobility
- multi-level bike lane and jogging track
- reservation for parking via application

Smart Living
- heat map monitoring density in building
- control lighting via tablet
- use robot in hospital
- e-payment
- smart access to building using application or QR code
- facial recognition
- reservation for meeting room via application
- smart home automation

Smart City Domain

SMART ENVIRONMENT | SMART MOBILITY | SMART LIVING

PAVEGEN

PaveGen has developed an off-grid technology that converts the kinetic energy from footsteps into electricity to be stored in batteries, or used to power applications such as lighting and signage. PaveGen had their first installation in Thailand at True Digital Park.

atelier ten

Atelier Ten worked with MQDC to develop its overall sustainability vision for the True Digital Park. Atelier Ten incorporated Smart City Thailand features into the project which led the project to be one of seven projects to receive a smart city design award in the Smart Cities Clean Energy project held by the Energy Policy and Planning Office and the Thai Green Building Institute.

Rama IV Smart District

Project Overview

Rama IV Smart District focuses on improving the Rama IV streetscape by building walking paths connecting significant real estate developments. In doing so, a unified mixed-use area will be created. The 13-kilometre long skywalk will also join two innovation zones - Siam and Kluay Nam Thai Innovation Districts. The mobility improvement will encourage foot traffic circulation.

Area: 10 sq.km
Cost: £375 Million
Organisation: PPP
Implemented in: 2038

Expected Outcome

Smart Environment
- expected zero waste target with AI garbage sorting climate monitoring

Smart Mobility
- multi-level (MRT and BTS) linkage
- energy saving tram, EV bus, and car
- solar street light

Smart Energy
- greenhouse gas reduction
- renewable energy

Smart Economy
- linkage between the project area and BMA and Thailand
- eCommerce and FinTech

Smart People
- 5G/ Wi-fi 6 with cyber security warning

Smart Living
- eHealth, TeleMed
- smart home

Smart Governance
- eGovernment networks
- big data and data centre
- open public data

Smart City Domain

SMART ENVIRONMENT
SMART MOBILITY
SMART ENERGY
SMART PEOPLE
SMART LIVING
SMART GOVERNANCE
SMART ECONOMY

Relevant Stakeholders

- Metropolitan Electricity Authority
- Mass Rapid Transit Authority of Thailand
- Bangkok Metropolitan Administration
- Ministry of Transportation
- Total Access Communication Public Company Limited
- Chulalongkorn University
- SC Asset Corporation Public Company Limited
- Central Group Company Limited
- Samyan Mitrtown
- Toyota Mobility Foundation
- One Bangkok
- Dusit Thani Public Company Limited

Chula Smart City

Project Overview

Property Management of Chulalongkorn University (PMCU) has a vision to develop Sam Yan to become an innovation hub and smart city model that acknowledges and creates shared values for communities. It combines quality of life and business goals to achieve maximum benefits that are sustainable. The project focuses on four smart city domains listed below, dubbed "SMART 4".

Area: 10 sq.km
Cost: N/A
Organisation: PPP
Implemented in: 2037

Relevant Stakeholders

- Urban Design and Development Centre
- Property Management of Chulalongkorn University
- Metropolitan Electricity Authority

Investors

- Chulalongkorn University

Expected Outcome

Smart Environment
- using technology that can monitor various environmental conditions

Smart Mobility
- allow every system connect to Internet of Things
- using eco vehicle with clean energy innovation

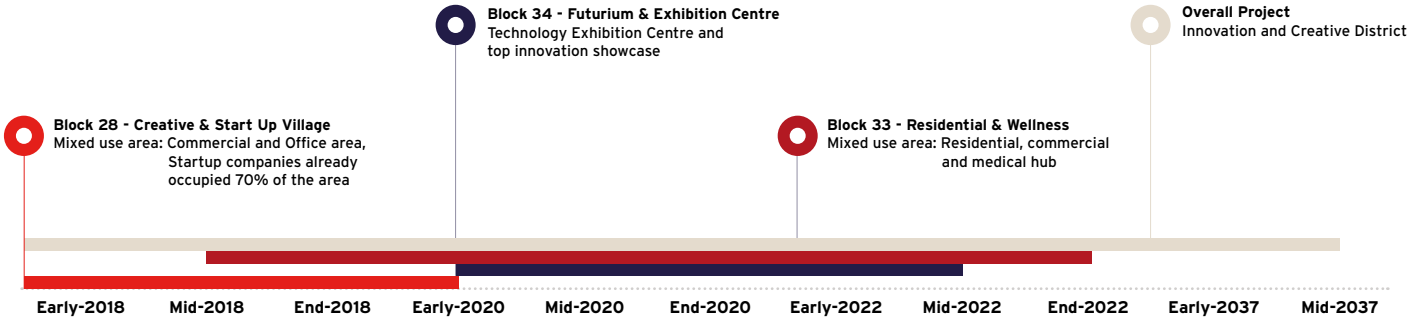
Smart Energy
- expected to reduce 40% of energy consumption
- expected to reduce 30% of greenhouse gas emissions

Smart Living
- create a network to link to the database in order to respond and support residents and users for learning through technology

Smart City Domain

SMART ENVIRONMENT
SMART MOBILITY
SMART ENERGY
SMART LIVING

Timeline



NIDA Smart Compact City

Project Overview

National Institute of Development Administration (NIDA) is a state higher education institution that is set to become a smart city in itself. The project aims to become an example of responsible community and urban development. Focuses are mainly on energy - reduction of energy demand and usage, implementation of alternative energy sources. As a byproduct, NIDA will reduce environmental impacts and make the development sustainable.

Area: 0.18 sq.km
Cost: £247,000
Organisation: Public Sectors
Implemented in: N/A

*Partial budget disclosed at this time

Relevant Stakeholders

Ministry of Energy

Office of Energy Conservation Promotion Fund

SSA Network (Thailand)

Thai Green Building Institute

Expected Outcome

- energy saving 7,016,907 kWh per year
- carbon dioxide reduced 3,725.2 ton per year
- solar PV on roof 1.7 MW
- biogas from organic waste 27,280 m3 per year
- energy storage of battery 561 kW x 6h
- EV bus in campus
- 1 charging station
- district cooling by 82%

Smart City Domain

SMART ENVIRONMENT
SMART MOBILITY
SMART ENERGY
SMART PEOPLE
SMART LIVING
SMART GOVERNANCE
SMART ECONOMY

Makkasan Complex

Project Overview

Makkasan Complex will contribute to the MICE industry, with developments revolving around shopping, convention venues, and medical institutions. It will be built on the vacant land around Airport Rail Link Makkasan Station, which is also the designated location of eastern high-speed rail linking three airports - Don Muang, Suvarnabhumi, and U-Tapao. This will make the complex a Bangkok gateway to the Eastern Economic Corridor.

