

DIGITAL
Cities Challenge

Designing Digital Transformation Strategies for EU Cities in the 21st Century

Challenges and Recommendations

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Luxembourg: Publications Office of the European Union, 2019
EA-04-19-484-EN-N – ISBN 978-92-9202-541-0 – doi:10.2826/91778

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Foreword



Cities are key enablers to drive growth, job creation and sustainable progress. As centres of economic activity, employment and innovation, cities have a vital role to play when it comes to promoting smart, sustainable and inclusive growth and tackling economic, environmental and social challenges.

In the global scene, the Sustainable Development Goals, Habitat III, and the European New Urban Agenda, recognise the power of cities as key agents to tackle modern day challenges and risks.

The emergence of advanced technologies, such as new sensing and communication technologies, open data, Internet of Things and Artificial Intelligence, offers to cities new and exciting opportunities to put in place modern city ecosystems that care for the citizens, the economy and the environment.

Cities offer the right scale and capacity to combine effectively industrial modernisation and sustainable growth. Cities-ecosystems can be on the front of the industrial transformation and transition to circular economy, clean tech and resource efficiency.

The recent "Vision for the European Industry until 2030", highlights the "Cities of the Future" as a game-changing action, with the view to connecting cities, learning from each other and offering innovative and sustainable services to citizens and businesses, using Artificial Intelligence, robotics and other advanced technologies.

It is in this context that the Commission has launched the **Digital Cities Challenge**, an initiative to help cities to become more productive, innovative and better places to live by building on the promises of advanced technologies.

Following a highly selective procedure, over 40 European cities participated in the Digital Cities Challenge, forming a network of collaboration, learning and shared insight covering every corner of the continent. This summary report displays the lessons learnt from this Digital Cities Challenge and provides recommendations to other cities on how to tackle the process of high-tech transformation.

And we are already looking forward. We commit to scale-up good practices with the next phase: the torch of the Digital Cities Challenge will pass to the 100 Intelligent Cities Challenge. By addressing the modern day challenges with the potential of advanced technologies, we will connect more city-ecosystems and empower them to achieve social and environmental sustainability together with smart growth. This will pave the way for a strategy for EU Cities in the 21st century.

I wish you an insightful reading!

Timo Pesonen

Director-General

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Executive summary

Digital Cities Challenge outcome

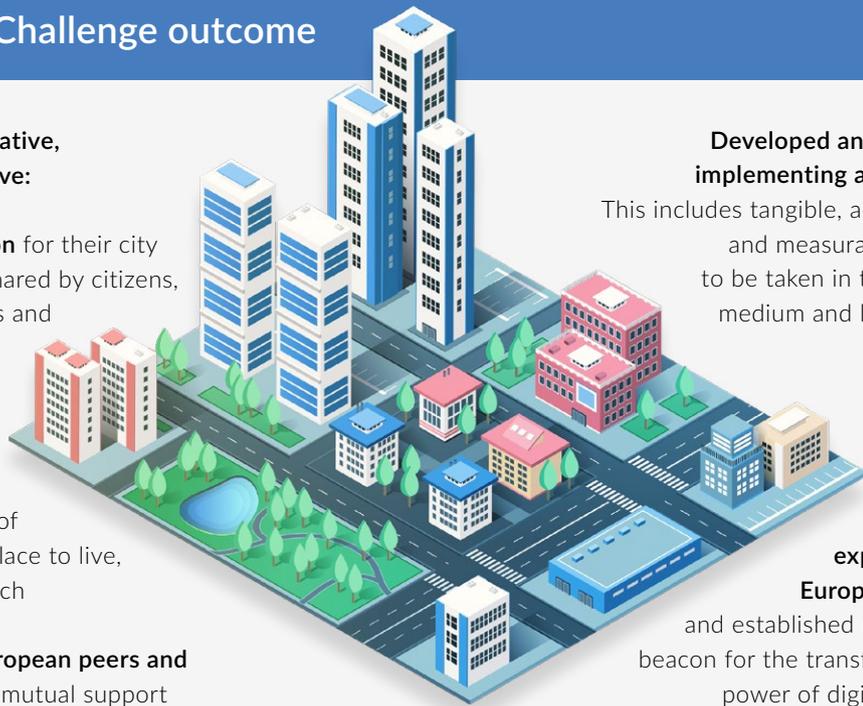
At the end of the initiative, participating cities have:

Set an ambitious vision for their city in the 21st century, shared by citizens, authorities, businesses and organisations

Built a community of local stakeholders

committed to engage in the transformation of their city to a better place to live, thanks to advanced tech

Built a network of European peers and partners able to offer mutual support and advice in the future



Developed and started implementing a strategy

This includes tangible, achievable and measurable steps to be taken in the short, medium and long term

Gained exposure at European level

and established itself as a beacon for the transformative power of digitalisation

The DCC initiative has supported digital transformation in EU cities by providing strategic orientations. It has ensured that the process of developing the strategy and making it operational is translated into a portfolio of relevant actions. Such actions support each other in achieving a common goal and are tailored to the local context. This report builds on the [Blueprint for cities and regions as launchpads for digital transformation](#). It synthesises the knowledge gained during two years of intensive work with the DCC cities on the ground. Cities that want to be game changers. Cities that seek to reignite growth and create jobs through the power of advanced technologies. Currently, the 15 cities selected for support have yet-to-be-released potential in digitalisation while demonstrating a strong commitment to engaging local stakeholders in digital transformation.

Outcomes from the DCC initiative relate to the strategy design process followed by DCC cities, including:

Designing ambitious yet actionable strategies

DCC cities acknowledge having designed **ambitious digital transformation strategies** which are translated into realistic actions. Many of the challenge cities involved have indicated that while the strategy set via the DCC is ambitious, nonetheless they hope to maintain the momentum the initiative has created.

DCC **strategies** are actionable since half of the DCC cities indicated a high probability of success in implementing all the actions in their respective strategies. The main arguments put forward by those cities which expect mixed success relate to the availability of funding, political support, and effective communication with stakeholders.

Co-creating strategies with the local community

By design, the DCC is a **participatory methodology**. Cities have started their digital transformation trajectory with a participatory assessment by local stakeholders of their digital maturity.

Likewise, each city's vision and strategy is the outcome of a process of assessment and consultation between the cities and their local stakeholders.

The difficulties they face in their ability to retain stakeholders' interest underlines the need to build a shared vision and sense of trust between local authorities and stakeholders in the collaboration process.

A holistic approach to strategy design

Prior to the launch of the DCC initiative, the actions were only in a rudimentary form or at least in an uncoordinated manner. The support provided has helped

cities to refine and strengthen their strategies. This is demonstrated in the DCC strategies by:

1. Developing activities in **sectors that are relevant for the local economy and are aligned with the priorities of the smart specialisation strategy.**
2. Complementary actions, with planned activities not overly focused on providing support for infrastructure investments but seeking to **stimulate demand for digital solutions.**
3. Encouraging activities in those areas related to **fostering entrepreneurship, improving the local digital skillset, and making use of open data platforms.** Such activities are considered to be of strategic importance for mid-sized cities, enabling them to become more competitive in a global economy.

Enabling and supporting entrepreneurial activity

An important first step in stimulating the uptake of advanced technologies is for city policymakers to understand the needs of the sectors in focus and the technological trends. This is not an easy task: it requires cities to work closely with people (from the public and private sector) who can help them understand the role of technology and its potential impact.

As the next step, the piloting and participation of companies, especially SMEs, in cooperative initiatives to test new technologies is key to transitioning towards implementation and eventually transformation. In particular, the role of the city can be instrumental for SMEs facing limited capacities to experiment with new technologies on their own. For example, the city of Goteborg, through its digital twin, can test new ideas with academies and business life to visualise the development of a sustainable business ecosystem.

Belonging to a European network striving for digital transformation

Cities' participation in networks is key to their advancement as ecosystems of technological transformation. Being part of a European network of cities of different maturity levels can act as a catalyst for the motivation and engagement of their decision-makers and ambassadors of transformation.

A sense of belonging to a European Commission initiative and corresponding network helps to activate initiatives locally, enabling cities to progress towards meeting their objectives. It also stimulates a pan-European culture of working together to solve challenges the 'European way', thereby putting the citizen at the centre as the ultimate beneficiary.



DCC takeaways

Citizens at the centre: visionary leadership and collaboration between citizens, business, academia and local governments is the secret of success as cities and ecosystems together design future strategies for smart sustainable growth.

Data is the big topic governing smart policy-making and sustainable growth. This is a clear message to city ecosystems to keep control of their data and unleash their full potential.

Skills and attracting talents are key for those cities developing innovative and disruptive education and training schemes to prepare their citizens for a bright future.

Cities are vibrant market creators as they increasingly base their decisions on data analytics and are procuring cutting-edge technology solutions and services.

The DCC methodology

The Digital Cities Challenge was designed as a tailored programme of coaching and facilitation to help European cities develop and implement digital policies that can transform day-to-day life for residents, businesses and entrepreneurs.

Individual expert teams worked with each participating city and their relevant partners (business organisations, academia, city labs, schools, community groups, local press, city and regional authorities) providing hands-on first-class policy advice, coaching, networking and peer support.

Besides meetings and workshops organised in the cities, representatives of their administration, business sector and experts met during the academy seminars to share experiences and take advantage of peer-to-peer learning.

On joining the project, cities embarked on a 'digital transformation trajectory' with the aim of identifying a clear strategy for digital transformation. This trajectory is broken down into four individual steps:

Digital transformation trajectory in four major steps



The **preparatory phase** aims to set the foundations for the digital transformation trajectory to take place within the city. It is meant to ensure that an adequate management structure is in place, as well as an adequate level of buy-in from key stakeholders. During this stage, the city leadership team should become fully acquainted with the full digital transformation methodology, as well as with the tools linked to it.

Step 1: digital maturity diagnosis

During **step one**, cities diagnose their **level of digital maturity**, which allows them to identify the starting points for discussion on strategy development. This should lead them to collectively define a long-term digital transformation vision for their city, acting as their 'point on the horizon' as they embark on the digital transformation journey.

Step 2: strategy design

As part of step 2, cities transform their digital transformation vision into a practical strategy ready for implementation. As part of this process, they will define operational objectives geared towards reaching their high-level ambitions. This will factor in existing policy strategies, leading them to develop a clear value proposition for their digital transformation strategy compared to existing strategies in related fields (e.g. smart specialisation or economic development). The idea is to identify the 'niche' the digital transformation strategy is going to fill, given its focus and objectives. The strategy will be developed collectively, with the support of those stakeholders who will be responsible for its implementation.

