Fostering the digital change in a smart city

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Abstract

Everybody wishes to live in a smart city, especially in a smart and connected world.
The cities hold the ability to create ecosystems in view to enhance the modernisation of administration, businesses based on digital technologies and new business models.
In view to create a sustainable digital ecosystem, the relevant successful factors could refer to leadership and smart governance, easy access to technologies and data in order to apply solutions for the local problems, improvement of digital competences focused on fostering the digital change and enhancing the physical and digital infrastructures in light to optimise the use of resources.
The paper presents the case of Oradea Smart City.

Keywords: digital change, smart city, ecosystem

1. Introduction

The cities and urban areas represent complex ecosystems, the main preoccupation being to ensure sustainable development and improvement of life quality. In the urban environment, the citizens, companies, public institutions have specific requirements and needs in areas such as health, education, public services, social media, energy, environment, safety . Those areas are moreover based on electronic applications, systems and digital infrastructures. Therefore the cities are facing the challenges to create, maintain and modernise the technological infrastructures, to establish efficient, open and participative innovation processes, in view to achieve innovative services for satisfying the citizens' requirements and expectations.

Smart cities should elaborate development strategies focused on the technological infrastructure, on the development of public-private partnerships aimed at increasing the attractiveness of the city, improving local prosperity, increase of the quality for the services provided.

According to the definition of Giffinger (2011), a smart city is "a city well performing built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens".

At the same time, "a city is to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel

sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" (Caragliu et al., 2011).

A comprehensive definition states: "A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens" (Hall, 2000).

Debating on the emergence of smart cities, Komninos (2002) has studied three different spatial models concerning the creation of the innovation environment, based on spatial proximity, learning organizations, ecosystems of digital innovation. The author (2008) explains the emergence of smart cities through the ability of integrating the collective intelligence for the purpose of collaboration and digital networks. Several types of applications concerning the concept of smart city, such as virtual city, crowdsourcing, online collaboration, smart environment have been identified.

According to the assertions of Komninos and Tsarchopoulos (2012), there are several important challenges for smart cities: digital divide, referring to citizen and company's capabilities to use the new technologies and to be creative. The authors recommend to the cities to explore various models of businesses and to identify the most suitable ones for each type of service provided. At the same time, the authors assert that the methodologies concerning the virtual laboratories, the social experiments, crowdsourcing, open platforms for creating and promoting the electronic applications and services could provide solutions and mobilise the creative skills of the city's inhabitants.

The landscape of a smart city comprises several important dimensions of innovative systems, i.e. technologies, electronic applications, methodologies, policies, actors (Schaffers et al. 2011; Komnimos et al 2011).

At the same time, it could be shaped a map of opportunities for innovations in a smart city, as well as models for collaboration within the innovation ecosystems.

According to Dincă (2009), there are two main aspects concerning the relation between technology and public services: to what extent the new technologies are incorporated in public service delivery and to what extent the new technologies determine the emergence of public services.

For information and communication technology (ICT) several trends are shaped for 2017. We witness the increase of the number of Internet users and traffic of zettabytes.

By 2020, the internet traffic at global level will be 95 times higher than in 2005 (CISCO, 2016). The increase is determined by a higher number of users (4.1 billion by 2020), more connected devices and faster broadband speeds. By 2020, 71% of IP total traffic will derive from smartphones, tablets and TV sets. Additionally the Internet of Things (IoT) will generate more traffic.

Other ICT trend refers to networks ready for digitization. A digital network, ready for the digital change ensures automation by means of controllers, real-time analytics, network functions virtualization and the limitless scalability of the cloud (CISCO, 2016). As already known an open network supports the digital change through provision of automation and threat protection.

The artificial intelligence opens new horizons in the cybernetic security. Thus, the artificial intelligence represents a support in view to analyse and investigate suspect web traffic.

Fog computing extends the cloud computing to the border of the network.

