VTT

VTT CITYTUNE® – SMART CITY GUIDE

Machine-assisted mayor: decision-making in future cities

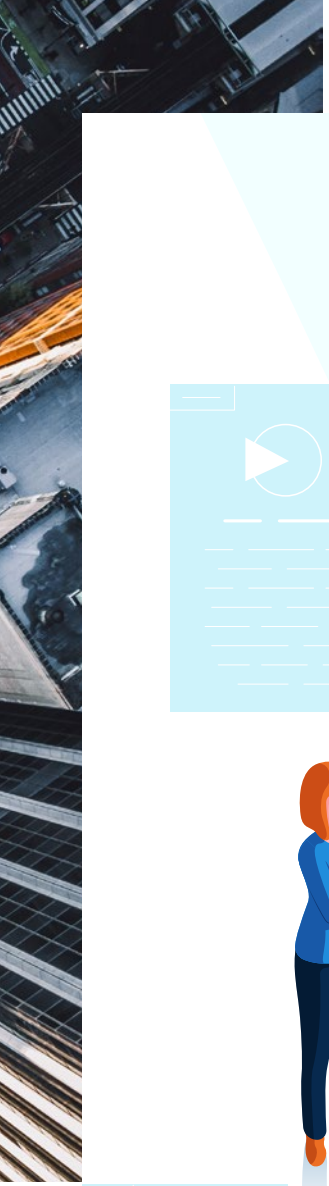
beyond the obvious

How do you want to shape your city?

When thinking of planning your ideal city, there are several questions to consider.

Do you wish to build a sustainable, dynamic, socially inclusive and resilient community? Are you looking to empower citizens, provide them with transparent information about city operations and make it easy to participate in community development? Or, perhaps you would rather turn the vast amounts of scattered data your city produces into meaningful information and foresight?

If your answer for any or all of the above is yes, then this guide is for you.



Cities with a smarter future

What can be done to reach the desired impact?

EXAMPLE 1

Resilient city for turbulent times

A severe storm hits the city flooding certain neighborhoods for days and causing city-wide power cuts. As normal life resumes slowly in the city, VTT CityTune® is used to ensure that next time the city will be ready. Weak points, critical infrastructure, risks of cascading impacts and unexpected ripple effects of different events are analyzed. “What if” scenarios are run on the city model to see how the city would cope under various threats and how quick the recovery would be. Armed with this information, the city enacts the necessary changes to ensure resilience in face of future risks.

EXAMPLE 2

Carbon neutral but profitable

An ambitious new strategy sets 2035 as the year when the city will be carbon-neutral. But how to ensure that along the way mobility is not hindered, energy security remains guaranteed and local economy will not suffer? VTT CityTune® is used to chart and compare different possible decision pathways. The model helps to recognize the optimal solutions for reaching the goal and brings up opportunities to develop the local economy along the way. Using VTT CityTune®, the city finds a path to reaching its goals while fostering the local business community.

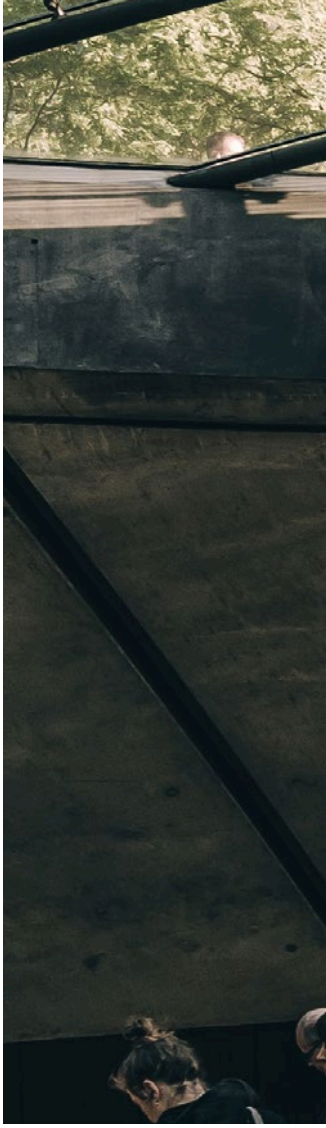
EXAMPLE 3

Light rail line to success

A new light rail connecting different parts of the city is being considered. However, analysing the changes in travel time shows that the expected impact is not enough to justify the investment. The mayor knows from experience that the benefits must be underestimated in the analysis, but how to prove it? VTT CityTune® is used to show that on top of travel time other benefits are accrued: better quality of service that will attract new inhabitants, new housing can be planned along the planned line and businesses will benefit from the constant flow of people around busy stations.