Attributes assessing digital maturity

Accelerators to enhance digitalisation of industry

Overall coordination and **governance** is needed to streamline the process

The ecosystem greatly benefits from a portfolio of **support services** facilitating digital transformation

Funding is needed to support digital projects

Interactions between different stakeholders of the **ecosystem** can enhance digitalisation

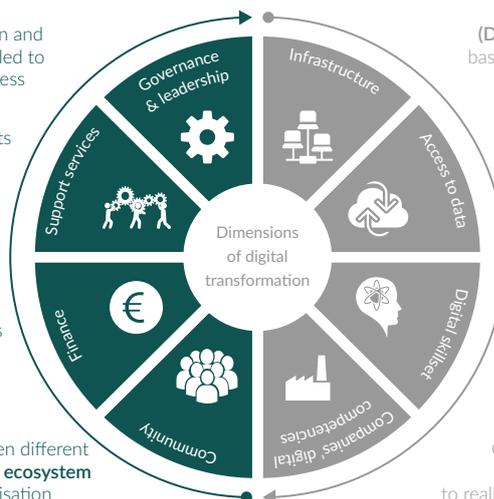
Prerequisites to create favourable framework conditions

(Digital) **infrastructure** is a basic requirement to enable digitalisation

Processing of data requires **access to data** through technology

Human assets and capabilities are prerequisites to enhance digital transformation

Companies need specific **digital competencies** to realise digital transformation



Step 3: roadmap

The **roadmap** is defined in **step 3** as the component of the digital transformation strategy that describes the practical implementation of the strategy, including priority activities and governance. One of the key elements in the process of defining the roadmap is identification of the priority activities to be implemented in order to fulfil the strategic objectives. These activities represent the specific actions through which the strategy will be implemented. An activity can be described as a tangible and concrete action, with a beginning and an end, accompanied by a specific objective and resources for its implementation.

During this step, cities are also encouraged to define the **governance framework** for implementation of their strategy, as well as identifying potential funding streams for it.

Step 4: monitoring and evaluation

The last and final step, **step 4**, of the digital transformation trajectory is aimed at developing a monitoring and evaluation framework for cities' digital transformation strategy. This will enable them to measure progress against targets linked to the implementation of their

strategy. While cities can establish the monitoring indicators at the end of their strategy development, it is recommended that they do so in parallel with the definition of the strategy itself. This will ensure a higher degree of relevance of the selected indicators and targets. It is recommended that cities establish three levels of indicators:

- First-level indicators are linked to ambition statements and should measure strategy outcomes (5 to 10 years);
- Second-level indicators are linked to operational objectives and should measure intermediate outcomes (3-5 years); and
- Third-level indicators are linked to the activities and should measure outputs (1- 3 years).

The steps are presented in detail in the Digital Cities handbook. Cities wishing to embark on a similar digital transformation journey can refer to the handbook in order to organise and implement their strategy development process. The handbook contains useful tips and advice as well as examples of real-life cases drawn from participating challenge cities. The tools and guidelines associated with each step can be found on the project's [website](#).

DCC ecosystem building



Cities' vision for a digital transformation strategy



DCC cities' strategies start with their **vision**. The common areas emphasised in their vision and ambition statements determines the following:

Emphasis on cooperation (public-private partnerships, community)

DCC cities have placed significant emphasis on promoting a culture of cooperation in the quadruple helix framework. In some cases, these partnerships are seen as a transversal tool to tackle different pressing issues on the digital transformation agenda, such as mobility, environment, and utilities – among many others. For instance, Reggio Emilia (Italy) states that in order to be effective 'digital transformation must span across sectoral, hierarchical and organisational boundaries and involve stakeholders from different areas, ranging from industry to intermediary organisations to education providers and cultural actors up to citizens, informal communities and the third sector'. The municipality has set out to build an 'open lab' within a renovated monastery. This facility provides citizens, start-ups, research centres and business with a new public space to offer novel opportunities to build professional networks as well as fostering cooperation and innovative collaboration. Over the next three years, the manag-

ing authority will begin launching the services, with funds from the European Regional Development Fund (ERDF) and the municipality.

As such, the cities have defined specific actors to act as facilitators within each stakeholder group, to ensure accountability. According to cities, it is essential to find the middle ground – a coordinator – to bring together a strategy that satisfies all.

Cities that thrive in the long run keep reinventing themselves, jumping from one technology to another. One important aspect for the future of cities is to link digitally driven companies, non-digital companies and city administrations together to create new markets. Such is the case of the 'open participation' initiative in the city of Espoo (Finland). This will take into account inputs from different stakeholders, as well as the way they each interact with one another. A determining factor of this model is the flexibility to predict any potential conflicts between the different ecosystem actors. This initiative fits within the 6Aika Six City Strategy being implemented within the larger context of Finnish cities and funded by the ERDF alongside national and regional authorities.

Emphasis on cooperation



Karlskrona: Innovated, designed and manufactured in the Karlskrona I-Hub

'To become an innovation hub in a sustainable growing region with the best conditions for an expansive business that is at the forefront of the international market'

Thessaloniki: A living lab for digitalisation

'Thessaloniki turns into a resilient city which relies on digital transformation, its human capital and institutions to boost economic growth and improve quality of life'

Padova: PadovaNext

'To support the digital transition, to increase opportunities for millennials, to enhance the living standards of the elderly, granting easier access to the city's public services, to move on to smarter and more sustainable public transportation, to attract and keep the best talents supporting the research hubs, to create a digital community for sharing skills and competencies'

Kavala: City as a platform

'By 2030, Kavala wants to become a digitally advanced "City as a platform", fostering sustainable development in the tourism, agricultural, logistics and ICT sectors, leveraging evolving citizens' and SMEs' digital skills and exploiting a state-of-the-art city and private-sector digital infrastructure, successfully transforming the region into a vivid entrepreneurial ecosystem, and eventually providing a higher quality of life for its citizens and visitors'

Heidelberg: Pioneers at the digital frontier

'Heidelberg is striving to become a pioneering digital city by 2030 through: sustainable city services using open standards, an empowered population and administration with modern entrepreneurial methods and digital practices, and an expanding international network of ambitious technology firms'

Iasi: A growing digital powerhouse built on skills and entrepreneurship

'Iasi wishes to use responsibly digital transformation to make Iasi a place where people want to live, work and play. Building on skills and entrepreneurial acumen to create an environment where businesses, citizens and authorities can interact and create more value'

Pori: Artificially intelligent Pori

'To become the most significant and attractive city in Northern Europe for AI, automatisisation and robotics in the industrial sector'

L'Aquila: DigitalAQ - Living Lab for Crafting a City 4.0

'Transforming L'Aquila into a living lab for research, development and deployment of services and products using the cutting-edge technology deployed in the city'

Ventspils: Municipality should be managed as a socially responsible enterprise

'Develop a city as a remarkable participant in the network of international education and science institutions, on the way to becoming a European-level hub for smart technologies'

Alicante: DigitAlic

'To become a reference area on digital innovation by exploiting its infrastructure, climate and socio-cultural conditions as an attraction pole and relying on local talent and open, creative and entrepreneurial human capital'

Patras: PATRas E-city Urban Strategy

'The vision of Patras is to become a smart digital city with the aim of improving the living conditions of its citizens, professionals and visitors through the active involvement of its human resources, through innovative initiatives by academic and research institutes and by the business sector, taking advantage of the opportunities offered by the development of a next-generation network'

Emphasis on infrastructure and open data

Besides improving the broadband connections and better provision of internet access to cities' communities, nearly all DCC cities highlighted the importance of public open data. Indeed, cities seek to encourage all stakeholders to use and share open data, most notably that which can bring value to the cities' economic sectors.

An example is Karlskrona in Sweden with its focus on public data digitisation to ease daily interactions with public authorities, both for citizens and the private sector. The main argument is to save time and improve efficiency which might otherwise be slowed down by inefficient bureaucratic processes. Private-sector actors were tasked with providing the public administration with wireless infrastructure based on the technology involving an open standard designed to connect battery-powered objects to the internet through high-security encryption. Thanks to the installed infrastructure, the municipality has created a smart city forum to gather together the city's actors to build Karlskrona into a smart city. The IoT solutions most used by the city include water temperature control and parking sensors.

The final conference discussions showcased the opportunity of using the digitised city as a large-scale experiment. For example, network connectivity in city sensors can enable urban laboratories whereby different community actors can come together to co-design and test innovative IoT projects. Engaging in such projects highlights the importance of developing ICT infrastructure. Another key point places emphasis on developing key processes for city management, such as data support. Besides broadband access, this also covers research facilities and education infrastructure, utilities, etc. For example, the city can improve decision-making by measuring the cost of air pollution and its impact on the quality of urban life. In terms of mobility, countless hours can be lost due to traffic jams, affecting economic growth. Several cities, including Patras (Greece) and Sofia (Bulgaria) have implemented solutions that promote smart mobility. Patras collects and processes the distribution of traffic data via multiple channels of real-time communication. Sofia has created an integrated mobility platform that provides real-time information about all types of transport and routes in the city.

Emphasis on infrastructure and open data

Reggio Emilia: DIRECT – Digital Innovation for Reggio Emilia City

'Support the city's shift towards a knowledge-based economy, guaranteeing jobs and skills for its citizens, thus contributing to a more cohesive society in a more sustainable urban environment'

Alcoy: DigAlcoy

'To promote talent and human capital as the invigorating element for digital transformation in local companies and the city, strengthening constant communication between economic, educational and public sectors'

Derry Londonderry: Building our Smart City Future

'An open innovation eco-system – reflective of our values of community, inclusiveness and creativity – focused on sustainable digital transformation and productivity improvement of target economic sectors, by developing key research strengths and the digital skills of all our citizens'

Cork: the connected city – Innovative, inclusive, incredible

'Based on the idea that collectively everyone has a part to play in supporting digital transformation. Through col-

laboration and joint efforts of local stakeholders across the quadruple helix, Cork's citizens and businesses can benefit from digital developments to enhance quality of life and improve competitiveness'

Sofia: Platform-based smart growth

'To define and elaborate an action plan and a series of actions that strengthen the ICT business ecosystem located in Sofia, enabling it: (a) to develop innovative solutions for the digital transformation of the city; (b) to create new markets for digital products and services, at local, national or global levels, and facilitate access to these markets; and (c) to support the system of innovation (local or national) for the development and absorption of new digital services and solutions'

Grand-Orly Seine Bièvre: Turning digital technology opportunities into assets for territorial development

'To develop and test novel policy levers in a collaborative approach with the involvement of other cities as peers, Grand-Orly Seine Bièvre will demonstrate how to reap the benefits offered by the transformative power of digitisation. It will showcase how to fill the gaps which are currently hindering the city to advance and capture the benefits of digital transformation'

Emphasis on digital skills (citizens, students, businesses)

One of the most recurring topics throughout the cities' statements on vision and ambition is the emphasis on developing digital talent and digital capacity building. Skills are seen as the intangible asset for digitalisation.

