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The Digital Cities Challenge

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

Final Report

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Unit A1- COSME

Contact: Piedad RIVAS

E-mail: Piedad.Rivas@ec.europa.eu

Directorate General for Internal Market, Industry, Entrepreneurship and SMEs

Unit F2 - Advanced Technologies, Clusters and Social Economy

Contact: Iordana ELEFTHERIADOU

E-mail: Iordana.Eleftheriadou@ec.europa.eu

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FOREWARD

Cities are key engines to drive growth, job creation and sustainable progress. They have a pivotal role to play in the digital transformation of the economy, achieving sustained growth in the digital sector and leveraging high technology to serve the citizens.

The emergence of advanced technologies, such as new sensing and communication technologies, open data, the Internet of Things (IoT) and artificial intelligence (AI), provides cities with substantial opportunities to unlock the potential of the data economy, support companies in their efforts towards digital transformation, and facilitate collaboration in city ecosystems centred around citizens.

Cities face multiple, interconnected and complex challenges. Significant societal issues, such as energy and climate change, employment, social inequality and efficient health-care systems, require them to find new ways of designing strategies, building resilience and, ultimately, combining economic growth with the quality of life.

By taking advantage of their digital potential, cities can become smarter and better geared towards understanding citizens' needs while creating markets where businesses can strive and improving city services and infrastructure.

As prerequisites for the advancement and success of city ecosystems, they must attract and harness digital skills, facilitate new forms of city stakeholder collaboration, and act as catalysts for innovative ideas to advance businesses.

The Digital Cities Challenge

In this context, the Digital Cities Challenge (DCC), a European Commission initiative, is following up on its previous work in the Blueprint for cities and regions as launchpads for digital transformation.

The Digital Cities Challenge comprises a network of 40 cities. It started with 15 challenge cities which received policy advice and support en route to their digital transformation. Due to the high demand from cities in the EU, 21 fellow cities where added which followed the methodology using their own resources. Among the blueprint cities, five joined to provide mentoring and benefit from further exchanges within the network.

The support offered aimed to speed up the digital transformation and industrial modernisation of cities to enable them to take full advantage of digital and advanced technologies.

This final summary report summarises the lessons learnt from implementation of the digital strategy in order to provide recommendations on how to tackle the process of digital transformation. In addition, a practical guide [link guide online] for local policymakers is provided based on the DCC methodology and fine-tuned from the DCC cities' experience in their own digital transformation trajectories.

DCC take-aways

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 policymaking 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.

EXECUTIVE SUMMARY

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 (see Figure 1).

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.

Figure 1 Digital Cities Challenge Outcome

DCC components

The **DCC journey** started with cities' expression of interest to become part of the initiative. A high interest from cities was expressed with 92 applications demonstrating the **demand** for support in designing digital transformation strategies. Cities expressing interest included cities of all sizes, but predominantly small to medium sized cities with different levels of digital maturity, ranging from cities with a very low level of digital maturity to blueprint cities.

The core of the initiative focused on providing support to selected DCC cities to develop their digital transformation strategies. This support was provided by means of **field advisory services,** by a group of high-level experts and peer reviewers; as well as a series of capacity building and networking seminars conducted as part of the **DCC Academy**. The DCC Academy brought together all participating cities, mentor cities and experts in light of sharing practices, take advantage of peer to peer learning and working together to enhance and improve each step of their digital transformation strategy development.

DCC cities have thus formed a **network** with a clear mandate to grow further. The possibility to interact with other cities and learn from the experiences of a growing pool of cities with common strategic priorities has been the key attraction for cities to join in.

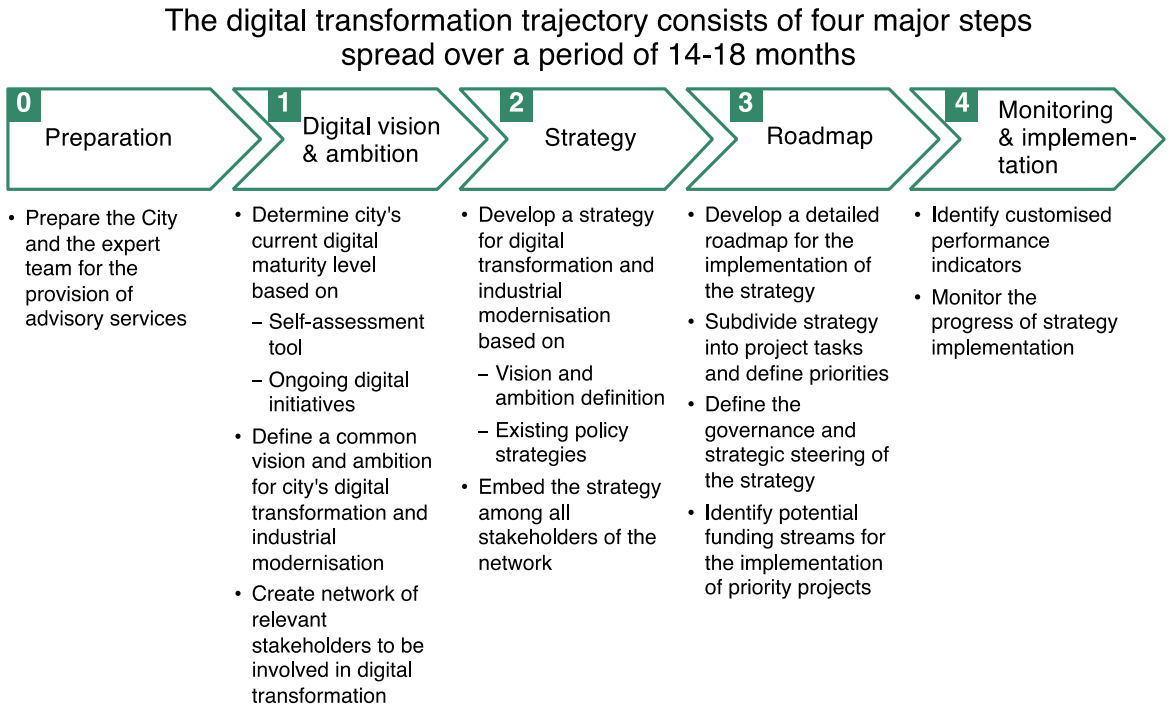
Access to **knowledge** as provided by the experts leading the city assignments and providing in depth thematic insights at the level of technologies, sectors and enabling conditions of digital transformation assisted policy makers in their understanding of the transformations taking place and opportunities for further engagement in related thematic networks.

Given the nature and ambition of the DCC initiative, the engagement of **political leadership** at the city level has been critical to secure early in the process, namely during the development of the digital transformation strategies. The DCC has thus directly engaged with the Mayors of the supported cities. In December 2018, the Mayors Summit was organised in Brussels to reflect upon the ongoing work and co-design the technological transformation trajectory of European cities.

DCC Methodology

The **methodological framework** and tools of the DCC helped cities follow a structured approach and timeline to design their digital transformation strategies. This four-step process - referred to as the **'digital transformation trajectory'** - allowed participating cities to organise, structure and coordinate the process of developing a comprehensive digital transformation strategy. It provided the cities the added value of having a robust and harmonized approach to identifying their digital transformation potential, and transforming it into a full-fledged strategic transformation vision (see Figure 2).

Figure 2 DCC Methodology – the Digital Transformation Trajectory



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

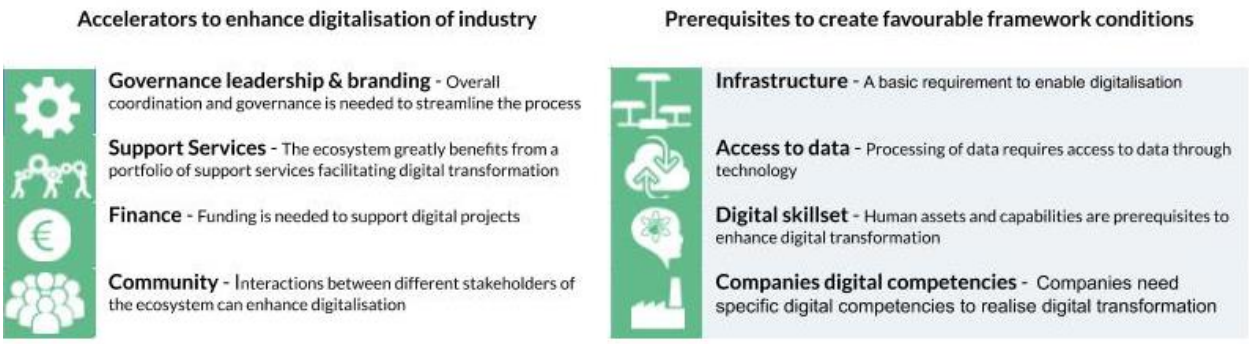
During step one, cities diagnose their level of digital maturity, which allows them to identify the starting points for discussion on strategy development. This should lead them to collectively define a long-term digital transformation vision for their city, acting as their 'point on the horizon' as 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, cities define operational objectives geared towards reaching their high-level ambitions.

This factors in existing policy strategies, leading cities 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 is developed collectively, with the support of those stakeholders who will be responsible for its implementation.

Figure 3 Attributes assessing digital maturity



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 enables 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 ensures 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 (see chapter 8). Cities wishing to embark on a similar digital transformation journey can use the handbook as a reference point to organise and implement their digital transformation strategy development process. The handbook contains useful tips and advice, as well as examples of real-life cases drawn from participating Challenge Cities.

DCC outcomes

The main **achievements of cities** from their participation in the Digital Cities Challenge demonstrating a practice that should be transferred to other cities include:

Cities designing ambitious yet actionable strategies co-created with the local community. Ambitious, Actionable and Co-created, are the three key features of the DCC digital transformation strategies. DCC cities acknowledge to have designed ambitious digital transformation strategies but translated into realistic actions. Many challenge cities in particular have indicated that while the strategy set through the DCC is ambitious they nonetheless hope to maintain the momentum the initiative has created.

DCC strategies are actionable considering that half of the DCC cities indicated high chances of success in implementing all the actions of their respective strategies and the other half anticipating a mixed outcome with some actions potentially not reaching operationalisation. The main arguments put forward by the cities that expect mixed chances of success relate to availability of funding, political support, and effective communication to stakeholders. Political support is seen as a common challenge to all cities, as local teams need to build political momentum – depending on the timeline of elections – to implement a digital strategy. The challenges cities face in their ability to retain stakeholders' interest emphasises the need to build a shared vision and sense of trust between local authorities and stakeholders in the collaboration process. Cities that have indicated high engagement of stakeholders have tended to show a higher chance of success of implementing actions set out by their respective strategies.

Cities applying a holistic approach to strategy design in alignment with other ongoing strategies. Prior to the launch of the DCC initiative, the actions existed only in a rudimentary form or at least in an uncoordinated manner. In fact, many cities in Europe do not have a digital strategy. They launch and participate in various projects but often the involved stakeholders do not have an overview of all the relevant activities in support of digital transformation in their city. Following a funding driven approach without a higher level strategy actually leads to a fragmented landscape of actions.

The provided support has thus helped the city teams responsible for digital transformation to refine their strategies to make them more successful. The digital transformation strategies are relevant to cities' needs and take also into account the future potential in this area.

This is demonstrated in the DCC strategies through the:

1. Development of activities on sectors that are relevant for the local economy and are aligned with the Smart Specialisation Strategy priorities. Some activities will

be financed within the European Structural Investment Funds Operational Programmes.

2. Recognition that digital transformation requires complementary actions, with planned activities not overly focused on providing support for infrastructure investments but seeking to stimulate demand for digital solutions.
3. Encouragement of activities in the areas, which are related to fostering entrepreneurship, improving the local digital skillset, and open data platforms. They are considered to be of strategic importance for mid-sized cities allowing them to become more competitive in a global economy.

Cities shaping their role as enablers of local SMEs digital transformation, supporting entrepreneurial activity and smart and sustainable growth: The DCC put the emphasis on technology as an enabler to smart and sustainable growth. Cities have been looking at technology generation and technology uptake from a sectoral angle - focusing on their priority sectors and the SMEs in their cities, and from a horizontal angle - focusing on boosting entrepreneurship and innovation.

An important first step in stimulating the uptake of advanced technologies including thus digital technologies is for the city policy makers to understand the needs of the sectors in focus and the technological trends. This is not easy and it requires that cities work closely with stakeholders (from the public and private sector) who can help them understand the role of technology and its potential impact.

As the next step, piloting and participation of companies and especially SMEs in cooperative initiatives to test new technologies is key to transition towards implementation and eventually transformation. Cities can facilitate this process especially for SMEs with limited capacities to experiment with new technologies on their own.

Cities activated by a sense of belonging to a European network of cities realising opportunities of digital transformation: Cities participation in networks is key in their advancement as ecosystems of digital transformation. A sense of belonging to a European Commission initiative and corresponding network helps activate initiatives locally allowing cities to progress in meeting their objectives. It also stimulates a pan-european culture of working together to solve challenges cities are facing putting the citizen in the centre.

In summary, the key finding from this two years exercise is that cities have a great potential as poles of transformation and as such on the ground initiatives like the DCC can achieve impact and act as models for inspiration for many more cities in Europe.

The DCC experience clearly demonstrated that apart from the need to guarantee the necessary funding for the implementation, the main challenges lying ahead mainly concern the ability to operationalise the planned actions (i.e. from a technical feasibility point of view and overall intervention readiness) as well as the institutional capacity in order to ensure the strategic coordination and facilitate the development of digital solutions.

To thus help cities go through the phase of implementation it is necessary to do this jointly within a network of cities. Stimulating joint initiatives for cooperation such as the open data initiative are a great way to retain momentum and progress in what is a key ingredient in the transformation of sectors and stimulation of entrepreneurial activity and innovation.

In conclusion, this report builds on the Blueprint for cities and regions as launchpads of digital transformation. It synthesises the knowledge gained during the two years of intense work with the DCC cities and paves the way for the future actions within the Intelligent Cities initiative.

1 THE DIGITAL CITIES CHALLENGE INITIATIVE

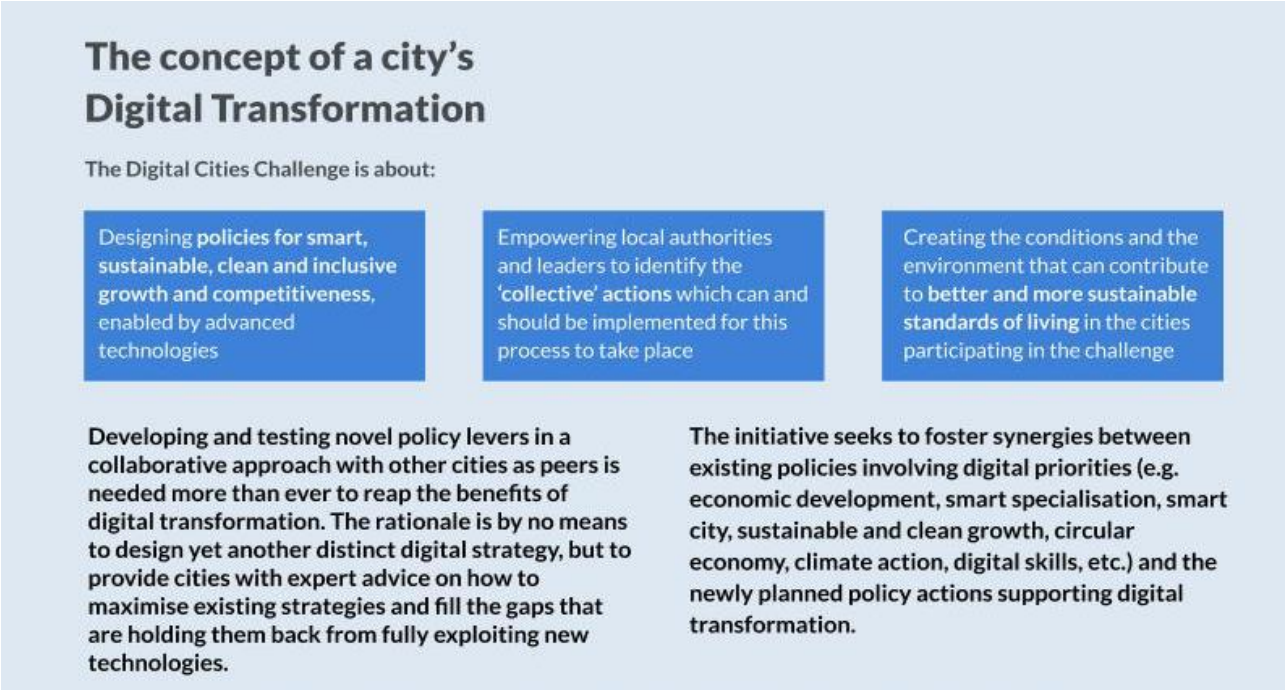
The Digital Cities Challenge is a network of 40 cities (see Figure 4). The initiative started with 15 Challenge Cities, which received policy advice and support in their path to digital transformation. Due to the high demand from other cities in the EU, 21 Fellow Cities were added, following the same methodology but using their own resources. In addition, five of the Blueprint Cities joined to provide mentoring and benefit from further exchanges with the network.

Figure 4 About the Digital Cities Challenge Initiative

Concept

The support offered by the initiative aimed to speed up cities' digital transformation and industrial modernisation to enable them to take full advantage of digital and advanced technologies. The concept of digital transformation emphasises the role of technology as an enabler for growth (see Figure 5).

Figure 5 The concept of a city's digital transformation



Ecosystem

One of the key features of the DCC methodology has been the inherent engagement of local stakeholders in every step of the digital strategy design, ultimately building an active ecosystem around the city team. The project led to the development of local networks, each one growing around its own city and bringing different stakeholders together with the common objective of developing both a digital strategy for their city and a European ecosystem of digital cities (see Figure 6).

Figure 6 Digital Cities Challenge outcome

The engagement of stakeholders started with an invitation to assess the digital maturity.

Self Assessment Tool: More than 770 stakeholders across Europe participated in the self-assessment of their cities' digital maturity.

Stakeholders' participation varied greatly depending of the category they belong to. For the challenge and fellow cities, public (30%) and industry (35%) stakeholders represent the majority of participants – with a share of 65% (see figure 7).

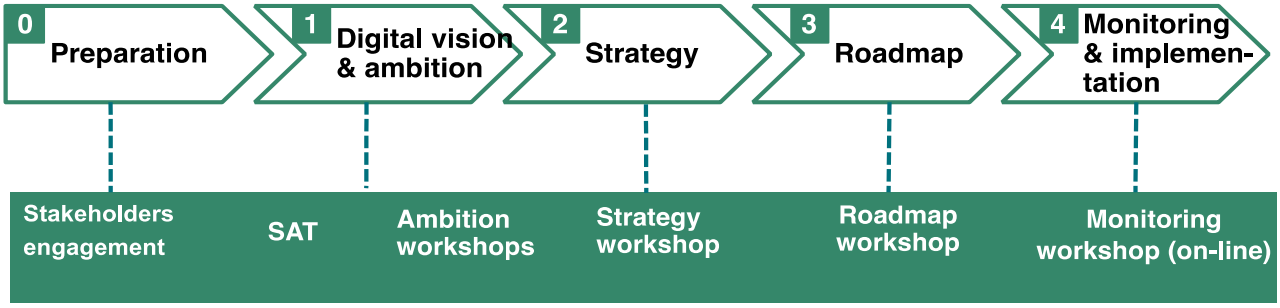
For the 15 challenge cities, the average number of stakeholders per city that responded to the SAT was 29. The highest number of respondents came from industry (35%) and was followed by public administrations (27%), education (23%), utilities (11%) and financial (4%) (see Figure 8).

Figure 7 DCC stakeholder's participation in the SAT

Cities' stakeholder engagement continued along the design of the digital strategy thanks to workshops, seminars and the final conference.

Workshops: City workshops were organised that attracted the participation of more than 1525 stakeholders in total. Six different types of workshops were organised: assessment, digital vision and ambition workshops, 2 strategy workshops, and a roadmap and a monitoring workshop. On average, there were 17 stakeholders participating in each workshop.

Figure 8 Engagement of stakeholders throughout the DCC methodology



Challenge and fellow cities indicated that, in most cases, stakeholders are enthusiastic and committed to the development of the digital strategy. Some of them also noted that although stakeholders are enthusiastic and committed, it requires substantial effort to engage them in the process. Finally, city leaders indicated that in most cases the engagement of stakeholders remained stable or increased throughout the process, which demonstrates very positively the will of local stakeholders to collaborate in cities' digital transformation.

Seminars: In addition to the SAT and the workshops, the local DCC teams participated in 4 academic seminars taking place in Brussels, Thessaloniki and Algeciras. These seminars were an additional opportunity for local stakeholders to meet the rest of the European community and exchange on their digital strategies.

Final conference: The DCC final conference brought together some 295 stakeholders, showcasing the success of the initiative and overall engaging the European community towards the digital transformation of European cities.

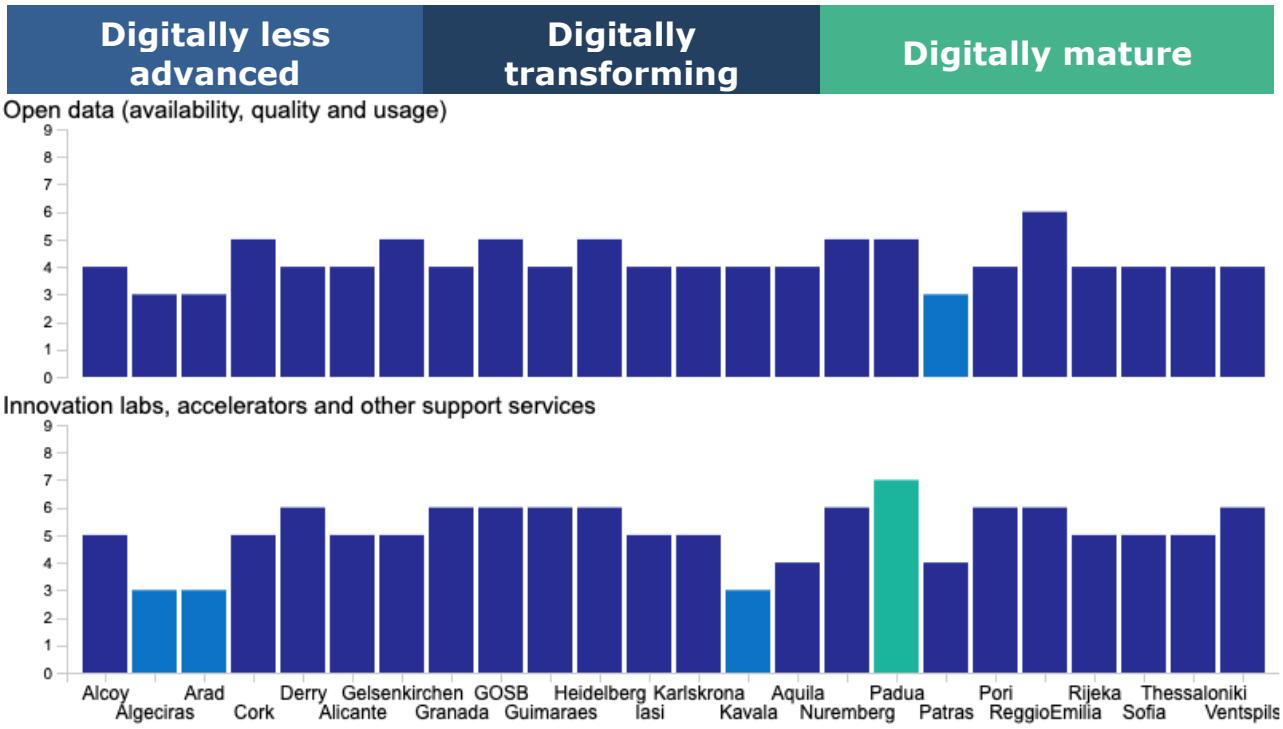
In conclusion, local stakeholders have been a key component in the co-design process of the DCC cities' digital strategies. They actively participated and contributed to the design of the strategies and are now active as members of the steering boards and/or implementing agents.

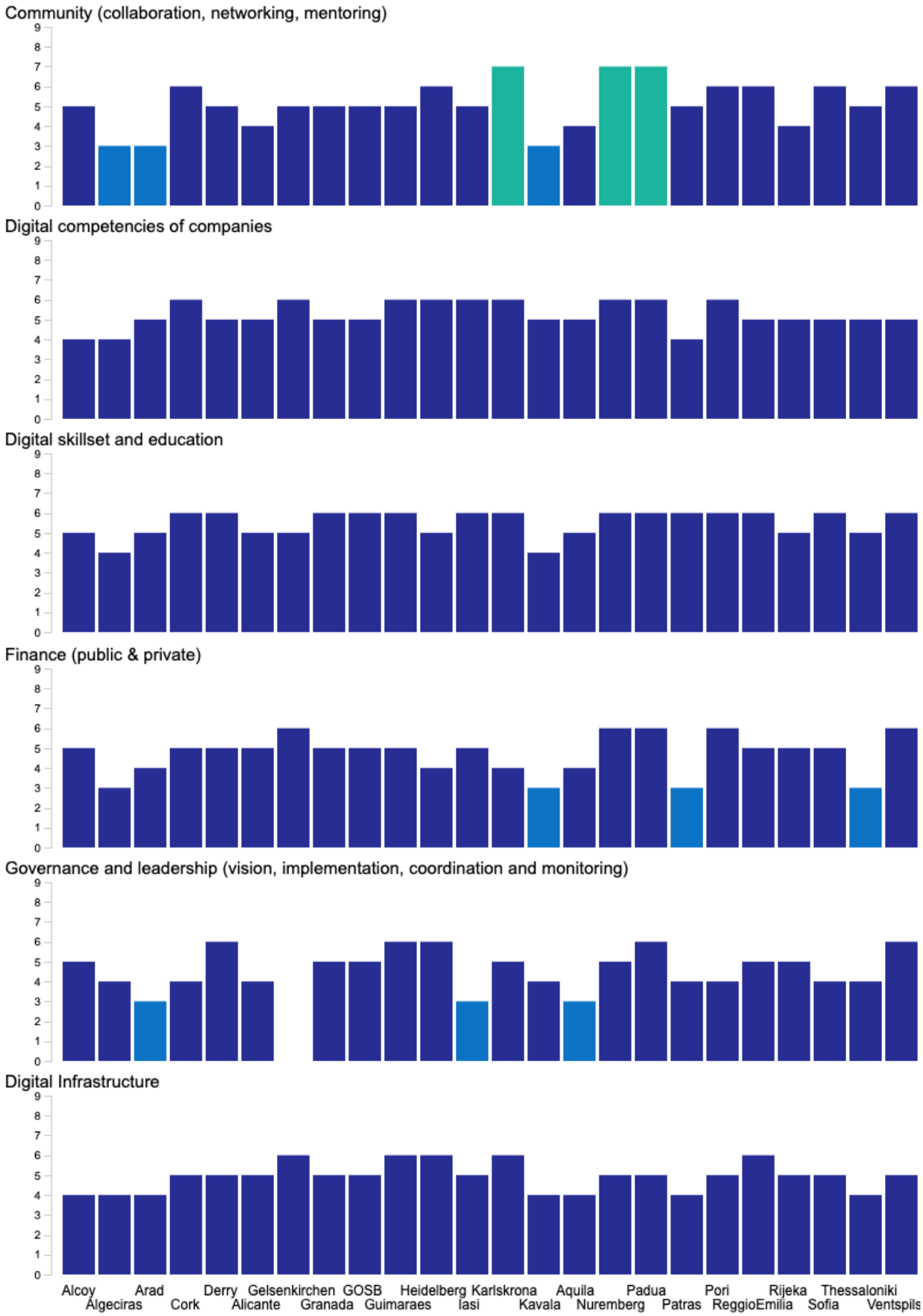
2 DIGITAL CITIES CHALLENGE - STRATEGIES

The DCC network includes cities that want to be game-changers: cities that seek to reignite growth and create jobs through the power of advanced technologies. The 15 cities selected for support currently have yet to-be-released potential in digitalisation and demonstrate a strong commitment to engaging local stakeholders in digital transformation.