In 2017, fog computing will take advantages of cloud computing, extending the capabilities of analysis and control to the border of the network. The concept of fog computing will be turned into account in implementing solutions for smart cities. In a smart city, fog computing ensures capabilities of computing, storage and networking towards the remote devices in view to improve the public services such as traffic management, smart lightning, parking, public safety etc.

2. Successful factors for a sustainable digital ecosystem

The cities and urban areas should maximize the role of digital technologies. The digital changes eliminate the geographic borders, being essential for social interaction, communication and trade.

The cities and urban areas hold the ability to develop an important ecosystem in view to enhance the modernization of administration, companies, based on the digital technologies.

Most cities are adapting the best practices in this area in order to achieve the genuine digital changes.

Based on the study of literature and case studies, we have identified the successful factors for a sustainable digital ecosystem, referring to:

- Smart governance of the local digital ecosystem;
- Improvement of digital skills in light to enhance the digital changes;
- Access to new technologies and relevant data in view to achieve solutions for local needs;
- Investments in technological infrastructure.

2.1 Smart governance of the local digital ecosystem

The development of the local digital ecosystem should take into consideration the coordination actions among local government, companies, universities, citizens and non-government organisations.

The projects and networks should be coordinated by local leaders, i.e. mayors, presidents of local councils, directors or CEOs of businesses.

In the digital era, the networks are essential for creating and developing the digital ecosystem.

For the time being, we witness the shift from governing for citizens to governing together with citizens, to co-creation of innovative projects together with citizens.
In this context, the following main successful factors emerge:

- elaborating a digital strategy;
- creating public-private partnerships;
- collaboration for the governance of local digital ecosystems.

The smart cities and urban areas should gather key stakeholders in view to identify the main challenges, best practices and opportunities for the digital changes.

As shown by Figure 1, the main actors involved in the digital change are the following: mayors, presidents of local councils, city managers, citizens, researchers, academics, social partners, investors, directors of SMEs, entrepreneurs, NGOs representatives.

The mayors, presidents of local councils, city managers should create and develop the environment suitable for the digital ecosystem, gathering the local resources and enabling the collaboration among academics, researchers, policy makers, businesses, thus fostering the digital change and creating new opportunities for companies.

The researchers, academics represent key actors in a digital ecosystem, being essential for the digital change of the cities.

Figure 1. Actors of the digital ecosystem
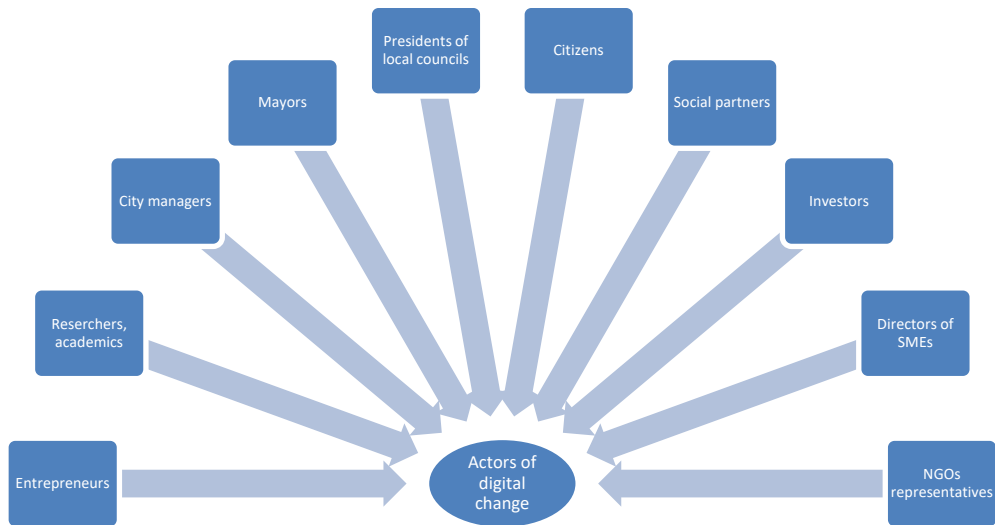
The above actors of the digital ecosystem should permanently interact, exchange opinions and expertise, select partnerships and collaborative projects, identifying new collaborative opportunities, thus enhancing the digital change of their city.