For example, the city of Nice (France) acknowledges human capital as a driver for digital transformation in Europe. The city's strategy aims to bridge the digital skills gap. Through several projects, it offers **training programmes to curb digital exclusion**.

A **digital school** has been implemented thanks to financing from the city. This school aims to ensure that younger generations acquire the required skills to meet the current and future needs of local and regional businesses in those tech sectors with high potential for growth. Through different **partnerships with associations, the city aims to develop skills among socially fragile parts of the population**, such as the elderly and children.

An application launched by the city in 2018 aims to **help job seekers find employment** based on geographical and sectoral proximity.

Guimaraes (Portugal) and Nice have highlighted the need to reinforce the **digital literacy of local communities** in order to respond to special needs, such as socio-economic disadvantages, the brain drain, disabilities, etc. It highlights another crucial aspect of developing digital skills across cities to improve the flow of information among stakeholders, and emphasises how a higher level of skills helps to **diminish ecosystem fragmentation** (i.e. bringing stakeholders together).

- The French region of Grand-Orly-Seine-Bièvre has highlighted the fact that one of the key factors in successfully designing the digital strategy and making it operational is the mobilisation of digital skills. As such, the city has undertaken an assessment of both company needs and the current offer in terms of vocational training. They intend to build a tool to monitor this continuously.
- The city of Rijeka in Croatia underlines the crucial need for digital education and talent management among prevalent issues related to labour shortages and skill gaps. This is why it has promoted an open-data portal and software coding skills on different IT platforms among teachers and pupils in elementary schools.

Emphasis on digital skills

Gelsenkirchen: Drilling for OIL 2.0

'To be a pioneer in digitalisation, Gelsenkirchen needs an open innovation lab in which different stakeholders from different sectors can work together to build the digital city of the future'

Guimaraes: Build Guimaraes' Digital Future

'To foster local development, economic growth and citizens' engagement by deploying innovative digital solutions that reinforce the identity of Guimaraes and improve people's quality of life'

Rijeka: Digital Ri-wave

'Efficiently transition from an industrial city to an economically diverse one that attracts, nurtures and retains digital talent for sustainable economic development and improved quality of life'

Arad: AR@Digital: Open.Educated.Innovative

'Transform the city's potential for economic growth and alignment to the digital economy through proactive col-

laboration between local players who are genuinely involved'

Granada: Creativity and wellness, core of the digital transformation in Granada

'To become an international reference in creativity and wellness as focal points of the local economy, and consequently to become the main regional pole for the development of innovative solutions focused on people in these sectors'

Algeciras: Bridge to Europe

'To pave the way towards a continuous digital transformation and modernisation process that will enable Algeciras to become the open, dynamic, social inclusive, and talent-based southernmost gateway of Europe as well as a worldwide reference for a citizens-driven sustainable mobility hub'

Nuremberg: Digital Nuremberg/#nuedigital

'To become a digital city which is actively utilising the potential of innovative IC and technologies'

Support for SMEs and entrepreneurship

As one of the main drivers of economic growth, small businesses are crucial to cities' development. Therefore, it is crucial for them to foster an environment and set up the tools within which a dynamic entrepreneurial culture can flourish.

Each of the previous aspects feed into creating such a favourable environment for entrepreneurs: first, by increasing the pool of people who possess the digital knowledge to empower small businesses with adequate human resources equipped with digital skills. Next, they boost cooperation between different stakeholders (e.g. higher education institutes that attract young university graduates to job opportunities created in the city). And finally, they support the ecosystem through technologies (e.g. smart sensors) that gener-

ate added value to local infrastructure (e.g. mobility and transport).

Participating cities have developed a number of activities that aim to support SMEs while providing a nurturing environment for entrepreneurs. For instance, the cities of Granada (Spain) and Iași (Romania) have both set out to create soft-landing spaces for non-local companies in order to facilitate the establishment of new high-tech companies. Iași aims to provide start-ups and smaller businesses with support from different actors within the local ecosystem. Other cities, such as Thessaloniki (Greece) have planned a range of activities to support the development of new products and services through grants. One such activity is OK!Thess which aims to improve training by attracting retired entrepreneurs as coaches.

Challenges and recommendations in strategy design

The DCC initiative included cities representing diverse ecosystems, with differing levels of digital maturity. While the experience in designing a digital strategy varied across cities, a significant number of challenges and lessons learnt are common to all the cities. In this section, we present the common challenges they experienced coupled with recommendations and success factors suggested by the DCC network – cities and experts (lead, local, thematic experts, academy participants), during this two-year initiative.

The objective is to provide practical recommendations on the process of designing a digital strategy.

Challenge 1: Define the local government's role in a city's digital transformation

Design policies for smart, sustainable, clean and inclusive growth enabled by advanced technologies:

Consider the dual role of the city: on the one hand, as a provider of infrastructure and services for better and sustainable standards of living for its citizens. On the other hand, it is an enabler creating the conditions and environment for companies, especially SMEs, to be more productive and sustainable while helping them

retain and improve their competitiveness with the help of advanced technologies.

Decide how much control to exert over the supply of services:

In principle, service providers testing solutions in a city should offer a solution to a challenge the city is facing. Monitoring and evaluation of the results should be part of the agreement and piloting phase.

Design a governance model reflecting the open and collaborative process of strategy design:

The bottom-up process engages local stakeholders in the design of the strategy; these stakeholders from the quadruple helix should have a role in the digital strategy governance. The city's vision and ambition must be shared by the municipality and its stakeholders.

Assure access to critical data and data accountability:

Challenges arise with business models created within the sharing economy. Data ownership is shifting from the public authorities to the private sector, for example in transport and housing. It is important that accountability for such data remains high on the agenda to ensure that the city keeps control of its crucial functions.

Example: Digital-Agentur (Heidelberg)

The aims of Digital-Agentur Heidelberg include identifying and evaluating trends, monitoring digital projects and establishing partnerships with stakeholders in digitalisation. The agency combines everything under one roof. Its task is to continue implementation of the city's digital smart solutions and create conditions that will enable Heidelberg to establish itself as one of Germany's pioneering digital cities.

The key challenge faced by many city departments leading the governance of digital transformation is to get buy-in from elected representatives by convincing them that the allocation of resources is a good investment, and ensuring collaboration with other departments and groups of digital stakeholders. Heidelberg has successfully involved **the middle management from different city departments and bodies through the so-called 'digital scouts' who act as the main contacts** for activities related to digital transformation. A key principle here is that **any use of new technologies should always serve to sustainably improve the lives of local people** – within a city that is both smart and sensible. To this end, Digital-Agentur Heidelberg GmbH operates on two levels:

1. On the application level, the digital agency takes the role of a development company, working closely with municipal offices and the city's public utility company (Stadtwerke Heidelberg) and advising on technological issues. Two examples:
 - **Monitoring energy networks through wireless technology:** sensors are now providing initial information about free parking spaces in the city. In the future, they will also be able to detect when glass containers are full. The monitoring is being done in cooperation with Stadtwerke Heidelberg,
 - **Setting up 'data lakes':** These will hold all the data collected from individual city offices and make it available across all departments, in cooperation with the city hall.
2. Digital-Agentur Heidelberg GmbH's second key operational area concerns developing partnerships. In addition to collaboration with the city's administration, public utility companies, local people and local business, the agency also partners with technology companies geared to developing the smart city. For many of these companies, Heidelberg offers an attractive environment as a business location. The goal is to establish a digital scene in Heidelberg and mainstream the 'smart sensible city' concept across all areas of daily life.

Challenge II: Identify the synergies between your digital strategy and other ongoing strategies

Foster synergies between your digital strategy and other strategies involving or benefiting from digital technologies: To maximise the return on public interventions in any area, strategic documents and policy support instruments need to be aligned with territorial needs and take into account any future development potential. They must be complementary and support each other towards achieving a common vision and ambition. They must consider ongoing strategies in economic development, smart specialisation, smart

city, sustainable and clean growth, the circular economy, climate action, digital skills, tourism, etc.

Conduct an appraisal of your strategy's alignment with your city's objectives: It is equally important that a complete appraisal of how the digital transformation strategies align with the city's objectives is performed based on a wide consultation with local actors and an in-depth ex-ante analysis. This is particularly true when it comes to digital transformation because of multi-stakeholder' involvement in the programming and implementation of digital smart solutions to tackle a city's main challenges as well as cross-cutting activities.

Example: Digital transformation strategy and links to other strategies (Iași)

The **digital strategy for Iași is anchored in the existing regional and metropolitan areas' strategies** which support ICT and economic development and competitiveness. The North East region's **regional development strategy 2014-2020** targets improving the region's competitiveness and identifies the IT sector as an area of smart specialisation. Relevant investment priorities identified in the strategy include increasing access to ICT infrastructure and supporting innovation and the competitiveness of the private sector. The vision for Iași, as defined in the **Integrated Urban Development Strategy 2015-2030**, is that the city should become an intelligent European metropolis with a competitive economy and an identity built on its historical tradition, culture and universities. The strategy's first objective is to support the city's competitiveness through innovation, by promoting Iași's key areas, such as ICT and the creative sector. In addition, Iași has a **'cyber city' strategy** which seeks to guide the city's transformation into a hub for robotics and artificial intelligence.

Challenge III: Design a strategy with short-term implementation potential, which remains relevant for the longer term

Appoint a coordinator with sufficient capacity during the process of strategy design: The appointment of a lead expert coordinating the strategy design requires a sufficient allocation of time. The expert can be either internal or external.