As part of the initial steps of elaborating their digitally strategies, cities took part in a self-assessment exercise to determine how each type of stakeholder perceived the level of maturity of specific indicators (see Figure 9 for a summary of the SAT results).

Figure 9 Self-Assessment Tool results by city





Source: Digital Cities Challenge, 2019

Figure 9 above shows the results of stakeholders' responses for each city to the Self-Assessment Tool, for the dimensions of Community, Digital Competencies, Digital skillset and education, Finance, Governance, Open data, and Support Services. Scores under each dimension ranging from 1 to 3 define cities are *digitally less advanced*, from 4 to 6 as *digitally transforming,* and from 7 to 9 as *digitally mature*. The main takeout of these results highlights that stakeholders from the city administration, academia, financial institutions, industry and utilities perceive most of the dimensions of each city as *digitally transforming*.

The number of stakeholder responses varies from one city to another. The largest number of respondents originate from city administrations and industry, followed by academia.

For example, in Patras there are many higher education institutions and research centres in the city, which is reflected in the number of respondents from academia being proportionally higher. In comparison, in Londonderry, industry actors expressed a higher commitment to the project, which explains the higher number of private sector responses. This private sector commitment was mainly driven by smaller companies.

Across dimensions, *Governance and Leadership*, as well as *Open data*, show the lowest average scores given by the cities' respective stakeholders. In the case of Governance and Leadership, several cities' strategies have implemented a centralised body to coordinate activities linked to digital transformation. The void created when there is a lack of such a centralised body might explain the lower ranking by some city stakeholders for this dimension. In fact, in some cities the strategy was the first document to provide a vision for future digital transformation activities.

Regarding Open data, the activities of several experts revealed that many cities were starting from scratch. Thematic experts working with cities on open data found the context to be quite difficult to navigate in some cases. Notably, before the data production process could take place, it was important to identify the end-users. In general, academic and public stakeholders gave a higher score to this dimension than industrial stakeholders. This suggests that they are generally the main actors producing such data, while the end-user is the private sector. In other cases, some of the main challenges with open data were linked to releasing good quality data, as well as a reluctance to release and share it.

Overall, there are limited inputs from financial institutions, often due to a low interest in the Digital Cities Challenge. Another reason for the low involvement of financial institutions in the project is that many of them are managed centrally – decisions being taken at national rather than local level.

As put by the city representatives: "Employing a self assessment was very useful because it made the process of assessment more objective, and it made people engage", (Arad, Iasi).

3 CITIES' DIGITAL TRANSFORMATION VISION

3.1 Thematic areas emphasised in DCC strategies

The DCC digital transformation strategies are uniquely adjusted to each city's local specificities and needs. They follow a holistic approach addressing both the accelerators to enhance digital transformation of economic sectors and the prerequisites to create favourable conditions of digital transformation.

Their **vision and ambition statements** emphasise the following thematic areas:

3.1.1 Emphasis on Cooperation (public private partnerships, community)

DCC cities have placed great emphasis on promoting a culture of cooperation in the triple helix framework (see figure 9). These partnerships are in some cases seen as a transversal tool to tackle different issues of the digital transformation agenda, such as mobility, environment, and utilities (among many others). For instance, Reggio Emilia 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 recovered monastery. This open lab provides a new public space for citizens, startups, research centres, and businesses to offer novel opportunities to build professional networks, as well as fostering cooperation and innovative collaborations. During the next three years, the managing authority will begin launching services, with funds from the ERDF and the municipality.

As such, the cities have defined specific actors to take on the role of facilitator within each stakeholder group, to ensure accountability. It is essential, according to cities, to find a middle ground and a coordinator to bring a strategy together that satisfies all.

Cities that thrive in the long run keep re-inventing 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 in creating new markets. Such is the case of the "open participation" initiative of the city of Espoo. It will take into account the inputs from different stakeholders, as well as the way each interacts with others. A determining factor of this model is its flexibility to predict any potential conflicts between the different actors of the ecosystem. This initiative fits within the Six City Strategy of 6Aika, which is implemented within the larger context of Finnish cities, funded by the ERDF, as well as national and regional authorities.

Figure 10 DCC strategies focused on cooperation

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'	**Iași: 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, automatisation 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'	

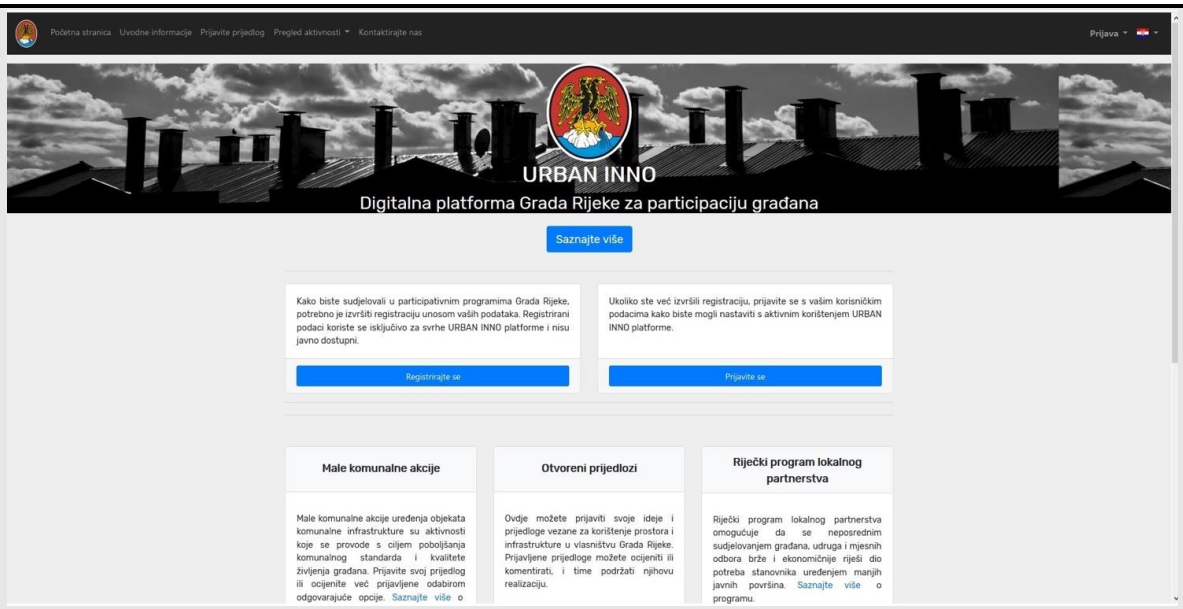
Across the participating cities, there are activities that focus on bringing the stakeholders of each respective ecosystem together. Such activities range from creating an operational entity that is capable of centralising and administrating resources across the city, to simply ensuring that there is a constant communication channel to better understand the ongoing issues of each actor.

Rijeka provides an ideal example of cooperation among actors from the city's different communities. The city recognises that the digitalisation process goes beyond the work of a single individual project, and the importance of creating a shared vision among involved stakeholders. Interaction between ICT and non-ICT entities, as well as building sufficient mass within the community has been highlighted as a weakness. The SAT results show that *ecosystem collaboration* is ranked among the digitally transforming dimensions, while *networking and mentoring* is considered by stakeholders as digitally less advanced. Nonetheless, one of the main opportunities for the city is its systematic development of the ecosystem, where a digital community consisting of ICT companies, universities and research centres work together.

Some of the planned activities aiming to foster a cooperative environment among city actors include:

- *City eServices platform integrated with NIAS (National Identification and Authentication System):* The Croatian Government has launched project e-Citizen in order to modernise, simplify and speed up communication between citizens and the public administration, and increases the transparency of the public sector in providing public services.
- *e-Procurement*: the initiative aims to establish a system of electronic delivery and receipt of bids in procurement procedures and make processes transparent to all stakeholders. The overarching objective is to promote and initiate the support activities aimed at ecosystem development through digital orientation and public-private institutional collaboration.

Box 1 Citizen Collaboration Platform (Rijeka)



Source: Interreg Central Europe, Engaging citizens in creation of Citizen Collaboration Platform – CCP

Box 2 Citizen Collaboration Platform (Rijeka), continued

One of the flagship initiatives of the City of Rijeka is the URBAN INNO project, supported by the Interreg Central Europe programme. Its two primary goals are maximising innovation potential of its ecosystem through an efficient connection between stakeholders of its innovation systems, as well as developing and implementing new participatory methods and tools to engage with end-users. The main challenge highlighted relates to the need to better link actors within urban innovation ecosystems (i.e. between public authorities, research organisations, industry, and end-users).

The two main components of the platform include ensuring communication and interaction with citizens, as well as facility management. Currently, three main target groups are engaged in the process of planning, developing and selecting the content in specific areas, notably through participatory workshops. In the future, the CCP will be the subject of online public consultations, by using existing direct democracy tool e-Consultations.

3.1.2 Emphasis on infrastructure and open data

Besides improving the broadband connections and better provision of internet access to the cities' communities nearly all DCC cities highlighted public open data (see figure 11). Indeed, cities seek to encourage all stakeholders to use and share open data, most notably data that can bring value to the economic sectors of the cities.

An example is given by Karlskrona with its focus on public data digitisation to ease daily interactions with public authorities, both with citizens and the private sector. The main motivation being to save time and improve efficiency, which otherwise could be slowed down by inefficient bureaucratic processes. Actors from the private sector were tasked with providing the public administration with wireless infrastructure, the technology being 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 the city's actors in building Karlskrona into a smart city. IoT solutions most used by the city include water temperature and parking sensors.

The final conference discussions showcased the opportunity to use the digitalised city as a large-scale experiment. For example, network connectivity in city sensors can enable urban laboratories, where different actors of the community can come together to co-design and test innovative Internet of Things projects. Engaging in such projects highlights the importance of developing ICT infrastructure. Another key point emphasised developing key processes, such as data support to city management. This concerns more than just broadband access, but also research facilities and education infrastructure, utilities, etc.

For example, the city can improve decision-making by measuring the cost of air pollution and its impacts on the quality of urban life. In terms of mobility, countless hours can be lost due to traffic jams, affecting the economic growth. Several cities including Patras and Sofia 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.

Figure 11 DCC strategies focused on infrastructure and open data

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 collaboration 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'

It is interesting to note that in the majority of the challenge cities (11 out of 15 in total) activities are foreseen in the area of open data. In comparison, only 7 cities are planning specific actions supporting digital infrastructure.

Alcoy provides a good illustration of the city which is planning both type of activities. It is a small-sized city with 60 000 inhabitants where the industrial sector plays an important role in local economy. The city stakeholders acknowledge that new models of balanced growth are needed to be designed and implemented.

The analysis of SAT results shows that open data and infrastructure are among the less mature dimensions. With regards to the infrastructure itself, fibre optic networks cover the entire city of Alcoy, including its industrial areas, where aspects such as physical infrastructure and mobile coverage are considered crucial. However, the main weaknesses are related to lack of budget, lack of local companies capable of building infrastructure in the area, and residential and business areas with poor or no mobile coverage and broadband.

With support for digitalisation of cities from the regional government, Alcoy recognises that infrastructure can contribute to improving the IoT/communications network, launching business activities in the area to provide coverage for such a network, and increasing the number of IoT services in the city.

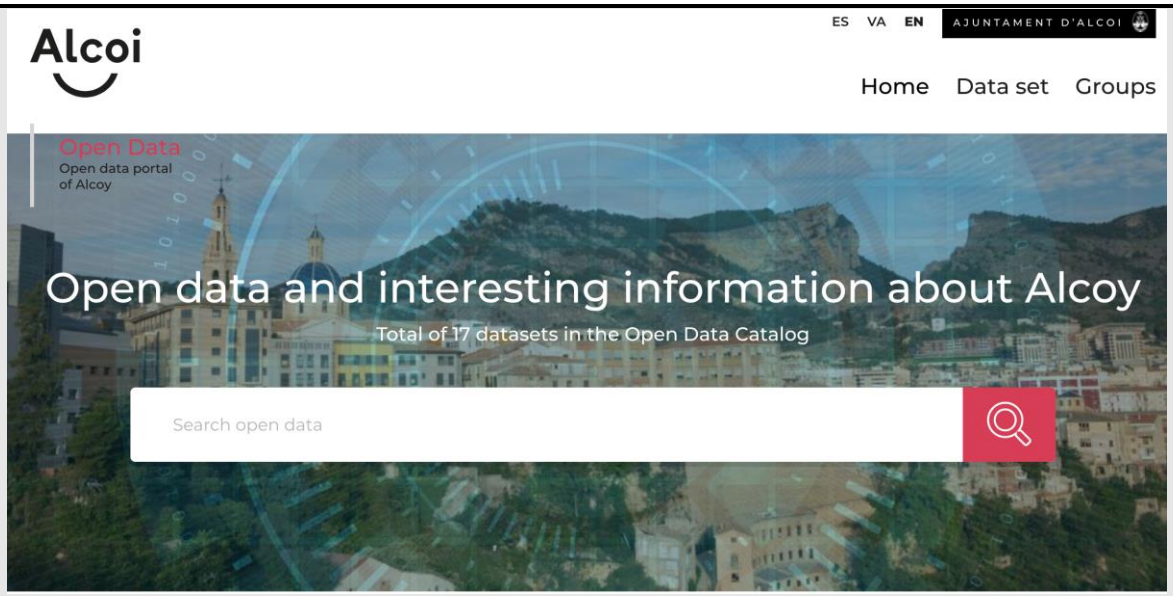
Specifically, the planned actions for the development of infrastructure are the following:

- *LoRaWAN Network:* Designing and setting up a communication mini-network with LoRaWAN technology (one district coverage) available to the public administration, university, citizens and companies for the installation of IoT devices and transmission of data in a free and safe manner. This project is a pilot within a larger IoT network infrastructure project planned to serve as a production environment for the city council as well as a proof of concept environment for novel ideas raised in the city.
- *IoT Communication Network:* As a continuation of the pilot activity *LoRaWAN Network,* development of an IoT communications network with a geographic scope larger than the city itself. The network will be available for citizens, companies, educational centres and public administrations within the area of influence, with a potential to connect any IoT sensor/driver/device and smart nodes.

Among the city's key assets in the area of open data are the presence of an international digital company ADSALSA, which is specialised in B2C lead generation and performance marketing, telemarketing data, and email marketing lists. The city has also sensor networks for collecting information related to fields such as mobility, environment, citizen and local business data. Alocy recognises opportunities to create public data sets as support for business generation among companies / entrepreneurs, to raise awareness among the business sector about the type of data potentially available from public administrations, and provide training to companies to read and understand data.

One of the pilot activities undertaken by the city of Alcoy is related to the development of *OpenData Portal*. The objective of this activity is the implementation of an open data portal composed of around 15 datasets where least one of the datasets allows the collection of real-time data. The portal has been operational since April 2019 and gradually been improved over time. This project is framed within a city plan for the development of a unique and interconnected Big Data-Open Data platform.

Box 3 Open Data Portal (Alcoy)



Source: https://opendata.alcoi.org

Box 4 Open Data Portal (Alcoy) continued

Alcoy plans *Smart Economy Development Project – Backoffice*, which aims at defining the planning and management side of the several digital projects embraced by the City Digital Transformation Strategy developed with the DCC initiative. The project aims to get to know the business sector in Alcoy, its evolution and the comparison with other cities, which appears to be key in order to understand Alcoy and act in an efficient manner.
In that context, Alcoy plans to develop a unique and interconnected *Big Data-Open Data* platform allowing the economic dynamisation of the city through the data from IoT devices, in order to face environmental, mobility, social, cultural and touristic challenges. The platform will be built in different phases and through partial developments.

In conclusion, the case of Alcoy shows that without big investment estimated at ca. €155 000 for infrastructure (2018-2019) and €58 000 for open data (2018-2022), the city can play an important role in supporting the development of digital infrastructure and promoting open data. Developing IoT solutions will require an excellent quality of information. This is a particular challenge that Alcoy will face, based on the experience of other European cities.

3.1.3 Emphasis on Digital Skills (citizens, students, businesses)

One of the most recurring topics in the vision and ambition statements of cities is the emphasis put on developing digital talent and capacity-building. Skills are considered an intangible asset needed for digitalisation (see Figure 12). Altogether, there are 82 activities across 13 cities (out of 15 challenge cities), and on average 6 initiatives per city, to enhance and foster the upskilling and increase of digital skills of citizens and businesses.

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

- The region of Grand-Orly-Seine-Bièvre has highlighted that one of the key success factors in designing and operationalising the digital strategy is the mobilisation of digital skills. As such the city has undertaken an assessment of both the needs of companies and the existing offer in terms of vocational training. They intend to build a tool for continuous monitoring.
- The city of Rijeka emphasises digital education and talent management as a critical need in the area of labour shortages and skill gaps. This is why the city has promoted an open data portal and software coding skills on different IT platforms for teachers and pupils in elementary schools.

Figure 12 DCC strategies focused on digital skills

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 collaboration 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'	

The city of Nice offers a good example of activities supporting the development of human capital as a driver for digital transformation.

Box 5 Regional Campus for Learning (Nice)

Source: https://www.cote-azur.cci.fr

Box 6 Regional Campus for Learning (Nice) continuation

The new campus will open in 2020 and will welcome 2000 students. Its main objective is to ensure that the young people have the required skills (including digital) to bridge the gap of the local needs of business in the tech sectors with high potential for growth. The strategy of the city aims also to bridge the digital skills gap through other actions, such as the following:

- A digital school has been implemented thanks to financing by the city. This school seeks to ensure that younger generations obtain the required skills to meet the current and future needs of local and regional businesses in the 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. A recent application launched in 2018 by the city, aims to help job seekers find jobs based on geographical and sectoral proximity.
- The university Côte d'Azur is a recently established cluster of higher education institutions. The university aims to develop new models based on interactions between disciplines. It also enhances coordination between research, teaching, and innovation, and strong partnerships with the private sector and local authorities.
- Connecting civil servants in the public administration, including projects related to e-administration such as planning authorisations, school transport, public procurement, etc.

3.1.4 Support to SMEs and Entrepreneurship across cities

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

Each of the previous aspects feeds into creating such a favourable environment for entrepreneurs. First, by increasing the pool of people with the digital knowledge to empower small businesses, ensuring adequate human resources equipped with digital skills. Then, by boosting the cooperation between different stakeholders (e.g. higher education institutes that attract young university graduates to the job opportunities created within the city). And finally, by supporting the ecosystem with technologies that bring key added value to local infrastructure.

Participating cities have elaborated a number of activities that aim to provide support to SMEs as well as provide a nurturing environment for entrepreneurs. Altogether there are some 78 activities planned by the DCC challenge cities (on average 5 per city) to strengthen support for the digital transformation of local companies and the creation of digital businesses.

As such, the cities of Granada and Iasi have both set out to create soft-landing spaces for non-local companies, in order to facilitate the establishment of new high-tech companies. Iasi aims to provide startups and smaller businesses with support from the local ecosystem's various actors.

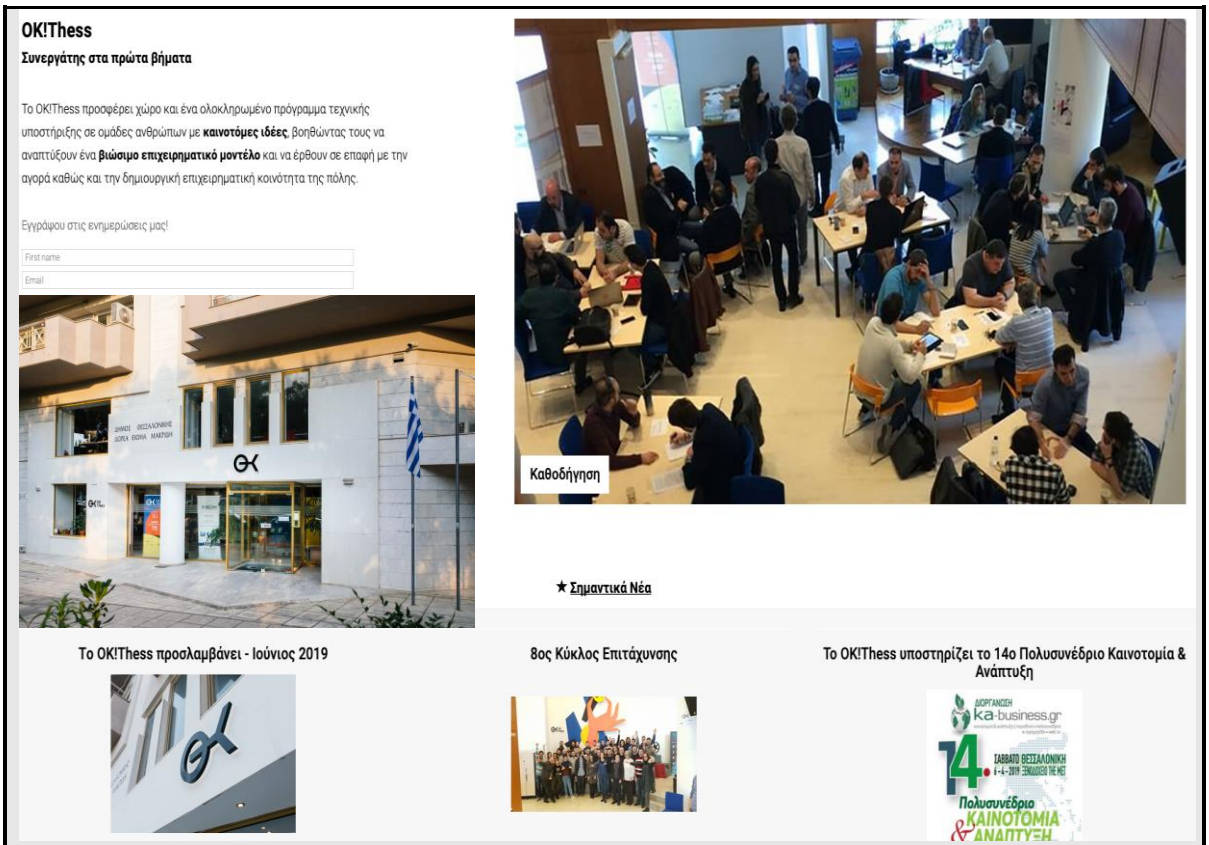
Other cities, such as Thessaloniki, have planned a range of activities to support the development of new products and services. Overall, the digital competences of companies in Thessaloniki vary quite significantly, ranging from a dynamic ICT sector to a general low level of competence in the non-digital sector.

The latter is considered by the DCC local team as one of the significant challenges that should be addressed during the process of the digital transformation of the city. Particularly, one of the obstacles to the adoption of digital technologies by local companies is their relatively low absorptive capacity.

To encourage the creation of startups, co-creation and experimentation for the development of digital innovations, the city of Thessaloniki plans a range of activities:

- *Grants for private investments in local digital companies for developing new products:* Provision of grants to local IT companies for the development of new products and services. The grants will decrease the companies' risk in experimenting and developing innovative products.
- *Improvement of OKThess services:* OKThess is a pre-incubator which provides space and technical support to young entrepreneurs with innovative ideas helping them to develop and validate a business model fast, and to meet, mix and connect with like-minded peers. It also helps entrepreneurs to pitch their ideas to potential funders. In the second semester of 2018, the investments in startups incubated from the OKThess amounted to €1 million and it is expected to reach €2-3 million in 2019.

Box 7 OKThess (Thessaloniki)



Source: https://okthess.gr/el

OKThess will improve the quality of services and the attraction of investors by organising the following activities:

- *Entrepreneurial residence:* Successful retired entrepreneurs from all over the world will be invited for a short period as mentors for the coaching programme.
- *Organisation of an annual matching event for attracting investors and development of a business angels network.*

- *Development of virtual incubation services:* OKThess aims at increasing its deal flow and its viability, by providing virtual and on-premises pre-incubation services to the whole of northern Greece.

The virtual services will include:

  - audio-visual modules for coaching
  - webinars with Q&As

On-premises services:

  - boot-camp weekend in Thessaloniki for the remote participants
  - participation in the annual demonstration days for the presentation of ideas to investors.

- *Setting up and operation of a fab lab:* The fab-lab will provide space and equipment to new entrepreneurs and companies for them to design and develop their prototypes. The list of equipment includes:
  - 3D printer
  - Machine shop for the development of small equipment, cases and the packaging of applications
  - Equipment for PCBs.

The fab lab will provide also technical assistance for the use of the equipment. It will be hosted in the premises of OKThess.

The main opportunities for the city of Thessaloniki are: to digitalise the processes in key economic sectors, to exploit synergies among sectors across the value chain, and to develop know-how for Smart Cities technologies and services in local ICT companies and public administration, and to experiment with disruptive technologies.

In this context, it is important to note that the Digital Transformation Strategy for the city of Thessaloniki will be implemented through other activities: such as support for consolidation and digitalisation of the supply chain, with a view to increasing logistics performance and productivity, and for further digitalisation of the tourism experience.

3.2 Common strategy design features

Co-creation, ambition and actionability are the three key features of the DCC digital transformation strategies. The responses from the survey and interviews can substantiate the activities and strategies that have been set out by the participating cities.