Area: 0.24 sq.km
Cost: £3.4 Billion
Organisation: PPP
Implemented in: 2023-2024

Expected Outcome

- National Railway Maintenance Centre
- new international commercial district
- waterfront promenade
- connect primary and secondary road with shuttle bus
- pedestrian friendly
- bike lane
- complex project
- park and ride

Smart City Domain

SMART ENVIRONMENT
SMART MOBILITY
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SMART ECONOMY

Relevant Stakeholders

State Railway of Thailand
Ministry of Transportation
Ch. Karnchang Public Company Limited
Bangkok Expressway and Metro Public Company Limited
Italian-Thai Development Public Company Limited
China Railway Construction Corporation Limited
Eastern Economic Corridor
Magnolia Quality Development Corporation Limited
Charoen Pokphand Group Company Limited

The Forestias

Project Overview

Magnolia Quality Development Corporation (MQDC) is building The Forestias which is a prototype for town development. The project is committed to creating a real estate that narrows the gap between residents and natural environment. In doing so, it will its promise of 'well-being for all'. An environmentally conscious design process will bring innovation and technology to be applied environment conservation. Another main focus is to ensure it is usable by at least four generations in families and societal demographic.

Area: 0.63 sq.km
Cost: £3.09 Billion
Organisation: Private Sectors
Implemented in: 2022

Relevant Stakeholders

- Ministry of Energy
- ITEC Entertainment Corporation
- Foster + Partners Thailand
- EEC Engineering Network Company Limited
- Six Senses Hotels Resorts Spas
- Atelier Ten (Thailand) Company Limited
- Mulberry Grove
- The Aspen Tree
- Whizdom by MQDC
- Magnolia Quality Development Corporation Limited

Expected Outcome

Smart Environment
- protect air quality
- storage & collection of recyclable
- mitigate urban heat island
- flood resilience
- storm water retention and grey water irrigation
- good internal connectivity

Smart Mobility
- EV charging stations
- non polluting electric vehicles

Smart Living
- support social connection
- educational elements
- world class hospital with 350 beds
- support physical activities and mental restoration
- universal design
- pedestrian and cycling network

Smart Energy
- renewable energy, purchase green power and purchase carbon offsets
- district cooling and heating
- passive design enhanced by technology

Smart City Domain

SMART ENVIRONMENT · SMART MOBILITY · SMART ENERGY · SMART LIVING

Foster + Partners

Foster + Partners Thailand is renowned for architecture, urbanism and design, rooted in sustainability. Foster + Partners Thailand designed the masterplan and architecture of the Forestias project to create pioneering solutions for intergenerational co-living and people-centred connectivity between ecology and traditional Thai architecture.

atelier ten

With the vision "Imagine Happiness," Atelier Ten worked with MQDC's design team to develop a new innovative masterplan development, incorporating innovative holistic strategies for The Forestias to be an exemplar development that leads Thailand market transformation towards a healthier and more sustainable environment.

Restrata

Restrata were commissioned to develop the Security Masterplan, which provided clear vision and strategy for Physical Security provision, in particular for the public realm, the Pavilion and for the site wide infrastructure. Restrata were also further contracted to provide physical security design services for the Forestias.

Rattanakosin Innovation District

Project Overview

Rattanakosin Innovation District aims to become a leading creative economy hub in Southeast Asia. Silpakorn University is to be a centre for the development of creative and business skills. Developments will include business and housing innovations, travel and lifestyle services, and coworking spaces for activities and integration. Pak Klong Talad, Sampeng Phahurat, Ratchadamnoen Road, Tha Chang, Tha Maharat, and Bang Lamphu are strategic locales in the plan.

Area: N/A
Cost: N/A
Organisation: Public Sectors
Implemented in: N/A

Relevant Stakeholders

National Innovation Agency

Silpakorn Uniersity

Old Bangkok Innovation District

Urban Research and Laboratory Group

Expected Outcome

Smart Environment
- digital infrastructure
- cultural heritage is preserved and utilised appropriately

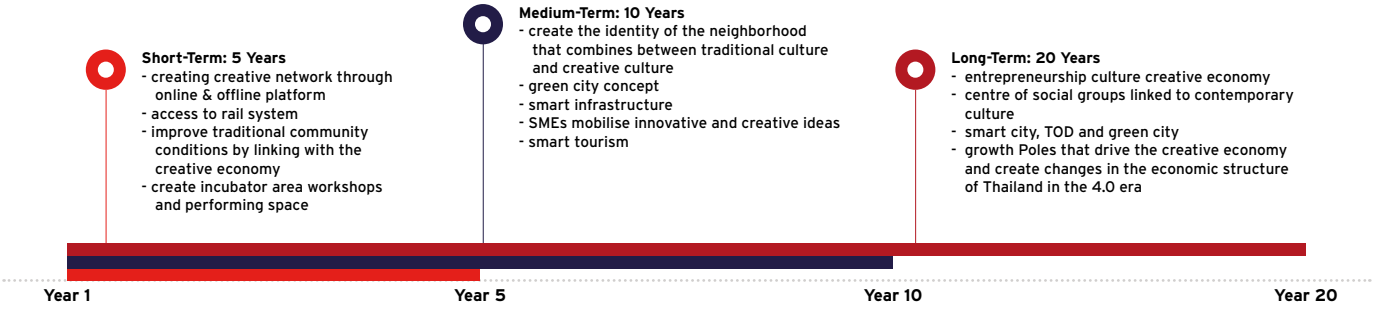
Smart Economy
- a place of incubation and accelerating startups about creative work

Smart People
- constant creative activities in the district create an entrepreneurial culture creative industries were connected and interacted

Smart City Domain

SMART ENVIRONMENT
SMART PEOPLE
SMART ECONOMY

Timeline



Yothi Medical Innovation District

Project Overview

Yothi Medical Innovation District consists of developing and connecting medical institutions, educational institutions, residential spaces, research units, restaurants, cafes, and co-working spaces. The focus is to make an area conducive for meetings and the exchange ideas that lead to medical innovations that can be brought to the global market. The area already contains many medical institutions, which reflects its potential to be a prototype development area and investment in medical industry of Thailand.