Start the strategy design process with an assessment of a city's digital maturity: Adding this step helps make the design of the strategy more objective. If done cooperatively and engaging all relevant stakeholders, it helps to mobilise them in co-designing their city's strategy early in the process. Including stakeholders in the process from step 1, setting the vision of their city, is key for their future engagement. Use the DCC self-assessment tool to assess the existing state of digital maturity in your city.

Treat the strategy as a living document: Throughout the design process, during which workshops and discussions among stakeholders and thematic experts are being conducted, the strategy is continuously taking shape and operational objectives, activities and the hierarchy of key performance indicators (KPIs) can change. Actions can be piloted, may fail, then new pilots can be designed.

Take inspiration from what other cities are doing: Having identified the main challenges to be tackled, reaching out to cities which have experienced similar challenges and have implemented solutions with good results will help make better decisions – faster. Reaching out to the Digital Cities Challenge network provides a key knowledge asset for cities.

Pilot activities: Orchestrating or enabling pilots to take place in your city is important and will allow you to test what works and what does not at a limited cost. Pilot activities can then be scaled up into broader activities to be rolled out in the medium term.

Monitor and evaluate all activities, including pilots: To be able to decide on the best course of action, support activities must be monitored and evaluated. Monitoring indicators are defined in terms of the strategy's measurable targets. These may be operational, such as the number of training events organised by the city, or strategic, such as the amount of revenue generated for innovative products and services. Mon-

itoring indicators should be chosen to be challenging and inspiring, as well as measurable. The time frame for established targets should be included: when do you want to achieve what? Designing the monitoring framework is considered to be the most challenging step of the digital transformation trajectory.

Since collecting the necessary evidence can also be challenging, it will be important to use the existing databases available at the city level and keep them up to date.



Align monitoring indicators across cities for benchmarking: A long list of indicators to measure the success of the strategy and monitor the level of their digital maturity is embedded in the strategies designed by the Digital Cities Challenge community. Targets are set by cities to monitor progress internally, but benchmarks can also be defined based on a selection of indicators.

Run parallel actions: Following a bottom-up process of strategy design, as performed in the DCC, requires parallel actions for the identification of funding sources (especially liaison with the regional authorities) and endorsement of the action plan by the city council.

Lobby for funds: With the aim of moving from strategy to implementation, cities need to increase their capacity to mobilise financial resources for each activity included in their roadmaps. Not just one source of funding will be required but rather a mix of different instruments depending on the type and nature of the planned interventions. A number of programmes and instruments are available to finance the transformation process. From the DCC experience, cities need guidance and technical support in order to make the best use of existing financial instruments in conjunction with procurement as a tool for developing digital smart solutions.

Example: Kavala's strategy

The overall strategic orientation of Kavala is to develop four key areas of services to be offered as a platform:

- 1) infrastructures;
- 2) skills;
- 3) entrepreneurship; and
- 4) open data and marketplaces.



The platform services are then utilised and embedded in products and services by the four key sectors in the local economy:

- 1) tourism;
- 2) agriculture and food industry;
- 3) logistics (coordination hub for port, rail, airport and road transport); and
- 4) information and communication technologies.

Digital transformation strategy for Kavala City as a platform

Mission Statement

Kavala wants by 2030 to become a digitally advanced "City as a platform", fostering sustainable development in the tourism, the agricultural, the logistics and ICT sectors, leveraging upon evolving citizens' and SME's digital skills and exploiting a state-of-the-art city and private sector digital infrastructure, successfully transforming the region into a vivid entrepreneurial ecosystem, and eventually providing a higher quality of life to its citizens and visitors

Ambition Statement 1

To create a state-of-the-art City Digital Infrastructure, able to act as an enabler for citizens and local businesses

Ambition Statement 2

To set up and implement a strategy that develops digital skills, promotes awareness and achieves the participation of citizens and SME's

Ambition Statement 3

To achieve Entrepreneurship Acceleration via Digital Means, contributing to the sectoral development plan of the City

Ambition Statement 4

To leverage the potential of Digital Marketplaces and Open Data for sectoral Development

Operational Objective 1.1

Improve and share the city's ICT infrastructures (networks, sensors, information systems, facilities) (AS 4)

Operational Objective 1.2

Develop new digital services for Citizens and Businesses (one-stop, mobile, fully digital services provision) (AS 3)

Operational Objective 2.1

Raise awareness and digital participation of citizens and businesses in city activities (incentives, analytics) (AS 3)

Operational Objective 2.2

Training for citizens and SME's in digital technologies (AS 3)

Operational Objective 3.1

Establish a Entrepreneurship Acceleration System, heavily utilising Digital Means, targeting the 4 sectors of the local economy (AS 2)

Operational Objective 3.2

Develop digital services to support a coordinated agrofood and logistics center (high precision agriculture, supply agro-food chain management) (AS 4)

Operational Objective 3.3

Digitize and market existing and new touristic services, including blue economy offerings (AS 1, AS 2, AS 3)

Operational Objective 4.1

Establish and maintain a universal infrastructure for open data (research, market, demographic, spatial) that could be used by local enterprises to develop new services (AS 3)

Activities

- Networks planning and sharing (WiFi, Fiber, etc)
- Sensors (Air, water, energy, etc) for generating real time open data
- Sharing of the LHC Computing Grid - University of Kavala

Activities

- New Digital Services for the Municipality (complaints, parking, e-payments, elderly and disabled, fully digital admin services, transportation, social media, mobile, etc)
- New Digital Services in the areas of: Health, Mobility, Parking, Elderly & Disabled
- New Digital Services for businesses (malls, mobile apps, branding)

Activities

- Kavala eparticipation. Platform and incentives programme for citizens and businesses
- Kavala Open Collaboration platform and pilot projects on collaborative governance (design a new service, collaborative budgeting, digital strategy)

Activities

- Life-long learning platform and training programmes for citizens in ICT
- Training of SME's in ICT, utilising digital platforms

Activities

- The Kavala Business Incubator (University - based and Virtual)
- The Kavala Business Accelerator (Technology Park, AgroCenter, Funding, etc.) The Kavala Business Incubator (University - based and Virtual)
- Digitally coordinated competitions and events for new startup ideas (in focused sectors) and Networking activities (EEN, Greek startup ecosystem, etc.)

Activities

- Precision Farming Technology Centre
- Agrofood branding and marketing hub & mall Precision Farming Technology Centre
- Digital logistics management centre (port/rail/airport/road)

Activities

- Kavala City Advisor (mobile app for tourists and citizens)
- Tourism branding digital hub and mall for new touristic services (e.g. culture, conferences, religion, etc) and certification Kavala City Advisor (mobile app for tourists and citizens)
- Virtual trips and multimedia applications for local cultural sites

Activities

- Kavala Open Data Platform - Collection and curation
- Kavala Open Data Platform - Publishing (as datasets and API's) and charging model Kavala Open Data Platform - Collection and curation

The strategies of all DCC cities can be found [here](#).

Challenge IV: Engage stakeholders in designing and implementing a strategy, and retain momentum

Identify people in key positions: Identify stakeholders in key positions with decision-making power who must be truly committed to helping start the implementation of pilots and activities planned in the strategy's roadmap. This includes, for instance, the regional authorities, representatives from a port authority, the ICT industry and industry representatives from key sectors.

Organise face-to face meetings to review progress: To maintain momentum, a regular three-month review of the strategy could be conducted for 12 months. Ideally, this should be formal and include two face-to-face meetings with the governance agents after 6 and 12 months. External experts can be invited.

Organise working sessions with cities to solve actual problems together: Cities meeting to discuss how they address challenges collectively is a great way to sustain the network and engage local stakeholders in a pan-European context and under the umbrella of EU initiatives. During these sessions, there should be extensive coverage of the thematic areas.

Bring local stakeholders directly into contact with international experts and stakeholders from other European cities: To inspire local stakeholders in the roadmap it is important to involve them in meet-ups with other cities and experts. 'Study visits' in DCC mentor cities could be one of the activities.

Brand your city's mission: To attract the interest of a wider pool of relevant stakeholders and stimulate citizens to become part of the transformation brand, your city's mission is to create the feeling of local pride and belonging to a community.

Challenge V: Identify suitable partnerships for common actions

Identify common challenges: Many cities at different levels of digital maturity are facing similar challenges. Exchanges between cities with similar challenges are most likely to occur among those with similar or complementary strategic lines. For instance, the main potential areas for cross-city collaboration, based on the common actions planned among DCC cities – as reflected in their Strategy Reports – are summarised in figure "Synergies per focus area among DCC cities".

Scope solutions and cities (people) behind the initiatives: Digitally mature cities are likely to have experimented with different solutions giving either positive or negative outcomes.

Ensure commitment from participating cities: For cooperation to pass successfully through the implementation phase and achieve good results, all the participating cities must remain committed and see the value added of the cooperation. At least one city should be coordinating and pushing the activities forward.

Narrow down the thematic in focus: Scoping the themes of potential cooperation is an iterative process. Looking at detail into transversal and thematic areas will help cities to better understand the common challenges and opportunities of cross-city cooperation. They will need to meet up and exchange ideas, facilitated by a framework to help identify the most suitable theme and participating cities.

Explore in parallel suitable funding streams: Cooperation may or may not be driven by a specific call. Where it is not, funding streams must be explored in parallel to avoid losing momentum.

Synergies per focus area among DCC cities

Skills & talent	Business & entrepreneurship	Business & entrepreneurship	
<p>Design of ICT / digital training and courses</p> <ul style="list-style-type: none"> Alcoy, Algeciras, Arad, Guimarães, L'Aquila, Thessaloniki, Ventspils 	<p>Creation or scaling up of incubation or funding related initiatives</p> <ul style="list-style-type: none"> Algeciras, Grand-Orly Seine Bièvre, Guimarães, L'Aquila and Pori 	<p>Campaign use and uptake of open data or improve accessibility to existing datasets</p> <ul style="list-style-type: none"> Grand-Orly Seine Bièvre, Kavala, Pori, Thessaloniki 	<p>Launch of city policy or strategy for the development and uptake of open data</p> <ul style="list-style-type: none"> Arad, Grand-Orly Seine Bièvre, Pori and Thessaloniki
<p>Development of online platform for collaborative learning</p> <ul style="list-style-type: none"> Iași, Kavala, Patras, Rijeka 	<p>Strengthen link between academic / research actors and local businesses</p> <ul style="list-style-type: none"> Algeciras, Arad, Granada, Guimarães, Iași, Kavala, L'Aquila, Thessaloniki 	<p>Identify relevant data to provide and design and delivery of open data services</p> <ul style="list-style-type: none"> Grand-Orly Seine Bièvre, Iași, Kavala, Patras, Sofia and Thessaloniki 	<p>Provide new or extend existing infrastructure / platform</p> <ul style="list-style-type: none"> Alcoy, Arad, Grand-Orly Seine Bièvre, Guimarães, Iași, Kavala, L'Aquila, Pori, Sofia and Thessaloniki

Example: Cross-city cooperation within the framework of URBACT

(Algeciras, Kavala, L'Aquila, Pori, Rijeka, Heidelberg and Ventspils)

To further promote the digitalisation momentum, the DCC cities submitted a proposal to the URBACT III programme. The idea is to further the work on the best governance model for implementing the digital transformation strategy. If successful during phase 1 evaluation, Algeciras will submit a proposal for phase 2 with the cities of Kavala (Greece), L'Aquila (Italy), Pori (Finland), Rijeka (Croatia), Heidelberg (Germany) and Ventspils (Latvia).