VTT CityTune ® - Better futures through data

Watch the introduction >



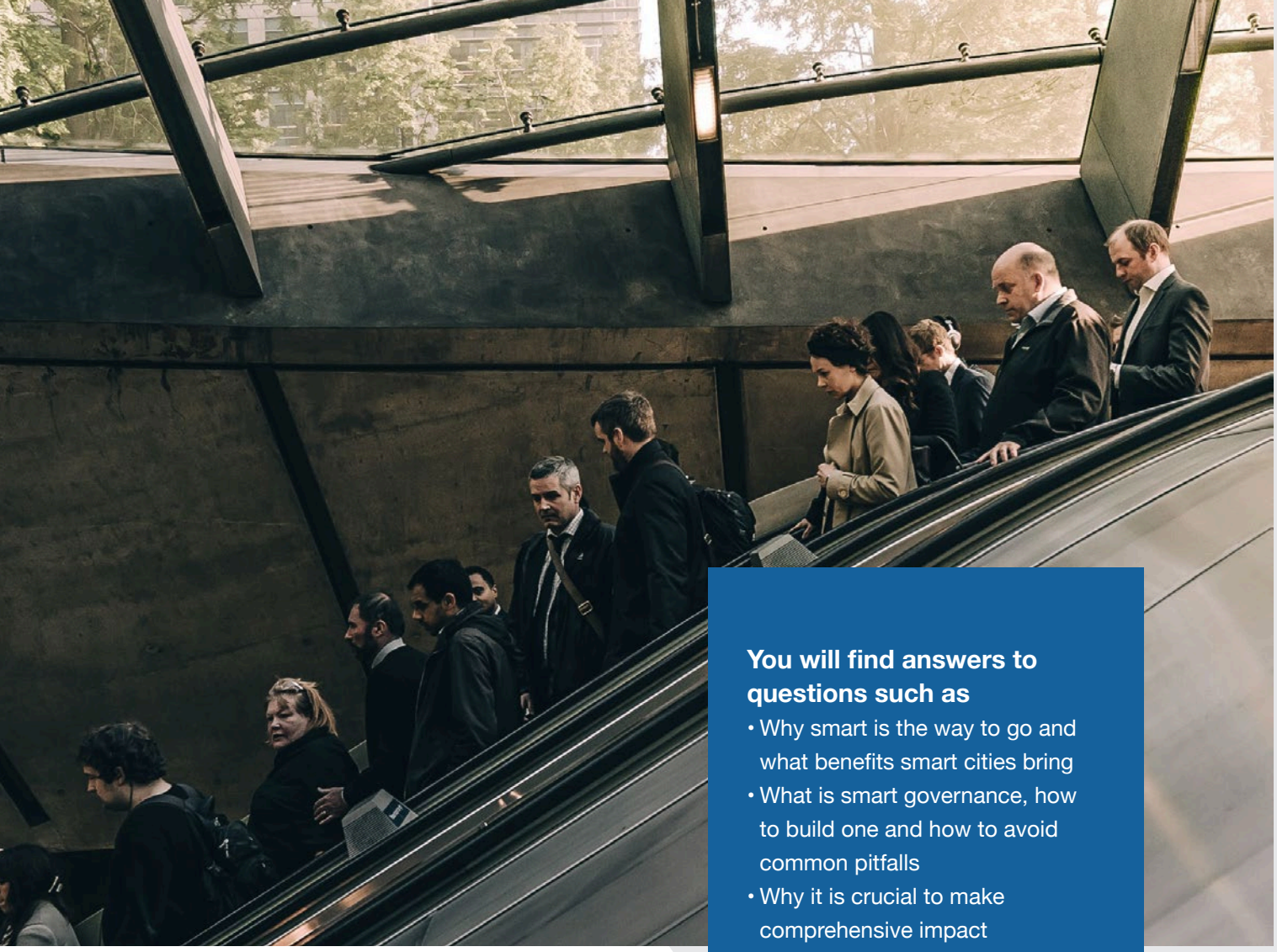
Summary

The built environment, energy, waste, transport, resilience, services and carbon-neutrality goals all shape the future city. And every city is unique. Although many cities face the same challenges, the solutions that work are almost always city-specific.

Simultaneously practical, large-scale deployments for smart city solutions are still in their infancy. Adoption and upscaling are often hampered by the complexity of urban systems, siloed decision-making, lack of skills, incumbent technology, and existing infrastructure.

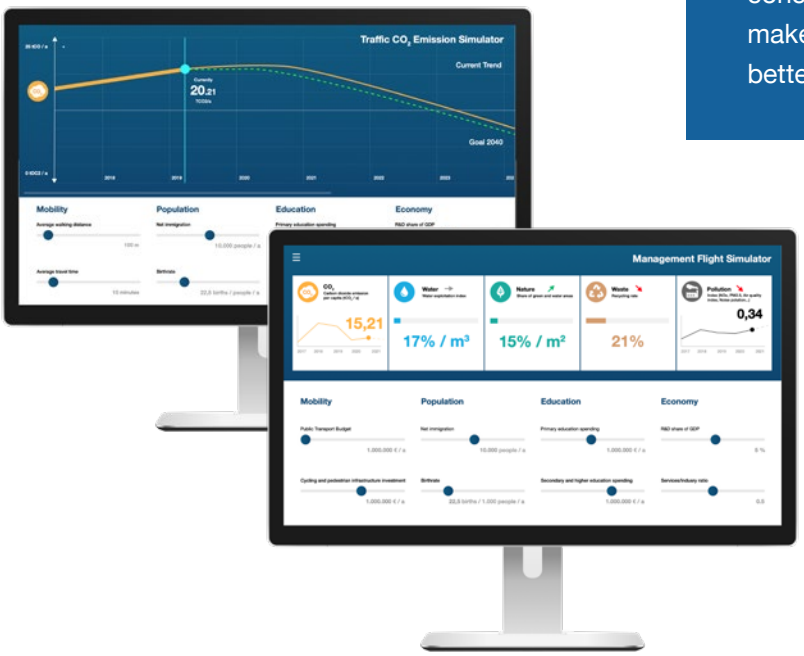
To truly plan a successfully functioning smart city, one needs to have active participation of its every stakeholder. Holistic impact assessments are equally important. When a holistic picture is missing, it is nearly impossible for decision-makers to foresee future impacts.

This Smart City Guide will show you how to overcome these challenges via VTT CityTune® and teach you how to realise your unique smart city vision.



You will find answers to questions such as

- Why smart is the way to go and what benefits smart cities bring
- What is smart governance, how to build one and how to avoid common pitfalls
- Why it is crucial to make comprehensive impact assessments
- Why data means a revolution in city management and decision-making and how to harness the data that your city produces to make smart decisions
- What is the VTT CityTune® concept and how it helps you to make better decisions and build better futures through data



Smart is the way to go. But how?

There are almost as many definitions of a smart city as there are cities. A smart city can be defined in different ways depending on the level of development, resources and aspirations of its residents.

In general, a smart city is developed when 'smart' technologies are deployed to change the nature and economics of the surrounding infrastructure and urban services. A smart city is a city where the built environment and buildings run on smart energy and the people and businesses utilise smart mobility.