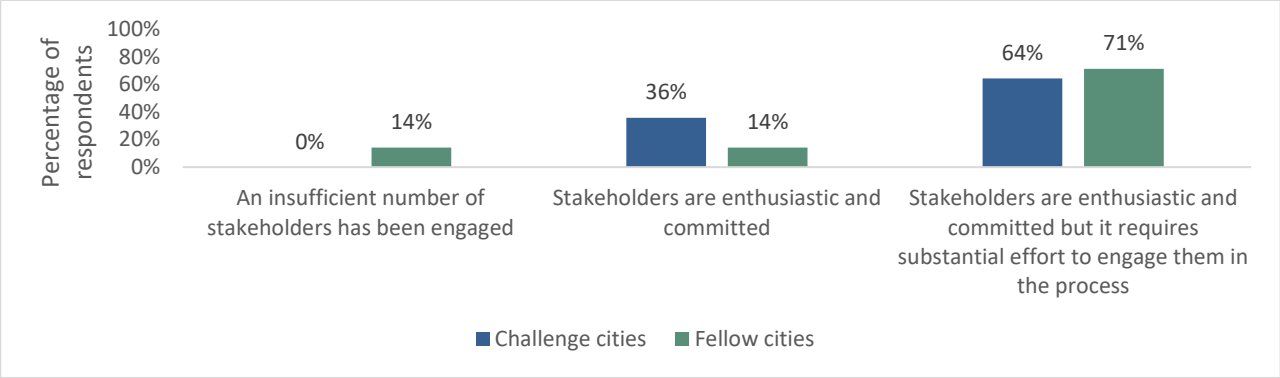
3.2.1 Co-creation

Cities completed their digital transformation trajectory, starting with a participatory assessment of their digital maturity to the governance and monitoring mechanism.

The vision and strategy of each city is the outcome of an assessment and consultation process between the cities and their local stakeholders during workshops and meetings, supported by the DCC lead and local experts working on the ground with the cities.

One of the crucial factors linked to the success of a city's strategy depended on their ability to gather and retain the involvement of its respective stakeholders. The survey results in Figure 13 show that the majority of stakeholders seemed enthusiastic and committed, with cities emphasising that substantial effort was required to keep their engagement throughout the process of the project. However, a comparatively higher number of stakeholders in challenge cities did not require substantial effort to be retained. One fellow city did however express the difficulty of engaging a sufficient number of stakeholders.

Figure 13 How do you assess the stakeholder engagement of your city?



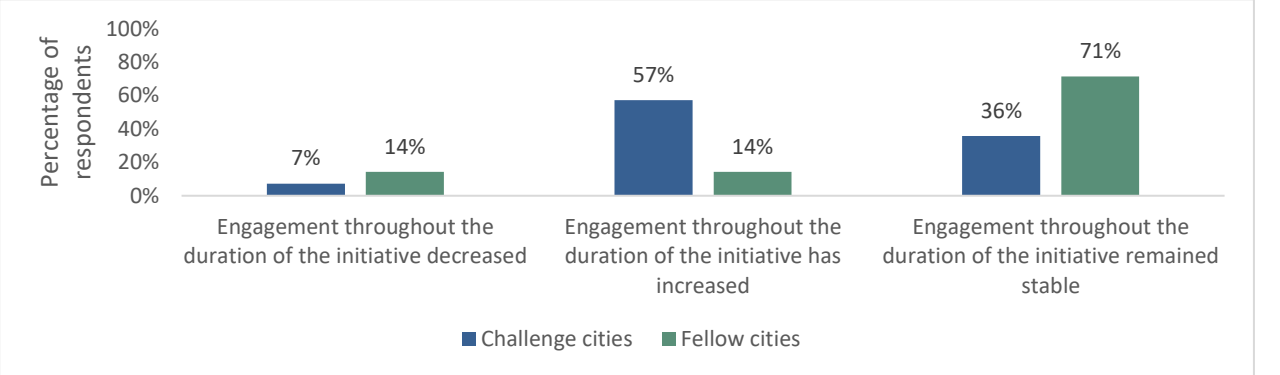
Source: Digital Cities Challenge, 2019

The city of Nuremberg highlighted that the project was an opportunity to gather new types of stakeholders from increasingly digital backgrounds. The city representative noted that this would not have possible without the structured methodology elaborated in the DCC.

Across challenge and fellow cities, survey respondents stated that the ICT sector expressed a great interest in taking part in the initiative. In fact, the city of Thessaloniki specified that these types of stakeholders contributed decisively to the development of the strategy. Nonetheless, Sofia emphasised that SMEs tended to be more active than large companies.

On the other hand, the results from the SAT and the survey respondents show that there was a low engagement in all cities from the financial sector. For example, the city of Arad explains that it was difficult for such stakeholders to receive specific authorisations rapidly from central management. In general, all other cities tended to agree with the fact that financial institutions were not very active throughout the process, due to low interest. This lack of involvement is linked to the fact that many of these institutions are local branches of larger institutions, and thus often lack the authority to make executive decisions necessary for the project.

Figure 14 What is the trend in stakeholder engagement throughout the process?



Source: Digital Cities Challenge, 2019

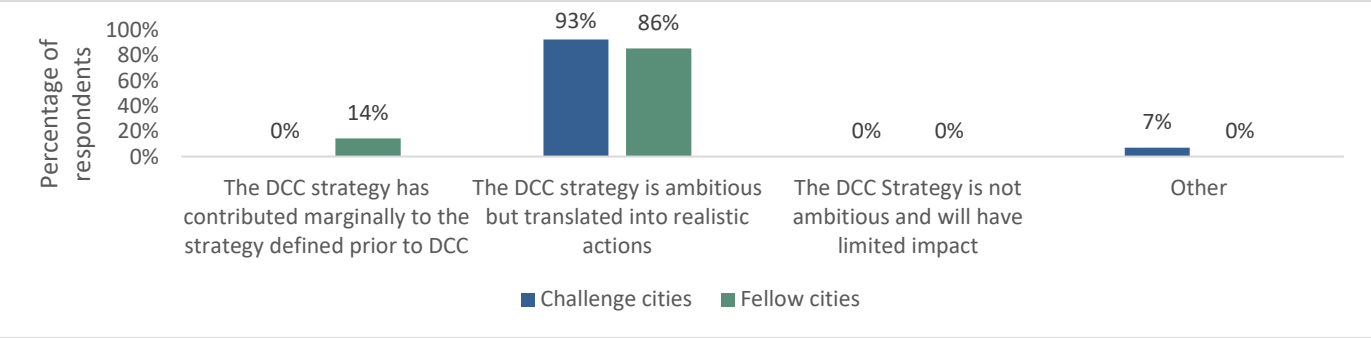
Another key aspect of the DCC, highlighted during the previous question, relates to the engagement of stakeholders throughout the process. One notable difference between the challenge and fellow cities is that there was an increase in stakeholder engagement in the first, while the engagement remained stable in the latter. Only a small percentage in either category showed stakeholder engagement decreasing.

3.2.2 Ambition

DCC cities have predominantly indicated that their *digital strategy* is ambitious but is translated into realistic actions (see figure 15). Many challenge cities in particular have indicated that while the strategy set through the DCC is ambitious, or even "very ambitious", they nonetheless hope to maintain the momentum the project has created. Arad added that the project helped the municipality design a significant vision that will shape the administration's actions for the next 3-5 years.

While no challenge city has highlighted that the DCC strategy has contributed marginally to the strategy defined prior to the DCC, 14% of fellow cities stated that this is the case. One of the challenge cities, Algeciras, has indicated that the DCC strategy is ambitious but will in the short term have limited impact due to the current lack of funding.

Figure 15 How would you characterise the level of ambition of your strategy?



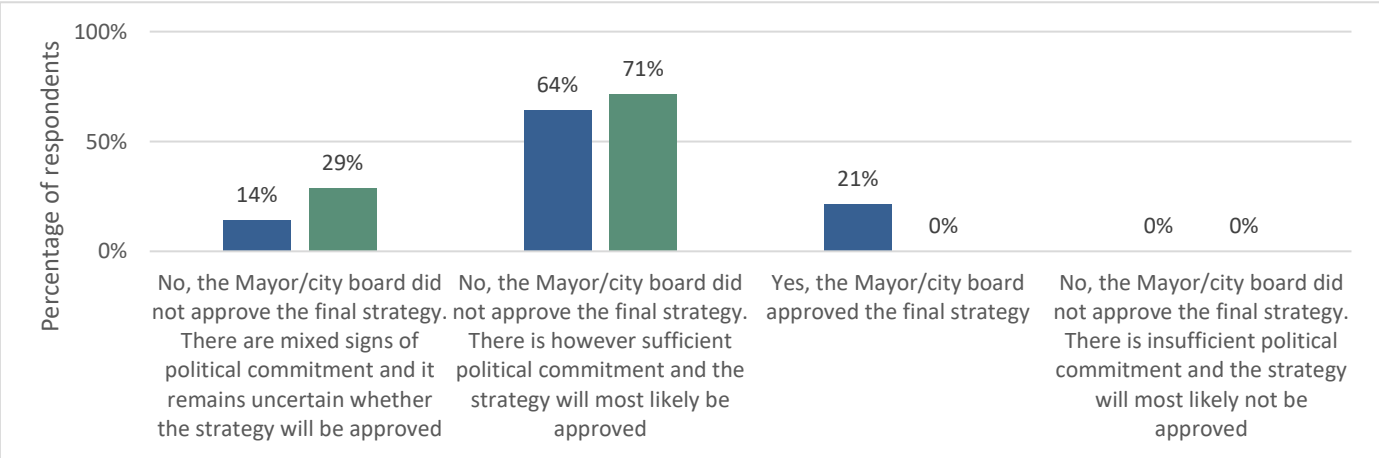
Source: Digital Cities Challenge, 2019

3.2.3 Actionability

About half of the DCC cities indicate high chances of success for the implementation of the actions in their respective strategies and the other half anticipates a mixed outcome with only some of the planned actions reaching implementation phase (see figure 16). For example, the city of Iasi explains that it expects 80% of the actions to be achieved within the time period set in the strategy.

The main arguments put forward by the cities that expect mixed chances of success relate to availability of funding, political support, and effective communication to stakeholders. Political support is seen as a problem common to all cities, as local teams need to build political momentum – depending on the timeline of elections – to implement a digital strategy.

Figure 16 Has the Mayor/City board approved the final strategy?

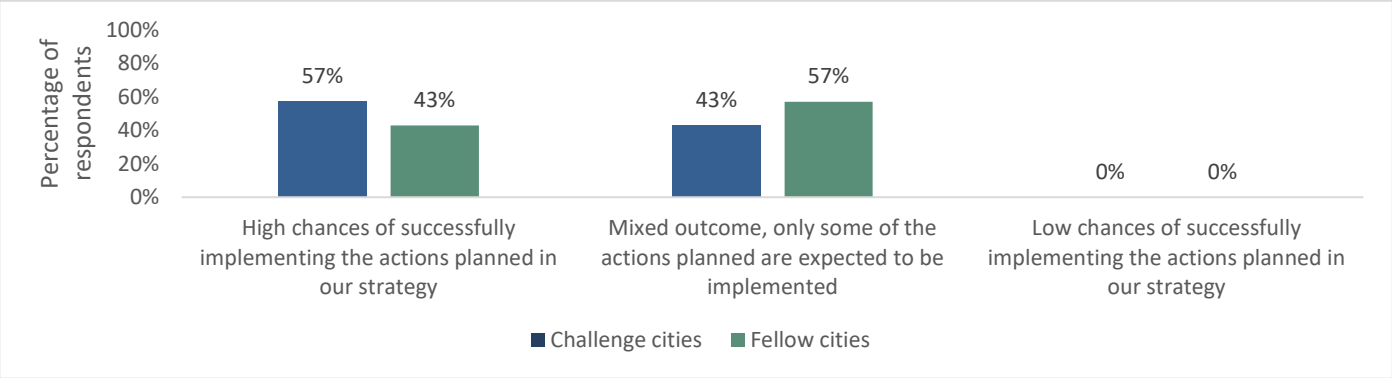


Source: Digital Cities Challenge, 2019

The cities have emphasised that the mixed outcomes arise from the large number of actions required from the stakeholders, and the city's ability to retain their interest. This emphasises the need to build a shared vision and sense of trust between local authorities and stakeholders in the collaboration process. Conversely, cities that have indicated high engagement of stakeholders have tended to indicate a higher chance of success for implementing the actions set out in their respective strategies.

Strategies that have set out realistic objectives and activities – linked to the ambitions and main objectives of the existing local strategies – ensure consistency, sustainability, and hence, a higher likelihood of implementation. Some cities have stated that higher chances of success in operationalising actions is linked to the commitment and support of the DCC Team (see Figure 17).

Figure 17 How would you rate the chances of success of implementing the actions of your strategy?



Source: Digital Cities Challenge, 2019

Having the DCC digital transformation strategies available to all cities is an ideal opportunity to compare one's own strategy with those of cities with comparable digital maturities.

In terms of the contributions of the DCC's support one of the city representatives pointed out that: "*The initiative to design a digital strategy and certainly the monitoring of the activities of stakeholders would not have taken place without the DCC support*" (Patras). It was acknowledged by a representative of another participating city that: "*Thanks to DCC we too, together with Trikala, Heraklion and Thessaloniki have a complete digital strategy in alignment with our other strategies and aiming to support our key sectors*" (Kavala). A positive opinion about the contributions of the DCC initiative was shared among the city representatives of the fellow cities. For example, it was noted that: "*The project enabled us to set the foundations of our digital strategy that was previously non-existent in our city"* (Heidelberg).

4 DIGITAL TRANSFORMATION STRATEGIES IN ALIGNMENT WITH CITIES'S OBJECTIVES ON GROWTH, SMART CITY AND URBAN DEVELOPMENT STRATEGIES

To maximise the return of public interventions in any area, strategic documents and policy support instruments need to be aligned with the territorial needs, also taking into account the future development potential. They need to be complementary and support each other towards achieving a common vision and ambition. It is equally important that a complete appraisal of the alignment of the digital transformation strategies with cities' 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 stakeholders' involvement in the programming and implementation of digital smart solutions to cities' main challenges as well as cross-cutting activities.

In this report, we share insights on the **alignment between the strategies and cities' needs**, gained during the development of roadmap activities in the DCC cities. We take into account the diagnosis of the baseline situation, the planned activities in support of digital transformation by the DCC cities and the results emerging from the consultations with the relevant stakeholders. Moreover, we highlight **existing synergies and complementarities between the different strategic documents** and elaborate on the adopted practices by the DCC cities.

4.1 Alignment of strategies with cities' needs and potential

Prior to the launch of the DCC initiative, the actions existed only in a rudimentary form or at least in an uncoordinated manner. The provided support has helped the city teams responsible for digital transformation to refine their strategies to make them more successful. The digital transformation strategies are relevant to cities' needs and take into account the future potential in this area.

This is demonstrated in the cities' digital transformation strategies through the following:

- Development of activities in sectors that are relevant for the local economy and are aligned with the Smart Specialisation Strategy priorities. Some activities will be financed within the European Structural Investment Fund Regional Operational Programmes.
- Recognition that digital transformation requires complementary actions, with planned activities not overly focused on providing support for infrastructure investments but seeking to stimulate demand for digital solutions.
- Encouragement of activities in areas related to fostering entrepreneurship, improving the local digital skillset, and open data platforms. They are considered to be of strategic importance for mid-sized cities allowing them to become more competitive in a global economy.

Apart from the need to guarantee the necessary funding for implementation, the main challenges lying ahead mainly concern the ability to operationalise the planned actions (i.e. from a technical feasibility point of view and overall intervention readiness), as well as the institutional capacity to ensure the strategic coordination and facilitate the development of digital cities' smart solutions. Without properly addressing those challenges, it is most likely that the strategies will not be fully implemented, calling into question the overall relevance of the foreseen actions.

4.2 Synergies and complementarities with other strategic documents

The newly developed strategies are linked to other existing strategies but propose a different angle to digitalisation, with a focus on economic development and the cities' competitiveness. The cornerstone of the strategies is to improve citizens' quality of life, foster interaction among citizens and businesses, reduce administrative costs, and at the same time create new business opportunities.

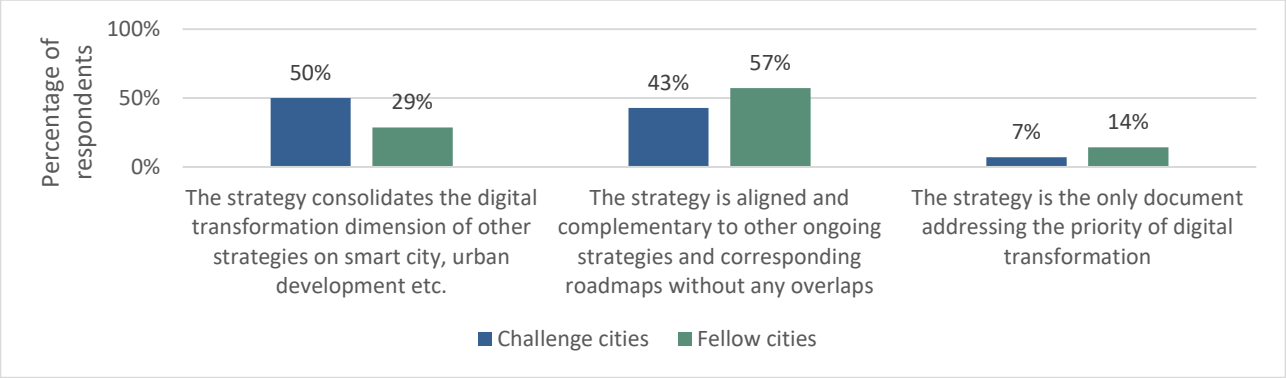
Strategic objectives and activities are aligned to Urban Development, Smart City Strategies and other cities' strategies, and there has been an attempt to avoid overlaps with the national digital strategies.

The existing evidence points to the fact that the digital transformation strategies are characterised by a combination of actions building upon the previous activities undertaken by the city and developing new city models based on different paradigms.

More specifically, cities can be split as follows (see Figure 18):

- Cities with **DCC strategies consolidating the digital transformation dimension of other strategies** on smart cities, urban development, sustainable mobility, air climate energy plans, smart specialisation, green strategies, strategic growth plans, etc. These cities do not have a digital strategy per se and have indicated that their current strategy consolidates the digital transformation dimension of other strategies. These cities indicate that the transversal topic of digital transformation corresponds well to the long-term objectives of sectors such as Health, Agri-Food, Tourism & Culture, etc.
- Cities with **DCC strategies that do not have overlaps with other strategies and are as such introducing new elements to existing strategies with a digital transformation component.**
- **Cities** whose delivered **strategy was the only document addressing the priority of digital transformation**. Sofia, Iasi, and Cork have stated that the strategy is the only document addressing the priority of digital transformation.

Figure 18 Is your strategy aligned with your city's related objectives on growth and/or smart city and/or urban development strategies?



Source: Digital Cities Challenge, 2019

It remains to be seen how those synergies and complementarities will be implemented in practice, but the developed strategies offer a good basis for the implementation of coherent actions in support of digital transformation in the DCC cities. Overall, the DCC methodology was considered by many respondents as an added value to contextualising actions and identifying synergies between them.

5 ACTIONABLE ROADMAPS, GOVERNANCE MODELS AND FINANCING

5.1 Actionable roadmaps

The roadmap is the component of the transformation strategy that describes the practical implementation of the strategy, including priority setting, activities and governance.

Following the DCC methodology, cities worked on their actionable roadmap. The process leading to the design of the actionable roadmap covers the definition of the mission statement, the ambition statements, the operational objectives and finally the selection and prioritisation of activities (see Figure 19).

Figure 19 Actionable roadmap design

Actionable roadmap design
1. Mission statement: Strategic orientation
2. Ambition statements: Common vision and ambition for the city's digital transformation
3. Operational objectives: Operational objectives are generally related to one or several policy levers**.**
4. Activities: The specific actions through which the strategy will be implemented. An activity can be described as a tangible and concrete action, which has a beginning and an end, accompanied by a specific objective and resources for its implementation.

The operational objectives reflect the means through which each city will achieve its digital ambition. Objectives are operational because they are of an actionable nature. They represent the 'how' behind the high-level strategic vision. Then, cities define the concrete and tangible activities to implement the strategies.

Challenge and fellow cities defined more than **190 operational objectives** and selected more than **415 activities** to implement these objectives, while designing their digital strategies. As regards the challenge cities, an average of 8 operational objectives and 16 activities (including pilots) are planned per city. In most cities, on average, 3 pilot activities are foreseen.

During the process, at first a very high number of activities were identified that later were **prioritised and selected according to feasibility and impact.** The majority of activities are planned for the short to medium term (3-5 years) while some are to be implemented within a 10-year timeframe.

Additionally, cities selected up to **4 pilot activities** to be initiated during the DCC project: these pilot activities aim at achieving short-term results and showcase direct impact of the cities' digital strategies. The pilot activities are short-term activities that, in most cases, can be funded directly by the municipalities.

While identifying and defining the activities to be implemented, cities considered the following aspects: the activity's link to the operational objective, a clear description of the activity, its timeframe, estimated cost and source of funding, and its feasibility, priority and implementing agent(s).

The type of activities planned are organised below in Figure 20 as a toolbox conceptualised as a maturity model. The phases of the digital transformation process are: 1) **Understand**, which includes a typology of interventions to diagnose/assess and raise awareness, and 2) **Design and transform**, which includes a typology of interventions to implement and innovate. The toolbox is illustrated below, showcasing in each case interesting examples from the DCC network.

Figure 20 Activities toolbox

Typology of interventions	Activities	DCC inspiring examples
UNDERSTAND		
Diagnose/ Assess	**Mapping existing and relevant resources**	• Mapping existing and relevant data and data sources within units of the district as well as elsewhere on the territory (Grand-Orly Seine Bièvre). The activity will contribute to gain a global view on data currently being produced and required in the future for socio-economic development. Various data types and formats exist: data included in the information system, data from business applications, data from IoT, data from the web and social networks, video and images...). Cost is not estimable at this stage. Planned date of implementation is 2019. • Develop a digital competences and resources mapping (Algeciras). Carry out an offer-demand analysis contrasting professional training capabilities and business requirements. Main aim is to setup a solid reality-based information source. Estimated cost accounts for €80.000 with the support of European Commission Erasmus programme and the Marie Curie Actions. The planned date for implementation is 2019.
	Feasibility study for the implementation of supporting action	• Feasibility study and action plan for the creation of co-working spaces in the city (Algeciras). This activity entails mapping of alternatives and potential locations for a co-working spaces network in the city among the different options already available. Particularly interesting will be those locations situated in areas specifically labelled as less favoured or being target of especial attention by the Municipality's social policies. Co-working spaces includes basic installations, equipment, human resources, etc. Estimated cost accounts for €250.000 with the support of Research and innovation PO ERDF Andalusia 2014-2020 / Atlantic Area / Interreg Europe / H2020. The planned date for implementation is 2019.
	Identification/ assessment of companies' needs (skills, competences…)	• Identify and follow-up on needs of economic, social and institutional territorial actors (Grand-Orly Seine Bièvre). The aim is to assess both the needs of companies and the existing offer in terms of initial and vocational training, in order to have a complete vision of training in the digital field in the territory. A tool for continuous monitoring of these needs will be created. Estimated cost accounts for €157.000 in 2019 and €394.000 in 2020-2022. • Providing digital audits for businesses (Ventspils). To carry out digital audits for local companies and provide feedback on possible improvements. Increased operational capacity of local businesses and productivity by providing necessary tools and network for digital innovations. Cost is not estimable at this stage. Planned date of implementation is 2020.

Typology of interventions	Activities	DCC inspiring examples
Awareness	**Organisation of events, workshops, hackathons, congresses on ICT technologies**	• Organisation of I Big Data Alcoy Congress (Alcoy). Organisation of first edition of Alcoy Big Data congress as a professional forum oriented to the presentation of progress around Big Data applied to AI and smart territories management with a business-wise digital transformation purpose. Estimated cost accounts for €25.000 from the municipality funds and other institutions in Comunidad Valenciana. Planned date of implementation is 2019. • Technology Forum annual event (Thessaloniki) The Technology Forum annual conference in Thessaloniki bring together business, researchers and academia to discuss and be updated on main technological trends and the latest development in the digital world. Keynote speakers are well known members of the international business and academic world. Estimated cost accounts for €48.000 with the support of sponsors, participation fees and the contribution of the organisers. Planned date of implementation is 2019. • Organise networking activities for Arad's digital ecosystem (Arad). Organise activities to stimulate digital entrepreneurship by presenting good practice and approaching modern IT subjects. Organise networking activities and ICT training programmes for SMEs and start-ups. Organise exchange events with other cities/companies/institutions on digital entrepreneurship education. Estimated cost accounts for €50.000 with the support of local funds, the University and Chamber of Commerce. Planned date of implementation is 2019.
	Launch of informational campaigns to raise awareness about digital transformation	• Launching informational campaigns for businesses regarding new smart technologies (Ventspils). To inform local businesses on various smart technology opportunities to expand awareness about various smart technology opportunities and increase productivity. The cost is not estimable at this stage. Planned date of implementation is 2019.
DESIGN AND TRANSFORM		
Implement and monitor	**Deployment of technologies such as LoRaWAN network, 5G infrastructure, broadband connectivity, smart sensors network for real time open data, high bandwidth, hotspots, narrowband, DLT…**	• Deployment, Operation and Management and future extension of open networking 5G infrastructure with open access (Patras). The overall ambition is to create an open 5G-based smart city digital infrastructure that will enable the formation of a research and innovation ecosystem taking advantage of the highly competent class of people in the area (scientists, entrepreneurs, start-ups, public administrators, students, citizens etc), eager to keep up with the new international challenges of the digital society. Estimated cost accounts for €500.000 with the support of the Horizon 2020 projects: 5GINFIRE and 5GVINNI. Implementation started in 2017. • Broadband connectivity to industrial areas (Reggio Emilia). This activity aims to ensure the availability of critical digital infrastructures, such as broadband connectivity, to industrial areas. The first goal is to provide broadband connectivity to Mancasale, the main industrial district in the province. The cost is not estimable at this stage but will be supported by by a public-private partnership. The Municipality and the Regional Government (Emilia-Romagna) finance the infrastructure and the network appliances, while the interested businesses will pay a fixed quote una tantum and the connectivity service. Planned date of implementation is 2019. • Development of smart sensors network to improve the quality of the urban environment (Patras).