2.2.   Improvement of digital skills in light to enhance the digital changes

For any digital change, the digital skills and talents are vital.

The digital change in a smart city could be possible only if there are the adequate skilled persons capable to valorise the digital technologies and opportunities.

It is also crucial that local public administrations, universities, research centres are attracting and valorising the skilled persons who are genuinely able to create and develop the digital ecosystem of the smart city.

The digital revolution triggers the education revolution.

In the digital era, the digital skills represent a crucial factor for acquiring digital knowledge. Therefore the authorities should provide training programmes for improving skills, competences, knowledge. In this context, it is important to develop an education strategy, comprising the vision to acquire digital knowledge.
An important aspect refers to training the civil servants and public employees in view to create conditions for sustainable digital change.

The university and research centres play an increasingly active role in creating and implementing projects for the digital change of local companies. They should enhance their expertise and experience in focused areas.

Local governments should involve in reskilling the labour force, should achieve collaborative partnerships to achieve training programmes for acquiring new digital competences and create local brands in view to attract investments and talented persons.

Also, the local governments should invest in developing an entrepreneurial culture both at the level of public administration and local businesses.

The creation and development of an entrepreneurial culture represent in fact a co-creation process between the public, private sector and citizens.

On the other hand, the entrepreneurs should identify the digital challenges and opportunities for local companies.

2.3 Access to new technologies and relevant data in view to achieve solutions for local needs

The cities and urban areas should foster the digitization of the economic environment. Thus, they should ensure access to data and technologies for improving the transparency, accountability of local governments, for providing citizen-centred public services and creating the framework for local companies for innovation and experimentation.

An important successful factor refers to opening the access to data by creating open data platforms and ensuring access to the digital technologies.

Smart and open innovation could trigger the creation of an adequate framework for experiments, innovative projects and digital change. In this respect, it could be beneficial to apply for projects funded by the EU Structural funds or Horizon 2020 Research and Innovation Programme.

As mentioned by various documents and studies (EC, 2016), in view to achieve the digital change, the smart cities should use the following:

- "Infrastructures in the area of public and private transportation and mobility. Charging infrastructure for electric vehicles.
- Internet of Things (IoT) to respond to high investment costs in view to build broadband networks;
- Broadband connectivity to tackle challenges related to some IP networks which are not yet IoT ready;
- Smart personal devices to address a raising digital divide while guaranteeing data protection and security;

- Cloud computing with challenges including security and privacy; complexity of managing cloud components and interoperability;
- Big data analytics to address a shortage of talent and assure data policies on privacy and security".

At the same time, as stated by the EU (2016), the open data platforms represent an important pillar for successful smart cities as the use of open data triggers experimentation, creation of innovative projects for satisfying the citizens' needs and expectations. Also the open data platforms reveal transparency and possibility for IT communities to be involved in local government decision making and public service provision.

Thus, a tough task for the local governments is to ensure the accessibility, interoperability and usability of data.

2.4 Investments in technological infrastructure

The digital ecosystem is based on adequate technological infrastructure.

The cities and urban areas should be able to foster the integration of digital technologies in order to optimize the use of all types of resources. In this context, the most innovative business models and ICTs represent the pillars for changing the provision of public services in a smart city.

It is worth to mention that the development of the digital applications could solve the needs and expectations of the citizens. Thus, the investments in the infrastructure for implementing and developing the digital solutions for various urban challenges are important.