Not simply cleaner and greener, the development of smart cities is driven by the desire to maximise the potential of buildings and municipal infrastructures, such as energy and transport networks, in order to create the best possible living environment for the citizens.

The full potential of smart cities is in

- Creating a safe and comfortable environment, with a high standard of living for the inhabitants.
- Realising a socially inclusive community where both the citizens and private-sector companies collaborate openly with and for the city.
- Maximising resource and energy efficiency with sustainable production and consumption.
- Establishing firm foundations for economic growth and innovation-driven future.
- Launching smart-city ecosystems, where positive cycles of development feed the development of each and every stakeholder.

Already
78%
of Europeans live in cities.

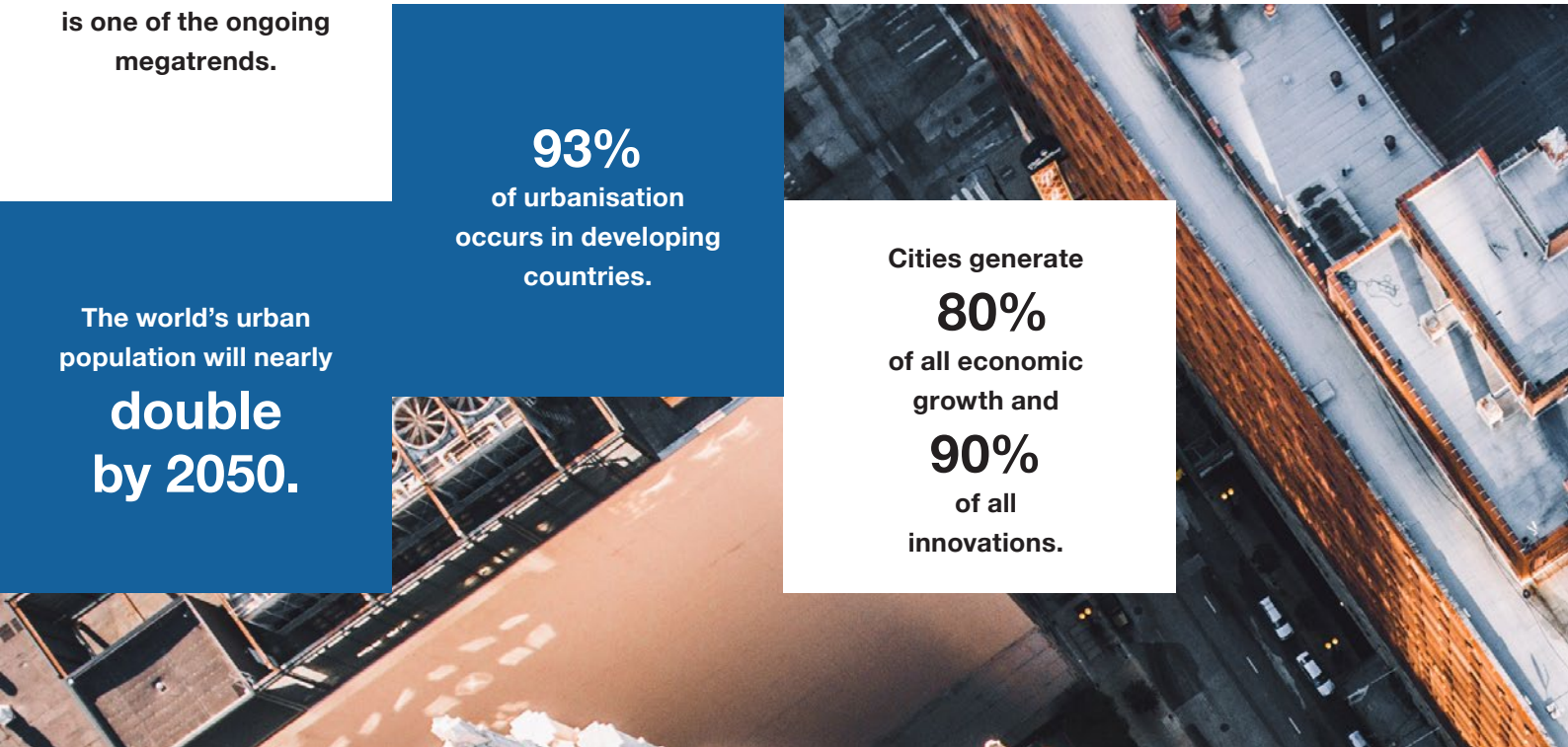
Urbanisation

is one of the ongoing megatrends.

93%
of urbanisation occurs in developing countries.

The world's urban population will nearly
double by 2050.

Cities generate
80%
of all economic growth and
90%
of all innovations.



Never too late to start

Creating a smart city does not need to start with a blank canvas: any existing city can be transformed into a smart one.

To reap the benefits that smart cities can offer, all governing players from city technical departments, development departments, and procurement need to share the same ambition with the top-level city officials as well as with the private-sector companies that are involved in the provision of the city services for the citizens.

In a truly smart city, the future vision is built atop local conditions together with all the stakeholders. The vision needs to be translated into a sustainable strategy and a concrete action plan. Finally, a set of indicators need to be deployed to measure and affirm the success of projects and operations. To make this happen, there are several changes that need to be rolled out on strategic and operational levels.

One thing is certain: investing in the city's sustainable and smart future pays off for all related parties. Happy and healthy workforce feed the economy, which increases stability and growth capability, which in turn attracts new investments for the further development of the city.

Key changes to turn your city smart

- A clear smart city vision and city-level strategy with commitment from the city staff.
- Independent, yet interconnected, decision-making backed up by clear and transparent leadership processes.
- Moving away from silos and sub-optimisation into system-level design and operation, and multi-objective optimisation.
- Open-minded experimentation on new agile and innovative business models that feed emerging ecosystems.

Urban areas occupy only three per cent of the planet's surface but they consume between

60-80%

of all energy.