Typology of interventions	Activities	DCC inspiring examples
		The creation of a distributed network of smart sensors that can measure many parameters for more effective management of the Historic City Centre (addressing environmental data, i.e. air pollution, radiation etc and ensuring open data access). Estimated cost accounts for €150.000 with the support of ERDF (Operational Programme of Western Greece). Planned date of implementation is 2019.
	Development of technological platforms/ portals to support the digital transformation of the city	• Create a platform for Open Data (Arad). A platform for Open Data will be created, in order to share comprehensive database, including public services, demographics, traffic, pollution, education, culture, tourism, buildings, services and local companies etc. A long-term plan for providing open data will be developed and data sharing protocols will be set up. Estimated cost accounts for €15.000/20.000 with the support of local funds. Planned date of implementation is 2019. • Guimarães + Intelligent (Guimarães) G+i will be an open platform for knowledge and interchanging where access to digital projects', description, replicability, open data, real time data will be provided. Estimated cost accounts for €4.800 with the support of the Guimarães Municipality Investment. Planned date of implementation is 2019.
	Development of business incubator/ accelerator/ platform to support the creation of digital based start-ups	• The Kavala Business Accelerator (Technology Park, AgroCenter, Funding, etc. (Kavala). The development of an Entrepreneurship Acceleration System, heavily utilising Digital Means, targeting the 4 sectors of the local economy will facilitate the digital transformation of the local enterprises. Estimated cost of €1.000.000 with support of CSF and National Funds. Planned date of implementation is 2020. • Entrepreneurial Information platform (EIP) (Rijeka). The main goal of the platform is to provide support to entrepreneurs and future entrepreneurs in the development of their business ideas and to encourage cooperation between IT sector and other business branches. Cost is not estimable at this stage. Planned date of implementation is 2021. • I9G (Guimarães) 9G is an innovation project designed for companies based in Guimarães to create a new concept of regional innovation project aimed to transfer critical knowledge produced at the University to companies based in Guimarães. This project will act in several critical dimensions for businesses, i.e. research, development and innovation, human potential, productive capacity and industrial property. I9G is providing the creation of an industrial base incubator, the requalification, training and retention of high academic skills, and the transfer of knowledge from universities to industry. Estimated cost accounts for 200M€ to be supported by government budget, both National and European structural funds and private funds. Planned date of implementation is January 2020. • Digital and physical space for start-ups located in Sofia (Sofia). Development of new or customisation of an existing e-platform for start-ups and scale-ups. Creation of an office for consultations for founders. The team there would also be responsible for synchronising, supporting and developing existing initiatives engaged with inspiring entrepreneurial qualities and innovative thinking. Estimated cost accounts for €750.000 with the support of EU and local funds, Fund of Funds, Ministry of education and science, America for Bulgaria, Sofia Tech Park, local business. Planned date of implementation is 2020.
	Facilitating the establishment of new	• Soft landing and exchange (Granada).

Typology of interventions	Activities	DCC inspiring examples
	high-tech companies in the city	Soft-landing initiative launched by OnGranada. It is a project designed to support the attraction of companies in the city of Granada. In this respect, a number of customised services are offered to target companies. Estimated cost accounts for €30.000 with the support of membership fees on own resources of OnGranada. Planned date of implementation is 2019. • Talent attraction and ICT employment (Granada). Development of the action plan for talent attraction and employment in Granada (University and Health Technology Park). Estimated cost accounts for €650.000 with the support of the Ministry of Economy and Industry (Red.es) and ESF. Planned date of implementation is 2019.
	Creation of training and learning programmes to support the employees'/citizens'/ children's skills and competences	• Foster Life Long Learning for the citizens (Iasi). Create a collaborative learning context through applied innovative initiatives and a platform that will bring together all conferences and other educational programmes and events in Iaşi. Estimated cost accounts for €1.750.000 with the support of European and local funds. Planned date for implementation is 2020. • Digital Technologies in School (L'Aquila). Promoting digital technologies in primary and secondary schools. The cost and planned date are not available.
	Organisation of training in accordance with the needs of the territory to avoid digital exclusion	• Provide training in accordance with the needs of the territory (Grand-Orly Seine Bièvre). The objective is to increase inhabitant awareness of locally available training for the digital sector. In addition, the production of new training programmes will be facilitated by involving training and employment actors. This will be done on the basis of the needs expressed by economic actors of the territory. Cost is not estimable at this stage. Planned date of implementation is 2020. • Definition of a Digital divide reduction & capability building program (Algeciras). The main objective of this activity is to acquire the guiding lines in order to launch a digital divide reduction program. For this purpose, the results of the competences mapping will pave the way to tackle this topic through all social layers in the city. Main actors involved in this activity are those academia related members of the observatory in close cooperation with the social department of the city of Algeciras. Estimated cost accounts for €60.000 with the support of local public resources contained in the EDUSI budget, ERASMUS +, Marie Curie Actions. Planned date of implementation is 2020.
	Scaling up existing training initiatives to support the development of digital competences	• Bring together existing training initiatives & scale them up (Iaşi). This activity is designed to bring together as many of events (Codecamp, Codecamp Hackathon, NDR – The AI Conference, Civic Hackathon, FinTech Camp, Adapting and Connecting, DevExperience BringITon, FIIPractic, StagiiPeBune, plenty of technology related meetups, Informal School of IT, various programming courses, and many others), under one roof coordinated by the City Hall and helped by voluntary developers, a forum on new technologies and how they can improve the lives of citizens, which can take place over several days. Costs are not estimable at this stage. Planned date of implementation is 2019.
	Organisation of training events, hackathons and	• Training events in practical use of ICT (Ventspils) Ventspils Digital Centre will organize at least 100 training events each year to facilitate the development of practical ICT skills for inhabitants.

Typology of interventions	Activities	DCC inspiring examples
	workshops on practical use of ICT	Improved ICT skills of society. Costs are not estimable at this stage. Planned date for implementation is 2019.
	Support for the uptake of digital technologies by local businesses	• Business Collaboration Platform (Alcoy). Being part of the activity "Digital Transformation Office", creation of both an online portal and a physical space allowing companies to share information on initiatives, projects, problems and ideas. The approach is to provide solutions to problems raised by companies or entrepreneurs in a collaborative manner. Estimated cost accounts for €200.000 with the support of regional and national funds. Planned date of implementation is 2020. • DigiBusiness training (Pori) Developing the concept of DigiBusiness training for SMEs. Training supports companies' preparedness and ability to utilise digitalisation on their own business (financial management, sales, marketing, production). The focus is to boost digital skills of entrepreneurs. Estimated cost accounts for €400.000 with support from the European Social Fund. Planned date of implementation is 2020. • Local Business Exploring 5G (L'Aquila) Running thematic sessions on the impact of emerging tech and 5G on sectors relevant for city economy (construction, tourism, agri-food, pharma, cultural heritage, social innovation) for local companies and organisations. Cost is not estimated at this stage. Planned date of implementation is 2019.
	Implementation of e-participation platform	• Kavala e-participation Platform and incentives programme for citizens and businesses (Kavala). A platform informing businesses and citizens on issues of interest and providing a space for discussion is expected to increase participation levels of local businesses and citizens. Estimated cost accounts for €250.000 with the support of CSF and national funds. Planned date of implementation is 2020.
Innovate	**Development of a Digital Innovation Hub to allow businesses to test technologies before invest**	• Set up a Digital Innovation Hub (Alcoy). Establishment of a Digital Innovation Hub providing capacitation, consultancy and access to technology experimentation services. The first phase of the activity would embrace the development of the Hub business model, the engagement of participating stakeholders and the creation of a service portfolio to initiate operations in the market. Estimated cost accounts for €60.000 with the support of national and European funds. Planned date for implementation is 2019. • Set up Digital Lab as an R&D space (Arad). The Digital Lab will be the main image of the initiative 'AR@Digital: Open. Educated. Innovative', as part of the integrated strategic marketing and projection of Arad into the future. Estimated cost of €70.000 with the support of local and European funds. Planned date of implementation is 2019.
	Setting up and operation of a fab lab	• Setting up and operation of a fab lab (Thessaloniki). A fab-lab and maker space will be developed within the premises of OKThess to offer services to start-ups and to existing companies which want to develop new digital products. Estimated cost accounts for €100.000 with the support of sponsors. Planned date of implementation is 2020.

Typology of interventions	Activities	DCC inspiring examples
	Organisation of competitions and events for new startups ideas	• Digitally coordinated competitions and events for new startups ideas (in focused sectors) and Networking activities (EEN, Greek startups ecosystem, etc.) (Kavala). Organisation of startup competitions to identify promising ideas and innovative offerings that match/exploit the territorial competitive assets of Kavala. Also, networking activities will create a collaboration culture among local enterprises and entrepreneurs for new firm/innovative products development. Estimated cost accounts for €200.000 with the support of CSF and national funds. Planned date for implementation is 2020.
	Support to the development of new products and applications by the local digital companies	• PoC Proof of Concept program- Patras Science Park (Patras) Patras Science Park "Proof of Concept" Program aims to empower researchers to push forward their ideas and turn them into a product. The objective is to bring innovations to the commercialization stage through: - Licensing procedures for a new or existing company, or - Financing a start-up company by venture capital, taking into consideration the nature of the idea, the potential of the market and the plan of the inventors. Innovations that will mature will be channelled to investors but also to social and environmental stakeholders, including social entrepreneurs, volunteers and non-profit organizations. Cost is not estimable at this stage, neither the date of implementation. • Grants for private investments in local digital companies for developing new products (Thessaloniki). The development of new products and applications by the local digital companies will be supported with grants. Estimated cost accounts for €500.000 with the support of the Regional Operational Programme of Central Macedonia. Planned date of implementation is 2019.
	Development of public procurement innovation in the local public administration	• Innovative public procurement (Pori). Chancing the role of city's public procurement towards more innovative public procurement, e.g. utilising reverse auctions. For example, organising a reverse auction or challenge competition in order to find new welfare solutions (digital solution(s) which supports wellbeing of citizens). Estimated cost is not available. Planned date of implementation is 2019. • E-procurement (Rijeka) The activity aims to establish a system of electronic delivery and receipt of bids in procurement procedures and make processes transparent to all stakeholders. Estimated cost accounts for €40.000 from the city budget. Planned date for implementation is 2020.
	Digital twin to help decision makers and experts to better plan and make decisions about development of the city	• Digital twin - cyber-physical platform for decision-making optimisation (Sofia). • Digital twin – a digital profile of the physical city that helps to optimise its performance and can be used as a platform for planning and decision- making but also experimentation, and research and development. Estimated cost accounts for €500.000 with the support of EU funding and Municipal funds and the planned date of implementation is June 2021.

5.2 Governance models

The governance model refers to the implementation framework of the digital transformation strategy of the city. The governance model comprises the set of rules, procedures and processes for the implementation of the strategy. Indeed, governance determines how power is exercised, how stakeholders participate, how decisions are taken and how decision-makers are accountable. Despite this general definition, there is no single solution that can be universally applied to all cities; cities need to determine their own governance model.

In the definition of an optimal governance model, cities seek to reach the following objectives:

- To involve all the relevant players of the digital strategy of the city;
- To implement the strategy in a coherent manner;
- To continuously monitor and evaluate the implementation of the activities.

5.2.1 The Digital Cities Challenge methodology

Within the DCC, defining a governance model has been identified as key to the successful implementation of the digital strategy and as a challenge for most of the cities. All cities involved actively worked on defining their own structure. As a result, each governance model is unique and adapted to the specific characteristics of the local city context.

In order to guide cities in designing their governance model, the methodology identified three pillars: strategy ownership, strategy steering and oversight and implementing agent(s) (see Box 5). As a first step, city leaders have to identify who will be responsible for each pillar and what their responsibilities will be.

Box 8 Governance Pillars

Three Governance Pillars

1. **Strategy ownership:**
   - ***Who***: the strategy owner can be a single institution, or an ad-hoc institution or body.
   - ***What***: its main role is the identification of resources (human and financial) for strategy management within the organisation.
2. **Strategy steering and oversight:**
   - ***Who***: composed of representatives of all stakeholders involved in the definition of the strategy.
   - ***What***: coordination and monitoring of the strategic plan. Take main strategic and operational decisions.
3. **Implementing agent(s):**
   - ***Who:*** a single institution or stakeholders.
   - ***What:*** day-to-day management of the implementation of the digital transformation strategy, reporting to steering bodies, monitoring of progress and results, management of financial resources, among others.

5.2.2 Key aspects

While defining their governance model, city leaders should take a few key aspects into account. These aspects are key to defining a sustainable governance model:

- **Political component:** the governance model of cities has to take into account the political component. As part of the DCC, most cities leaders have had the autonomy to design the digital strategy of the cities. Once the strategies are finalised, city leaders present the strategies to the city council to receive approval (and budget) and to move towards implementation. Within DCC, 34 mayors signed the declaration of collaboration and committed to the digital strategy of their cities. In some cases, the digital strategy and governance structure have a dependency on municipal elections and cannot yet be acted upon. This is the case for L'Aquila, for instance, where different governance models will be presented for the city council to choose.
- **Open and collaborative process:** designing the digital strategy is a collaborative work following a bottom-up open process. This collaborative model has to be reflected in the governance model of the city.
- **Engagement of stakeholders**: the bottom-up process engages local stakeholders in the design of the strategy, and these stakeholders from the quadruple helix should have a role in the digital strategy governance. The vision and ambition of the city must be shared by the municipality and its stakeholders.
- **Link to other policy and initiatives**: involve a digital transformation component in other policies and initiatives, as the digital strategy is transversal, and responsibility for these initiatives should be integrated in the governance.
- **Evolving model:** the governance model has to be flexible towards changes. As the strategy evolves, the governance evolves as well.

5.2.3 DCC cities governance models

The main governance models adopted by the cities are summarised in Figure 21.

Figure 21 DCC governance models

	Governance structure		
	Strategy ownership		
	City council		
	Strategy steering and oversight		
Who	Different municipality departments involved in digital transformation (Algeciras, Arad, Rijeka)	Chaired by the municipality and involving the main local stakeholders (Alcoy, Cork, Guimarães, Granada, Iasi, Kavala, Londonderry, Patras, Pori, Thessaloniki…)	Supervised by an external public agency and involve stakeholders (Sofia and Ventspils)
	Implementing agents		

	Municipality project managers from different departments (Thessaloniki, Londonderry…)	Municipality project managers and stakeholders (Alcoy, Algeciras, Cork, Guimarães, Granada, Iasi, Kavala, Pori…)

Strategy ownership

In all cities, the city council owns the digital strategy, meaning that the municipality as a public representative body of its citizens and SMEs is responsible for a strategy that belongs and has been conceived to benefit them.

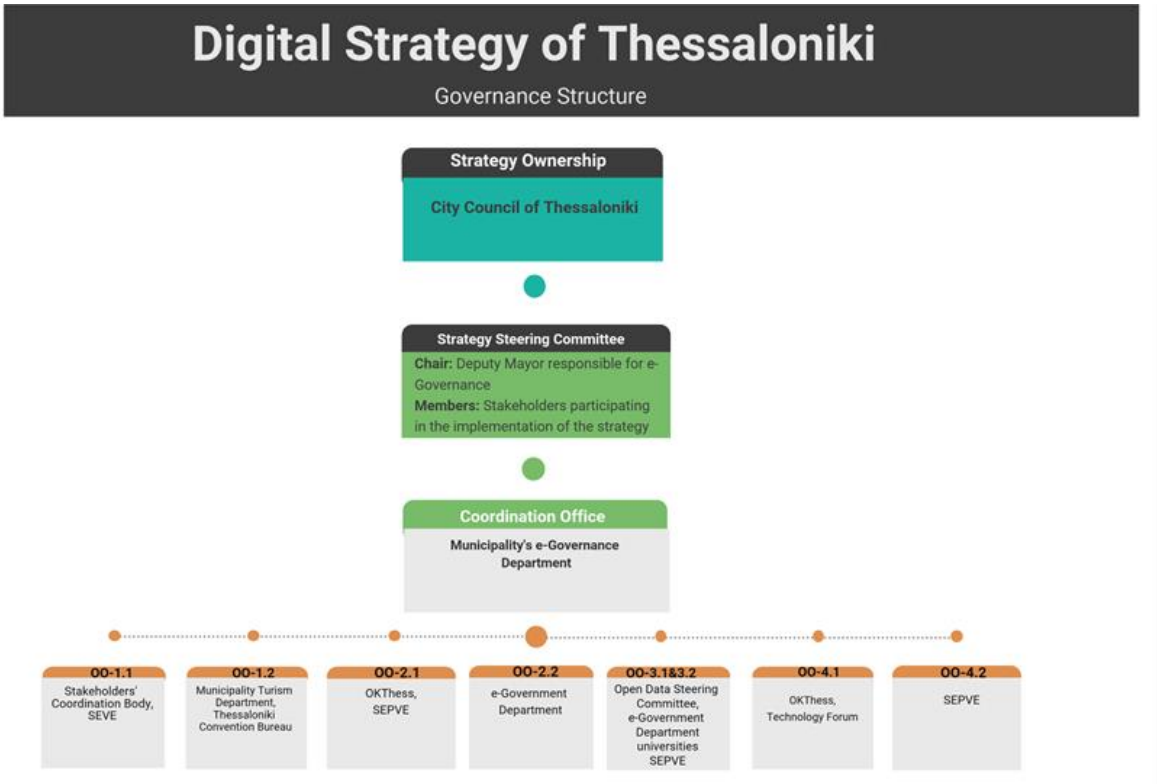
Strategy steering and oversight

The strategy steering and oversight role is to take main strategic and operational decisions. In the DCC cities, the strategy steering body differs, it can be composed of:

- Different municipality departments involved in the digital transformation.
- Chaired by the municipality and engaging representatives of the main regional stakeholders that have been involved in the definition of the strategy.
- Chaired by a public agency and engaging representatives of the main regional stakeholders that have been involved in the definition of the strategy.

In the city of Thessaloniki (see Figure 22), the strategy steering committee is chaired by the deputy mayor and the members are the stakeholders participating in the implementation of the strategy (implementing agents).

Figure 22 Governance models – steering committee in Thessaloniki



In the city of Algeciras (see Figure 23), the steering committee is composed of different Algeciras municipality departments (the head of the committee rotate annually).

Figure 23 Governance models – steering committee in Algeciras

City leaders indicated that it is challenging to keep the stakeholders engaged along the process from the design of the strategy to its implementation. Therefore, the creation of a board is a means to keep everyone engaged and working together towards the implementation of the digital strategy beyond its definition. In addition, the board is an evolving open body, where members are evolving together with the strategy and its priorities.

Implementing agents

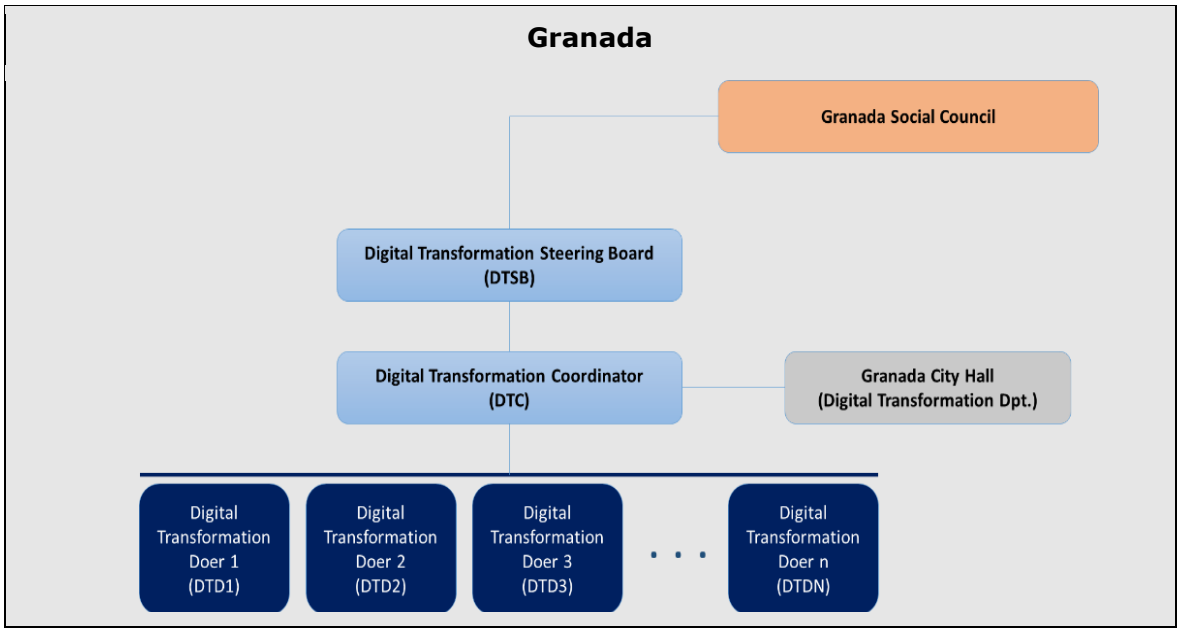
The implementing agent(s) are most commonly one of the following:

- Municipality project managers from different departments;
- Municipality project managers and local stakeholders. Responsibilities of the implementation of activities are divided among the municipality and the regional stakeholders depending on the characteristics of the activities.

Coordinating body

In addition, in some cases an additional layer was added in-between the steering committee and the implementing agents. It is a **coordinating body** that acts as an interface between the strategy steering board and the implementing agents. This is the case in Granada with the "Digital Transformation Coordinator", in Guimarães with the "Coordination division" and in Thessaloniki with the "Coordination Office".

Figure 24 Governance model - coordinating body in Granada



When dealing with specific technologies or sectors, cities can create a**d hoc committees/board/working groups** with members from the strategy steering board and external experts.

In other cases, a **digital department** was created in the municipality, thanks to the DCC initiative, to work closely with other departments in charge of other policies and in collaboration with stakeholders. This is the case in Padua with the creation of the Digital Transformation Office, a transversal structure, including at least one member representing each internal department. The city of Sofia is also considering the creation of the Sofia Digital Agency (SDA).

5.3 Financing channels

With the objective to move from strategy to implementation, digital cities estimated the cost and source of funding of each activity included in their action plan. As a result, the main financing channels have been identified by the digital cities. It has to be noted that in many cases, there is not only one source of funding identified but rather a mix of different channels to fund one activity.

Public funding

Public funding is the primary channel to finance cities' activities. Funding opportunities directly available at European level identified by the DCC cities are mapped below.

Box 9 Digital Cities applications during the Digital Cities Challenge initiative

Wifi4EU: The WiFi4EU initiative promotes free access to Wi-Fi connectivity for citizens in public spaces including parks, squares, public buildings, libraries, health centres and museums in municipalities throughout Europe. In the first two calls of the initiative, 6.200 municipalities received a €15.000 voucher. Many digital cities were successful in the call (Alcoy, Algeciras, Arad, Cork, Kavala, Iasi, Karlskrona, Rijeka, Sevilla, Trikala…). More calls to come[1]

URBACT III: A group of 7 challenge cities applied to the URBACT III action planning networks call for projects. The proposal focused on the challenge of governance for digital cities.

European direct funding opportunities

The European Regional Development Funds (ERDF) offer various funding programme for cities, in fact, half of ERDF funds is spent in cities. Part of this fund is managed at European level through programmes such as Urban Innovative Action, INTERREG Europe, ESPON and URBACT. The EC gathered all relevant information for cities and urban development in a dedicated webpage: https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development_en.

In addition, 5% of total ERDF in Member States is to be directly managed by cities. Cities can directly contact managing authorities responsible for ERDF in specific regions/Member States. The Member States contact webpage is: https://ec.europa.eu/regional_policy/en/atlas/.

Other European programmes, such as Horizon 2020, Erasmus+ or Marie Curie actions, can fund specific cities' activities. Figure 25 below summarises the funding available for cities' activities.

Figure 25 European direct funding opportunities

	Funding source	Target	Projects	Where to apply
ERDF	**INTERREG** European Territorial cooperation			https://interreg.eu
	1. INTERREG cross-border cooperation (60 programmes)	Public authorities, managing authorities/ intermediate bodies, agencies, research institutes, thematic and non-profit organisations	Financial support, peer learning, expert advice and skills, expand network on innovation, healthcare, education, employment and labour mobility	https://interreg.eu/strand-of-cooperation/interreg-a-cross-border-cooperation/
	2. INTERREG transnational (15 programmes)	Public authorities, managing authorities/ intermediate bodies, agencies, research institutes, thematic and non-profit organisations	Financial support, peer learning, expert advice and skills, expand network on innovation, environment, accessibility including telecommunications and sustainable urban development	https://interreg.eu/strand-of-cooperation/interreg-b-transnational-

[1] https://ec.europa.eu/digital-single-market/en/policies/wifi4eu-free-wi-fi-europeans

	Funding source		Target	Projects	Where to apply
					cooperation/
	3. INTERREG interregional (4 programmes)	**INTERREG Europe**	Public authorities, managing authorities/ intermediate bodies, agencies, research institutes, thematic and non-profit organisations	Financial support, peer learning, expert advice and skills, expand network on research and innovation, SME competitiveness, low-carbon economy and environment and resource efficiency	https://www.interregeurope.eu/
		URBACT	Decision makers & practitioners	Transnational exchanges capacity building capitalisation & dissemination	https://urbact.eu/
	URBIS Urban Investment Advisory Support		Cities	Awareness raising, technical and financial advice, innovative financing	http://www.ict-urbis.eu/
	Urban Innovative Actions		Urban authorities	Test new and unproven solutions to address urban challenges	www.uia-initiative.eu
Smart Specialisation Platform			Countries and regions	Guidance, peer-review, access to data, training	http://s3platform.jrc.ec.europa.eu/
ERASMUS+			Public and private organisations, individuals	Support education, training, youth and sport	https://ec.europa.eu/programmes/erasmus-plus/node_en
Horizon 2020			Organisations, SMEs, individual researchers	Research and Innovation projects	https://ec.europa.eu/programmes/horizon2020/
Marie Curie actions			Researchers	Research Fellowship	https://ec.europa.eu/research/mariecurieactions/
Wifi4EU			Municipalities	Vouchers for Wi-Fi connectivity for citizens in public spaces	https://ec.europa.eu/digital-single-market/en/policies/wifi4eu-free-

	Funding source	Target	Projects	Where to apply
				wi-fi-europeans
	EIF European Investment Fund	Financial intermediaries	Entrepreneurship and innovation	http://www.eif.org/
	CEF Connected Europe Facility	There are no restrictions for public entities – whether national, local or regional – to participate in proposals under these calls, provided they meet the applicable eligibility and selection criteria as specified in the respective call texts	The forthcoming call will fund actions from the 2019-2020 Work Programme to improve the availability for re-use of existing open data falling into the high-value data sets categories	https://ec.europa.eu/inea/en/connecting-europe-facility/cef-telecom/apply-funding/2019-cef-telecom-calls-proposals

European funding opportunities available at national and regional levels

Funding opportunities available at regional and national levels as identified by the DCC cities are mapped below.

Figure 26 European funding opportunities at regional level

Funding source	Target	Projects	Where to apply
EFSI European Fund for Strategic Investment	Private sector, public sector, banks, national promotional banks or other financial institutions, collective investment vehicles and investment platforms	Strategic infrastructure, including digital, transport and energy; Education, research, development and innovation; Renewable energy and resource efficiency; Support for small and medium-sized businesses.	www.access2finance.eu
ERDF European Regional Development Fund	Regions	Thematics: Innovation and research; digital agenda; support for small and medium-sized enterprises; low-carbon economy.	https://ec.europa.eu/regional_policy/en/atlas
ESF European Social Fund	Member States and regions	Employment-related projects and digital capability building	http://ec.europa.eu/esf
EaSI European Programme for Employment and Social Innovation	Countries	Employment, social affairs and inclusion	https://ec.europa.eu/social/main.jsp?catId=1081

Funding source	Target	Projects	Where to apply
CF Cohesion funds	Countries	Transport and environment projects	https://ec.europa.eu/regional_policy/en/funding/cohesion-fund

More details are available in the DCC European Funding Guide.