Example: Open data working group

(Alcoy, Algeciras, Derry/Londonderry, Guimarães, Karlskrona, Kavala, Nice and Sofia)

The DCC project sparked the interest of several participating cities in engaging in a working group based on the thematic area of open data. While cities are at different stages of progress in achieving open data, they have nonetheless expressed their interest to work together on practical aspects of implementation as well as scoping activities. The working group is a good example of retaining the momentum built within the scope of the DCC. One of the main steps for the working group is to create a task force with interested cities to assess a proposal submission to the Connecting Europe Facility (CEF).

Challenges and recommendations in thematic areas



The objective is to provide practical recommendations on the process of designing a digital strategy in thematic areas of key interest to many of the DCC cities with activities planned in their roadmaps.

Open data and the Internet of Things

Open data Digital transformation for cities of all sizes

Larger cities such as Amsterdam, Barcelona, London, Vienna or New York often dominate the headlines when it comes to digital smart initiatives. They boast a mix of critical mass of human resources and finances, and access to innovators that is difficult to rival by smaller cities. But you don't have to be "rich and famous" to get your digital smart solutions off the ground.

Larger cities, such as Amsterdam, Barcelona, London, Vienna or New York, often dominate the headlines when it comes to digital smart initiatives. They boast a mix of critical mass of human resources and finances, political impetus and access to innovators which is difficult for smaller cities to rival. Add to that the high visibility they usually gain at the national or international level, and it not surprising that they are often front runners in digital transformation. The ability to capture data and exploit it for more informed data-driven decision-making is one of the key pillars. However, roles such as a dedicated chief data officer or teams of costly data scientists are difficult to afford within smaller cities' budgets.

Nevertheless, you do not have to be 'rich and famous' to get your digital smart solutions off the ground and reap the benefits of digital transformation. This section will show how smaller cities can get started and become members of a rapidly growing community of digital cities. We argue that now is a good time to join the smart city movement, no matter how small or infamous your city may be.

RECOMMENDATIONS

Start small and scale incrementally

Digital transformation can begin with more modest ambitions and investments. A key element is to set up a clear strategy for digital transformation that is aligned with local priorities, realistic funding and investment opportunities, and stakeholder interests.

Required resources can be secured incrementally through competitive regional, national or EU funding opportunities and the smart reuse of budgets allocated to the renewal of existing tenders for public service delivery.

Initially, resources will be scarce and will often depend on 'burning the midnight oil' and the passion of enthusiastic people in your organisation. It is important to find the right champions within your organisation to drive different areas of the strategy on a voluntary basis.

It is also important to secure the right buy-in from the administrative and political leadership. This requires being opportunistic sometimes regarding what priorities of your established strategy to focus on and depending on which of the current battles you think you can win. At the end of the day, the only thing that really matters is that you have advanced your initiative's overall goal and mission.

Build the right partnerships

Expertise and infrastructure can be acquired through viable partnerships with local organisations or other peer cities. Various smaller-sized cities have managed to build a significant reputation in digital transformation over the years thanks to smart partnerships with local universities and companies and the incremental acquisition of funding opportunities. Smart Santander and Bristol is Open were both able to lean on strong academic leadership with local universities to boot-

strap their now well-known digital initiatives. The universities not only bring in the necessary technical expertise but also the experience to win the competitive research and innovation funding necessary to realise and grow the local smart city's ambitions.

A similar partnership with academic leadership can also be found in Cambridge under the umbrella of the Smart Cambridge initiative. Other examples of effective resource sharing include Belgium and Denmark. In order to get an open data platform up and running, a variety of Danish cities came together under the leadership of Aarhus to set up a common open data portal which they jointly maintain. This has enabled them to share the costs and provides a network for further sharing of experiences. Another example of resource sharing is Digipolis, an organisation that provides ICT services to both Antwerp and Ghent in Belgium. This organisation is involved in a variety of digital transformation initiatives and can serve both cities more effectively.

Other organisations to look out for are local tech hubs and clusters of start-ups and scale-ups, informal tech communities and research and technology organisations. They are willing partners in jointly developing parts of a smart city agenda and are constantly looking for challenges that can result in interesting problems to solve or new business opportunities.

Leverage your agility

When it comes to disruptive innovation, smaller start-ups and scale-ups have an edge over larger established businesses. A key factor here is their ability to

be lean and agile – to rapidly adjust their approach and learn quickly from market feedback (and mistakes). Large companies are more like big oil tankers in that it will take a lot of time and effort to change their initial course of action.

At times, when smart city propositions have yet to be proven, being agile is a considerable advantage in enabling effective digital transformation within cities. Smaller cities can leverage their size as a strength when it comes to stimulating collaboration across different city departments, the number of decision-making layers, the time it takes to implement decisions and the revision of initial ones that have not proven to be very successful.

Establish the right culture for continuous innovation

Every new technology undergoes a common technology adoption cycle whereby an early group of innovators and technology enthusiasts (often smaller businesses and start-ups) take some risk and act as early adaptors. It is only later when the technology becomes mainstream and proven by a majority on the market that larger companies will adopt these disruptive innovations. This situation is no different for smart city technologies.

The existing procurement processes in cities make it more difficult to acquire solutions from smaller business which have yet to be fully proven. They tend to influence cities to buy more from the mainly bigger technology vendors and system integrators. The result is that cities are unable to benefit from emerging disruptive technologies quick enough and are likely to be-

Not being a front runner also has its benefits

Although occupying the limelight by being first is often enticing, early fame does not always guarantee success. As we know, everyone talks about their successes rather than their failures and cities are often no different. Many pioneering cities have had to learn the lessons the hard way. While it is important to learn from failures, it is sometimes easier to learn from others.

Because of their high visibility, bigger cities are frequently the natural first targets for big tech companies to introduce new technologies as it provides them with a larger PR and marketing opportunity. They often try to convince cities to join initiatives that have yet to be proven just to show off a piece of technology they have developed. However, this does not necessarily mean that the best technological choices for the right use cases have been made. There are countless examples of tech giants, such as Cisco, Siemens, IBM or Google, where initial smart city attempts have failed to establish themselves to become sustainable initiatives.

The problem of such early engagement for front-runner cities is that this creates a legacy, in terms of both infrastructure and experience, that is difficult to change or eradicate if not proven successful.

Beginning with a clean slate allows many of the smaller newcomer cities to learn from these early experiences and move much faster. By adopting solutions that have proven to actually work, there is no need for even more effort to deal with the established technology legacy or a culture of resistance in the organisation or leadership due to a previous negative experience.

come laggards instead of leading the way. Another effect of this broken procurement is that cities find it hard to engage with local start-ups and smaller businesses, which they could champion to develop solutions that address their needs (and those of other cities).

Experimentation is key in order to establish the right confidence in newly emerging technologies. Cities must find ways to engage local start-ups and smaller businesses in experimenting with new solutions that can help them solve the complex challenges they are facing. This requires a change in procurement from a traditional public tender model for proven solutions to smaller but more flexible experiments and contracts. The outcome of such experiments can then inform the procurement of larger solutions that have been proven to work during the experimentation stage. Such change requires an open innovation culture and the right set-up to allow more flexible engagement with local innovation ecosystems. Good examples of such initiatives can be found in [Digipolis](#) or the [Digital Catapult](#).

Cities need more than just open data

Over the last decade, the importance of making urban data openly available for city innovation has increased significantly. Many cities are starting to invest in appropriate data infrastructures to make urban data more widely available for internal use and more accessible to third parties.

The starting point for most cities has been static data sets and GIS information coming from internal city council databases and planning departments. This has led to the emergence of open-data stores in various cities, which act as the front end for third parties to access and exploit this data. These efforts have increased public transparency and encouraged greater participation from civic communities in local government decision-making and service delivery. The data sets have been picked up by different smaller companies to create new value-added services, and public-sector service providers. Commercial success stories have emerged in particular around geospatial, environmental and transport data. However, cities are still trying to find the right balance between the efforts required to open up and maintain data sets and the value they are creating.

To drive urban innovation even further, cities need to look beyond mere open-data sets and provide richer data environments that offer opportunities to create services which can respond to emerging real-world situations to improve the delivery of public services and

citizen experience. By opening up real-time data from closed vertical legacy systems, such as energy and transport or the deployment of new IoT infrastructures in cities, a richer set of data can be made available for services able to react to real-world events and drive new efficiencies of public service delivery and/or significantly improve the experience of citizens.

Data strategies should not only focus on open data which, by definition, is of less value since the data owners are willing to share it for free. They should also consider how other stakeholders holding valuable data sources and infrastructures can be incentivised to share it with the city and other third parties to create value.

Valuable data may be readily available from public service providers such as utility, waste management or transportation providers. However, sharing this data can often prove difficult as, in many cases, the agreed service contracts do not require the providers to share the data with the city or third party. This means the city may need to renegotiate the current service level agreement with respect to data ownership, which can be a complex and costly process.

A good practice is to consider data sharing as a requirement in any future public tender to ensure it can be effectively reused for other urban innovation and services.

Recently, IoT data marketplaces have been emerging as environments able to complement urban data platforms. Cities such as Santander, Manchester and Porto are now starting to experiment with the data marketplace as a way to expose IoT data streams and other valuable data sources about the city to businesses and stakeholders. These marketplaces allow data owners to define licences and service level agreements for the data as well as appropriate payment models. Data providers can search for suitable data sources and acquire or purchase access rights to them. Although IoT data marketplaces are still in their infancy, they are likely to gain more momentum in future. They have the potential to galvanise high-value data sources related to a city and create opportunities to deploy new IoT infrastructure that can be exploited by multiple applications.