Some

91%

of the urban population worldwide are breathing air with particulate matter over the World Health Organization guidelines value (PM 2.5)

Cities are responsible for three quarters of all greenhouse gas emissions and

70%

of all waste.

Sources: European Commission, United Nations (2019)

The meaning of smart governance

A healthy, inclusive community and a robust economy are essential building blocks for any smart city. However, they cannot be built without the active participation of all the stakeholders.

In smart cities, citizens are given ample opportunities to take part in planning and developing their living environment, providing feedback, and taking an active role in the co-creation of communal services.

The ideal form of smart governance is built on digitised and inclusive citizen-centric processes that enable the provision of city-services in a smart and convenient way. Goals, such as improving the health and well-being of the citizens, enhancing the economy, increasing safety, and improving the resilience of city operations, are some of the key focus areas.

Let's co-create

Participatory processes and user-centric service design can help increase environmental awareness and alter citizen behaviour. The availability of easy-to-use digital service platforms, transparent data, and abundant channels of communication enable citizens to turn into more active community members

City policy-makers and communal service providers should engage citizens in co-ideation and co-creation, as these are a resource-efficient way to develop fit-for-purpose services and build an inclusive community. With advanced digital technologies and services that are built upon new digital service concepts and business models, the role of citizens can change from consumers to prosumers.

Ideally, co-creation can be a very productive way to find new innovations for city-planning and design processes, relating for example to the development of built environment, energy and transport systems.

Better inclusion of citizens in decision-making, together with transparent processes, can improve citizen satisfaction.

How to make governance smart

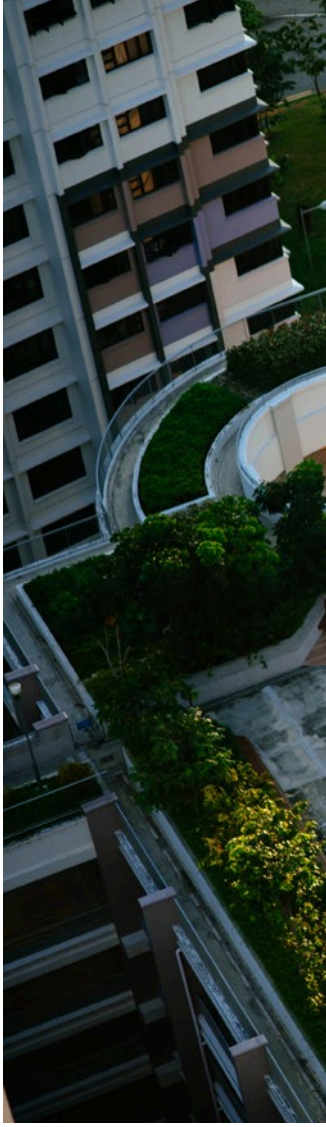
In current city practices, there is ample room for improvement. To reach the vision, a shared strategy and common goals should guide all city and government decision-making bodies.

Better inclusion requires new processes that enable efficient collaboration among different actors – citizens, city decision-makers and private companies. Accessibility of data is one of the trends that spur the development of new innovative services and increases collaboration between entrepreneurs and citizens.

"Smart governance can change citizens from consumers to prosumers."

Increasing and encouraging citizen engagement also requires the development of new types of physical spaces to serve collective functions. As neighbourhoods become more communal, buildings may become multifunctional. In mixed-use buildings, the residents could be provided with the type of services they want on-demand.

Smart city ecosystems can be seen as learning communities where citizens, service providers, and decision-makers gather together to develop solutions for real problems and learn together.



It’s all about collaboration and co-development

Advancing smart governance requires collaboration platforms that enable growth and development of the city ecosystem while supporting social, economic and environmental sustainability and improving the well-being of citizens.

Collaboration between the private and the public sector should be encouraged in smart cities. Sustainable business innovations contribute to the economic welfare of the city. Innovations that are co-generated in smart city ecosystems tend to improve citizen well-being as well as social and environmental sustainability.

The innovation of new technologies and business models is a result of co-development, even though their implementation is commonly up to private-sector companies. To enable a truly self-fuelling development cycle, governance arrangements should be altered to align public interest on social outcomes with the profit-seeking company’s capacity for technological innovation and potential to invest in new business.

New project delivery models such as public-private-people partnerships (PPPPs) should be more widely adopted. To avoid technology lock-in, cities and governments should facilitate development and deployment of open standards and interoperability across various technologies.

Open competition should also be encouraged. Incorporating interoperability requirements for public procurement would support the adoption of new innovations from small- and medium-sized enterprises. Investing in knowledge creation and dissemination offers increasing returns on investment for public authorities, through wider adoption of solutions and broader learning in society.

The coordination and integration of city systems and services requires open communication and collaboration among different city departments and officials, as well as with private service and system providers and the end-users. Smooth interoperability and data exchange between systems would facilitate more efficient use of resources.

City officials and planners would also benefit from new planning and design tools, with quick and easy evaluation and performance estimations. For maximum benefit, the design tools need to access various data sources

and provide clear, easy-to-understand visualisation of the expected impacts of alternative scenarios. This would help discuss objectives and their impacts with different stakeholders. Mixed-reality solutions, for instance, help concretise planned solutions to the citizens in an understandable way.

Shared ready-made smart city models would support better management and coordination of urban planning from district- to municipal- and regional level. Standardisation of data models, along with information exchange interfaces and systems would speed things up and increase efficiency by means of a wider sharing of assets and knowledge.

“Adopt new project delivery models such as public-private-people partnerships (PPPPs).”

From plans to actions - how to speed up the adoption of smart solutions

Market-based developments are not enough to initiate fast deployment of smart city solutions. City authorities and central governments need a clear path for success.

Intermediary organisations, such as research institutes, economic development agencies, consultancies, or think tanks can take on an instrumental role in facilitating projects with multiple partners.