Figure 2. Key dimensions of investments
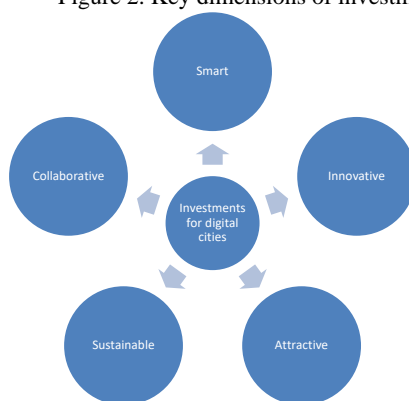
Source: PwC Analysis, PwC, 2013, Future of government,
https://www.pwc.com/gx/en/psrc/publications/assets/pwc_future_of_government_pdf.pdf

As shown by Figure 2, the key dimensions of investments in the smart cities focus on: the component 'smart' – in other words to achieve strategic investments, on being 'innovative' – namely innovative financing, new instruments for funding, on the component 'attractive' – that is to be attractive for other investors, the dimension 'collaborative' – referring to public–private partnerships, 'sustainable'- namely well targeted.

In this area, the main successful factors refer to ensuring the digital infrastructures for the digital change in a smart city, assuring the economic sustainability of the investments in technological infrastructures at local level.

In view to ensure funds for the needs of technological infrastructures, the local authorities should mobilise and achieve projects funded at local, national or European level. Also it could be important to involve the development agencies, the financial institutions, universities, research centres, NGOs, investors.

3. Oradea Smart City

Oradea, the capital city of Bihor County and Crisana region holds a unique database with all necessary information on taxes, charges and invoices, achieves online payment of taxes and charges, has smart public lightning, systems of irrigation for parks depending on air humidity, has parking fee directly paid through SMS, electronic payment system for public transport, a ticketing system that is used by the citizens of Oradea and allows to configure on the public transport the routes depending on their availability, GPS for public transport, 60 Wi-Fi hotspots.

Cityhall of Oradea Municipality was awarded the distinction "The most active local administration". The award was gained for interoperability of IT systems and increase of quality of public services. In fact in 2002 Oradea set up the first GIS consortium in Romania for sustainable spatial development management in the metropolitan area. In July 2016 it launched the strategy Oradea Smart City, aiming the interconnection of all databases, in view to make available the necessary information in a free, quickly and fair manner to its citizens.

The transformation of Oradea into a smart city has positive effects on the enhancement of its attractiveness, increase of local prosperity, citizen and tourist security, improvement of quality for public services.

Also, it will have direct implications on technological innovation, smart transport, increase of energy efficiency, telework, e-democracy, more transparency and active citizen participation at decision making process.