Embrace open standards and open platforms

Various pioneering cities have fallen into the generous vendor trap, whereby a larger tech company engaged them in (partially) sponsored city initiatives with the aim of promoting their proprietary digital city platforms. No matter how attractive they may seem, such

initial references have longer-term consequences. As initial platforms are proprietary and do not follow any standards, it becomes more difficult at a later stage to switch to different urban data platform providers as existing applications and systems have to be adapted or redeveloped. This situation is often referred to as 'vendor lock-in'.

One good practice for cities is to select standards-based platforms for which multiple vendor implementations exist. This makes it easier in future to switch to a different vendor without breaking many existing dependencies. Standards-based ecosystems are often richer in terms of what they offer as market opportunities for a participating product, service and solution providers increase.

However, so far, open standards for urban data platforms have been rare and are only recently emerging. Key aspects that are currently standardised include data models and application programming interfaces (APIs) for both the integration of IoT data sources and developing smart city services on the platforms. Examples of such emerging standards are NGSI-LD by the European Telecommunications Standards Institute (ETSI) for context information management, FIWARE data models, and the TM Forum business ecosystem APIs for ecosystem transaction management. Multiple vendor implementations of urban data platforms around the aforementioned standards are now available. This also includes open source implementation such as that supported by the FIWARE foundation. An interesting aspect is that funding support is now available for public sector organisations to adapt such standards-compliant data platform components through the CEF.

The use of open technologies does not stop at urban data platforms but can also extend to the necessary connectivity layer in a future city. Recently emerging low-power, wide-area network technologies such as LoRaWAN have made IoT connectivity very affordable for cities. While previously they had to rely on network operators or external organisations to provide wide-area connectivity services, they can actually own their own network now at the fraction of the normal cost. This significantly reduces the barrier for smart city experimentation. In addition, free community-provided networks, such as The Things Network (TTN), enable cities to benefit from connectivity services provided by their citizens and tech communities.

Think global, act local

A city on its own is not a market. No matter how great your city or the adoption level of your smart city service by your city department and local residents are, it does not represent a big enough opportunity for smaller businesses to thrive. It might be attractive for a local business to provide you with a new smart parking app that integrates different local parking service providers. Nevertheless, in order to grow their business, or even to sustain their operation, they will need to sell the service to other cities too.

A city may help a local start-up to launch and sell its first application by allowing it to respond to a local challenge/market need and act as its first customer. However, if a city has adopted a proprietary urban data platform or if the challenge only exists in the local context it may be difficult for the start-up to scale up its service to different environments.

To make it easier for local start-ups to scale up or benefit from proven innovations in other cities worldwide, the city should become part of a wider, more unified marketplace. In Europe, this vision is often referred to as the Digital Single Market. More than 130 cities, many of them smaller cities from Europe and other parts of world have started to organise themselves into a new initiative called Open and Agile Smart Cities (OASC). Their ambition is to exchange experiences along their digitisation journey and align the urban data platform and common standards and APIs they are based on to form a larger, more coherent ecosystem. A large-scale pilot is already under way involving 18 such cities and over 50 smart city deployments. While best practices have yet to emerge, it is important to join the conversation and closely monitor the progress of this exciting initiative.

Industry 4.0

Industry 4.0

A wave of new digital industrial technologies transforming production

The broader subject of Industry 4.0 denotes both trends and clusters of technologies that reshape the manufacturing world. Given cities' linkages to production industries, it enables on one hand significant business and job creation opportunities but on the other hand requires readiness, adaptability and new forms of collaboration and skillsets.

The broader subject of Industry 4.0 denotes both trends and clusters of technologies that are reshaping the manufacturing world. The current transformation and digitisation is introducing substantial changes to manufacturing systems and products. Given the links between cities and the production industries¹, Industry 4.0 is enabling significant business and job-creation opportunities, on the one hand while, on the other hand, requiring readiness, adaptability and new forms of collaboration and skillsets.

Industry 4.0 comprises a wide spectrum of disruptive, innovative and technological advancements², including: cyber-physical systems bringing together the virtual and physical worlds through interconnected systems and potentially embedded sensors, intelligent robots or additive manufacturing devices; the application of ICT to digitise information and integrate systems; network communications to connect systems, machines, work products and human resources; big data, open data and cloud computing for complex analytics, prevention measures and productivity gains; and increased human-machine interaction through, for example, virtual and augmented reality technologies.

Industry trends: adaptation needs for cities and urban environments

The Factories of the Future roadmap³ outlines a vision that anchors the manufacturing industry as an active element in the smart city of the future. The roadmap further sketches out major long-term paradigms in the form of a shift towards sustainable, collaborative and human-centred approaches to manufacturing as well as

closer proximity between factories and citizens. These paradigms structure the sections that follow.

Socio-economic sustainability trends are anticipated to involve a shift towards lean, clean and green energy in order to reduce resource consumption, achieve sustainability in production processes and material as well as preserve scarce resources. Alongside the need for more sustainable and green manufacturing, the manufacturing environment is expected to move closer to citizens in cities or metropolitan areas, and taking accelerated population aggregation into account, too. As the close proximity of plants and production facilities will impact citizens living nearby, factories must be increasingly integrated and accepted in the living environment⁴.

Similarly, the manufacturing value chain will undergo transformative change in light of the greater complexity of manufacturing companies' processes and supply networks as well as cost pressures and more demanding customer expectations. In turn, it is foreseen that this will lead to more collaboration and agility in the manufacturing value chain built upon responsive, flexible and rapid change. In this process, manufacturing is also likely to become more human centred. Among other reasons, this will result from more use of human-oriented interfaces in the manufacturing environment, requiring knowledge in the interaction with technology, and a need to enhance opportunities for education, training, support functions and continuous learning. Overall, while manufacturing environments were previously perceived as production-centred operations, they will increasingly face the need to incorporate workers, suppliers and customers in a human-centred business.

RECOMMENDATIONS

Planning and intervention to achieve sustainability through Industry 4.0 technologies

Industry 4.0 technologies, including AI-enhanced energy, water and waste management as well as urban transportation, provides cities with the necessary tools to reduce consumption and CO₂ emissions, among others⁵. They offer opportunities for achieving the 2030 Agenda and to adapt to growing city populations. While Industry 4.0 technologies have a role to play in inducing sustainable industrial development and increasingly environment-friendly smart cities, this necessitates intervention by city authorities and stakeholders in the planning, investment and uptake of new advanced digital technologies⁶. For such an intervention to be successful, it requires a comprehensive, holistic and integrated approach to policies and planning that takes into account the highly complex interaction of different systems that exist in cities as well as all industrial requirements, business needs and citizens' life.

Social responsibility in the local environment

Greater proximity between manufacturing environments and citizens and workers calls for a focus on social responsibility in the local environment. City authorities and businesses need to introduce measures that make factory locations attractive, not only based on economic arguments but also on social perspectives. Specifically, such initiatives need to address questions about energy demands and consumption, safety in the workplace and the overall quality of life.

Clustering of companies and sustainable partnerships

Local synergies and market opportunities can be created on the basis of clustering companies and by promoting stakeholder partnerships among companies with different competences and size in a given field. The city should have visions and strategies that facilitate such collaborative endeavours among the industry stakeholders to embed Industry 4.0 and digital transformation projects while exploiting certain market niches. The example of AS-Fabrik, which is founded in the city of Bilbao's strategic vision and objectives, serves to showcase how an Industry 4.0 hub and clustering of local companies can revitalise an old industrial harbour area of a city⁷. At the core of the project are visions and integrated strategies to induce and establish the conditions for collaboration and clustering of local companies to tap into market niches. Another example is the Swedish pilot initiative KickStart which involves 10 Swedish

cities with the aim – through workshop activities – to bring together companies to enhance understanding of how digitalisation can help them and to induce relationship building among companies with similar needs⁸.

Ensuring the effective engagement of SMEs

The lack of resources and capacities among SMEs is a challenge which requires efforts to ensure their effective engagement⁹. As engagement in Industry 4.0 can be resource intensive for SMEs, cities should look into measures offering local support for funding applications and should facilitate collaborative partnerships that connect the local industry landscape around synergies while also enhancing collaboration between business and research stakeholders.

Open standards as a facilitator of collaboration in the value chain

When industries and cities are looking for venues to explore, open standards represent one path towards facilitating collaboration in the value chain. Not only do they allow for interoperability in terms of data and applications, but they also enable a more compatible framework through which different enterprise systems can co-interact. Similarly, the take-up of ICT technologies will further enhance the constant feedback loops covering the full cycle involving product designers, engineers, production facilities and customers¹⁰.

The need to upgrade skills and competences for Industry 4.0

Supporting workers at the factory level to access new skills and competences also calls for focus and support from policymakers, whether at the national or city level. Factory workers will need to acquire new skills and competences – and training of a more continuous nature – to be prepared for new production methods and Industry 4.0 technologies. Furthermore, the focus must move to analytical thinking, innovation, technology design and programming, combined with active learning and learning strategies¹¹. This requires measures and investment in innovative education systems and continuous learning activities on the part of industry and the public authorities alike.

A dual education system combining academic knowledge and on-the-job training may offer a possible solution to addressing the significant challenges facing education¹².

Robotics and artificial intelligence

Digital transformation with robotics and AI

Opportunities for cities and manufacturing industries

All cities have an opportunity to take profit from the Digital Transformation, of which Robotics and AI have become one of the most important drivers. Rapidly changing consumer trends, shortage of resources, shortage of skilled workers, and aging society are the main driving forces in using robots in manufacturing.

There may be an impression that the 4th Industrial Revolution is rushing past and skipping small and mid-size European cities. This is due to the fact that only a few cities and regions in Europe commonly appear in the media as technically avant-garde. They are the seat of renowned universities and IT companies; they are the ones receiving generous funding.

Another question being discussed is whether digital transformation is widening the gap between urban 'IT haves' and 'IT have-nots'.

All cities have an opportunity to profit from digital transformation, in which robotics and AI have become among the most important drivers.