Area: 1.7 sq.km
Cost: N/A
Organisation: Public Sectors
Implemented in: N/A

Relevant Stakeholders

- National Innovation Agency
- Bangkok Metropolitan Administration
- Ministry of Education
- Ministry of Higher Education Science, Research and Innovation
- Cat Telecom Public Company Limited
- Ministry of Public Health
- International Business Machines Corporation
- Dell Incorporated
- Thai Embedded Systems Association

Expected Outcome

Smart Mobility
- connecting walking footpath
- public transport links within the district

Smart Economy
- promoting measures & policies to support innovation investment
- medical database development
- innovation promotion area

Smart Living
- linking information and communication technology tech startup community
- connecting IoT to everything for efficiency
- medical service centre
- medical research & startup

Smart City Domain

SMART MOBILITY · SMART LIVING · SMART ECONOMY

If Thailand were a wheel, then Bangkok is the centre that every other city revolves around. It is no secret that Bangkok commands a disproportionate amount of attention and investment from its own government.

The government recognises that Bangkok cannot be the only city in the country that has everything. Bangkok's growth if left unchecked will become unmanageable. Wealth and opportunities must be distributed to secondary cities so they can grow and support the population around them in a sustainable manner.

To assist in this, Smart City Thailand has begun to clearly identify and support select pilot cities.

Chapter 4

EEC & Pilot Cities

Though often called ‘secondary cities’, nearly 85% of Thailand’s population lives in the cities, towns and villages outside of Bangkok. A major emphasis of the country’s development goals and smart city agenda is to support the places and people living in other regional hubs to grow into stronger centres of activity and build a more balanced and sustainable model for Thailand’s future growth.

This chapter highlights six such cities and provinces, including progress reports on Smart City Thailand’s first pilot cities, as well as the Eastern Economic Corridor (EEC) special-economic zone that is a major economic engine for the future of the nation.

Eastern Economic Corridor

The Eastern Economic Corridor, or EEC, is a special-economic zone established in early 2017. Encompassing the eastern seaboard to the east and southeast of Bangkok, it includes three provinces that border the Gulf of Thailand, Chachoengsao, Chonburi, and Rayong, that are home to much of the country's major industrial activity, together making up approximately 13,266 km^2 and with an estimated population of nearly three million.

EEC is a key component of the Thailand 4.0 policy, receiving substantial support from central leadership and being granted a budget of THB 1.5 trillion (£37.6 billion) over its first five years.

BUSINESS & INVESTMENT OPPORTUNITIES

EEC promotes investment into 12 key industries that have been strategically chosen to position Thailand as an innovation hub in the region, and help the country escape the 'middle-income trap'. Many of these industries would bolster the local smart city market, as they are in industries related to digital technology and innovation. These industries include:

1. Next-generation Automotive
2. Intelligent Electronics
3. Advanced Agriculture & Biotechnology
4. Food for the Future
5. High-value and Medical Tourism
6. Automation and Robotics
7. Aviation and Logistics
8. Medical and Comprehensive Healthcare
9. Biofuel and Biochemical
10. Digital Technology
11. Defense
12. Education and Human Resource Development

EEC AND THE SMART CITY

EEC is viewed as a new model of regional development in Thailand and is expected to act as a showcase for the deployment of smart city concepts and technologies throughout the special-economic zone.

Plans are already underway to develop Thailand's first high-speed rail (HSR) in EEC, connecting Don Mueang, Suvarnabhumi and U-Tapao international airports, with stops at key locations along the way. Each one of these locations is expected to follow a transit-oriented development (TOD) model, incorporating smart city best practices in the process.

Much of this future development hinges on the success of the HSR. In late 2019, Charoen Pokphand Holding (CP Group) signed a THB 224.5 billion (£5.6 billion) contract to build the railway, and construction is expected to begin sometime in 2021, though delays have occurred.

Other smart city related initiatives are being pursued in the many industrial parks, as EEC grants special access to BOI incentives for upgrading existing infrastructure with smart technologies for better energy efficiency, productivity, and environmental outcomes.

EASTERN ECONOMIC CORRIDOR OFFICE (EECO)

The Eastern Economic Corridor Office of Thailand (EECO) is the public agency responsible for business facilitation and overseeing implementation of the EEC master plan.

In accordance with the EEC Act, EECO holds the equivalent power and authority as other government agencies to approve, permit, and grant rights and concessions for relevant projects.

INCENTIVES & SCHEMES

The EEC Act of 2019 established specific tax incentives and investment schemes for promoted zones and the specified industries. Investment incentive schemes for 2020-21 include:

- Tax holidays & deductions
- Import duty exemptions
- Currency exchange exemptions
- Land ownership
- Immigration and visa exemptions

LEARN MORE:

Website: www.eeco.or.th
Contact: info@eeco.or.th

EEC PROMOTED ZONES

EEC has designated 21 Promoted Zones to be a location for the 12 targeted industries where investors will be eligible to receive both tax and non-tax privileges.

In addition, five area-based projects are being promoted for smart city development (seen on the map to the right).

EECH - HIGH-SPEED RAIL RIBBON

EECh consists of High-Speed Railway and Transit-Oriented Development areas (TOD), located at the Makkasan and Si Racha station, measuring 140 Rai (22.4 Hectares) and 25 Rai (4 Hectares), respectively

EECI - INNOVATION PLATFORM

EECi is a novel ecosystem designed to promote innovation and upgrade modern technology that will serve future business needs. A complete "innovation ecosystem" will transform technological and innovation research into practical industrial applications.

EECA - EASTERN AIRPORT CITY

EECa consists of business and facilities in the U-Tapao International Airport, including a commercial gateway, a cargo terminal, an aviation training centre, an MRO centre, and Free Trade Zone that will enhance business operations and provide a world-class experience for everyone.

EECMD - MEDICAL HUB

EECmd is projected to be Thailand's first medical hub, where the area would offer complete health care and medical services. EECmd aims to elevate Thailand's health services and equip the country for the expansion of its aging population.