Public-private funding

In some cases, cities identified public-private partnerships (PPPs) as a potential financing channel. Typically, municipalities would join forces with local relevant industrial corporations in order to design and put forward funding, prizes and competition programmes that foster digital innovation and economic dynamism within city boundaries. Target audiences for these programmes are commonly startups, entrepreneurs and local SMEs active in key sectors of the local economy.

For instance, the Reggio Emilia city identified among its activities to bring broadband connectivity to industrial areas. This activity aims to ensure the availability of critical digital infrastructures, such as broadband connectivity, to industrial areas through a public-private partnership. The city's plan is that the municipality and the regional government finance the infrastructure and the network appliances, while the interested businesses will pay a fixed quote once and the connectivity service. Another PPP is proposed in Algeciras to set up a fund devoted to micro-finance, and provide seed and venture capital to invest in promising startups and SMEs with digital solutions.

Private funding opportunities

Private funding opportunities identified by the DCC cities are summarised in Figure 27.

Figure 27 Private funding opportunities

Private financing opportunities	Examples of planned activities by digital cities
Banks: EIB loans, micro-credits	Establish new growth fund for start-ups and for micro and small companies as well as to strengthen digitalisation in companies.
Regional stakeholders: universities, telecommunication operators, private companies…	Technology deployment (telecommunication operators)
Sponsorship	Technology Forum annual event, Setting up and operation of a fab lab…
Membership fees	Digital innovation hubs, skills hub
Donation	Development of virtual incubation and existing services (extending the geographical coverage)

Private financing can be used in the case of the Digital Innovation Hubs (DIH). Indeed, DIH are one-stop-shops that help companies to become more competitive with regard

to their business/production processes, products or services using digital technologies.[2] Membership fees serve as a mean of financing the services that will contribute to the digitalisation of SMEs.

6 COMMON 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 good number of challenges and lessons learned are common to all the cities. In this section, we present the common challenges experienced by the cities, coupled with recommendations and success factors as suggested by the DCC network – cities and experts (lead, local, thematic experts and academy participants) – during the two years of this initiative. The objective is to provide practical recommendations on 1) the process of designing a digital strategy in general and 2) specifically in the thematic areas of key interest to many of the DCC cities with activities planned in their roadmaps.

6.1 Challenge I: Define the role the local government will play 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.

Box 10 Success factors on the role of the city as enabler

Awareness of the needs of citizens and businesses: Learn by observing and mapping**.** To understand what support is needed, a city should map the needs of citizens and businesses. For instance, answer questions such as 'how do your citizens use the physical and digital mobility infrastructure?' or 'what are the hardware needs of my local industry to enable experimentation with advanced technologies?'.

[2] Source: http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs

Access to contacts with companies/organisations in your city who can help you: get to know the solution providers available in your region and the thematic and ICT experts to help you deal with technical complexity. You may be exposed to substantial technology push. While some technology push is needed, a city needs to be aware what challenge the technology is going to address and what the city is going to do with the technology. For instance, understanding the implications of introducing a digital solution which requires a full-time equivalent employee to monitor it.

Examples from DCC cities

Box 11 Digital strategy governance (Alcoy)

As the key element for the digital strategy governance structure, above the implementing agents there is a steering committee/board making the main strategic and operational decisions. This body will be led by the municipality of Alcoy under the figure of the City Council, taking the overall responsibility not only for the implementation and monitoring of the digital strategy but also for the appointment and coordination of the steering committee/board. It will be considered as an evolving open body whose members (persons) can change over time. The overall structure follows a clear and well-configured framework facilitating both the involvement of new members and the withdrawal of existing ones.

Each of those members belongs to a local organisation representing one of the four different domains either directly affected or enabling the digital transformation process, that is: public institutions, education, industry and research/innovation domains. The five representative organisations are selected by the entities/companies under such domains, also known as local stakeholders. The selection approach will follow a turning or rotating process among the main existing options within each city domain. The initially proposed representatives are the City Council for public institutions, the UPV and CIP Batoi vocational centre for education, FEDAC for industry and AITEX for research/innovation. In principle, the members will be part of the steering committee/board for a period of 1 year; every 12 months a new steering committee/board will be constituted where new members (persons) and/or representative organisations will be selected. The members will at the same time vote a president for the steering committee/board every year.

The primary responsibility of the steering committee/board is the implementation and monitoring of the digital strategy. Whilst input should be taken from as many internal and external sources as possible and stakeholders should have a thorough understanding of the direction of the city in general and of the digital transformation strategy in particular, the steering committee/board must provide leadership and input into all steps in the process. The steering committee/board will meet 3 times a year. Hence, the most critical decisions are taken in the steering committee/board, where every member has one vote. In the event of a tied vote, the elected president shall have the casting vote.

In addition, there will be a member of the steering committee/board responsible for the coordination and supervision of the different agents implementing the activities, and monitoring progress and results under the scope of the digital transformation strategy of the city. Such a member will be a person thoroughly selected for that purpose, and appointed by the Alcoy City Council as the digital strategy ownership body, and normally will be associated to the Innovation and Smart City department.

Source: DCC, Digital Transformation Strategy for Alcoy (2019)

Box 12 Digital-Agentur (Heidelberg)

Digital-Agentur Heidelberg roles include identifying and evaluating trends, monitoring digital projects and establishing partnerships with stakeholders in digitalization.

Contacts and advisors, coordinators, instigators and project developers – Digital-Agentur Heidelberg GmbH combines everything under one roof. The task of the agency is to continue implementation of city digital smart solutions and create conditions that will enable Heidelberg to establish itself as one of Germany's pioneering digital cities.

The key challenge many city departments leading the governance of digital transformation are facing is to get buy in from elected representatives, convince that the allocation of resources is a good investment, and ensure collaboration with other departments and groups of digital stakeholders. Heidelberg has successfully involved middle management of different city departments and bodies through the so-called 'digital scouts' who act as the main contact persons for activities which are 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:

On the application level, the digital agency has 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: In collaboration with Stadtwerke Heidelberg, Digital-Agentur Heidelberg GmbH has been promoting the monitoring of energy networks through wireless technology. Sensors are now providing initial information about free parking spaces in the city, for example. In future, sensors will also detect when glass containers are full. The digital agency is also working with City Hall to set up "data lakes". These will hold all the data collected from individual city offices and make it available across all departments.

The second key area of operation of Digital-Agentur Heidelberg GmbH is in developing partnerships. In addition to collaborations with the city administration, the city's public utility company, local people and local business, the agency also partners technology companies geared to development of 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 in all areas of life.

Digital-Agentur Heidelberg GmbH is funded in equal measure by the city administration and by Stadtwerke Heidelberg.

Source: https://www.heidelberg.de/Digitale-Stadt/startseite/projekte/digital-agentur.html

Box 13 Digital governance models (L'Aquila)

L'Aquila city team and stakeholders acknowledge the importance of having a governance structure dedicated to digital transformation strategy to realise full potential that the city has in terms of digital transformation. The four smart governance models are based on best practices learned with exchanges with other Digital Cities Challenge participants and a review of other experiences of smart governance models in socio-economic context like L'Aquila.

The City Team proposes the policy makers of L'Aquila a continuum of choices. On one side, a pure public-centric approach (Digital Transformation Unit and Digital Transformation Metropolitan Unit). On the opposite side, a pure private-oriented approach where the deployment of the strategy is in the hand of a private entity. In the middle, there is a well-known private-public partnership model.

Source: DCC, Digital Transformation Strategy for L'Aquila (2019)

Box 14 Digital strategy governance (Sofia)

Governance is the implementation framework of the strategy for digital transformation. It consists of a set of rules, procedures and processes through which the implementation of the strategy will be overseen, managed and updated. Each governance setting is unique and therefore, there is no single solution that can be universally applied to every regional context.

The institutional framework is the most important contextual factor that influences governance through legislation and the autonomy of the governance processes. In Sofia, the Smart Specialisation Strategy (S3), which is national, partly defines the legal and administrative framework for the DTSS. On the other hand, there is limited autonomy of the municipal government in managing the wider process of innovation- and digital agenda-based transformation, which are frameworks for the DTSS. Both S3 and limited municipal autonomy drive toward a participatory governance model, based on the alliance of many stakeholders. Since the Sofia S3 is grounded on the Quintuple Helix model, it is important to have all five stakeholder groups represented in the DTSS governance: industry, academia, administration, users (groups and organisations representing citizens), and experts in sustainable development of the environment and use of natural resources.

The governing bodies will be responsible for creating the necessary procedures to insure a suitable implementation of the digital technologies and applications. The priorities will be open source software and modularity. Software development can choose between different solutions of control and collaboration. Control options range from using proprietary software, through a usage permission granted according to a license which describes the usage conditions in detail, to Free Open Source Software (FOSS), which offers full control over the software through an ex-ante agreement about the rights to use, modify and distribute software. Collaboration options range from full in-house development to external collaboration with local or global developers. The collaboration or development model is independent from the software control model, as collaboration can take place both in proprietary software and FOSS. A public repository of solutions, a government cloud (G-cloud) may enable a modular development of solutions and applications and re-combination of developed modules into new solutions. When employing the cloud related technologies, government departments can usefully deploy SOA (service-oriented-architecture) for the construction of software for distributed computing, e-services and integration of software applications.

Box 15 Digital strategy governance (Sofia) continued

Datasets and data will be organised into a Distributed Open Data Repository (DODR – a storage repository holding various types of data for Sofia which is open to the public. The journey to implement open data and create a dashboard will require a detailed and well-executed set of activities, from organisational development and executive orders to data organisation and technology modernisation.

At the outset, the Mayor/Sofia Municipal Council should consider establishing an Office of the Chief Digital Officer (OCDO) to be led by a newly appointed Chief Digital Officer, a director-level position that will have the executive authority to mobilise the open data initiative across the Municipality's varied departments. The primary responsibility of the OCDO is to establish a system for data management and the policies and practices that ensure that data is collected, stored, analysed and shared consistently across the municipality and the organisations collaborating in the DORD. A CDO is also an important function in the establishment of the city data platform – one of the 14 identified activities. The CDO should work to enable the curation of adequate data and enable adoption of data-driven decision-making across the organisation.

The organisation responsible for overseeing the implementation of the DTSS is going to be Sofia Investment Agency. The Mayor/Sofia Municipal Council should also consider establishing Sofia Digital Agency (SDA). SDA can take over the functions related to the DTSS implementation monitoring from Sofia Investment Agency. Another responsibility of the SDA will be to facilitate the long-term digital transformation of Sofia through identifying new opportunities for digital/smart city projects and working towards their implementation. This team can be either a newly formed municipal organisation or part of an already existing one.

Source: DCC, Digital Transformation Strategy for Sofia (2019)

6.2 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.

Box 16 Success factors of synergies between cities' strategies

Breaking silos: activated cooperation between city administration departments and city-region cooperation.

Include actions planned under other strategies in your digital strategies: take advantage of other ongoing initiatives to create natural opportunities for cross-fertilisation across strategies.

Examples from DCC cities

Box 17 Digital Transformation Strategy and links to other strategies (Iaşi)

The Digital Strategy for Iaşi is anchored in the existing regional and metropolitan area strategies which support ICT and economic development and competitiveness. The North East region's regional development strategy 2014-2020 targets the increase in 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, supporting innovation and competitiveness of the private sector. The vision for Iaşi as formulated 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 strategic objective is to support the city's competitiveness through innovation, by supporting Iaşi's key domains, such as ICT and the creative sector. In addition, Iaşi has a "Cyber City" strategy, which targets the transformation of Iaşi into a hub for robotics and artificial intelligence.

Source: DCC, Digital Transformation Strategy for Iaşi (2019)

Box 18 Digital Transformation Strategy and links to other strategies (Karlskroa)

Karlskrona municipality works strategically with business development with support of digitalisation. Development plan for the smart Karlskrona was adopted by the General Council on 18 May 2017. The plan describes why, what and how the municipality should work with digitalisation to target the three goals:

- Simpler everyday life for citizens and businesses

- Smarter and more open management that supports innovation and participation

- Higher quality and efficiency in the business.

The development plan therefore aims at facilitating accessibility, information, treatment, competence, efficiency and legal certainty to the municipality's service and administration.

The digital transformation strategy complements the development plan by directly targeting the companies' business development, economic development and competitiveness through digitalisation. The strategy is based on existing ecosystems such as Blue Science Park, Almi, Blekinge Institute of Technology, Region Blekinge and digitally mature companies. The ecosystem has since been supplemented by more company-promoting organisations, financial organisations and non-digitally mature companies.

Source: DCC, Karlskrona (2019)

Box 19 Digital Transformation Strategy and links to other strategies (Thessaloniki)

The existing Digital Strategy of the city focuses on the digitalisation of the governance and the improvement of the quality of life of the citizens, improvement of the interaction with citizens and businesses, and reduction of the administration cost. The Digital Cities Challenge (DCC) Strategy will complement the existing strategy by building on and where necessary expanding the infrastructures foreseen in the Digital Strategy. Also, the former integrates the digitalisation of the interaction of the municipality with businesses into a broader framework of digital services.

The focus of the DCC Strategy on tourism, transport/logistics and ICT is aligned with the Smart Specialisation Strategy priorities. The DCC strategy adopted one of the priorities of Thessaloniki's Resilience Strategy, to develop a sustainable urban supply chain, and provides the means for achieving the objectives of that priority.

The operational objectives of the DCC Strategy are aligned with the investment objectives of the Regional Operational Programme for Central Macedonia, and it is expected that several of the activities of the former will be financed by the latter.

Source: DCC, Digital Transformation Strategy for Thessaloniki (2019)

6.3 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. Monitoring 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.

Box 20 Success factors for dynamic strategies translated into actions in the short to longer term

Commitment of core city team: at least one person to be the face of the digital transformation and push the process of policy design forward as planned.

Measurable KPIs: KPIs to be relevant and realistic in terms of the potential for collection in multiple intervals to allow the measurement of change.

Planned milestones to review the strategy: the bodies forming the governance structure should agree to meet and discuss progress and needs for adaptation.

Methodological framework: Use a framework to guide you step by step in designing the strategy, and an agenda with the timeframe for completing the various activities.

Monitoring framework as prerequisite posed by the city to service providers using your city to test their solutions: City to be in control and agreements with service providers on the provision of data to be made at the onset.

Lobby for funds: Increase capacity to mobilise financial resources – regional funds, for instance.

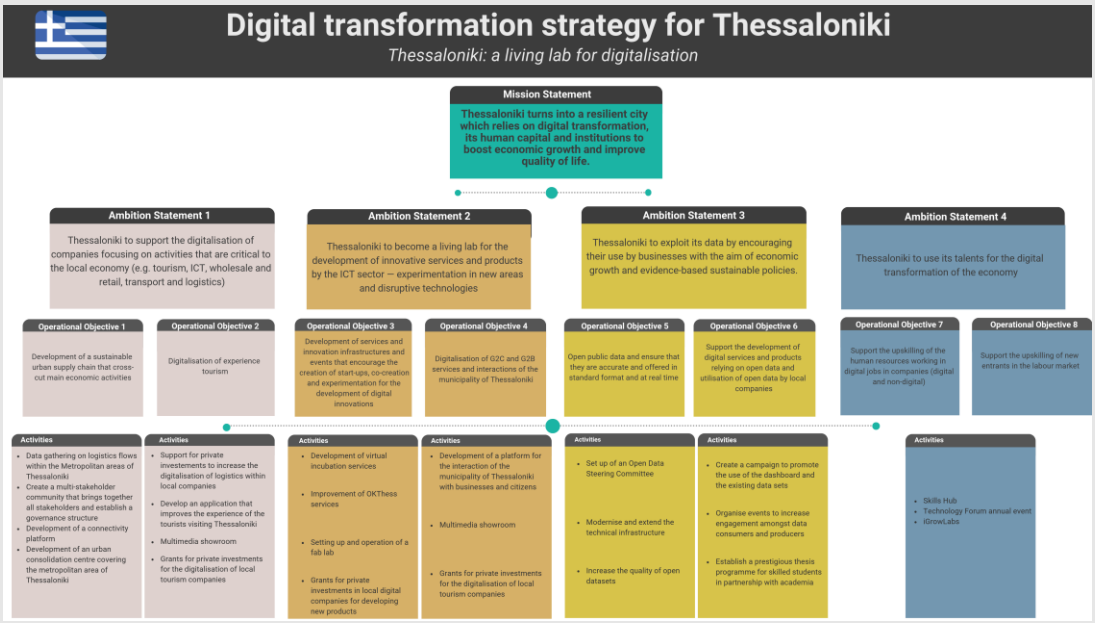
Decision-makers' support: Policy-makers with decision-making power engaged early in the process.

Leadership: Achieving political commitment for the medium to longer term.

Example from DCC cities

Box 21 Digital transformation strategy (Thessaloniki)

The strategy aims at contributing to the digital transformation of key economic activities in the city, while at the same time creating a favourable environment for the dynamic local ICT industry by providing opportunities to develop their capabilities and exploit early entry advantages in emerging market niches. The following figure provides an overview of the full digital transformation strategy for the city of Thessaloniki.



Source: DCC, Digital Transformation Strategy for Thessaloniki (2019)

6.4 Challenge IV: Engage stakeholders in the process of 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.

Box 22 Success factors for stakeholder engagement

Engaged local experts with good networking capabilities: Local experts well networked with key stakeholders using personal contacts to get stakeholders interested and engaged.

Engaged stakeholders from the first steps of the process of transformation: In the process of designing a strategy, start engaging relevant stakeholders early on. Stakeholders need to feel that they are part of the solution.

A limited number of local enthusiasts: to retain momentum identify the ambassadors of your digital strategy and ensure mobilisation of digital skills as preconditions of successful and sustainable community engagement.

Your city as part of network(s): Get your city involved in existing networks. Communicate your involvement in networks and European initiatives, as the EC label or a pan-European network can boost local engagement.

Multiple local stakeholders engaged in networks: Stimulate and provide your relevant stakeholders opportunities for interaction with international experts and stakeholders from other European cities by allowing them to accompany city representatives to networking events.

Examples from DCC cities

The city of Alcoy has designed and set up the dissemination and communication channel that aims to raise awareness about the need of digital transformation, having access to related up-to-date knowledge and information, and creating a common meeting point for interaction among the different stakeholders that they can support and advice each other.[3]

Guimarães Municipality Intelligent Systems Division ISD creation was a municipality strategy for Digital Transformation, Smart Cities and Industry 4.0, with the purpose, to collaborate with other divisions and relevant players, coordinating linked digital transformation, intelligent cities and industry 4.0, actions i.e. coordinate roadmap implementation, propose activities, obtain and provide data, identify funds.[4]

Open Data creates an opportunity to identify solutions to the needs and the development opportunities for the city of Iaşi. Regular innovation and solutioning events will be organised to bring together all stakeholders to analyse and identify the right solutions. Examples of event types/formats: conference, hackathons, other types of civic and organisational engagement etc.[5]

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[3] DCC, Digital Transformation Strategy for Alcoy (2019)

[4] Digital Transformation Strategy for Guimarães (2019)

[5] Digital Transformation Strategy for Iaşi (2019)

The city of Ventspils has built an installation of ultra high capacity (one petabyte) storage system to take advantage of big data analytics. By doing the city expects the strengthen city-wide data processing and analytics infrastructure. By organising bimonthly meetings the stakeholders of the local ecosystem will help shape the services that can be offered through this installation.[6]

6.5 Challenge V: Identify suitable partnerships for common actions

- **Identify common challenges:** many cities from different levels of digital maturity are facing similar challenges. Exchanges between cities with similar challenges are most likely to occur among cities with similar or complementary strategic lines.
- **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.

Box 23 Success factors for the identification of suitable partnerships

Involvement in city networks: Initiatives such as DCC and other networks of cities can play an important role in facilitating different forms of co-operation.

Win-Win co-operation: For cooperation to successfully deliver during its implementation stage all partners involved must have something to gain from the cooperation. For instance, the drivers for cooperation as identified in the context of the Vanguard Initiative and the European Entrepreneurial Regions project[7]include:Policy learning/alignment;

Access missing competencies;

Reaching critical mass;

Access to a wider community of potential (end) users;

Reducing duplications/redundancies/ costs

Increasing efficiency

[6] DCC, Digital Transformation Strategy for Ventspils (2019)

[7] Fostering collaboration through mapping, analysing and interlinking of European Entrepreneurial Regions

Box 24 Success factors for the identification of suitable partnerships (continued)

Visibility/ Extroversion: one person to be the face of the digital transformation of the city that can be easily traced and contacted by cities interested in cross city co-operations. Not a generic contact email.

Examples from DCC cities

Box 25 Cross city cooperation in the framework of URBACT (Algeciras, Kavala, L'Aquila, Pori, Rijeka, Heidelberg, and Ventspils)

In order to further promote the digitalisation momentum, the DCC cities have replied to the recent URBACT call and plan to try on different European funding programmes that are supporting this type of initiatives. An URBACT III Action Planning Networks project proposal has been submitted to a Call published by the programme during 2019. The idea is to further work on the best governance model for implementing our digital transformation strategy together with other cities members of DCC. If successful during Phase 1 evaluation (actions will go from September 2019 to March 2020), Algeciras will submit a proposal for Phase 2 (covering 2 years' time of activities with peer cities of Kavala (Greece), L'Aquila (Italy), Pori (Finland), Rijeka (Croatia), Heidelberg (Germany) and Ventspils (Latvia). The latter has teamed up with municipalities of Iași (Romania), Oulu (Finland), Almeria (Spain), Messina (Italy), Saint-Quentin (France), Limerick (Ireland) and Águeda (Portugal) another project named Digital Innovation 4 Cities – DI4C in the framework of the URBACT III programme. Relevant EC initiatives and opportunities for funding will be explored by the DCC city members together and presented during the regular meetings when the roles in possible projects are established.

Source: DCC, Digital Transformation Strategies for Algeciras (2019)

Box 26 Cross city cooperation in the framework of H2020 (Sofia, Heidelberg, Antwerp)

As a result of the work on Digital Cities Challenge Sofia Investment Agency was invited to represent Sofia in three other projects. The team was invited to partner in a project under Horizon 2020 with fellow DCC cities Heidelberg and Antwerp. The aim of the project is to replicate successful smart city initiatives between the participating partners. The application for that project was submitted in March 2019. As a result of contacts made during DCC city workshops, we were contacted by a local financing institution and are now in the process of applying for advisory support from EIB for the creation of a Pipeline for Digitalisation of City Projects. The aim of the project is to develop a mechanism/procedure for identifying and attracting digitalisation projects to Sofia and helping those projects secure funding.

Source: DCC, Digital Transformation Strategies for Sofia (2019)

Box 27 6Aika-the Six City Strategy (Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu)

The six largest cities in Finland share the same challenges of urbanisation. In the Six City Strategy, Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu tackle those challenges together and develop better services.

The Six City Strategy is based on co-operation, which includes cities, residents, companies and research organisations. The co-operation between cities is close and practical, since all Six City Strategy projects involve operators from at least two of the Six Cities.

Box 28 6Aika-the Six City Strategy (Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu) (continued)

Co-operation requires openness. In the Six City Strategy projects, information and experiences are shared among cities and other project partners. Shared experiences and learning strengthen trust. The Six City Strategy started in 2014, and it has now created a developer network consisting of hundreds of experts.

In the Six City Strategy, openness also means a new positioning of the cities. The cities have opened up so that companies get to test their products and services with real users in authentic urban environments, such as schools, shopping centres, hospitals, nursing homes and neighbourhoods. We call these physical, virtual and functional spaces for co-creation 'innovation platforms'.

Companies are both target groups and partners in 6Aika projects. Companies use urban environments as platforms for testing and developing new products and services. Cities enable knowledge building in businesses (e.g. trainings in smart city development). **The main achievements so far are**:

- 64 new innovation platforms & 376 products or services tested in them
- Almost 1500 companies have co-created with the cities
- Over 260 companies have started R&D&I operation with universities or R&D&I organisations
- 2370 companies have participated in projects run by R&D&I organisation

Projects are the engine of the Six City Strategy. The themes of the projects range from smart mobility to learning and from health and well-being to circular economy and energy efficiency. The Six City Strategy also involves projects related to employment and competence. Open innovation platforms are physical, virtual, or functional urban environments that are systematically opened up to external developers.

The cross-sectoral Six City Strategy offers a unique framework for smart and sustainable urban development. Altogether there are some 43 pilot projects in various themes: Health and wellbeing; Smart mobility and logistics; Learning; Gaming; Circular economy and cleantech; Media; City as a testbed; Urban data; Service design; Co-creation; Career paths for the youth Employment.

Main lessons learnt:

- Make choices, also determine tolerated risk level (more narrow focus is easier to control, but the most innovative outcomes may be unpredictable)
- Share leadership and embed it in the governance structure
- Spend enough time building a common vision in the beginning
- Reflect together on the findings as the work is progressing
- Update frequently and re-focus, if needed
- Involve openly the quadrable helix actors (public, private, citizens, academia) from the start

The Six City Strategy – Open and Smart Services 2014–2020 is part of Finland's structural fund programme for sustainable growth and jobs 2014–2020. The strategy and its projects are funded by European Regional Development Fund (ERDF), European Social Fund (ESF), the Finnish Government, the participating cities and project partners. Helsinki Uusimaa Regional Council is the authority responsible for ERDF funding and Häme Centre for Economic Development, Transport and the Environment is the authority responsible for ESF funding. The budget amounts to 100 million euros, approximately. The City Strategy represents Finland in EU Cohesion Policy's 30th anniversary year.

Source: https://6aika.fi/en

7 CHALLENGES AND RECOMMENDATIONS IN THEMATIC AREAS

7.1 Open Data - Digital transformation for every size city

7.1.1 Introduction

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.

7.1.2 Recommendations

Start small and scale incrementally

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

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

Resources will be initially scarce and will often depend on midnight oil and passion of enthusiastic people within 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 to be sometimes opportunistic on what priorities of your established strategy to focus on, depending on which current battles you can currently win. At the end of the day only matters that you have advanced the overall goal and mission of your initiative.

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 bootstrap 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.

Box 29 Digipolis (Antwerp and Ghent)

The procurement processes of public authorities represent a major barrier for innovative startup and scaleup businesses. Responding to public tenders is a painful process that usually takes time and which suits better larger well-established businesses.

In order to benefit from digital innovation, Digipolis – an organisation responsible for IT services of the city of Antwerp and Ghent - has introduced more flexible procurement processes that better suit smaller businesses, which are often the driver for disruptive innovation.

This required the introduction of a new IT architecture for city services move away from a monolithic to micro-service architecture, modularising system functionality into smaller service building blocks. Such smaller building blocks can be more flexibly procured from different vendors as incremental add-ons to the existing platform. This allows the city to carry out procurement of services often below the threshold of €144k, which greatly simplifies procurement processes on a national level.

Digipolis is now able to significantly shorten the procurement cycles to about 6 weeks from the initial public call to contract award, making it more appealing for smaller innovative businesses to respond.

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.

Box 30 Not being a front runner has also 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.