Rapidly changing consumer trends, a shortage of resources and skilled workers, and an ageing society are the main driving forces behind the use of robots in manufacturing. Today, robotics has permeated almost all sectors and branches of manufacturing and the service industries, from mining to forestry, from underwater exploration to drones, from retail to maintenance. New applications appear almost every month¹. Many cutting-edge technologies are connected with the field of robotics, such as machine learning and AI, IoT and autonomous cars. Robotics has become a major part of national and regional strategies for digital transformation.

However, all this is by no means proof that 'the scissors are widening' and that cities currently making slower progress in digital transformation will lose out. Many cities have assets – for example, their SMEs, which are the backbone of the EU economy. They

bring expertise the IT industries lack: they provide quality in manufacturing, servicing, maintenance, culture and entertainment, and often in retail.

All strategic considerations should start with a city's assets. There is no simple answer to the question whether or not it is more profitable to invest in using robots or in producing robots and components. This should also be considered from the point of creating new employment opportunities. Given the expansion of robotics in almost all fields of the economy and society, including the consumer market, the production of robots or robotic components may create more jobs, although it requires adequate qualifications. Hence, training and retraining the existing human resources may need to become part of the strategy².

RECOMMENDATIONS

Start with an analysis of innovation readiness

Each strategy must be preceded by an analysis. A SWOT analysis may be a good starting point, but how can we identify the strengths, weaknesses, opportunities and threats? One suggestion to start with is the annual EU Regional Innovation Score (RIS)³. Although a city within this region may differ from the region's overall statistics, an assessment of the surrounding region may be a good starting point to determine the situation in the city. In addition to statistics such as those from the RIS, it is important to establish a complete 'picture' of the local industry: their products and markets, their level of robotisation, automation, digitisa-

Robots have become a pivotal technology for all sectors of industry and services

Robots are made for the mechanical interaction with the physical world. The advent of programmable robots revolutionised car manufacturing in the 1980s. Later, to respond to the growing need for flexible, custom-tailored production scenarios, many robots were given sensors and 'intelligent' control systems. Around the year 2000, robotic producers developed lightweight robots with force control that opened the way for scenarios whereby human workers and robots – now called collaborative robots – can work together safely. Little is known about how industrial robots also make 're-sourcing' possible, i.e. they may bring production back to locations which had previously lost entire industries to other continents. Adidas has started producing shoes again in Germany – using robots. Customers can define their desired style online and get the shoes delivered one or two days later. There are plenty of success stories where robots and online orders allow production and logistics 'on-demand'. Service robots are a bit more complex than industrial robots since they often need to move and navigate. They originally left the research labs to fulfil cleaning jobs, later taking on logistics, followed by agriculture, healthcare, food industry and infrastructural inspection services.

tion and innovation rate, and current supply and value chains, to obtain a better basis for the SWOT analysis.

From analysis to roadmap and KPIs

Whereas the SWOT analysis collects strengths and weaknesses in qualitative terms, subsequent stages ought to develop quantitative, i.e. measurable, targets. Draw up a picture of the local industry: their products and markets, their level of digitisation and innovation rate. Roadmaps can take various forms but the most common approach is based on the form proposed by the European Industrial Research Management Association (EIRMA) (1997)⁴.

Start with simple improvements followed by more complex solutions

Robotics and AI are often described in a way that makes them 'beyond grasp', resulting in a mental block when it comes to practical innovation paths. A good way to start with AI in companies is to digitise as much as possible – calculations for previous offers, construction details, maintenance dates, etc. – and enter the information into one or more databases. Start with simple queries then advance to more complex, 'AI-intensive' queries, for example, to compare a new offer with previous ones. Another 'starter' for AI may be a system that keeps track of incoming emails which are to be distributed to the right people in the organisation. When it comes to analysing 'big data', open source algorithms are available for certain experi-

ments. Consultation should be provided by the technology transfer centre and its experts.

Given the rapid expansion of worldwide market for almost all categories of robots, supply chains have developed for components, such as motors and gearboxes, sensors and grippers. Software is needed for programming robots (for example, by demonstration of a human), and for the operational execution. This creates additional opportunities for innovations, especially for SMEs, such as:

- Innovation by combining know-how: special know-how which may exist in a region or a city, for example in food production, which may lead to innovative grippers and sensors for robotic manipulation and packaging;
- Intra-industry innovation: producers of robots for industrial logistics may discover opportunities for an adapted version in the healthcare market; or producers of machines for road construction may find a way to 'robotise' them by making these machines autonomous and suitable for mining;
- Inter-industry innovation: (inbound) 'virtual reality' developed for games may be good candidates for using autonomous robots; (and outbound) sensors and software for robots navigating in factories may be useful for innovative safety systems in hospitals.

In all uses of robotics or AI, of importance is the 'institutional readiness' for innovation, not only in regional

and local industry, but also in public institutions (such as education and training centres) and the city's administration. This includes:

- The availability of leaders within the organisations who can adapt, innovate, and thrive in complex, challenging and uncertain environments;
- The degree to which the organisation can create value from implementing new ideas and have sufficient resources to support the change;
- The degree to which the organisation is willing to collaborate with others as well as to engage stakeholders and the public; is there an opportunity for value-chain building in the region?

Robotics and AI pushed by public authorities

Besides providing infrastructure with a central technology transfer centre, and designing a campaign to attract external companies and experts to move to the city, public authorities have great potential to drive innovation for robotics and AI through innovative civic services.

Civic services provide a significant market for robotics. The incentive to develop and use robots arises mainly in unpleasant jobs which are dirty, smelly or present other physical challenges. Robots can be employed for rubbish collection and separation. Other examples include the inspection of sewage systems and inspecting structures which require close examination of parts that are virtually inaccessible to humans but can be reached, for example, by drones.

Cities have huge potential to improve services based on their large archives of data⁵. This concerns the field of 'deep learning' which can help to optimise services

or create completely new city services – such as AI-based online citizen consultations.

Licences for using open data should also be available to private organisations. Geographical data is a necessity for both public and private services. Data on weather, traffic and transport may be used for tourism, city planning, logistics and transportation. Data on public infrastructure may be used for anticipating maintenance work. Data on electricity and water provision and consumption may be used for saving energy and lowering CO₂ emissions. City services in health-care can also take advantage of deep learning, e.g. for optimising the response to emergencies.

Support for innovation must come from the population

Innovation projects initiated by the city government 'top-down' have little impact if they are not implemented 'bottom-up' by the local stakeholders – and not supported by the population at large. In fact, communities are only successful when the population is included and there is a climate of trust among all stakeholders. This is all the more important in robotics and AI since both technologies are accompanied by fears of losing jobs or being subjected to unethical effects. Local and regional media have an important role in communicating the messages from both sides. Organise information events as early as possible and open the doors of robotics and AI labs to the general public. Let schools participate in the annual 'European Robotics Week' via robot competitions and other 'cool' events. Include all strata of society and explain the roadmap and how innovation will benefit the local industry and community at large.

Tourism

Tourism was one of the first sectors in which business processes were digitalized on a global scale. To ensure that the competitiveness, growth and sustainable development of the sector are maintained over time, the tourism sector must constantly innovate and generate new business opportunities.



Tourism was one of the first sectors in which business processes were digitalised on a global scale, since on-line reservation for flights and hotels was a pioneering initiative in the digital field.

To ensure the sector's competitiveness, growth and sustainable development is maintained over time, the tourism sector must constantly innovate and generate new business opportunities.

Digitalisation, is expected to facilitate the travel experience and increase its quality, as well as helping to eliminate traditional obstacles, such as bookings, payments or mobility, among others. Intelligent destinations have become consolidated as tourist spaces. These are based on an avant-garde technological infrastructure using intelligent systems that capture information continuously, to analyse and understand events in real time, in order to facilitate visitor interaction with the tourist environment¹.

RECOMMENDATIONS

Understand tourist demands and trends

Cities' digital strategy for tourism should take into account the main trends related to a tourist's motivation and inspiration to choose one destination over another. To start with, there are many reports from official entities (i.e. World Tourism Organization UNWTO²) providing accurate data about worldwide tourist demands and trends, such as the relationship between relaxing and technology, providing infrastructures and cities which are adequately connected, and giving rise to two new tourist profiles JOMO (Joy Of Missing Out) and FOMO (Fear Of Missing Out).

In the same way, European cities should be aware that the tourist profile is changing faster than the destination might expect. Tourists are looking for destinations that add value to their personal development, with an exponential growth in the number of tourists who travel alone and are interested in unique experiences, local culture and traditions and staying in private houses rather than hotels or similar accommodation³. Cities have to work hard to provide authenticity, personalisation, a wide variety of activities, and connectivity, among others, in a digital environment.

The way towards smart destinations should include a mandatory analysis of global tourist evolution in order to make the right, up-to-date decisions.

Use technologies efficiently to meet tourists' demands

Over the last few years, the technological revolution in the tourism sector has conditioned the behaviour of tourism demands, the marketing processes and the design of tourism provided. As in the previous recommendation, one step required in the design of a tourism strategy should be to review the technological advances. The use of technologies such as the IoT, AI, machine learning, virtual and augmented reality and block chain, generates a more attractive tourism offer, which is inclusive and sustainable in economic, social and environmental terms. Furthermore, the appearance of new interfaces, such as voice or virtual assistant technologies, facilitates a more natural interaction between humans and technology.

In this context, big data could be considered as one of the key technologies in a city's digital strategy for

tourism. It enables users to process large volumes of data so that, a priori, it could become an essential tool for any company and tourist destination. Big data is the perfect tool for predictive analysis to customise tourists' experience on different levels⁴.

Considering that the tourism sector is very interested in disruptive technologies, the main focus of the strategy, in particular the innovations being stimulated, should ultimately be on offering good user experiences. These should provide efficient solutions (cost-time ratio) to tourist demands, such as connected business, mobile payments, digital tickets, smart accommodation and mobility, etc. In future, cities, will be capable of managing the huge amount of data they generate through data centres to offer their citizens/tourists more services to improve their quality of life and support decision-making⁵.

Define the city's role as an enabler of digital transformation

To improve the perception and total experience of tourists, cities must offer a quality 'product' providing easy access to information and user-friendly management of all the necessary procedures. This can be done based on a technological network infrastructure that enables its incursion and management from any device, in a personalised way, at any time and in any part of the world.

Thanks to tourists and their demands and needs, competing service providers are trying to cover a series of needs and trends that can facilitate procedures. These range from the selection of a product or service to its use, to make a tourist's stay more pleasant and comfortable and thus to generate satisfaction.