EECD - DIGITAL PARK

EECd is the future destination for digital global players and digital biz innovators to explore, develop, and acquire original digital technology for thriving digital business. It consists of the world-class data centre, digital innovation testbed and IoT institutes which are fully equipped with high-tech facilities.

Eastern Economic Corridor Promotion Zones for Smart City Development

Chonburi

Area: 3.5 km² / 228.8 km²

Population: 27,815 / 322,057

Population density: 7,947.14 per km²/ 1,484.26 per km²

Chonburi is a city approximately 90 km to the east of Bangkok. It is a key strategic city in the Eastern Economic Corridor (EEC) for international logistics, industry, tourism, and naval defence. It has the third-largest Gross Provincial Product in Thailand following Rayong and Bangkok metropolitan.

CURRENT STATE OF THE SMART CITY

Chonburi is home to smart city projects of various scales, from state down to local levels. A few local government-led smart cities, such Pattaya and Saensuk, and several private projects are in the provincial city area.

Through the EEC development plan, Chonburi is designated a centre for sea-air-land logistics. The transportation modes intersect and complement each other and are expected to boost the economy of Chonburi. Smart city projects include:

- Pattaya Mice City
- Saensuk Smart City
- Sriracha Smart City
- Laem Chabang Port
- Utapao Airport City
- EEC High-speed and Double track Freight
- WHA Industrial Estate

These aim to enhance the productivity of the city in logistics, industry, and tourism and improve citizen livelihood in general.

SMART LIVABLE CITY SMART NEW CITY

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SMART GOVERNANCE SMART LIVING SMART PEOPLE

SMART CITY DRIVERS

Smart cities in Chonburi are driven by actors across both private and public sectors. Pattaya, Saensuk, and Sriracha are driven through the local authority initiatives. The projects initiated in Pattaya and Saensuk are focused on improving community efficiency and sectors of energy, mobility, and health. Sriracha is planning a large-scale infrastructure development which will include housing complexes.

Regional logistics infrastructure projects are mostly in the form of public-private partnerships. The investment in these infrastructure alone top approximately half a trillion Baht (£13 billion). The state agencies are commissioning several private enterprises in investment deals. Charoen Phokphand Group is to build and operate high-speed rail. BBS, a consortium of multiple large companies, is to build and operate Utapao Airport.

Private initiative projects are of significance in the development of Chonburi. These are mostly housing, commercial, or industrial projects. Each will be equipping developments with advanced technology that are limited to within their own premises.

LEARN MORE

www.eeco.or.th/
www.saensukcity.go.th/
pattaya.smartcitythailand.or.th/

PROJECT HIGHLIGHTS

A crucial project pushing Chonburi towards becoming a smart city is the intercity high-speed rail, which is projected to bring business opportunities. The city has various types of smart city projects geared towards advanced industry, logistics, tourism, and more.

Utapao Airport City

Utapao airport city is a project that will retrofit the current Utapao airport to make it into an aviation industrial area. Utapao is located to the east of Bangkok and will be connected to the new high-speed and freight rail to two other major airports in Bangkok. The city aims to become a commercial gateway for aviation activity via the establishment of a free trade zone with facilities for air cargo, and maintenance, repair and overhaul facilities.

Pattaya

Pattaya is currently developing itself to become a MICE (Meetings, Incentives, Conferences and Exhibitions) city by improving capability of the city infrastructure and facilities. This includes building and augmenting venues, an environment and disaster warning system, IoT governance, and surveillance camera network for safety.

Laem Chabang Port - 3rd phase

Laem Chabang Port - 3rd phase is an extension of the current Laem Chabang port to increase the capability of the deep-sea logistic centre. The goal is to increase container freight handling by 10 million containers, 1 million cars from the current capacity. The project includes new ports, freight rail, and improved port automated operation systems.

Rayong

Area: 16.95 km² (Municipal) / 514.5 km² (City District)

Population: 64,256 / 282,312

Population density: 3,576 per km² / 548.71 per km²

Rayong is a city in the Eastern region of Thailand approximately 180 km away from the capital. The city is a strategic hub for industry and logistics. It is home to the industrial estate and deep-sea port in Maptaphut. Despite having a relatively smaller population size compared to other major Thai cities, Rayong has the highest Gross Provincial Product per capita in the country.

CURRENT STATE OF THE SMART CITY

Rayong, as a part of the Eastern Economic Corridor (EEC), is one of the key strategic cities considered as an economic driver in Thailand's 20-year plan. It has attracted investment from both public and private spheres. Major initiatives include:

- Double track logistic railway
- Maptaphut deep seaport phase 3
- PTT Wangchan Valley - Research, Development and academy for science and 4.0 Industry
- Smart City Rayong (Smart Housing, Hospitality, EV bus, Startup House, and Commercial Complex (Smart Block Project?))

These four projects aim to enhance productivity by increasing both capacity and capability of services. In doing so, Rayong is to become a leading advanced industrial hub of Southeast Asia.

SMART LIVABLE CITY SMART NEW CITY

SMART ENVIRONMENT SMART MOBILITY SMART ENERGY SMART ECONOMY SMART PEOPLE

SMART CITY DRIVERS

Rayong's development is driven by key actors from both the public and private sectors. Aside from the Eastern Economic Corridor Office of Thailand (EECO), the State Railway of Thailand (SRT) is in charge of the double-track EEC logistics rail. The local authorities in provincial, district, and subdistrict levels act as hosts for project implementation.

In the private sector, state-owned petrochemical enterprise PTT is investing in a research and development institution (EECi) that has a goal to become a leading knowledge hub in six manufacturing and innovation industries. Origin Property has representation in the city municipality to help develop their smart city via housing, hospitality, transportation, and commercial projects.

Rayong has also adopted the City Development Corporation model. Rayong City Development (RYCD) is focused on mitigating urban and citizen risks that may be borne of industrial development. Currently, there is no announced initiative from RYCD.

LEARN MORE

www.eeco.or.th/

PROJECT HIGHLIGHTS

Logistics and research and development institute are major strategic points driving Rayong towards being transformed into a leading industrial hub of Southeast Asia.

Maptaphut industrial Port Phase 3
The extension of the industrial port in the third phase aims to increase production capacity, specifically a deep-sea dock for liquid cargo, especially liquid energy, LNG. In this third phase, 1000 Rai (1.6 km²) of land is being reclaimed in the Gulf of Thailand.