Box 31 Not being a front runner has also its benefits (continued)

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.

Establish the right culture for continuous innovation

Every new technology undergoes a common technology adoption cycle whereby an early group of innovators and technology enthusiast (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 become 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.

Box 32 Digital Catapult

Cities and public authorities are considered laggards rather than early adopters when it comes to adoption of new disruptive technologies. The stringent procurement rules attached to spending public money may be partially to blame for. However, there are other ways cities can get started experimenting with emerging technologies to tackle the many challenges they face.

An example is the Things Connected programme for Local Authorities (TC4LA) of the Digital Catapult, which enables cities to experiment with new services and interventions enabled by low power wide area networks such as LoRaWAN. The programme helps councils to identify suitable challenges that can be addressed with LPWAN technologies and establish pilots with technology providers which are provided by innovative start-ups and scaleups.

Within TC4LA, several local authorities join forces and put forward a set of challenges which are published through an open call to innovators on the local market. After a selection phase a short list of companies is able to engage with the councils and refine their value proposition following discovery workshops and training provided by the Digital Catapult. The selection phase concludes with a pitching day, in which the winners receive funding for a pilot service deployment to address the challenge of a local authority. Digital Catapult provides pilot support and network access for the agreed pilot duration. Examples of pilots included services such as people flow monitoring on high streets, smart management of recycling facilities, monitoring of construction pollutions of larger redevelopments, smart parking and smart street lighting.

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 is 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 (API)s 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.

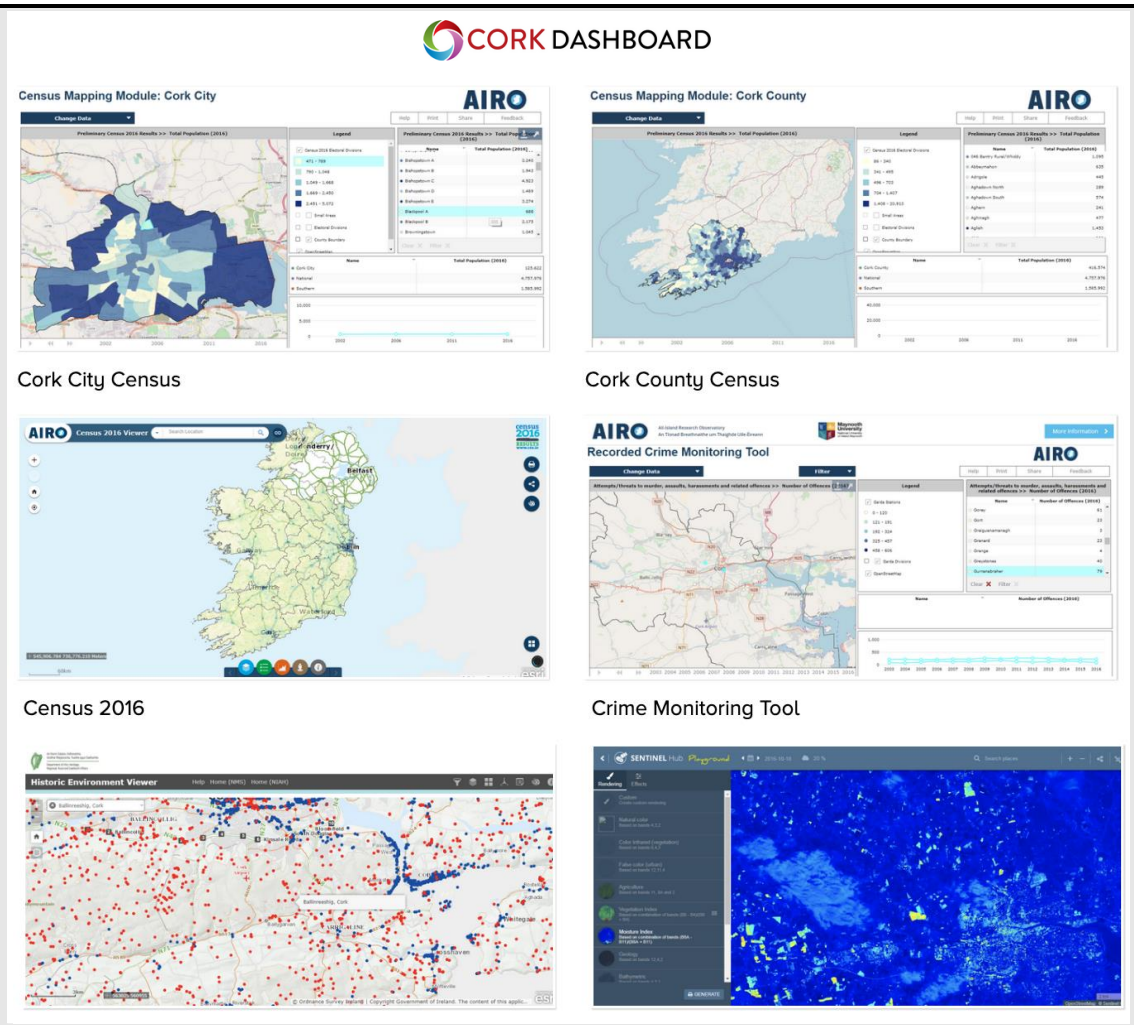
A city may help a local start-up to launch and sell its first application by allowing it to respond to a local challenge/market need and act as its first customer. However, if a city has adopted a proprietary urban data platform or if the challenge only exists in the local context it may be difficult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

The following testimonial put a spotlight on the potential benefits of open data for cities: "Open data can re-invent the way we manage cities' growth and respond to the big societal challenges. Open data provides access to information and facilitates improved decision-making, thereby it helps to address governmental inefficiencies and brings about efficiency gains for city administrations and stakeholders in the delivery of public services and processes" (Open Data Manchester).

Examples from DCC cities

Box 33 Data-driven innovation (Cork)

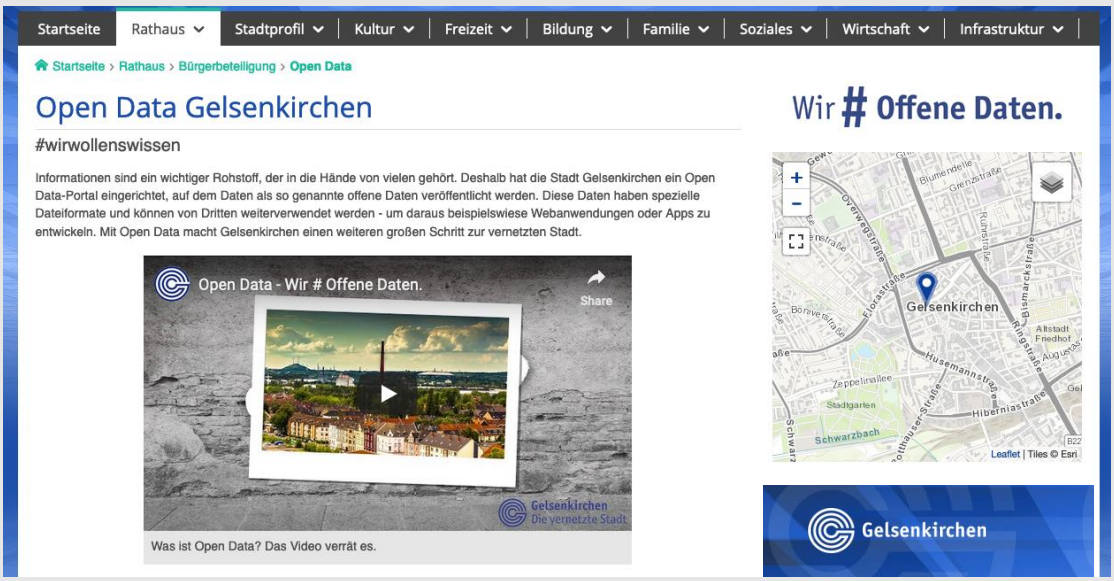


Source: http://www.corkdashboard.ie

The city of Cork made important efforts in developing an open data platform called the Cork Dashboard that allows users to monitor a huge range of public data at a glance – from real-time traffic and weather information to air quality and crime levels – all in one place and free of charge. The portal offers more than 100 real time and static data sets in collaboration with Maynooth University. The Cork Dashboard pulls together data from major data sources including Cork City and County Councils, the Central Statistics Office, Eurostat, the Environmental Protection Agency, Met Éireann, Transport Infrastructure Ireland, government departments, and links to a variety of existing applications. The underlying data is freely available so others can undertake their own analysis and build their own applications and visualisations.

Source: DCC, Cork (2019).

Box 34 Open Data Gelsenkirchen (Gelsenkirchen)

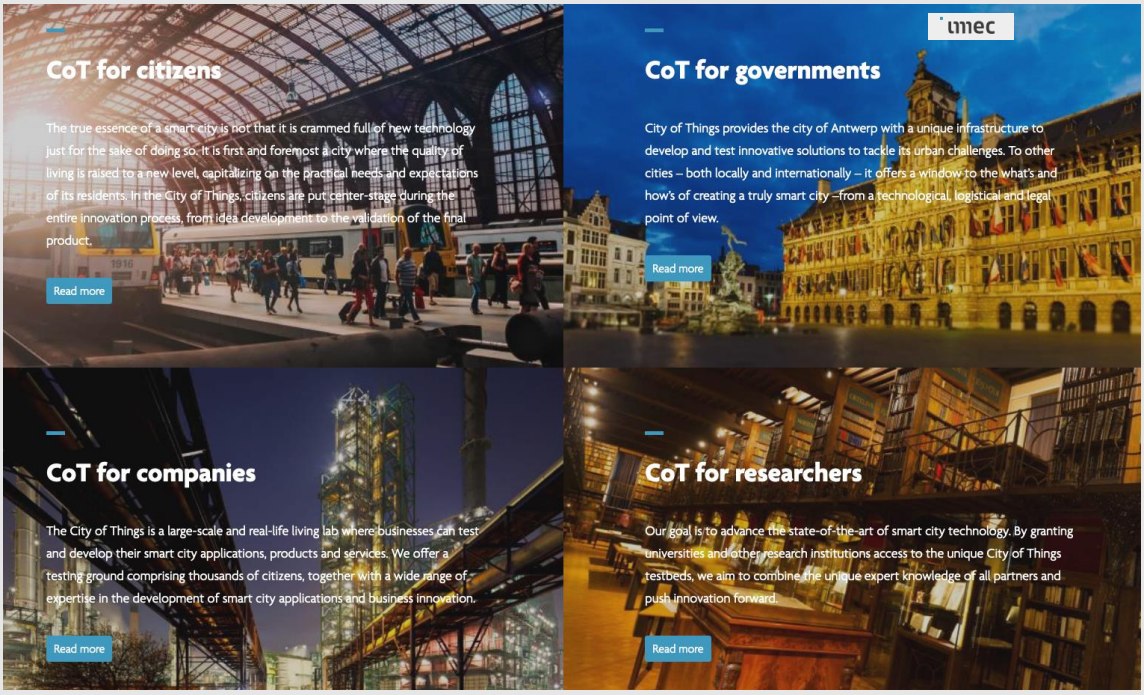


Source: https://opendata.gelsenkirchen.de

In May 2017, the city of Gelsenkirchen made many of its data available for free further use by third parties. This data can be used to create web applications and services as service offerings for the citizens of the city. Gelsenkirchen is thus one of only about 30 municipalities in North Rhine-Westphalia to offer such a service. An integral part of the Open Data project is a cooperation with the Westfälische Hochschule Gelsenkirchen (WH) Students of the study course "Journalism and PR" supported the city working group in the planning of the campaign and data management in advance. The Department of Computer Science and Communication also offers a seminar in which students use the data provided by the city to develop and implement initial ideas for applications. The Gelsenkirchen data will soon also be made available in the Open Data portals of the state (OpenNRW) and the federal government (GovData).

Source: DCC, Gelsenkirchen (2019), https://opendata.gelsenkirchen.de

Box 35 City of Things (Antwerp)



Source: https://www.imec-int.com/en/cityofthings

The new Antwerp economy relies on two innovation clusters: digital innovation and circular economy. To foster this transition, the city of Antwerp aims at becoming a referential smart city, using the Internet of Things and big data to tackle several societal challenges. In January 2017, the City Council approved a vision text on Antwerp as a smart city. The overarching theme in the smart city vision text is to tackle urban challenges in a smart way, in collaboration with citizens and enterprises and making use of technological innovations available. City of Things, an operationalisation of the city's broader smart city strategy, is one of the core initiatives contributing to this aim. With iMec, a world leading research institution in the field of nanotechnology, the city has partnered up for developing the City of Things project in Antwerp. The project consists of a city wide network of interconnected sensors and base stations, gathering rea-time data. Both parties established a 3-year covenant, committing themselves to co-financing Internet of Things products and services, to be developed and tested in City of Things. These structural investments will over time develop City of Things into Europe's largest living lab, a technological experimentation zone, connecting citizens with to be tested innovative products and services.

Source: DCC, Antwerp (2019), https://www.imec-int.com/nl/what-we-offer/innovation-services/city-of-things

Box 36 Smart Cities Innovation Hub (Patras)

Source: http://psp.org.gr

The Smart Cities Innovation Hub, based in Patras Science Park, is an initiative of the Network Architectures and Management Group together with the Patras Science Park. It is active in the development, production and exploitation of smart cities products and solutions. Its conception (in alignment with other innovation hubs) is an initiative of Patras Science Park, aiming at strengthening research, technological development, innovative ideas and cooperation with business partners. The Hub promotes digitalisation through open digital infrastructure projects and pilots for citizens, enterprisers and researchers. It has developed into an ecosystem supported by a blend of highly innovative SMEs and research labs active in the fields of IoT, cloud and related testbeds. The Hub together with the Municipality of Patras have developed and are currently in charge of implementing the part of the Strategic Smart City Plan related to the Digital Infrastructures.

Part of the overall ambition of the City of Patras and Smart City Innovation Hub is to create an open 5G-based smart city digital infrastructure that will enable the formation of a research and innovation ecosystem taking advantage of the highly competent class of people in the area (scientists, entrepreneurs, startups, public administrators, students, citizens, etc.), eager to keep up with the new international challenges of the digital society. This will be achieved in close collaboration with academic/research organisations, the city/region authorities, and industrially driven innovation hubs or other public agencies and will be adopted outcomes from international initiatives and open source/hardware projects of a number of individual network technologies with NFV, SDN, MEC, 5G and IoT being the major ones.

Source: DCC, Digital Transformation Strategy for Patras (2019), https://www.psp.org.gr/en/content/smart-cities-innovation-hub

7.2 Robotics and AI: Digital Transformation with Robotics and AI – opportunities for cities to catch up

7.2.1 Introduction

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 month . 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

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 1980ies. Later, to respond to the growing needs of flexible, custom-tailored production scenarios, many robots got sensors and "intelligent" control systems. Around 2000, robotic producers developed light-weight robots with force control that opened the way for scenarios where human workers and robots – now called collaborative robots – can safely work together. Little is known that industrial robots also make "re-sourcing" possible, i.e., they may bring production back to locations which previously had lost whole industries to other continents. Adidas has started producing shoes again in Germany – with robots. Customers can assemble the 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 left the research labs at first for fulfilling cleaning jobs, later for logistics, followed by agriculture, healthcare,

qualifications. Hence, training and retraining the existing human resources may need to become part of the strategy .

7.2.2 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)[8]. 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, digitisation and innovation rate, and current supply and value chains, to obtain a better basis for the SWOT analysis (see Figure 28 SWOT analysis based on the findings from these sources).

Figure 28 SWOT example

	Opportunities: • Regional cohesion supports innovation and markets • Diversity of robots: robots for special applications	**Threats**: • Competition • Financial crises • Lack of trust among regional partners
Strengths: • Lifelong learning • SMEs collaborating • SMEs innovating in-house • Product/Process innovation	**Strategies:** • Establish a Cluster • Innovation measures: establish a roadmap • Networking with researchers • Set up regional TechTransfer centre	**Strategies** • Diversification and "plan B" to expand • Offensive marketing • Find moderator • Collaboration with other clusters
Weaknesses: • behind in: medium and high technology manufacturing • behind in: knowledge intensive services • behind in: patents • low in R&D expenditures	**Strategies** • Establish a Cluster • Build Value Chains • Investment • Human resources: attract experts from outside • Set up an innovation "round table"	**Strategies** • Scale down to core stakeholders and competencies, diversification with "plan B" • Networking with researchers • Set up an innovation "round table" • Involve schools, education, support entrepreneurship

Set up an "Innovation Board" & create an "Innovation Hub"

A team of people is to be invited consisting of persons who have insight in the city's economy and social structure, and who are determined to turn the city into an "Innovation Hub". Innovation Hubs are regional clusters consisting of industry, education and training (also universities), Chamber of Commerce, technology transfer organisations etc. These organisations should select experts to establish an "Innovation Board" which should with the help of workshops perform the analysis and come up with an innovation strategy and a roadmap as the basis for innovation projects. This Board

8 See: https://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en

should also decide on the finances and staffing of an "Innovation Office", to implement the strategy, and meet regularly to supervise the implementation of the strategy.

Decisions need to be made regarding the financial resources for the operation of the Innovation Office: a management team with an inspiring General Manager, an office, and – strongly advised: a central building which serves as one-stop-shop for consultation, events, shows, conferences, training courses, and technology transfer for start-ups. There are plenty of examples proving the usefulness of a central "Technology Transfer Centre", possibly combined with an "incubator" for start-ups. Schools and universities may contribute with labs and "fab labs" (fabrication laboratories), i.e., small-scale workshops offering machinery and staff to students and start-ups for building prototypes.

One should keep in mind that robotics typically requires a lot of hardware and equipment for which start-ups often do not have the necessary resources; hence it helps if the "Technology Transfer Centre" offers hardware and equipment to share.

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)[9].

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 experiments. 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;

9 EIRMA (1997). 'Technology roadmapping - delivering business vision', Working group report, European Industrial Research Management Association, Paris, No. 52.

- 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 data . 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 healthcare can also take advantage of deep learning, e.g. for optimising the response to emergencies.

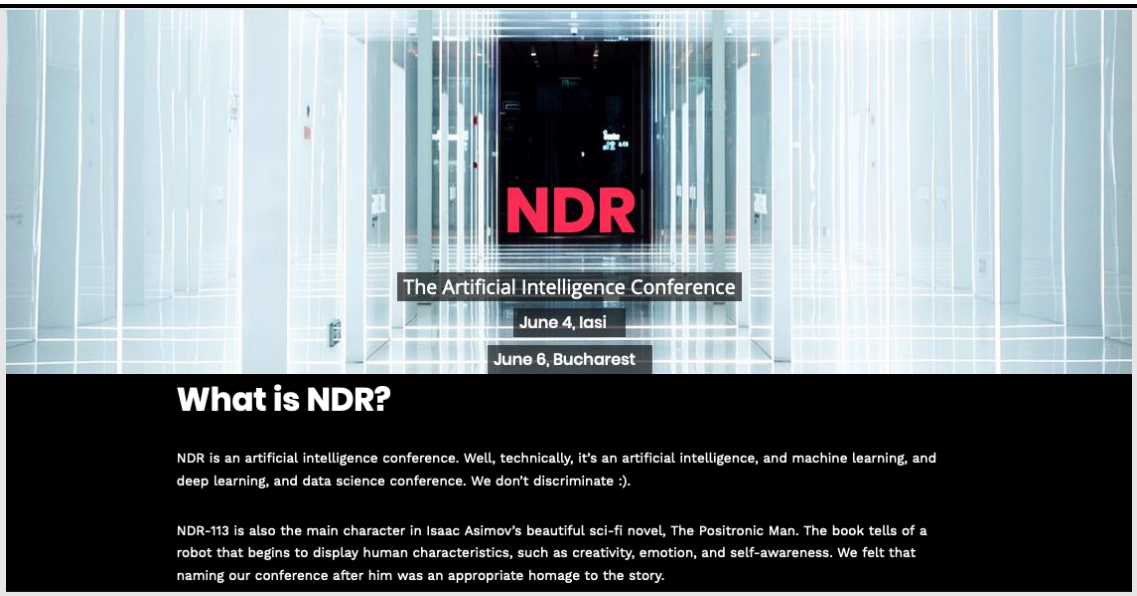
Support for innovation must come from the population

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.

Examples from DCC cities

Box 37 NDR – The Artificial Intelligence conference of the CEE (Iaşi)

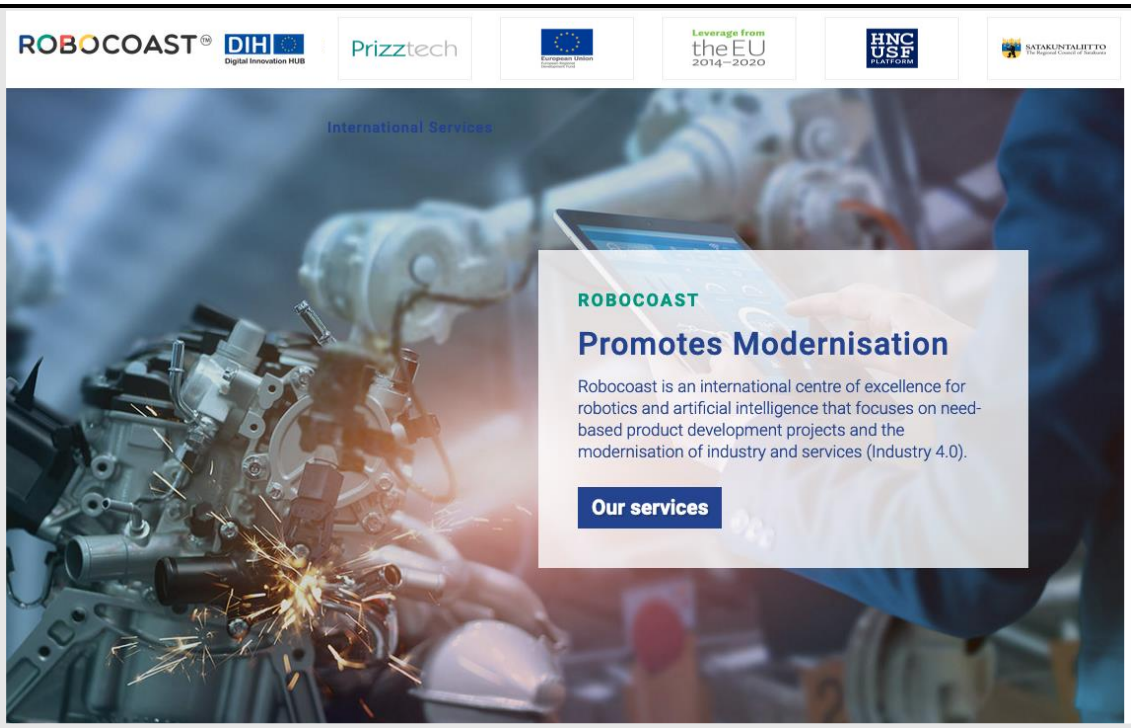


Source: https://ndrconf.ai

Artificial Intelligence is one of the technology fields that are already changing (and will continue to do that in an accelerated pace) the way we live and operate as individuals, businesses and societies. The need for a) every individual to have basic awareness, b) professionals to become experts, c) business and public institutions understand and invest when it comes to Artificial Intelligence represent a must for the time being and many years to come in order to achieve societal progress and economic business wealth, the need for proper education in this respect is mandatory.
What? Artificial Intelligence conference organised in Iaşi in 2018 with 500 participants - IT professionals, business owners, academia, students. The conference will continue in 2019 and the years to come with the aim to massively contribute to building in the region an AI capability recognised internationally. This has obviously a huge potential a) to generate economic growth for the local businesses, b) foster innovation which will eventually lead to more local Intellectual Property, products and startups / entrepreneurial initiatives, c) attract foreign investment into local services and products, d) create a solid foundation for a more intelligent city.

Source: DCC, Digital Tansformation Strategy for Iaşi (2019), https://ndrconf.ai

Box 38 City of Pori (Finland) and its Robotics and AI initiative



Source: https://robocoast.eu

Pori is a city and municipality on the west coast of Finland. With a population of 84,000, Pori is the 10th largest city in Finland, and the 7th largest urban area. Pori is also the capital of the Satakunta region (pop. 224,000). Its economy is characterized by a large number of manufacturing SMEs and a few mining conglomerates in the region. Western Finland ranks high in terms of education, knowledge economy and private sector innovation but is only average in economic performance. Pori is the location for a University of Applied Sciences, but lacks, other than Tampere only 120 km east of Pori, a notable basis for research and technological development. In 2014 the "Robocoast" was established (by the city of Ulvila) and since 2017 it has had DIF status (The cluster was one of the first DIH organisations in Finland). The aim is to strengthen the DIH status of the cluster and link artificial intelligence more strongly to this entity. Its mission is to increase the industrial competitiveness by providing modernisation services and RDI support for SMEs. Central to this objective are innovations with robotics and AI.
The Robocoast cluster includes companies both from robotics and automation sector. The growth of the cluster has been notable; in 2010-2018 the turnover (among the cluster organisations) has growth 97% and amount of personnel in turn 70%. In 2018 the turnover of the cluster was €0.5 billion.

In terms of the timing, the initiative came after other regions and cities in Finland had already established "Digital Innovation Hubs" in robotics and AI around Finland's leading universities and research centres.

In terms of its scope, Pori's initiative is targeted to "practical" solutions for the local, more than 100 SMEs with limited resources for large scale innovations. Given the situation, there was no model for any previous innovation initiative that Pori could copy from somewhere else.

Pori was successfully accepted for receiving support from the DCC project. As a result of the subsequent consultation, Pori amended and focused its strategy of the Robocoast Innovation Hub with, for example, the following components:

Box 39 City of Pori (Finland) and its Robotics and AI initiative (continued)

- In addition to *using* robots, companies were identified with a potential to *produce* robots (for new markets) which may have a wider positive effect for the local economy and employment;
- In order to extend consultation and technology transfer among regional SMEs, a recommendation was brought forward by the DCC experts to establish a Technology Transfer Centre for Robocoast which not only serves as "knowledge centre" to bundle and make available the experience of regional companies to others, but also as a location for events, training, networking, accommodation of start-ups and technology show rooms;
- The robotics department of the local University of Applied Science has the potential to be an integral partner of the initiative, for example by organising training courses in ROS, a standardised, general programming language for robots, and by helping with applying for further EU funding and connections with other European Innovation Hubs;
- With regards to Open Data, the city was advised of the potential value of public data beyond the geographical data which was already made available.
- Robocoast will build relationships with similar robotics/AI Innovation Hubs in Europe for exchanging experience, but also for teaming up for proposals for EU funding.
- The innovation cluster Robocoast was originally set up for a limited number of years; the city will look for ways to secure its sustainability thereafter.

The future of the Robotics cluster is depending on commitment of local cities and municipalities as well as other funding available. If the cluster will have DEP-DIH status in the next programme period, the funding is supported by EU and Finnish government.

7.3 Industry 4.0

7.3.1 Introduction

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 industries , 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 advancements , 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 roadmap 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 environment .