Investing in solutions is commonly hindered by risks, such as vendor lock-in and costs spiralling out of control. Cities themselves seldom have the resources to roll out new technological solutions and pilot programmes. It is then up to private-sector companies to develop, test and market their solutions. However, the risks of developing and introducing new products are high, if success depends on the other players.

“City decision-makers hold the power to speed up development.”

The introduction of innovative solutions requires agile public procurement practices. City decision-makers hold the power to speed up development by using public procurement and by enabling creation of smart ecosystems. By creating foundations for collaborative innovation and platforms for experimentation, cities can smooth things out for wider adoption.

Creating demand for new smart city solutions can be done through the procurement of research and development as well as by being the first buyer for new solutions when they are introduced to the marketplace.

The benefits of a self-fuelling city ecosystem

Investing in the development of smart governance practices has many benefits:

- A socially inclusive and safe society.
- A dynamic, adaptive, resilient and sustainable community.
- Democratic governance with increased transparency and ample information about city operations.
- Empowered citizens who feel welcome to participate in community development.
- Favourable conditions for private companies to roll out smart sustainable solutions that feed.

CASE | **KATHMANDU, NEPAL**

Helping a capital city grow sustainably.

WHAT

Nepal's capital city Kathmandu is growing rapidly. There are plans for Kathmandu to grow beyond the present airport area in the north-east with 0.5-1 million new inhabitants.

GOAL

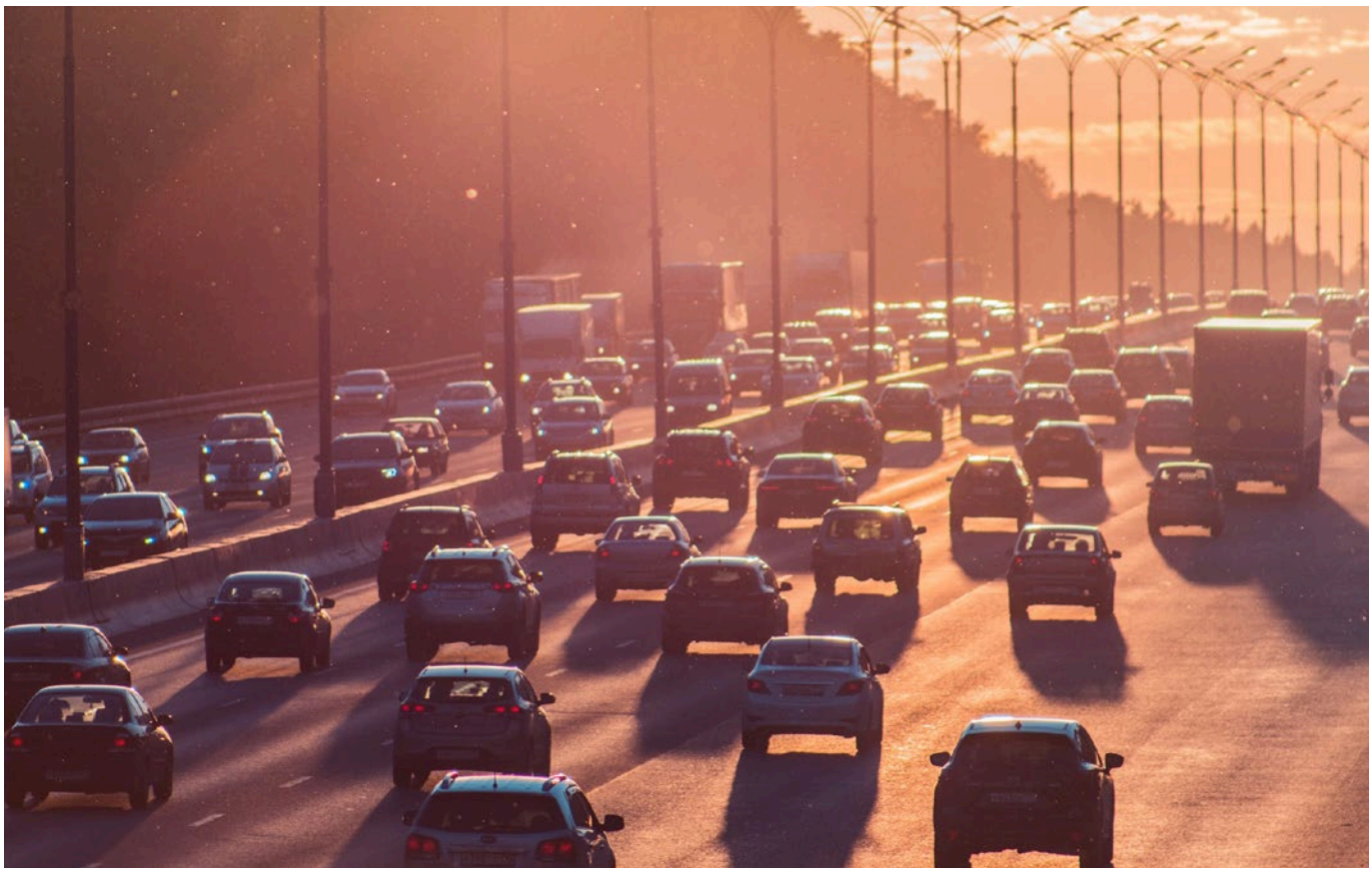
To ensure a good life for the city inhabitants.

PROCESS

Katmandu chose a sustainable and smart approach to planning. As part of the international planning team, VTT assessed the impacts of different urban development paths onto the local economy and jobs in the long-term, as well as helped to determine correct technology choices based on local needs and conditions.

RESULTS

VTT was able to support sustainable urbanisation in a fast-growing city and show what kind of path for expansion would most foster economic development of the capital region.



Machine-assisted city decision-making

Decision-makers in every city around the world know how difficult it is to make smart decisions. The importance of holistic urban planning is understood in cities, but its practical implementation is difficult.