Wangchan Valley
Wangchan Valley is a PTT research and development institute. The objective is to become a knowledge hub with a focus on upskilling people starting from high school onwards in fields of science, engineering and research. Field specialties include modern vehicle, automation, aerospace, medical, energy, agriculture, and biotechnology.

Chachoengsao

Area: 12.76 km² / 378.7 km²

Population: 39,233 / 162,230

Population: 3,074 per km² / 428.38 per km²

Chachoengsao is a coastal province located directly east of Bangkok. Most of the provincial border between Bangkok and Chachoengsao are agricultural and flood basin zones, and the urban fabrics of the two are completely separated. The city has the sixth largest Gross Provincial Product per Capita in the country, with industry making up 70% of its total productivity.

CURRENT STATE OF THE SMART CITY

Chachoengsao is set to be a strategic area of Bangkok expansion and the Eastern Economic Corridor (EEC). In the proposed plan, it is to host the expansion of the central government facilities from Bangkok, turning Chachoengsao into a central governance - satellite city. Projects are heavily focused on optimising governance to provide advanced services at local, regional, and national levels. The city expects a huge infrastructural change in parallel to match increasing demand in the following:

- Smart Mobility
- Smart Living and Housing
- Smart Economy

Chachoengsao will be home to a high-speed train station that is one of the two service depots along the 220 km long high-speed program. The high-speed station will play a critical role in the expansion of Chachoengsao as it will result in capacity, traffic flow, and economic gains for other related development projects.

SMART CITY DRIVERS

The driver for Chachoengsao smart city is largely the central government through the EEC proposal. The regional scale transit infrastructure, government facilities, Chachoengsao's central location between three major airports, and EEC investment privileges will have a high impact on the city's development path directly and indirectly.

Industrial estates as a group is another influential driver. Despite projects being limited to the confines of their premises, the cumulative environmental, social, and economic changes are likely to make impacts citywide considering their large contribution to city productivity and jobs.

Chachoengsao local authority is the local driver who is responsible for implementing the provincial and city scale initiatives. These are mainly focused on city infrastructure and digitisation of governance to increase Chachoengsao readiness for the massive changes from the regional development.

LEARN MORE

Chachoengsao Province: www.cgd.go.th
Chachoengsao Municipality: www.chachoengsao.go.th

PROJECT HIGHLIGHTS

Despite the province being a part of EEC, there are only minor initiatives on the urban infrastructure change for Chachoengsao. Nevertheless, it will still host the high speed train maintenance facility, and improve its educational system as response to the demand for services for EEC.

HSR Depot
Chachoengsao is set to host one of two EEC High Speed rail depots. It is situated on a 300 Rai (0.48 km2) area of land between Suvarnabhumi airport and Chachoengsao HSR station. The depot is a part of the HSR civil engineering budget approximately 113 billion Baht (£2.8 billion).

Skill and Re Skill education program
With the budget of 1,636,605,000 Baht (£41.28 million) provided by the city, Chacheongsao plans to uplift its school utilities, facilities and program in response to the demand of skilled and semi-skilled workers for EEC focusing on 10 industry services i.e. Food for The Future, Digital Economy, Medical Hub, Automation, Robotics, Aviation and Logistics, Agricultural and Biotechnology, Smart Electronics Affluent, Medical and Wellness Tourism, and Next-Generation Automotive

Phuket

Area: 12 km² / 224 km²

Population: 79,308 / 250,474

Population density: 6,609 per km² / 1,118.19 per km²

Despite being the second smallest province in Thailand, Phuket is a major international tourist destination known for its scenic environment and cultural heritage. The island is accessible via land, sea and air transportation. Phuket had more than 10 million visitors in 2017 with approximately. between 60,000 to 90,000 hotel rooms in service.

CURRENT STATE OF THE SMART CITY

Phuket is pioneering smart city projects in Thailand. It aims to become a MICE (Meetings, Incentives, Conferences and Exhibitions) city. The city has partnered with several local and global partners to create their development alliance. The city has set a clear vision and masterplan and commissioned a recommendation white paper. The focuses for Phuket are Smart Transit, Smart Tourism, Smart Energy.

Development projects include:

- City development corporation
- Public transportation - Smart Bus
- Cashless initiative
- City data platform

Initiatives such as LRT, solar renewable energy source, smart grid, surveillance camera network, and smart public lighting network are included in their future plan.

SMART CITY DRIVERS

Phuket smart city is a sphere of city development projects led by Phuket City Development Corp (PKCD). The corporation is spearheading development with a number of government and public sector partners. Similar to other Thai cities, PKCD is mainly partnered with Phuket town hall administration and Digital Economy Promotion Agency (DEPA).

DEPA played a key role in Phuket's development framework when it partnered with Huawei, a global technology company who is currently leading in 5G technology rollouts. Together, they released the framework for the Phuket development plan through technology with support from consulting firm Roland Berger.

PKCD has also established partnerships with domestic partners such as Rabbit payment company to develop a cashless system. The Mass Rapid Transit Authority of Thailand is set to build and operate the Phuket - Phan Nha LRT system. PKCD created its own enterprise entities with affiliate corporations. These include Phuket Smart Bus, Economic Center Development, and City Data Analytics, each to oversee their own initiated projects.

LEARN MORE

Phuket City Development Corporation
Website: www.pkcd.co.th

PROJECT HIGHLIGHTS

Phuket currently has several ongoing projects for its ambition to become the first smart city of the southern region and a MICE city. The goal for smart city development is to enhance their economy, governance, services, and citizen wellbeing.

Project Phuket LRT
Phuket LRT is the first phase of the Inter-city rail (Phuket - Phang Nga - Surat Thani). The project aims to connect the airport and several parts of the city with 21 stations along the line. The estimation of the project cost is approximately 35 billion Baht (£1 billion).

Project 2 City Data Platform
The city data platform is a project which has already begun service, but the system is currently undergoing improvements. The project is being overseen by City Data Analytics and available via phuket.cloud. It provides essential city information for public use.

Khon Kaen

Area: 46 km²

Population: 114,459

Population density: 2,488/km²

SMART LIVABLE CITY

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Khon Kaen is located in the centre of the northeast region of Thailand, also known as Isan. Approximately 450km north-northeast of Bangkok, Khon Kaen is an important transportation and logistics hub in the region, as it lies at the crossroads of east-west Highway 12 and north-south Highway 2, or the "Friendship Highway" that connects Bangkok and the Thai-Laos Friendship Bridge at Nongkhai.