The integrated IT strategy for Oradea Municipality has the following priorities:
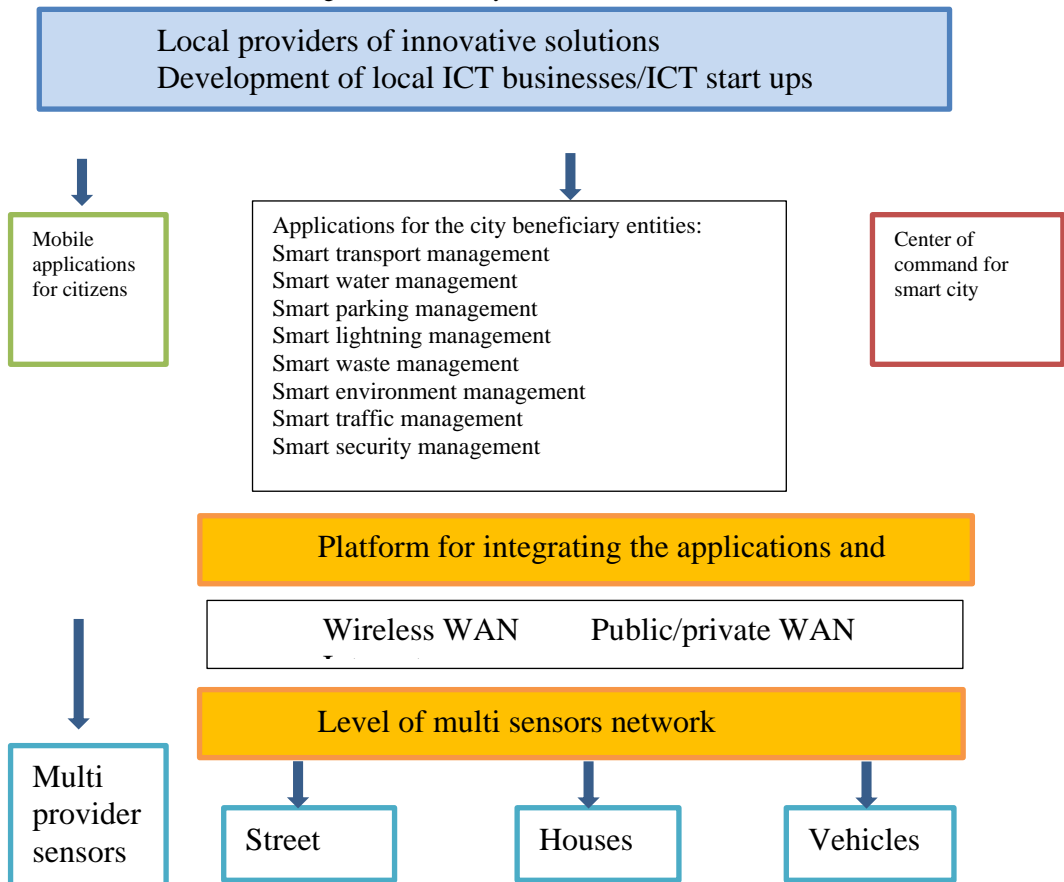
- Supporting the development of ICT sector at local level;

- Improving the relationship with citizens, businesses, tourists and potential investors, especially in the areas centered on education, health, public transport and utilities;
- An attractive touristic town by creating a powerful brand, improving its services (Oradea city card correlated with e-ticketing for metropolitan public transport);
- Increasing the pace for attracting European funds.

The results of implementing the integrated IT strategy for Oradea Municipality will be as follows:

- Quantifying the necessity for innovation in integrated ICT;
- Sectoral analysis of actual status for each core area (SWOT);
- Architecture of integrated ICT system;
- Models of partnerships;
- Benefits and challenges of integrated ICT;
- Harmonising the strategy with the national and international strategic directions;
- IT projects;
- Impact analysis;
- Classifying the projects related to a set of criteria;

Figure 4 Local ecosystem of ICT based innovation

Local providers of innovative solutions
Development of local ICT businesses/ICT start ups

Mobile applications for citizens

Applications for the city beneficiary entities:
Smart transport management
Smart water management
Smart parking management
Smart lightning management
Smart waste management
Smart environment management
Smart traffic management
Smart security management

Center of command for smart city

Platform for integrating the applications and

Wireless WAN   Public/private WAN

Level of multi sensors network

Multi provider sensors

Street

Houses

Vehicles

Source: Oradea Smart City Strategy, (2016), http://www.oradea.ro/

As presented in Figure 4, there will be new dimensions for innovation. The development of local ICT businesses will facilitate the achievement of new mobile applications for citizens, economic environment and tourists.

The cloud portal of Oradea smart city will comprise the component of cloud management for the physical infrastructure, the component of core software infrastructure and the level of 7 IT layers (public administration, network of urban transport, health network, network of urban utilities, education and cultural network, economic environment, intelligent housing).

Conclusions
As presented in the paper, smart governance of the local digital ecosystem represents a key successful factor. The main actors and stakeholders are essential to trigger the future of the city.

The access to data and technologies in view to address the local challenges could also be an important catalyst for the digital change.

The digital competences are also vital for fostering the digital change.

Local governments, universities, research centres should to attract skilled and talented persons, in view to be able to achieve the city's digital ecosystem.

Also the digital infrastructures represent a key successful factor in order to optimise the use of all types of resources.

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