Decision-makers operate in an extremely complex environment where each decision impacts everything else, while often creating ripple effects. Decision-making is further hampered by partial optimisation, fragmentation, and lack of specialist skills.

Different city operations are often very departmentalised and siloed. Data is scattered, often far away, and there might be many administrative steps in between. This means that all the necessary information is not being passed from one step or department to another and the information is not necessarily objective. Sometimes, part of the information needed to make decisions is simply not available.

At the same time, decisions can have far-reaching side-effects on many

different city operations, also beyond departmental boundaries. For example, the decision to improve cycling opportunities in the city will reduce the city's health spending.

Many city decision-makers feel that they are making decisions in the dark. When a holistic picture is missing, it is difficult to avoid risks and manage uncertainties. Above all, it is almost impossible to foresee future impacts.

Why holistic impact assessments are important

These challenges also make it difficult to carry out cross-cutting, comprehensive impact assessments. Thus, impact assessments are often incomplete and consider the effects of the solution only from a narrow perspective.

For example, the city may consider whether it is worthwhile to build a tramway in a particular area. The city's Department of Transportation conducts an impact assessment to determine how much travel time would be saved and how many people would use the tram. In other words, only the transport point of view is taken into account. According to the result, the benefits of the tram line will be small, and its construction is not profitable. For those in charge, a bus line seems a much cheaper and more flexible solution.

However, the tram actually has a much wider impact on the entire city ecosystem: It positively influences the image of the city and the attractiveness of the area for businesses and residents. The tram provides stability, allows for the construction of new housing, and adds value to existing homes along the tram line. Therefore, when a wider impact assessment is conducted, suddenly the project appears profitable for the city. The

Three key ingredients allow city managers to have better situational awareness and foresight in understanding the impacts of their decisions:

1. Holistic impact assessment: avoiding the pitfalls of a narrow scope that leaves certain types of impacts, as well as risks, out of the equation

2. Use of data to support decision-making: anchoring decisions to the real world instead of intuition, estimations, and rules-of-thumb

3. Using machine-assisted simulations to foresee the potential outcomes of decisions when dealing with complexities that entail the risk of unexpected impacts and side effects.

Armed with these tools, the leadership of a city can shed light into the complex uncertainties of the city as a system.

When facing the risks of a world that becomes more crowded, connected, and has a more extreme climate, cities need a clear pathway to sustainable prosperity and resilience. Foresight can help prepare for the challenges of the future and, when disaster strikes, find a sustainable way out of the fray.

previous narrow angle meant that some benefits were excluded from the calculation.

Or, let's imagine that a city decides to build a new eco-efficient neighbourhood in a beautiful area but does not pay attention to efficient public transport links in the area. As a result, the project fails because poor transport links do not attract residents or services.

Without a comprehensive impact-assessment, the decision-makers take a big risk that the project will not reach its goals, or it will have unexpected side effects, which will water down the whole project or make the current problems worse.

"Without a holistic impact-assessment, decision-makers take a big risk of unexpected side effects in projects."

Impact assessment is also an important tool when it comes to ensuring that the city's own strategic goals are realised. For example, the realisation of the carbon neutrality goal depends on the city being able to make the right decisions at the right time. It is also important not to accidentally rule out some alternatives at an early stage. For example, some forms of energy production that enable the transition to low-carbon energy production.

All in all, a comprehensive impact assessment is a crucial step in the city development process. It provides an opportunity to evaluate where decisions are leading with visibility into the future.

Harnessing data to make smart decisions

How to overcome all these challenges? The answer lies in one small word: data. Data means a revolution in city management, planning, and decision-making

Cities are treasure coves of data – there is a huge amount of data available from statistics and customer surveys to various sensors. But it has so far proved difficult to harness this data for foresight. Many cities use data mainly in different dashboards, which display a snapshot of the present moment, such as traffic jams.

Klein & Koenig (2017) suggest that cities need tools that support self-organisation and rapid feedback and exploitation. They stress that it is difficult to monitor development because cities are so rapidly and dynamically changing that it is difficult to monitor, for example, the indicators and what impacts policies have on these indicators.

Mass data can help detect what

kind of effects and side effects actions will have. Therefore, they present three models of urban planning: urban planners make plans and actions that receive feedback from the public, either indirectly, for example through social media or actual feedback applications, and another loop that automatically collects information to identify the direct and indirect effects of the measures.

Thirdly, it is also beneficial to collect feedback from companies. This helps to determine what kind of impact the decisions have on economic activity. Designers, civic activities and auto-collected data provide agility and rapid feedback cycles for city development.

“Data means revolution in city management, planning and decision-making.”

System dynamics modelling reveals the future

One example of how machines can help to make smart decisions is presented with system dynamics modelling, originally developed by MIT (Massachusetts Institute of Technology) to study complex systems (Forrester 1961).

Empirical studies (Cronin et al. 2009) have found that people's ability to perceive the operation of even a simple but dynamic system is limited. System dynamics emphasise the role of computer simulations in gaining a better understanding of complex systems.

Simulations can ask "what if" questions, instead of just explaining what, how, and why something happened in the past (Dooley 2002). Running simulations can be seen as a "virtual experiment" that can increase understanding of the systems' interactions and structures that influence human behaviour.

In foresight, the use of system dynamics enables the creation of dynamic scenarios. Simulations illustrate how change towards a particular future situation progresses over time. The dynamic approach also makes it possible to illustrate the effect of change-inhibiting factors, such as path dependence, on the system.
An additional benefit of simulation is that it forces you to create a logically consistent picture of the system's operation, rather than relying on unwritten assumptions for a particular future scenario. Simulation models can also be used as "scenario generators" in futures research. This means deductively calculating which behaviours are possible starting from certain assumptions about the system. Combined with other modelling methods – such as technical and economic models dependent on the case – VTT CityTune® also utilises the approach of system dynamics.

“Simulations can ask ‘what if’ questions, instead of just explaining what, how, and why something happened in the past.”

CASE | **Vienna, Austria**

Optimising city energy.