CURRENT STATE OF THE SMART CITY

Khon Kaen has developed one of the most robust strategic visions for smart city development in the country, Khon Kaen Smart City 2030, established after nearly two decades of dialogue between a broad network of local stakeholders. The strategy outlines three major pillars of development:

- Being a rail city (LRT)
- Being a centre for conferences and seminars (MICE City)
- Being a medical hub

All three are based on further establishing Khon Kaen as the 'Gateway of the Northeast'. Its strategic location at the centre of Isan, together with a new central train station and expanding airport, means the city is well positioned for strong growth as one of Thailand's up and coming secondary cities.

SMART CITY DRIVERS

Khon Kaen Smart City is driven by an engaged **Khon Kaen Municipality**, and an innovative group of public sector partners, local private entrepreneurs, and a heavily involved local university, **Khon Kaen University (KKU)**. depa is also an important strategic partner.

What makes Khon Kaen Smart City standout from other initiatives in the country is the major presence of an engaged private sector. Khon Kaen City Development Co. LTD, or **Khon Kaen Think Tank (KKTT)**, brings together 20 local businesses to develop the seed finance for a local, **municipal infrastructure fund**.

The innovative finance model is driven by a **THB 200m investment (£5.23m)** by the founding members of KKTT, which will be used to catalyze the development of the LRT network. TOD will then be leveraged through a public offering, of which the capital gains will be used to finance the rest of the 2030 agenda.

LEARN MORE

Khon Kaen City Development Co. Ltd
Website: www.khonkaenthinktank.com
Contact: info@khonkaenthinktank.com

PROJECT HIGHLIGHTS

At the foundation of Khon Kaen's comprehensive vision are the strategic pillars of infrastructure development (LRT, bus, and urban design) and smart technologies and data capabilities (WiFi, sensor networks, and data analytics).

Light Rail Transit (LRT)
Khon Kaen Transit System Co. (KKTS), founded in 2017 and funded by Khon Kaen Think Tank, has plans for a 26 km light rail network that will feature 18 to 21 stations, take two years to complete, and will cost 15 billion baht. The Land Traffic Management Commission (LTMC), a national think tank for transportation policy, has already given its support for the plan, and it is now awaiting approval before the Thai Cabinet before bidding on the project can begin. Construction is expected to begin by the end of 2020.

Smart City Operations Center (SCOPC)
Khon Kaen University has already built and began testing a Smart City Operation Center (SCOPC) on its campus to prepare the data platform needed to realise Khon Kaen's smart city plans. KKU is invested in research and development to train its faculty, students and public and private citizens in smart data analytics capabilities, and is positioned to become a Thai leader in the field.

Chiang Mai

Area: 40.22 km² / 152.4 km²

Population: 127,240 / 233,632

Population density: 3,212 per km² / 1,533 per km²

Chiang Mai is a major city in the northern region of Thailand. The city is known for its cultural and natural assets. The combination of urban and rural areas makes Chiang Mai a global tourist destination. It is home to the region's largest airport, while being accessible via road and rail. Chiang Mai is also a home to a few leading institutes including Chiang Mai University.

CURRENT STATE OF THE SMART CITY

Chiang Mai is the city leading smart city projects in the northern region and was one of the first cities to announce its plan in Thailand. Similar to other tourist destinations, Chiang Mai aims to become a MICE (Meetings, Incentives, Conferences and Exhibitions) city . The Chiang Mai smart city masterplan is derived from Smart City Thailand's seven domains.

Initiatives mainly involve the following domains:

- Smart Living
- Smart Mobility
- Smart Environment

Their initiatives are set to address issues which have been problematic for becoming a MICE city, such as pollution, traffic, accommodation, safety, and services.

SMART CITY DRIVERS

Chiang Mai smart city initiative is very diverse in its projects, which are aligned with several stakeholders from both government and private organisations. Most of the projects are included within the city budget, hence making the Chiang Mai Provincial Authority the main oversight body. Local drivers vary from provincial to sub district levels.

Another significant actor is the Chiang Mai City Development Corporation (CMDC), a private body pushing for smart city development. Their flagship initiative is Light Rail Transit (LRT), a partnership with Mass Rapid Transit Authority of Thailand (MRTA) to construct and operate the first metro rail transit in Chiang Mai.

There are also several other public agencies, such as Chiang Mai University (CMU), Digital Economy Promotional Agency (DEPA), Provincial Electricity Authority (PEA), The National Broadcasting and Telecommunications Commission (NBTC) and others that are invested in Chiang Mai.

LEARN MORE

Chiang Mai Smart City: www.chiangmai.go.th
Chiang Mai LRT - MRTA: www.mrta.co.th
Chiang Mai LRT - Red Line: www.chiangmai-transitredline.com

PROJECT HIGHLIGHTS

Chiang Mai has a long list of initiatives to be implemented within the seven domains of Smart City Thailand. It aims to become a MICE city and to resolve the long-standing issues of mobility and environment, which includes smog pollution that happens every year. The goal for smart city development is to enhance their economy, governance, services, and wellbeing of citizens.