In this context, experts, companies and public entities should work together to support their city's transformation as a smart destination. This collaboration should be at the initiative of the local public authorities which will provide resources to SMEs to develop specific applications for data exploitation⁶. This can

be executed through different ways: on the one hand, cities can choose to provide open data services to enable the development of advanced applications that facilitate citizens' lives as well as tourists' stays. On the other hand, cities can use public tenders to fund the development of these applications and tools that will also allow for and improve data collection.

The exploitation of data depends on a city's strategy. Large cities, such as Madrid or Barcelona, have a data strategy – that has been implemented for years – of collecting massive data sets to be sold to private entities and companies. Whereas small cities, with a brand new data strategy, may be interested in the implementation of applications and tools for data collection. In the latter case, data access for private entities tends to be easier than in cities with a mature strategy. Irrespective of a city's approach, an inventory of the data used by private companies, such as accommodation or booking companies, is necessary for the design of a city's digital tourist strategy.

Support creativity and innovation to create tourist attractiveness

Destinations that offer learning experiences are seen as a global trend in tourism. According to this, cities should be creative and rely on innovation together with the technology to develop new tourist attractions. Tourists are visiting places not only for leisure but also to look for experience, to learn and to interact with local culture, etc., which can also be achieved through technology.

Some cities may be wondering how to achieve that. Of course, it is not a simple exercise. A good starting point should be **identifying the city's key assets**. It is necessary to go deeper into individual assets to analyse the main strengths and opportunities associated with each one. When each asset has been assessed, synergies must be identified and merged to support the design and development of innovative projects with a high technological component and for which collaboration between entities is essential.

Mobility

Digital technology makes it possible to build new connections between people, information, places, and objects, creating in turn new opportunities to generate and capture value, from new services and social innovations, to new organisational and business models. Mobility, including vehicles, services and infrastructure, is a late joiner to the digital revolution, but recent years have seen an explosion of innovations



Digital technology makes it possible to build new connections between people, information, places and objects, thereby creating new opportunities to generate and capture value, from new services and social innovations to new organisational and business models.

The main trends in digital and smart mobility can be found in different mobility domains, such as:

- Public transport services
- ICT-enabled user navigation, routing, booking and ticketing applications
- Sharing and short-term rental
- Mobility as a service (MaaS)
- Mobility-on-demand
- Autonomous transport systems
- Smart mobility services in freight and logistics
- Drones and low-altitude aerial mobility
- Big and open data
- Data governance
- Data availability and processing
- Mobility optimisation
- Digitalisation of public infrastructure

Mobility, including vehicles, services and infrastructure, is a late joiner to the digital revolution, although recently there has been an explosion in innovations born directly from the new possibilities offered by digital technology. Innovation has taken place at different levels, from operational short-time traffic management to strategic long-term management of communication patterns, and from multimodal transport services to shared mobility. All these ambitious new provisions

make it faster, more convenient and more comfortable for people to move around safely, without jeopardising society and the environment.

Yet, a lot of the potential digital technology could bring to mobility remains un- or underexploited because **key user aspects** are too often being overlooked:

From access: is everyone able to access these services?

To adoption: is everyone willing and able to use these services?

And impact: is everyone fully benefiting from these services?

Thus, from the viewpoint of policymakers and regulators, a key challenge is to understand what actions should be taken, towards whom, and to steer and support inclusive digitally enhanced mobility. In other words, use digital technology in the mobility sector in a way that helps to optimise access, adoption and impact for all users and citizens.

Local politicians and city/regional policies promote smart mobility as an optimum way to organise transport services in their cities and regions. Unfortunately, the current landscape of smart mobility applications is fragmented, because of the many solutions provided by IT-driven businesses. The complexity of implementing genuine digital mobility solutions is being underestimated, whilst high expectations are almost never met. This complexity is built on hard factors such as reliability and affordability, as well as on soft factors like citizens' behaviour.

RECOMMENDATIONS

The correct introduction of new digital mobility solutions in the city

Every city will have its own strategy and implementation approach based on its specific citizen needs. However, there is some common ground within the different approaches. Below, we describe four steps that can help in the successful implementation of new digital mobility solutions. These are based on implementation projects in the Netherlands (Beter benutten) and Belgium (Slim naar Antwerpen) and on theories and approaches such as the 'design methodology'.

Step 1: Good diagnosis by broad problem and city analysis

- Make a quick scan of your city to understand how people move, which transport they use, how far they come to visit the city, etc. This does not need to be a full-scale study but rather a quick scan to give a broader view on who, why and when people are travelling to and in the city.
- Organise dialogue sessions or workshops with different stakeholders: try to involve as many interested parties and stakeholders (public, private, experts, citizen' groups, etc.) as possible.
- Together with interested parties and stakeholders (both public and private), the accessibility problem can be determined in a technical way in order to assess what, or rather who, is causing the problem. Next, the user group is studied more closely by looking at the relevant stakeholders that influence the users and by an analysis of the users' travel behaviour. In so doing, the user's perspective is taken as the starting point.

Step 2: Develop cost-effective solutions starting with knowledge of traveller behaviour

- Be aware that the solution is not necessarily a digital one: it may be that a concrete infrastructure measure or nudging the users is more likely to solve the problem rather than a digital response. One such example is the circulation plan in Ghent (Belgium) where some roads were closed for cut-through traffic and the pedestrian area was expanded.
- Explore potential solutions with the stakeholders; even try to design new ones and enable innovations. Ultimately, this can lead to alternative, innovative and smart measures.
- Organise meetings and speak to different service providers. Before actively engaging them, try to understand their vision and how this vision can match the required solution.

- Be aware what your role as the authority will be to focus on the things that are feasible within the organisation and not to compete with the private sector. For instance, as a city it might be better to provide correct and up-to-date information instead of developing your own smartphone applications.
- Perform a cost-effective analysis on the solutions to estimate the effects.
- Try to design future-proof solutions: be aware that with the upcoming automatisations, use of alternative fuels, alternative transport (scooters, electric vehicles, etc.) and new infrastructure, organisational aspects will be needed. So it is already important to take these future solutions into account. For example, in some regions, new parking lots are designed in a modular fashion so that they can be used in the future as, for instance, an office building if vehicle share or alternative mobility solutions are booming.

Step 3: Strength by (administrative) cooperation with other parties (public and private)

- Working together increases the commitment of regional governments and the business sector resulting in a solution that is backed by everyone. At the same time, close cooperation among those parties able to exercise influence on travellers' behaviour (employers, educational institutions, public attractions) actually provides more possibilities to be influential.
- Public-private cooperation can be a cost-saving measure – e.g. MaaS – where operators, service providers, etc. cooperate. For instance, many small and medium-sized cities around the world, like Ghent, want to get a better grip on traffic and mobility. Building separate, traditional traffic-management centres for all these cities is probably not the most efficient solution. The Traffic Management as a Service (TMaaS) project will build a platform that gives citizens and local governments an efficient view of what is happening in their city in terms of multimodal mobility.
- TMaaS envisages enabling cities to see what is happening 24/7 in their cities, to show and tell citizens what is going right and wrong on the streets, to listen to their responses and act upon them accordingly.

Step 4 Monitoring and evaluation

- Information must be gathered on whether the measures are (cost-) effective. To that end, a comprehensive monitoring and evaluation scheme is needed which allows for evidence-based statements about the effectiveness of the measures to be made. This provides insight into which types of

measures work and which do not. Implementation is everything!

The role of cities within smart urban mobility

As we know, digital mobility is more likely to be market driven. Therefore, a good balance must be found between market objectives and citizen needs. We can see that many digital solutions in cities grow organically or are the result of small pilots. It must be acknowledged that cities are good places for piloting and experimenting, which is to be encouraged. On the other hand, cities should prepare a proper implementation strategy following the completion of pilots and experiments.

Within smart mobility, we can define four important roles for cities:

Provision of regulatory frameworks

- This means that a certain regulation must be defined as to who can and is able to provide these new solutions. For instance, within MaaS there can be many players or providers. To ensure a good working ecosystem, every provider should have the same rights to accessing public data. Authorities have to guarantee that all providers can handle data within the same framework. In some cities, the authorities state that everybody can be a MaaS provider, but they must share their data with other third parties and have to proof their effect (e.g. in shifting from car-use to public transport) in the city's mobility.
- It must be ensured that every provider can act within the same rules (same rules for everybody).
- Provision of licences to operators and providers so that a certain quality can be delivered within the city. The prolongation of these licenses can be provided according to the monitoring and evaluation of the service.
- Ensure that certain standards are applied and that specific information can be transferred among relevant stakeholders.

Financing strategies

- Cities can provide subsidies to certain providers if, for example, they ensure that their solution encourages social inclusion or could have a high impact on livability in the city.
- Tax policies can also help to encourage the use of digital solutions, especially when the goal is to establish a modal shift in travelling.

Protecting passenger' and user' rights

- Cities should always be aware what the impact of new digital solutions can or could be and should be

prepared to take measures when certain passenger rights are ignored.

Privacy and security

- Cities or local authorities must ensure that the new solutions are secure and respect the privacy of the user.

Technology and data

- Cities should always be the backbone of the solution. Very often, they would like to provide and develop their own applications, even though these applications could be found on the market. On the other hand, cities can play an important role in providing good information and data or an integrated platform providing different city tools.
- Open data should also be encouraged. Mobility data have an endless number of possible reuses: improving operational efficiency and accessibility are just two examples. Data can also be used to advocate for more pro-transport policies, such as improving safety, developing pollution-reducing solutions, and creating new services to take more people out of individual cars and into more sustainable options. Making more data accessible, facilitating collaboration between private and public stakeholders, developing new (innovative) solutions in transport, better insights in urban mobility usage, etc. are all possible.

An integrated strategy for urban mobility

Smart and digital mobility is part of an integrated approach to urban mobility. Therefore, cities need an integral strategy which emerges from the active participation of multiple urban actors in order to manage key urban mobility factors within the framework of sustainable development.

A digital mobility strategy should always be in line with regions' and cities' public policies and strategies for the development of more sustainable mobility rather than being one strategy on its own.

Although digital mobility is one part of the digital city, it has a notable effect on multiple city domains: there may be negative effects (e.g. air pollution) as well as positive ones (inclusiveness, enabling people to go out, etc.). Within the mobility domain, there is mention of a new challenge which is to find the right balance between physical and digital mobility and to ensure that every citizen and city are part of a sustainable (mobility) ecosystem.

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