WHAT

A new group of buildings to the Austrian Institute of Technology campus.

GOAL

To create a new energy system where buildings not only consume energy but also produce it.

PROCESS

Local smart-controlled energy management is a complex system and ensuring optimal realisation is difficult. It was a challenge to minimise the emissions while ensuring the feasibility of the solution.

RESULTS

VTT used modelling of the energy system to find the optimal solution among many technology combinations.

CASE | **Saga, Japan**

Providing circular economy solutions.

WHAT

City of Saga in Japan is a local hub of agri-food and bio-based industry generating agricultural residues as a major waste flow.

GOAL

To create a circular strategy for agricultural residues.

PROCESS

VTT delivered a combined approach based on the understanding of biomaterials, food processing, value chains, business, infrastructure and system simulation expertise related to material flows in the local economy. The resulting solution helped analyse alternative approaches to closing the loops in material flows, weighing their benefits and drawbacks, and choosing the most promising solutions to be adopted.

RESULTS

Robust conversion of residual biomass to recyclable packaging and furnishings materials, systemic impact assessment for evaluating technological potential, as well as the economic and social value of the circular Saga ecosystem and simulator methodologies to support the municipal decision making.

CASE | **Kera, Espoo, Finland**

From an old industrial neighbourhood to a blooming circular centre.

WHAT

Kera is a district in the city of Espoo, situated next to the Finnish capital city Helsinki.

GOAL

To develop and build an attractive, blooming and sustainable business and living centre with thousands of new jobs in old industrial neighbourhoods.

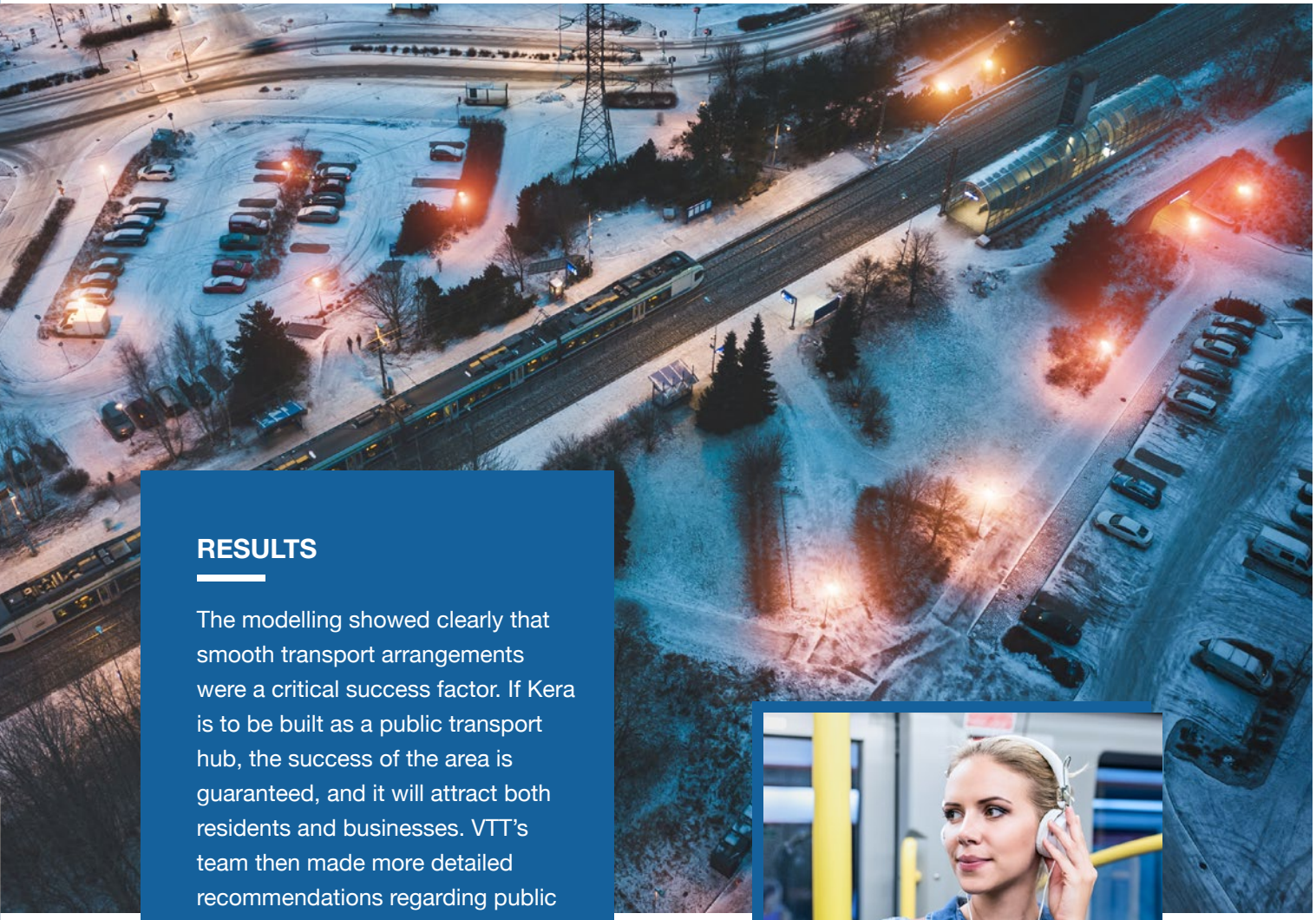
PROCESS

All stakeholders were brought to the table to participate in a workshop. First, participants wrote down open questions. The questions were then grouped by themes and a refined discussion was held on these themes. Finally, views were put together and summarised in a model that shows all the interactions.

The key question was how to make the area attractive? What is needed to attract citizens, consumers, services and companies? How they act and what they prioritise when they make both daily and long-term decisions? Many factors contribute to attractiveness for both businesses and residents, but each has its own characteristics, such as the value of housing and the different types of business ecosystems.