Chiang Mai LRT

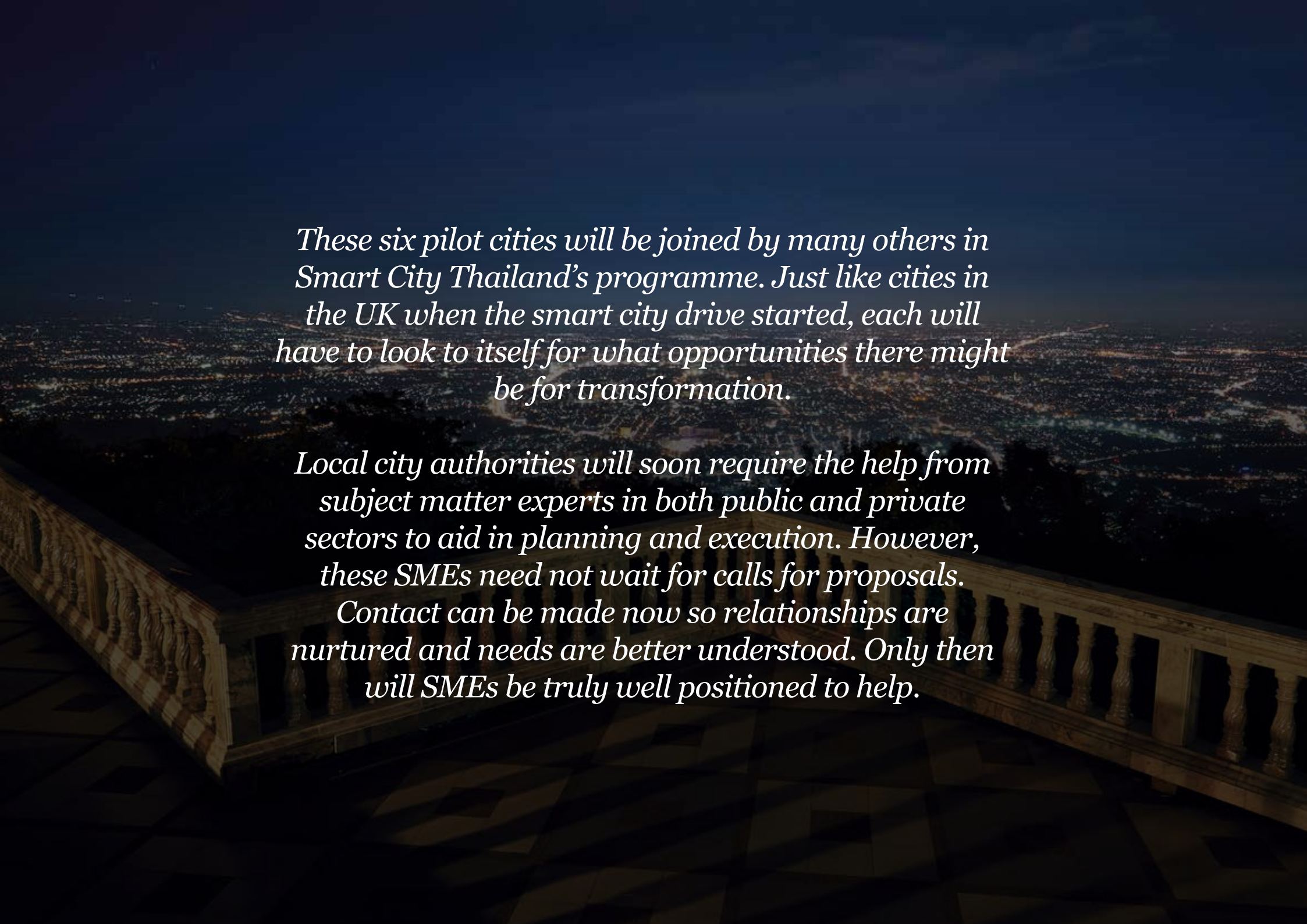
Chiang Mai LRT or Chiang Mai Transit Red Line (CMTR) is a proposed 15.9 km tram line, the first ever metro rail transit in Chiang Mai. The project will contain 16 stations both above and underground. CMTR is has cumulative budget of approximately 27 billion Baht (£690 million)

Walking Street

Chiang Mai Walking Street project is aiming to develop a digital platform for mobility and commercial purpose as a citykey. The digitalisation aim provided services and benefits for users such as a virtual guidebook, vouchers for products and services to conveniences and promote their local economy to citizens and tourists.

CMU Transit

Chiang Mai University (CMU) provides a free shuttle service for staff and students to travel within the main campus (known as Suan Sak Campus), using battery-powered cars, buses, and vans. This is part of an environmental awareness campaign to encourage students and staff to use energy-saving vehicles. The aim of the service is to minimise the use of personal cars or motorcycles, which will in turn alleviate the traffic congestion within the university.



These six pilot cities will be joined by many others in Smart City Thailand's programme. Just like cities in the UK when the smart city drive started, each will have to look to itself for what opportunities there might be for transformation.

Local city authorities will soon require the help from subject matter experts in both public and private sectors to aid in planning and execution. However, these SMEs need not wait for calls for proposals. Contact can be made now so relationships are nurtured and needs are better understood. Only then will SMEs be truly well positioned to help.

What's next?

With the basics of smart city laid out in previous chapters, Thai actors can now begin to analyse their own cities with a critical lens. Then, they must come up with their own vision and roadmap based on their city's context. But they need not reinvent the wheel. International smart city leaders, such as those in the UK, can proactively contact stakeholders or be called upon to assist. This chapter concludes on next steps that could be taken.

The UK as a Leader and Partner

Through decades-long progress in improving cities, both the UK Government and private enterprises have accumulated a significant amount of know-how and lessons learned in smart city implementation. One look at smart city ranking of UK cities can reveal how far ahead they are in digitizing its infrastructure and services.

Other countries can work with UK entities to look through how smart city projects have been executed and tease out applicable best practices to experiment in their own cities. The UK has much to provide with their wealth of experience in both successes and errors and are willing and ready to share with those who taking their own smart city journeys.

Throughout the remainder of this handbook you will find examples of how the UK has partnered with both public and private partners around the world.

PARTNERS IN GOVERNMENT

As seen from the short history of UK's own smart city endeavors, many UK Government and municipal bodies have participated and collaborated on projects that take advantage of technological development to respond to growing demands of smart citizens. They are open to assisting other nations in the same manner. Others can learn from their libraries of publicly available resources, such as that of British Standards Institute. More engaging partnerships are also possible, with services offered by many bodies.

Connected Places Catapult (CPC), the UK's centre of excellence for urban and mobility innovation, operates at the intersection between public and private sectors and between local government and transport authorities. CPC focus on growing businesses with innovations in mobility services and the built environment that enable new levels of physical, digital and social connectedness. Through their Global Programme, CPC help places around the world to design and develop programmes that grow innovation companies, scale high impact solutions to city challenges, future proof economies and form cross government bilateral business agreements for long term investments.

The best way to start engaging potential public bodies is by:

Contact the British Embassy Bangkok at info.bangkok@fcdo.gov.uk

PARTNERS IN ENTERPRISE

The UK's market making approach and propensity for public-private partnership has created a group of smart city enterprises that offer a wide range of products and services. From tangible goods like smart meters to more intangible knowledge like smart services consultation, these UK suppliers can augment and improve other countries' projects to upgrade their cities. Department for International Trade (DIT) is able to assist in connecting you with the most suitable UK partners.