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.

7.3.2 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 others. 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 necessities intervention by city authorities and stakeholders in the planning, investment and uptake of new advanced digital technologies . 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 city . 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 needs .

Ensuring the effective engagement of SMEs

The lack of resources and capacities among SMEs is a challenge which requires efforts to ensure their effective engagement . 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 customers .

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 strategies . This requires measures and investment in innovative education systems and continuous learning activities on the part of industry and the public authorities alike.

Box 40 AS-Fabrik to boost the Industry 4.0 ecosystem (Bilbao)

Source: https://www.spri.eus/es/upeuskadi-comunicacion/start-ups/bilbao-as-fabrik-implica-a-12-empresas-y-12-profesionales-en-industria-4-0/

The example of AS-Fabrik, which has a basis 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 revitalize an old industrial harbour area of a city.[10] 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 "Connected Manufacturing" is the Swedish pilot initiative KickStart that involves 10 Swedish cities with the objective - through workshop activities - to bring together companies to increase understanding of how digitalisation can help them and to induce relationship building among companies with similar needs.[11]

7.4 Mobility

7.4.1 Introduction

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.

Box 41 Applications in mobility domains

The main tendencies in digital and smart mobility can be found within different mobility domains like:

- 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

[10] Patti, D. (2018). The role of Industry 4.0 in the creation of a new urban identity: The case of the AS FABRIK in Bilbao. Techplace online.

[11] https://urbact.eu/cities-and-digitalisation-adapt-or-die

- 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.

7.4.2 Recommendations

- **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.

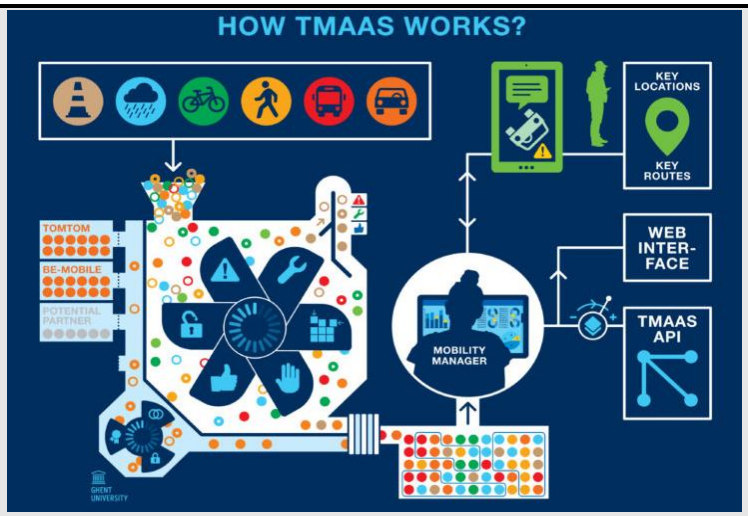
Step 2: Develop cost-effective solutions starting with knowledge of traveller behaviour

- Be aware that the solution is not necessary 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 [insert link].
- 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 automatisation, 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.

Box 42 Traffic Management as a Service (Ghent)



Source: https://drive.tmaas.eu/ghent

A lot of small and medium-sized cities around the world, like Ghent, want to get a grip on traffic and mobility. Building separate, traditional traffic management centres for all these cities is probably not the most feasible solution.

The Traffic Management as a Service (TMaaS) project will build a platform that offers 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. A key-aspect is transferability of data, taking into account safety, data licensing, privacy and data governance. Currently, the city of Ghent is testing this concept as part of the EU-funded TMaaS project. The goas is that other cities are able to use the concept and open software for their traffic management.

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.** One of most booming ride-sharing-platform is Uber. With Uber a new potential mobility solution entered cities but: user data was stored and possibly sold to third-parties for commercial goals (like personal advertisement, etc.). Besides that, a lot of discussions were also about the "work-circumstances" of the drivers and their (false) competition with taxi drivers who needed to have a license, respect certain driving hours, etc. Another example is the difficulty Maas-providers had, to integrate public transport in their application: for a long time, public transport authorities did not allow third parties to resell their tickets or give an exclusive right to one MaaS-provider to sell their tickets.

Privacy and security

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

Box 43 Main strategies related to mobility

Governance and urban planning, normative framework to use innovation in order to generate competitiveness:
- Implementing policies which promote citizen participation, sustainable consumption and production.
- Defining land uses.
- Generating incentives to produce and purchase non-polluting vehicles.
- Encouraging international cooperation.

Inclusive City to create accessible and integrated cities through:
- Urban transport planning.
- Effective use of public space.
- Promotion of shared and collaborative mobility

Mobility in line with climate change o mitigate the impact of mobility on cities:
- Diminishing air pollution.
- Promoting alternative energies.
- Improving citizen commitment to the environment.
- Implementing vehicular emissions control.

Health and security, to reduce the impact of mobility on citizens' health:
- Reducing noise pollution.

Source: Urban Mobility congress in Bilbao (2019)

Box 44 Example Connected driving (Eindhoven/Helmond)

In Brainport Eindhoven different methods are used to test C-ITS and traffic systems.

Source: https://www.drivenbyhelmond.nl/business-portal/helmond-living-lab

Because of its highly advanced infrastructure, dense traffic network, real-time traffic management and high 4G penetration rate the region is ideally suited for developing, testing and implementing smart mobility applications. That is why the world's first shockwave reduction project (applying car2x communication in 'normal' traffic) was introduced on a major public highway near the city of Eindhoven. This highway is equipped with cooperative roadside units. Besides this government regulation concerning testing cooperative and connected driving offers a lot of room for testing.

Box 45 Talking traffic for cyclists

Source: https://www.talking-traffic.com

Box 46Talking traffic for cyclists (continued)

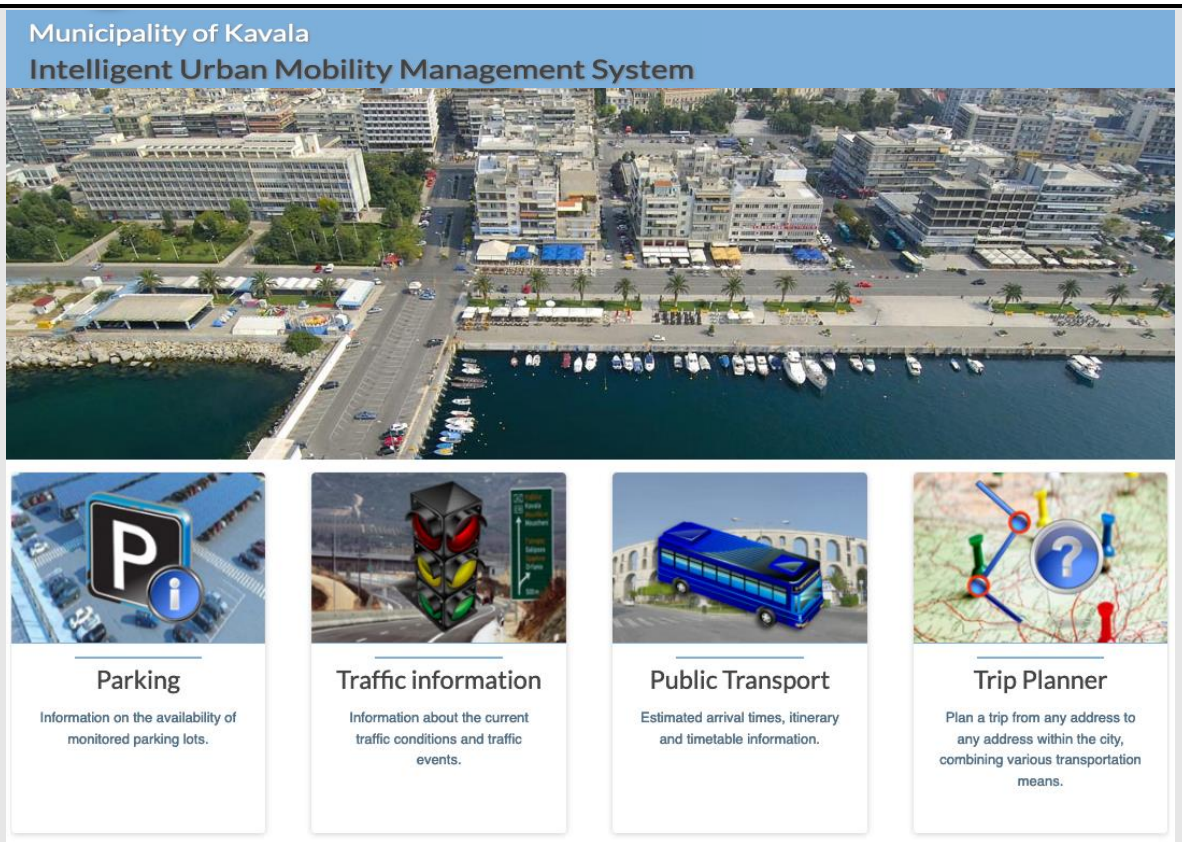
Within the Dutch Talking traffic project, a couple of applications are made in relation to Cooperative ITS or smart traffic lights

Green wave extension: The cyclists have an application that can communicate with the traffic lights. When the system detects a group of several cyclists, this group can get priority over other traffic. The traffic light switches from red to green sooner for the group or remains green for a bit longer.

Own green wave: your phone or another device, such as the smart bicycle bell (the halo) will receive a recommended speed to get to the next green light. The technique also allows you to select a parking space before you leave. You will see exactly where your bike will be parked safely and receive information about the opening hours and possible rates of the bicycle parking.

Examples from DCC cities

Box 47 Intelligent Transport System (Kavala)



Source: http://transport.kavala.gov.gr

ITS of Kavala, is a project included in the "Sustainable City" policy sector of Kavala's Operational Programme (KOP) 2015-2019, which has been implemented by SWARCO Hellas SA (created by the merger of former Signalbau Huber Hellas and Infotrip), while the web/mobile applications are hosted at and offered by the infrastructure of TEI-EAM.

Box 48 Intelligent Transport System (Kavala) continued

Traffic load is captured by detectors spread over the road network of the city. Through Wireless GPRS connections all the captured information is sent to the platform of the system installed at the IT infrastructure of Municipality of Kavala and, after processing, real-time traffic and parking information is then announced to drivers through Variable Message Signs (VMSs) with traffic condition messages and LED signs for parking lots availability. Transport/parking information is also available through the user-friendly web site of the system and is openly offered by APIs to stakeholders for further analysis and development of applications.

Improvements in the field of smart mobility are occurring rapidly and have positive effects on traffic flow and safety, on accessibility for people with special needs as well as on the possibility of having vehicles operate more economically and cleaner.

Intelligent Transport Systems (ITS) can provide road users with updated information and forecasts on traffic conditions, arrival times of public buses and availability of parking lots. In addition, they facilitate Information accuracy and decision-making speed in managing today's mobility of goods and people inside the city.

Having the real time, transport data open and freely available through APIs also enables the tech community and entrepreneurs to offer improved, smart mobility services and decision makers and academic researchers to draw conclusions and propose solutions to local government, in the framework of sustainable urban mobility policy of the city.ITS infrastructure consists of the Bluetooth and radar traffic load detectors and the parking lots monitoring devices, which communicate through Wireless GPRS connections with the Integrated information management platform of the system that provides:

- dynamic and real-time information to drivers about available parking spaces in six (6) municipal parking places (with the possibility to expand in the future to even more) via the two (2) informational LED signs,

- dynamic information of drivers regarding the current traffic conditions on the main streets of Kavala center via four (4) VMS and traffic counting stations,

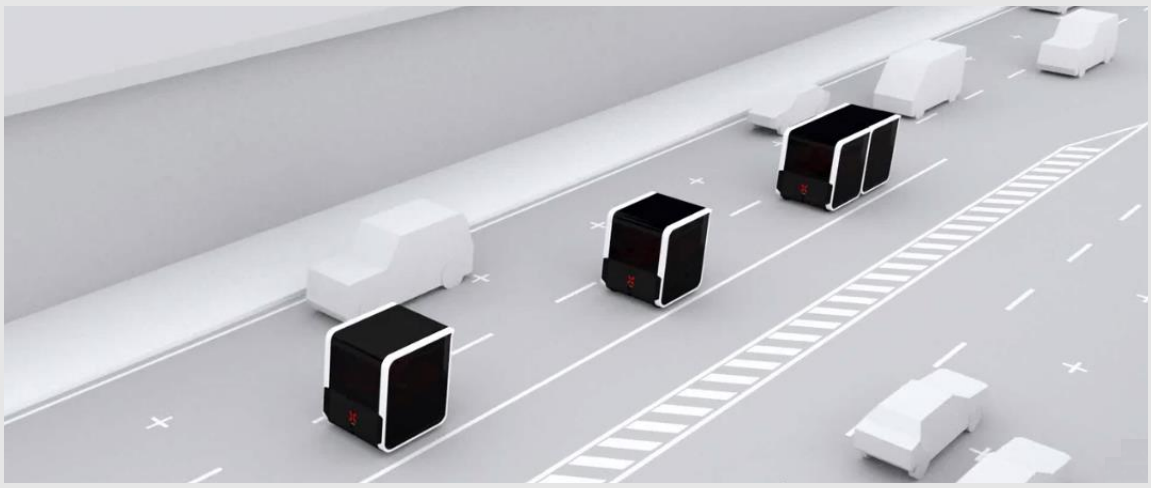
- real-time information to the citizens and tourists via a web/mobile portal and an SMS application regarding the current traffic conditions on the streets of Kavala, the available spaces on the monitored parking lots, the arrival times of public buses to bus stops and a multimodal routing application.

The ITS of Kavala improves the quality of citizens' everyday life and visitors' experience (in agreement with the principles of sustainable, urban mobility) by raising the level of awareness, but also by improving the quality of information to citizens/drivers on the prevailing traffic conditions and the availability of parking lots in real time, by reducing the congestion through the provision of timely information to drivers about alternative routes and facilitating the usage of public transport.

Furthermore, the acquired, freely available, real-time data on traffic issues (travel time, parking spaces, arrival times of buses etc.) enable both the local government to take smart decisions on city's mobility strategy and tech community/industry to offer improved, smart mobility services and solutions.

Source: DCC, Digital Transformation Strategy for Kavala (2019)

Box 49 Smart public mobility (Padua)



Source: https://www.next-future-mobility.com

The 'Smart public mobility' initiative of the city of Padua is a modular smart form of transportation that keeps together the service mobility for a large number of people and the singular needs to reach a specific destination. Six modules are connected that create a unique bus that brings more than one hundred people. Passengers can walk through the bus and can eat food and drink beverages that are served inside the bus. During the trip, one or more modules can break away in order to get different destinations and then unite again at the final one. Each module has a pilot, but the system is ready for autonomous driving, when the laws will allow it. The autonomous driving modules will be tested soon in a private area in Padua.

The main challenge to launch this initiative was related to financial and trust-based reasons. Unfortunately, in Italy some of the large investors are not willing to risk, even "small/medium" amount of money. They want an immediate high percentage of "fast-return-of-investment" and, unfortunately, some past bad experiences in public management confirm their behaviour. Luckily, some big cities (Milan on the top) overcome this problem and now is offering many solutions for the construction of public infrastructure for a modern smart city. Other cities, like Padua, are following Milan and the overall situation is improving. Padua shows a different and open-minded behaviour which is supporting networks, procedures and improvements.

The solution is network-based, in the sense that basically the effort of the City was to meet and keep together professionals, academics and other different people/entities. Basically, that was the solution that guaranteed the efficiency and value of the whole process. The City is near the signature of a common agreement, in which some partners will "venture" own money, and together will apply for other (and indispensable) external funds in order to support the business in the first 2-3 year; according to the overall business plan, after 2/3 years the system will become sustainable by itself.

Source: DCC, Padua (2019)

7.5 Tourism

7.5.1 Introduction

Tourism was one of the first sectors in which business processes were digitalised on a global scale, since online 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 environment.

7.5.2 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 UNWTO) 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 accommodation. 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 levels .

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-making.

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 exploitation . 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.

Box 50 Taüll 1123 (Catalonia)

Regarding this premise, the project **Taüll 1123** is an interesting example. This project invites tourists to take a trip back in time, go back almost 900 years of history and live for a moment the life of a Romanesque church in the Valley of Boí, Catalonia. In this case, it is an integral action in a building of a religious nature, in a good state of structural conservation, which, together with other churches in the same valley, was declared a UNESCO heritage site in 2000. All the 9 churches built in the X-XII century in the same "Romanesque" artistic style present a monumental ensemble unique in the world and an important medieval testimony of Europe. The project was developed during 2013 by a multidisciplinary team and the project was based on an in-depth study of the original Romanesque paintings located in the museum. This museum was later restored, reconstructed and animated with various digital tools. The result is a spherical multimedia projection that visually reconstructs the pictorial set in its original place and allows to understand the pictorial technique of the Romanesque frescoes. It is an immersive experience, experienced through sensations, in which music and specific sound effects take great importance, transporting visitors to the historical moment in which the work was created.

The project was awarded by the prestigious Museums and the Web Congress, as "the Best Virtual Recovery Multimedia Project" and also nominated for the European "Museum + Heritage Awards for Excellence" awards. Due to this action, according to the monitoring data the number of visitors has been increased considerably in the last years.

Source: http://pantocrator.cat/en/projectes

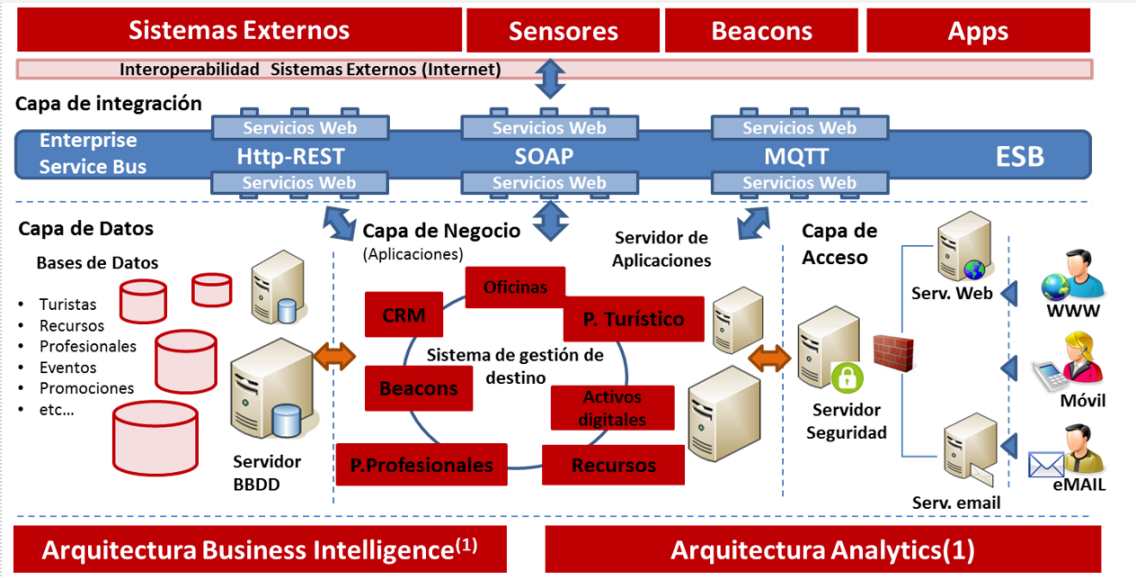
Box 51 Artistic residence (La Palma)

Another interesting example is the artistic residence developed in La Palma, a small island located in the Canaries with a population of 80K and recent history (1494) comparing with other European cities. **The main tourist offer of this beautiful place is the outdoor activities, specially the astronomic observation**. The artistic Residence in La Palma, was based on the fusion of art and technology, which main goal were to attract creative talents and tourist to the island. The city launched an international open call looking for artists to stay one month in the Astronomical Observatory of Roque de los Muchachos, where the world's largest optical telescope is located, and create a piece of art representing the technology of the place and the landscape of the island. As a result, more than 150 projects from all parts of the world were submitted, being the Australian artist Jessie Hughes who develop the piece "soul of sol La Palma". During one month, the artist was using the most advanced systems in astronomical observation for analysing and interpreting the millions of data that were being generated in the universe during her sojourn. Working close with the scientists and the Institute of Astrophysics Canary Islands (IAC), the artist explored the data that had been generated from the Sun and designed an artwork inspired by the sky of La Palma. **This project took part to the cultural tourist offer that the island had designed.**

Source: https://technarte.org/en/arte-y-tecnologia-para-crear-una-obra-en-directa-conexion-con-la-ciencia-de-la-astronomia

Examples from DCC cities

Box 52 Smart Costa Blanca (Alicante)



Source: https://www.red.es/redes/es/page/smart-costa-blanca

The "Smart Costa Blanca" project, which aims to transform the province of Alicante into an intelligent tourist destination, will receive €1.6 million from European funds, 60% of the investment planned for this initiative which contemplates, among other proposals, an intensive use of Information and Communication Technologies, the reuse of public data and the implementation of management systems, and information processing.

The initiative's objective is to promote the province's touristic offer and consolidate it with the Costa Blanca as one of the main holiday destinations of the region. Tourism is considered by the province as an economic engine, to source additional employment opportunities and generate income, while ensuring that tourist will become loyal to this destination.

The administration is also seeking to promote interoperability with different agents, as well as promoting transparent and universal access to public data services by citizens, visitors, professionals, and companies.

The Smart Costa Blanca initiative includes a digital asset management system, that creates databases with tourist information, photos and videos. Additionally, the system creates a module for the management of beacons and sensors in strategic elements such as the MARQ, as well as intelligent signalling on the highway leading to the city. The project is also seeking to implement initiatives based on the control of intelligent traffic control, such as parking push notifications on mobile phones.

Source: DCC, Alicante (2019)

Box 53 Digital Transformation2LB (Guimarães)

Source: https://www.guimaraesturismo.com

Guimarães is known for being the birthplace of the Portuguese nation. Here are important values-symbol of nationality, reason why the tourist vocation from the beginning was felt. However, it was essentially in the last two decades, particularly after the recognition of its historic centre as a UNESCO world heritage site that this vocation has developed more. The sector as a whole aggregates housing, catering and others, being responsible (2017) for a GVA of €31.2 million and the employment of 2.914 people.

Specifically, in the subsector of the accommodation, this generates a turnover of €14.8 million, with 39 establishments and a capacity corresponding to 2.289 beds. The main challenges posed to the sector are to keep intact the historical and cultural heritage that supports it, not to exceed the associated load capacity and raise some indicators, namely the current average stay per tourist (1.7 nights). Digital plays a key role here in being able to put Guimarães in a network with the main European (and worldwide) tourist centres, in the "quiet transformation" of the city and its capacity as a marketing tool.

The initiative seeks to tap into the potential of open innovation and use digital technologies as a driver for the tourism sector, innovation and local businesses as the key factors for digital transformation.

By tapping into the potential of open innovation, the city is moving towards addressing issues related to smart innovation by creating an open data framework and space to experiment innovation and digital transformation, providing tourism data to local businesses that want to optimise or implement innovative projects.

Secondly, by using digital technologies as a driver for the tourism sector innovation, the city intends to enable local businesses to better understand new opportunities that are offered by the digital revolution. The initiative raises awareness of local business managers on digital technologies. Technologies identified to deliver data to local businesses include big data, mobile tech, cloud computing, and the Internet of Things in tourism. Analysis of big data offers possibilities to predict and reflect behaviour and preferences of tourists. Moreover, mobile technologies are the preferred channel for tourist services.

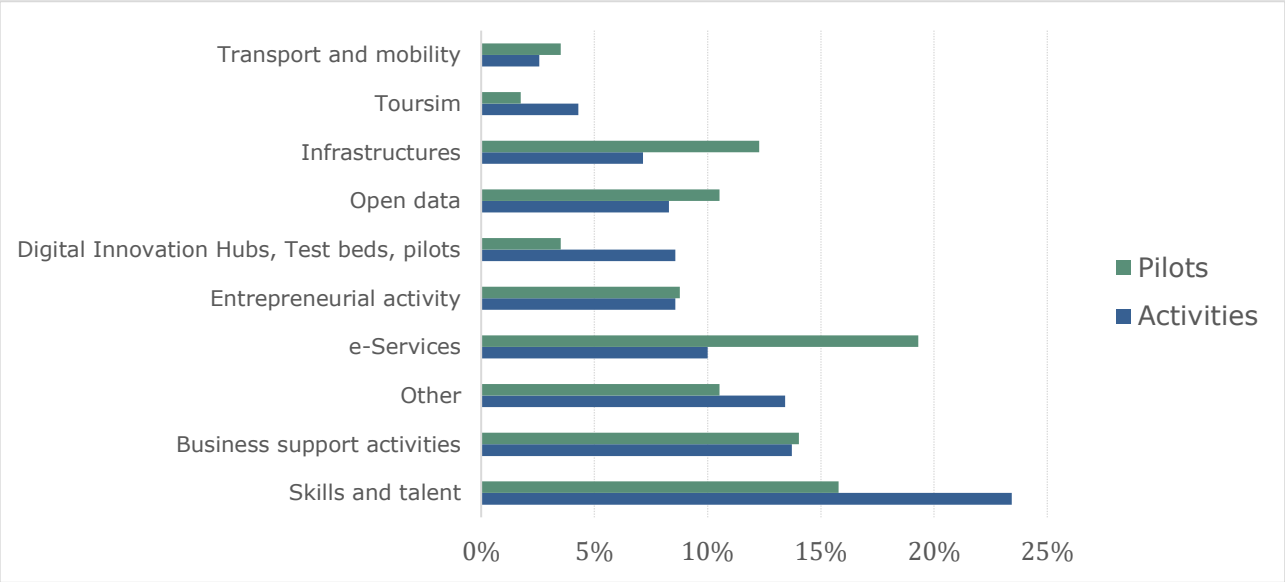
Source: DCC, Digital Transformation Strategy for Guimarães (2019), https://www.guimaraesturismo.com

8 FUTURE SYNERGIES

8.1 Shared activities and focus areas – potential cross-city collaborations

Focus areas such as skills and talent, business support activities, e-Services, entrepreneurial activities, Digital Innovation Hubs, open data and infrastructure are at the core of cities' digital transformation endeavours. Figure 29 sketches out the share of activities and pilot activities per focus area based on the DCC Strategy Reports, revealing potential synergies between cities of the DCC network.

Figure 29 Share of DCC cities' activities and pilots per focus area



Source: Digital Cities Challenge, 2019

When scoping the concrete activities within each focus area, a number of commonalities were found. Within the **skills and talent focus area**, there are in particular two main groupings of cities:

- The first group (Alcoy, Algeciras, Arad, Guimarães, L'Aquila, Thessaloniki, Ventspils, among others) share a focus on the design of ICT/digital training and courses/studies. The cities either seek to facilitate a digital upskilling of citizens or to boost digital skills for specific target segments such as entrepreneurs or SMEs.
- A second grouping (Iaşi, Kavala, Patras and Rijeka) seeks to provide some type of online platform as a tool for collaborative learning and with access to open ICT/digital courses. The platforms are generally oriented towards stimulating citizens' awareness of and interest in ICT, as well as promoting IT skills. A limited number of cities (Alcoy and Algeciras) are also focussing on mapping either existing or needed digital competences at city level.