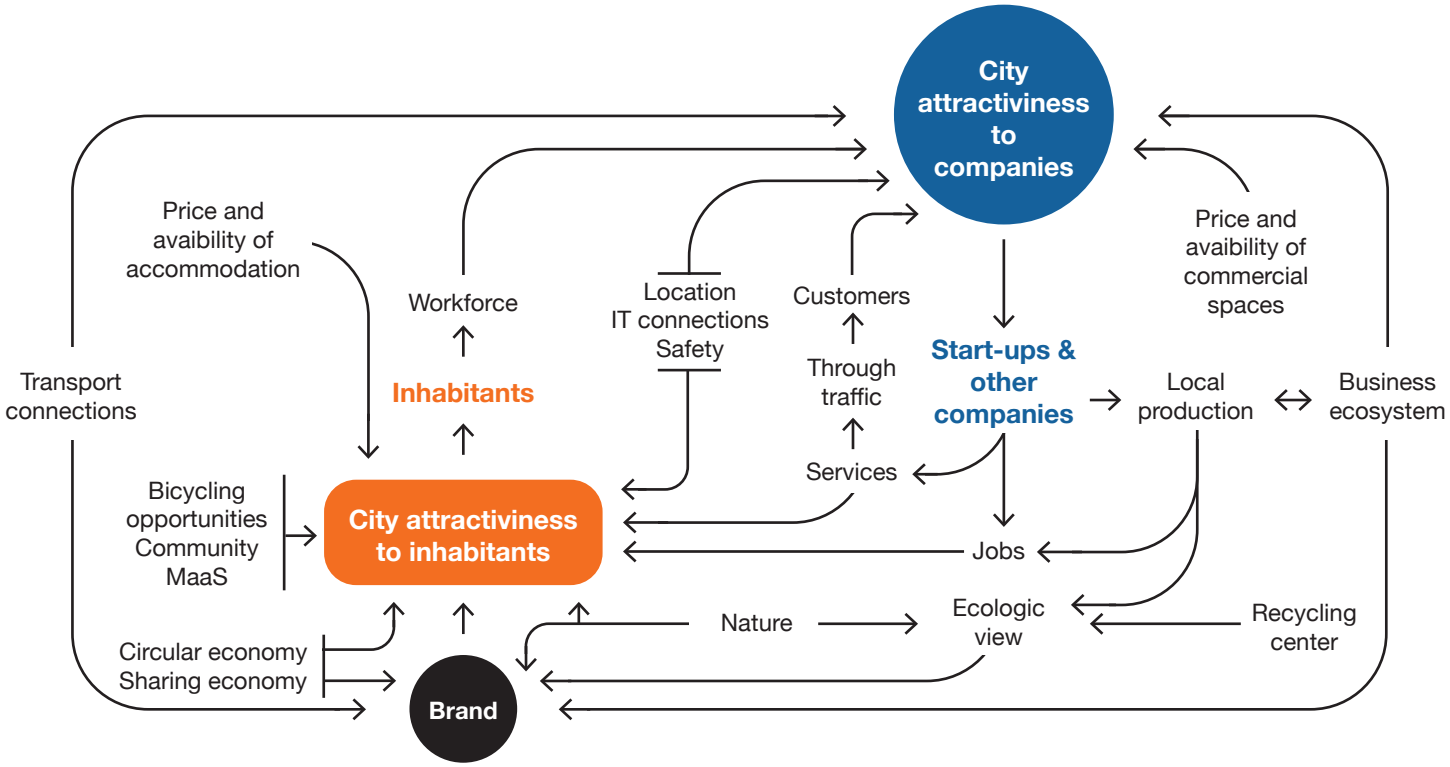
For some of the questions, it was easy to find a fact-based answer such as information on occupancy rates, household and housing volumes, and housing price levels. But there were also many hard-to-access information needs.

A model for a better understanding of neighbourhood developments was needed to assess the impact of the plans. System dynamic model was used to find what factors would ensure the success of the new district.



RESULTS

The modelling showed clearly that smooth transport arrangements were a critical success factor. If Kera is to be built as a public transport hub, the success of the area is guaranteed, and it will attract both residents and businesses. VTT's team then made more detailed recommendations regarding public transportation based on the findings. Now it is possible to develop Kera into a prosperous new centre.



“Cut through the noise and find the key factors of complex city development.”

VTT CityTune® – Unique and smart solutions for your city

VTT CityTune® is a data-based service that is capable of analysing all aspects of urban life. It helps you cut through the noise and find the key factors that affect a complex city development.

VTT CityTune® helps you to

MAKE sense of all the scattered data and turn it into useful, actionable information.

SAVE money, control risks and allocate funds more efficiently.

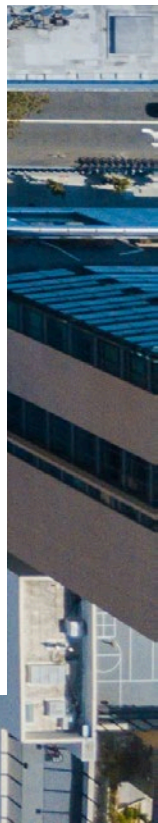
TACKLE mega-challenges, such as climate change and urbanisation and find unique solutions.

IDENTIFY complex cause and effect relationships and foresee unintended reactions.

FIND leverage points where changes can lead to developments.

BUILD cities that are healthy, sustainable and blossoming – together.

FORECAST likely effects of major decisions, be it, for example, planning new energy systems or city mobility, developing new areas, prioritisation of public services or maximising the impact of smart city investments.



VTT

What are the issues in your city that would benefit from an analytical approach and forecasting future developments?

Contact us:

Kirsi Kotilainen
Solution Sales Lead
kirsi.kotilainen@vtt.fi
+358 50 486 7742

Learn more about VTT CityTune®

Better futures through data

Watch >

Building smart cities with the help of VTT's CityTune concept

Read >

beyond the obvious