Please get in touch at Thailand.dit@fcdo.gov.uk

PARTNERS IN RESEARCH & DEVELOPMENT

A number of university collaborations bring together different expertise and facilities from across the UK and interdisciplinary research centres in universities connect leading edge research in different departments with public and private partners. International research collaborations and partnerships on smart cities bring new ideas into the UK research environment, and help support emerging markets like Thailand around the world. These can be some of the most fruitful ways to develop the specialised skills needed in the smart city space.

Learn more at UK Research & Innovation www.ukri.org

Department for International Trade (DIT)

The Department for International Trade is the specialist Government department that supports:

- Foreign companies seeking to set up or expand in the UK, and
- UK-based companies to trade internationally.

The Department for International Trade provides a fully integrated advisory service, delivering the latest business intelligence through a global network of commercial teams worldwide.

The Department for International Trade works in close partnership with investment and economic development agencies in England, Scotland, Wales and Northern Ireland to help overseas companies to maximise their business objectives in the UK.

FOR THAI COMPANIES INTERESTED IN UK SMART CITY PRODUCTS AND SERVICES

We can help Thai companies connect to UK companies through our network of trade specialists from the Technology & Smart Cities Team.

This includes:

- Identification of possible business partners
- Information on UK Technology and Smart Cities
- Support during visits to the UK

FOR UK COMPANIES INTERESTED IN THE THAI MARKET

DIT has trade specialists who can help you commission services from local experts overseas.

This includes:

- Country and sector advice
- Local market research
- Support during overseas visits
- Identification of possible business partners
- Preparation for exhibitions and events

FOR THAI INVESTORS INTERESTED TO INVEST IN THE UK

DIT will provide you with dedicated, professional assistance on locating and expanding your business in the UK.

DIT and our regional partners offer free, confidential and tailored support in a number of key areas:

- Links with centres of excellence (e.g. universities)
- Information on tax, regulatory and business planning issues
- Information on financial incentives if applicable
- Information on staff recruitment
- Site and Property search assistance
- Building key contacts- we can provide introductions to service providers, local, regional and national government and trade organisations.
- Aftercare through on-going support
- Maximising your global potential- Once you are established in the UK, we can help your company to take advantage of new business opportunities and branch out to new locations – both in the UK and overseas.

For more information, please contact Thailand.dit@fcdo.gov.uk

List of Abbreviations

AI	Artificial Intelligence
BEIS	UK Department of Business, Energy and Industrial Strategy
BIM	Building Information Management
BMA	Bangkok Metropolitan Administration
BMTA	Bangkok Mass Transit Authority
BOI	Thailand Board of Investment
BOT	Bank of Thailand
BSI	British Standards Institute
BTS	Bangkok Mass Transit System
CAT	CAT Telecom Public Ltd.
CDC	City Development Corporation
CEA	Creative Economy Agency
CPC	Connected Places Catapult
DCT	Digital Council of Thailand
DDPM	Department of Disaster Prevention and Mitigation
DEDE	Department of Alternative Energy Development & Efficiency
depa	Digital Economy Promotion Agency
DGA	Digital Government Development Agency
DIIF	Digital Infrastructure Fund
DIT	UK Department of International Trade
DPT	Department of Public Works and Town & Country Planning
DSP	Data Science Platform
DSR	Demand side response
DSS	Decision support system
EdTech	Education technology
EEC	Eastern Economic Corridor
EECO	Eastern Economic Corridor Office
EGAT	Electricity Generating Authority of Thailand
EPPO	Energy Policy and Planning Office
ERC	Energy Regulatory Commission
ETDA	Electronic Transaction Development Agency
EV	Electric vehicle
EVAT	Electric Vehicle Association of Thailand
EXAT	Expressway Authority of Thailand
FCDO	UK Foreign, Commonwealth and Development Office
FPO	Fiscal Policy Office
GDS	UK Government Digital Service
GFCP	Global Future Cities Programme
GIS	Geographic information systems
ICT	Information and communications technology
IDH	Integrated data hub
iHIS	Integrated health information system
IoT	Internet of Things
ITS	Intelligent transport system
LRT	Light rail transit
MaaS	Mobility-as-a-Service
MDES	Ministry of Digital Economy and Society
MEA	Metropolitan Electricity Authority
MHESI	Ministry of Higher Education, Science, Research & Innovation
MNRE	Ministry of Natural Resources and Environment
MOC	Ministry of Commerce
MOE	Ministry of Energy
MOEd	Ministry of Education
MOF	Ministry of Finance
MOI	Ministry of Interior
MOI	Ministry of Industry
MOPH	Ministry of Public Health
MOT	Ministry of Transport
MRTA	Mass Rapid Transit Authority of Thailand
MSDHS	Ministry of Social Development & Human Security
MWA	Metropolitan Waterworks Authority
NBTC	National Broadcasting and Telecommunications Commission
NESDC	National Economic and Social Development Council
NHS	UK National Health Service
NIA	National Innovation Agency
NRCT	National Research Council of Thailand
NSO	National Statistical Office
NSTDA	National Science and Technology Development Agency
NXPO	Office of National Higher Education Science Research and Innovation Policy Council
OCSC	Office of Civil Service Commission
ODI	Open Data Institute (UK)
ONDE	Office of the National Digital Economy and Society Commission
ONEC	Office of the Education Council
ONEP	Office of Natural Resources and Environmental Policy Planning
OPDC	Office of Public Sector Development Commission
OPEC	Office of Private Education Commission
OTP	Office of Transport and Traffic Policy and Planning
P2P	Peer-to-peer
PCD	Pollution Control Department
PDPA	Private Data Protection Act
PEA	Provincial Electricity Authority
PMCU	Property Management of Chulalongkorn University
POC	Proof of concept
ROI	Return on investment
RTP	Royal Thai Police
SaaS	Software-as-a-Service
SCI	Smart City Index
SDG	Sustainable Development Goals
SRT	State Railway of Thailand
STS	Smart ticketing system
TfL	Transport for London
TGBI	Thai Green Building Institute
TISI	Thai Industrial Standards Institute
TOD	Transit-Oriented Development
TODP	Transit-Oriented Development Plan
TOT	Telecom of Thailand
TSB	UK Technology Strategy Board (now Innovate UK)
UGDE	Urban Governance Data Ecosystem
UKRI	UK Research and Innovation
V2G	Vehicle-to-grid
WMA	Wastewater Management Authority

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