Turning to **business- and entrepreneurship-related focus areas**, the mapping of activities reveals two main types of city groups:

- Incubation and funding activities: Several cities (Algeciras, Grand-Orly Seine Bièvre, Guimarães, L'Aquila and Pori) aim to design and set up or scale up existing incubation- and funding-related initiatives. The design of incubation/funding initiatives are primarily geared towards providing startups and SMEs with digital and ICT-related support and mentoring. The underlying financing approaches tend to be based on venture capital, equity or loans.

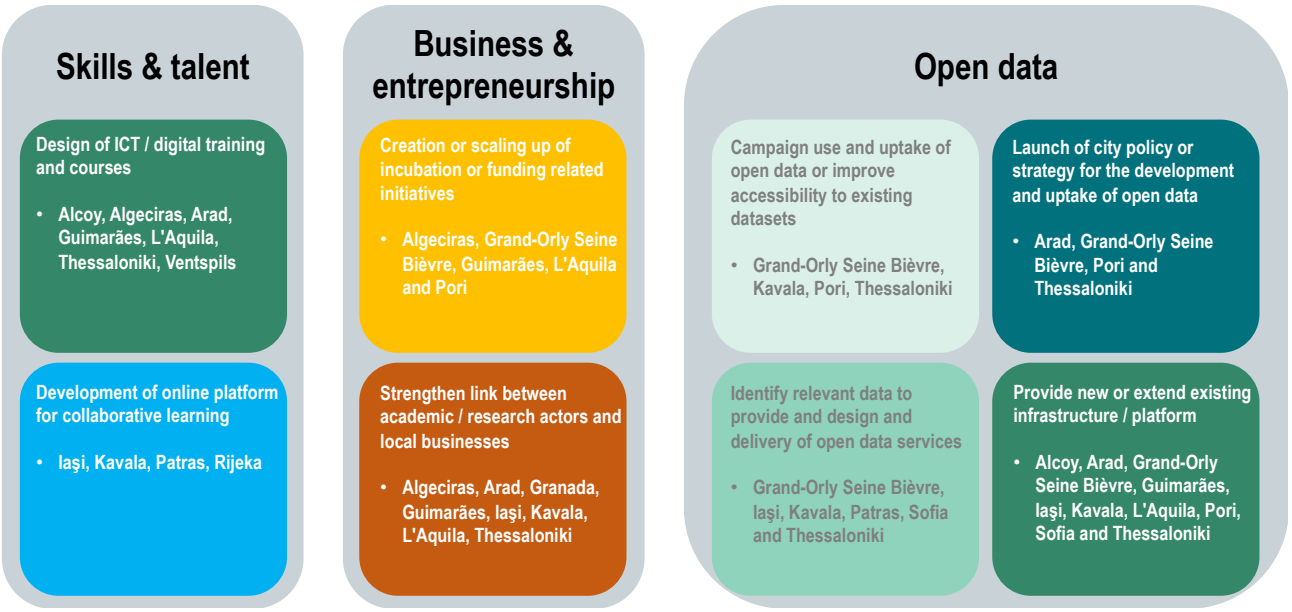
- Linking research and business: A considerable share of cities pursue initiatives that strengthen linkages between research actors and local companies. The proposed activities' sectoral focus is wide ranging, from traditional and less digitally matured industry sectors to sectors with a high level of digital engagement. Sectors covered include tourism, culture, wellness, agriculture, construction, retail and transportation. Such initiatives take a variety of forms:
  - Supporting knowledge exchange programmes or networking activities between research centres and enterprises (Granada, Guimarães and Kavala)
  - Promoting access for university students to engage with local companies on thesis writing or employment (Arad, L'Aquila and Thessaloniki)
  - Developing city or industry strategies, or creating digital strategy departments, to promote collaborative innovation projects involving research organisations and businesses (Algeciras, Arad and Granada)
  - Setting up local expert groups, comprising academic and business representatives, to identify digital solutions relevant for cities' needs (Arad and Iaşi).

In the open data focus area, a significant share of cities develop support measures to collect, exploit and spread **open data** among city stakeholders. The cities mainly perceive open data as a tool to improve planning and decision-making, foster R&D development and support companies in creating and delivering new services. The cities' efforts to push forward open data rests on several aspirations that demonstrate both the differences among cities but also common ground for alignment. The open data efforts are concentrated around initiatives that seek to:

- campaign on the use and uptake of open data (Grand-Orly Seine Bièvre, Kavala, Pori and Thessaloniki);
- identify relevant data and datasets to provide (Grand-Orly Seine Bièvre and Iaşi);
- launch a policy or strategy for the development and uptake of open data (Arad, Grand-Orly Seine Bièvre, Pori and Thessaloniki);
- improve accessibility to existing city datasets (Rijeka and Thessaloniki);
- provide new or extend existing infrastructure/platform for open data (Alcoy, Arad, Grand-Orly Seine Bièvre, Guimarães, Iaşi, Kavala, L'Aquila, Pori, Sofia and Thessaloniki); and
- Design and deliver open data services, such as datasets and maps (Iaşi, Kavala, Patras, Sofia and Thessaloniki).

On this background, the following **main potential areas for cross-city collaboration**, which have a base in identified commonalities among DCC Strategy Reports, have been outlined in Figure 30.

Figure 30 Synergies per focus area



Source: Digital Cities Challenge, 2019

Having sketched out the main potential areas for city-collaboration, it is worthwhile outlining the impact of the DCC network on improving **participating cities' interest in and ability** to set up and pursue cross-city cooperation.

As portrayed in Figure 31, DCC participation has for the majority of cities either motivated a **search for further cooperation opportunities** or induced cities to **actively look for collaboration** with other cities. Together with the synergies and commonalities identified above, the willingness to pursue collaboration provides the basis for concrete cross-city collaboration to be realised.

Figure 31 DCC cities willingness to pursue cross-city collaboration

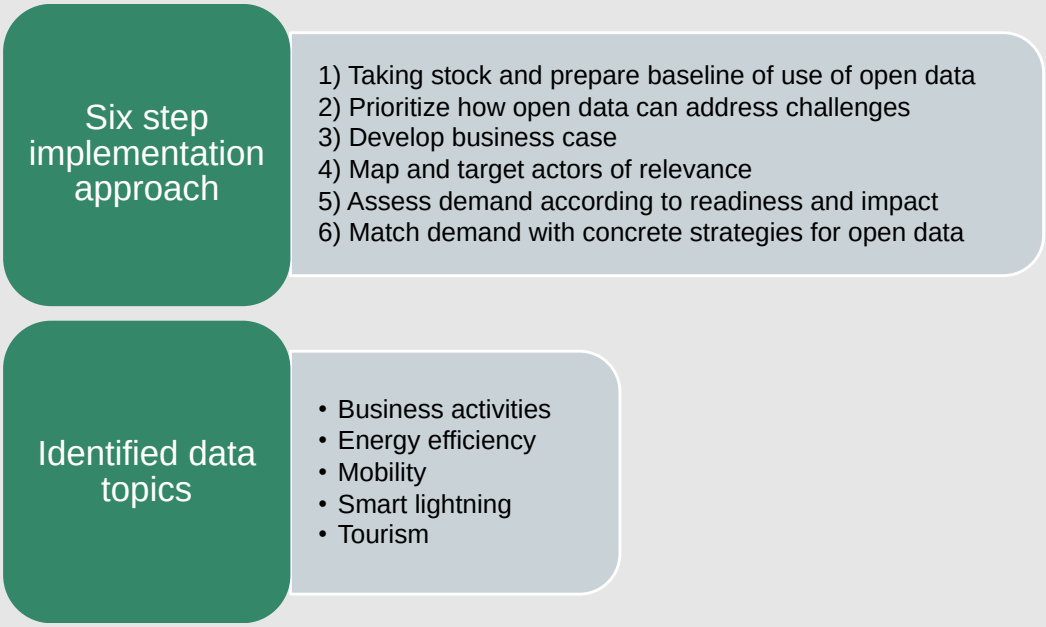
Source: Digital Cities Challenge, 2019

According to the survey, DCC cities emphasises a broad perspective on possible common activities, plans or thematic areas for collaboration as well as highlight the importance of funding as a lever to enable cross-city collaboration. In addition to the possible thematic areas for cooperation as already identified on the basis of the DCC Strategy Reports, the cities underline specifically an interest to pursue cross city collaboration in such areas as transferring entrepreneurship know-how to startups, designing sustainable urban digital transformation strategies, promoting energy efficiency and developing a common open data platform.

The later venue for collaboration has already induced a group of DCC cities to set up an open data working group with an eye to identify possible areas of cooperation and to develop an open data piloting initiative (see pilot initiative example below).

Box 54 Pilot initiative example – open data cross-city collaboration

On the basis of the first Academy Seminar in Brussels, interest in open data was triggered among participating DCC cities, inspired by the presentations on open data practices in Amsterdam and Espoo. Accordingly, open data was identified as an area of shared interest among several DCC cities. During the 5th Academy Seminar's open data peer group meeting, concrete ideas for city collaboration developed and a group of cities accordingly took an active role in promoting collaboration and exchanges on open data topics. At this seminar, possible cross-city collaboration opportunities were developed – such as collaboration models based on joint data identification to identify relevant datasets and the sharing of best practices, including support in accessing successful strategies, methods and tools.



A working group was set up – on a voluntary basis and open to all interested cities – as a platform for further conversation and cooperation as well as to explore opportunities for an open data pilot project. It is expected to be oriented towards a limited set of topics and on the transfer of experience and knowledge between mentor cities and interested Challenge and Fellow cities. Concretely, the project seeks to develop a business case for relevant open data topics at city-level, design an organisational and operational model for the management of open data activities and to test the business case and operational model through a pilot based on open source and open data software and tools.

The data working group's first face-to-face meeting took place in the margins of the DCC Final Conference in early June to discuss the demand-side case of open data, data topics and services for potential collaboration, and the piloting of an open data initiative. For the process, a six step approach[12] was discussed as a starting point: 1) taking stock of and preparing a baseline for the supply, use and impact of open data at city level; 2) prioritise how open data could address selected challenges; 3) development of a business case; 4) mapping and targeting actors of relevance for prioritised questions; 5) assessing demand according to readiness and impact (i.e. which stakeholders would most effectively use the open datasets; and 6) match demand through strategies to provide open data, engage stakeholders, leverage data to answer key questions, and create new public value. The group also saw the relevance of aligning with the Commission's forthcoming Open Data Directive and High Value Datasets.

[12] Tait, J. (2019) Developing an open data strategy, Open data working group, 6th June 2019

Box 55 Pilot initiative example – open data cross-city collaboration (continued)

Based on the meeting, the data topics identified as most relevant include mobility, tourism and business activities, showing some alignment among the cohort of cities. A lead group of participants will take a coordinating role to develop a shared vision and approach for the implementation of an open data pilot initiative, for which there are a few possible options. One way forward concerns the possibility to formulate a joint proposal for the CEF call with a concrete open data initiative; another approach would focus efforts on further assessment of data needs, sharing of information and identification of business cases, with the aim of developing a project around a common area of interest.

As noted by one of the representatives of so-called Mentor cities: "It is important to lower the barriers for contact between business and public actors – public procurement is not the only channel for cooperation" (Espoo – city). As put by a city representative of another participating city: "The culture of cooperation between the city's stakeholders was missing. The challenge was to set up a policy framework to facilitate cooperation and this was largely provided by the DCC initiative" (Patras – city).

European Commission

City Digital Transformation

Leveraging advanced digital technologies for growth and competitiveness at the local level

A step by step handbook for city digital transformation developed in the framework of the European Commission's Digital Cities Challenge

Contents

00

Foreword

According to recent data, 72% of the EU's population lives in cities, towns and suburbs, while generating 85% of its GDP. This makes cities the engines of the continent's economy. However, cities also face multiple, interconnected challenges, including energy and climate change, employment, migration, social inequality, and water, air and soil pollution.

Through advanced digital technologies, Europe has the opportunity to re-invent the way we manage our cities' development and respond to the key societal challenges, such as efficient health management, cleaner environment, green mobility, and offering great-value jobs. Due to their high density, cities are in an ideal position to create innovative ecosystems made up of a wide array of different stakeholders from government, industry, finance, academia, communitarian organisations, social partners, etc. Cities have the capacity to make policies become reality.

The Digital Cities Challenges has been launched to help cities reap the benefits of advanced digital technologies, and drive growth and competitiveness. The work conducted alongside a selected group of EU cities has already begun yielding very positive results, which we hope to multiply and disseminate through channels such as this handbook.

The Digital Cities Challenge is only the beginning of a continued European commitment to continue supporting our cities provide better and more sustainable living conditions for our citizens.

01

Overview of the Digital Cities Challenge

The Digital Cities Challenge, an initiative of the European Commission, helps to achieve sustainable economic growth in cities through the integration of advanced technologies. The initiative fosters complementarities and synergies between existing policies involving digital priorities (e.g. smart specialisation, digital city, e-government) and the newly planned policy actions supporting digital transformation.

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, workers, and entrepreneurs. Through hands-on first-class policy advice, coaching, networking and peer support, a group of cities in Europe benefitted from the opportunity to capture the benefits of digital transformation. Specific objectives of the initiative include:

- Helping European cities to improve the quality of life of their citizens
- Putting advanced technologies at the service of the citizens
- Transforming production and services to boost productivity and create growth
- Creating and attract talents and entrepreneurs
- Driving investments in critical infrastructures, technologies, open data.

When 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 five individual steps, each of which is presented in this handbook. Cities wishing to embark on a similar digital transformation journey can use this handbook as a reference point to organise and implement their digital transformation strategy development process.

The handbook contains useful tips and advice, as well as examples of real-life cases drawn from participating Digital Challenge Cities. The tools and guidelines associated to each step can be found on the project's website at: https://www.digitallytransformyourregion.eu/.

Each participating city appointed an internal Digital Challenge team in charge of overseeing the implementation fo the digital transformation trajectory. The team was usually headed by a staff member from the digital or economic development unit, supported by a local elected representative. In many cases, cities also involved a representative from the private sector to join the management of the roll-out of the digital transformation trajectory.

02

0 Preparation

- Prepare the City and the expert team for the provision of advisory services

1 Digital vision & ambition

- Determine city's current digital maturity level based on
  - Self-assessment tool
  - Ongoing digital initiatives
- Define a common vision and ambition for city's digital transformation and industrial modernisation
- Create network of relevant stakeholders to be involved in digital transformation

2 Strategy

- Develop a strategy for digital transformation and industrial modernisation based on
  - Vision and ambition definition
  - Existing policy strategies
- Embed the strategy among all stakeholders of the network

3 Roadmap

- Develop a detailed roadmap for the implementation of the strategy
- Subdivide strategy into project tasks and define priorities
- Define the governance and strategic steering of the strategy
- Identify potential funding streams for the implementation of priority projects

4 Monitoring & implementation

- Identify customised performance indicators
- Monitor the progress of strategy implementation

03

Step 0: Preparation

The preparatory phase aims at setting the basis for the Digital Transformation Trajectory to take place within the city. It's mean to ensure the adequate management structure is in place, as well as to ensure the 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.

A full and detailed methodological handbook has been developed for cities joining the Digital Cities Challenge. It includes a suggested timeline, as well as detailed instructions for each of the steps implemented as part of the trajectory. The handbook is publicly available here: XXXX.

Key activities

- Setting up the Digital City leadership team responsible for overseeing the delivery of the entire Digital Transformation Process. This team should be relatively small, but representative of the main actors and units which will be eventually responsible for overseeing the development and implementation of the Strategy.
- Map key digital stakeholders in the city and begin engaging with them on the basis of the Digital Transformation Strategy Development Plan.
- Begin collection of background data and reports on the state of digital maturity in the city.

DCC academy seminar working session by the city team of Thessaloniki

All systems go!

Your city will be ready to embark on the Digital Transformation Trajectory when:

- Clear political support has been identified and articulated for the city to go downthe path of Digital Transformation
- A team has been appointed internally to oversee the design and implementation of the Digital Transformation Strategy
- You have become acquainted with the methodology and tools of the Digital Cities Challenge
- You have mapped key stakeholders in the eco-system and begun tailoring a pitch to bring them on board
- You have collected and identified sources of information and data on the state of the city's digital maturity

Ensuring early buy in for the digital transformation process from key stakeholder groups in your city is a key determinant for success. Ensure your digital leadership team takes the time to reach out to these stakeholders and clear explain the purpose of the exercise. A clear pitch should be developed as well as a value proposition for each stakeholder group.

Our cities said

" The added value of the DCC for cities is the methodology, the network and of course the fact that they are able to formulate a strategy which previously had gone unformulated"

04

Step 1: Digital vision & ambition

During the first step you should diagnose the level of digital maturity of your city, allowing you to identify the starting points for discussion for the strategy development. This should lead you to collectively define a long-term digital transformation vision for your city, acting as your 'point on the horizon' as you embark on the digital transformation journey.

Key activities

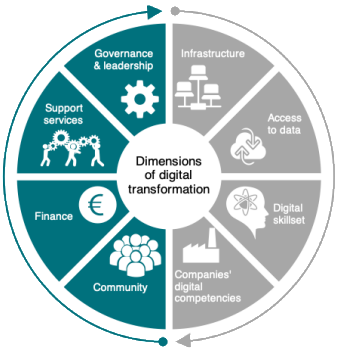
- Implement the Digital City Self Assessment Tool & collect information on Digital Key Performance Indicators
- Interact with key digital community stakeholders to collect their perceptions on existing bottlenecks and what direction the city should move in.
- Raise awareness on the Digital Transformation Strategy at the local level
- Develop a full assessment report presenting the insights gathered through the SAT and your interactions with the local stakeholder community.
- Collectively define a common vision and ambition statement for digital transformation i.e. the long term change you wish to achieve.

Using the Self Assessment Tool & Key Performance Indicators

The SAT is an online tool that will help you determine the digital maturity of your city and identify issues and points to address in your digital transformation strategy. The tool takes 20 minutes to complete.

The respondent group can include all stakeholders playing an important role in the digital ecosystem of the city e.g. utility companies, industry representation, education and research and the financial sector. Once the SAT implementation is complete, a self-generated report can be downloaded from the system which will include information on the level of digital maturity for 8 different dimensions. It also allows for cross-city comparison.

8 dimensions of the Self Assessment Tool



Examples of Digital Vision and Ambition statements (AS) from the Digital Cities Challenge

Sofia, AS1: "To enable most companies in the ICT business ecosystem of Sofia to engage in the digital transformation of the city by developing and offering innovative products and e-services"

Aquila, AS1: "Attracting external companies to design and develop products and services using existing digital infrastructures"

Thessaloniki, AS1: "Thessaloniki to support the digitalisation of companies focusing on activities that are critical to the local economy (e.g. tourism, ICT, wholesale and retail, transport and logistics)"

04

Step 2: Strategy

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

Key activities

- Develop of two or three strategy scenarios (i.e. different alternatives) to be discussed and explored with local stakeholders. Each scenario is built on a different assumption or priority. For instance, in one scenario you may decide to focus primarily on building skills, while in an other, you may want to focus primarily on infrastructure. Priority sectors (e.g. ICT, transport, retail) may also be used to define different scenarios.
- Organise local workshops to present the different strategy scenarios and select one scenario to develop your strategy upon.
- Identify the operational objectives to support the implementation of your strategy (a maximum of 6). Operational objectives reflect the means to achieve ambition statements. They are called operational because they are of an actionable nature.
- Operational objectives should be selected on the basis of their potential for impact and their feasibility.

DCC city representatives and lead experts during a DCC academy seminar

Should your strategy be linked to other existing local strategies?

Your digital transformation strategy should be explicitly linked to existing policy strategies of your city or region. For this reason, it is very important for you to clearly articulate how your digital transformation strategy differs from existing strategies, and what additional value it provides. You may want to explicitly link the digital transformation strategy to other strategies, by including activities foreseen elsewhere, into the digital transformation strategy. Overlapping is not necessarily a bad thing, as long as there this generates a leverage effect on both sides. For instance, if your region's Smart Specialisation Strategy includes a digital component, make sure you include it in your digital transformation strategy.
The newly developed DCC strategies are linked to other existing strategies but propose a different angle to digitalisation with a focus on the economic development and the cities' competitiveness.

Strategies should identify potential sources of funding for the different activities they plan to implement. As part of the DCC, a range of potential external funding sources have been identified which include: INTERREG programmes, the Smart Specialisation Platform, Urban Investment Advisory Support (URBIS), ERASMUS+, Horizon 2020, Marie Curie actions, Wifi4EU, European Investment Fund, European Fund for Strategic Investment, European Structural and Investment Funds, and Public-Private Partenerships.

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Step 3: Roadmap

The Roadmap is 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 the identification of priority activities to be implemented in order to fulfil strategic objectives. Priority activities represent the specific actions through which the strategy will be implemented. An activity can be described as a tangible and concrete action, which has a beginning and an end, accompanied by a specific objective and resources for its implementation. During this step, you are also encourage to define the governance framework for the implementation of your strategy, as well as identify potential funding streams for your strategy.

Key tasks

- Develop a long-list of potential activities to be implemented as part of your strategy, in accordance with your operational objectives. This may include on-going activities, as well as new initiatives which are yet to be implemented. An activity can be described as a tangible and concrete action, which has a beginning and an end, accompanied by a specific objective and resources for its implementation
- Organise a workshop with your local stakeholder community in order to identify you action plan and investment priorities. Selection of activities can be done on the basis of: cost, potential for immediate implementation, feasibility, and relevance.
- Organise a workshop with your local stakeholder community in order to define the governance and steering scheme for your strategy.
- Define a pilot activity.

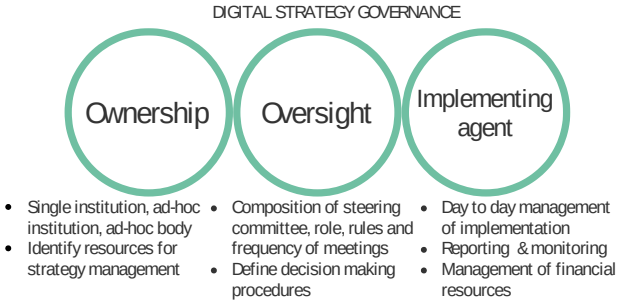
The Alcoi DCC city team during the Roadmap seminar

What should the strategy governance look like?

Your city is free to decide how the digital transformation is to be governed. We recommend the governance scheme include a definition of:

- The organization or body responsible for the general oversight of the strategy (i.e. who owns the strategy?)
- The composition of the strategy steering committee (e.g. representatives of the local digital community), role of the steering committee, frequency of meetings, and chairpersonship (i.e. who oversees the delivery of the strategy?)
- The existence of thematic working groups, and for what intent / purpose (i.e. who contributes to enriching the strategy on a rolling basis?)
- The operational team in charge of delivering activities or projects, monitoring results, reporting to the Steering Committee (i.e. who is responsible for the day to day implementation of the strategy and specific activities?)

DIGITAL STRATEGY GOVERNANCE



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Step 4: Monitoring & evaluation

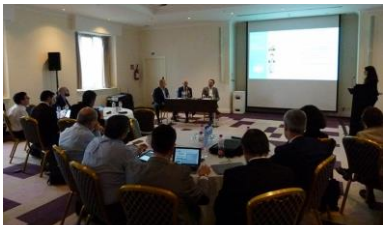
The last and final step of the digital transformation trajectory is aimed at developing a monitoring and evaluation framework for your digital transformation strategy. This will allow you to measure the progress against targets linked to the implementation of your strategy. While you can establish the monitoring indicators at the end of your strategy development, it is recommended that you do so in parallel to the definition of the strategy itself. This will allow to ensure a higher degree of relevance of selected indicators and targets. It is recommended that you establish three levels of indicators:

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

Key tasks

- Identify one or two monitoring indicators for each of the following elements of your strategy: ambition statements, operational objectives, and priority activities
- Define the monitoring and evaluation procedures and key responsibilities within the governance scheme
- Organise a first meeting of your governance and steering bodies
- Launch your pilot activity

Peer review session during a DCC academy seminar



What type of information is required to establish a robust monitoring framework?

Setting a target for Monitoring Indicators requires:

- Establishing a robust baseline reflecting the current situation
- Defining the breath of your ambitions e.g. do you want to double growth rates or simply increase them by 5%
- If data is not available to define the baseline at this stage, then you should identify the means through which you could develop the baseline at a later stage e.g.: collect data, conduct a study, conduct a survey, etc
- Establish a target which seems reasonable at this point in time. Targets can always be adjusted later.
- Targets should always be accompanied by a timeframe, e.g. supporting the creation of 200 innovative companies over the next 4 years.
- The timeframe for output related indicators should be shorter than for outcomes
- Outcomes should not be set to appear before 5-10 years.

For more information and access to DCC resources, visit the DCC Digital Library: https://www.digitallytransformyourregion.eu/digital-library

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Conclusion

The DCC initiative included cities representing diverse ecosystems, with differing levels of digital maturity. This said, a number of cross-cutting lessons have emerged from the implementation of the Digital Cities Challenge, which may be of use to other cities wishing to embark on a similar journey. Through the DCC we have learned that:

- There is a need to define correctly the role the local government will play in the city's digital transformation. Cities should act as enablers of the digital transformation journey, making sure they leverage their available capacities and resources to ensure a collective mobilisation of the local digital ecosystem. Success factors for cities to act as enables include an increased level of awareness of citizen and business needs and interests, and access to contacts with contacts and organisations who are committed to the digital transformation cause.
- Correctly identify the potential synergies between your digital transformation strategy and other existing strategies. This may be driven by the breaking down of silos across government departments, but also by including mutual activities supporting cross-fertilisation.
- Design a strategy with short term implementation potential, but which remains relevant for longer-term ambitions. This can be supported by appointing a coordinator with sufficient capacity during the process of strategy design, starting the design process with a digital maturity assessment, and treating the strategy as a living document. Long-term sustainability will also be undoubtedly supported by the use of a robust monitoring and evaluation framework, and the short term implementation of pilot actions or 'quick wins'.

The Digital Cities team and wave 2 cities at the final Academy Seminar

www.digitallytransformyourregion.eu

Contributors

Technopolis Group

Paresa Markianidou

Sebastian Otte

Morten Rasmussen

Jacek Walendowski

Carlos Hinojosa

Morgane Veillet-Lavallee

Carsa

Marie Bourdon

Thematic Experts

Open Data: Dr Alex Gluhak (Digital Catapult)

Industry 4.0: Alicia Gonzalez and Daniel Echebarria (Innovalia Association)

Robotics: Dr. Uwe Haas (Roboconsult)

Mobility: Dr. Sven Vlassenroot (Tractebel)

Tourism: Jose Cabello (Carsa)

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