University of Economics in Katowice

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Marcin Baron

DO WE NEED SMART CITIES FOR RESILIENCE

Introduction

It is obvious in contemporary urban studies that there is no such a fancy idea in the early 21st Century that could overcome the concept of Smart City. This notion has rapidly drawn attention of not only urban planners and policy makers, but (maybe first of all) is strongly supported by hi-tech businesses that consider introducing ICT in urban space as a vast market and real business challenge. Moreover Smart City is quite appealing to expectations and lifestyles of modern urban citizens, especially the young and 25-40 aged generation, who are well accustomed to utilizing ICT in everyday life and work.

Smart City mainly stands for transition in municipal (metropolitan) services based upon implementation of new technologies that allow new pathways of delivery or brand new services related to communication, security and sustainability. It is also an approach to face social, spatial and economic challenges in urban areas. Therefore, Smart City can be considered:

– a specific strategic orientation towards development of new (or revitalised) quarters in which technologies: support interactions between service providers and consumers, force expected social behaviours or enhance civil security;
– a way of implementing technological solutions into existing urban structures by which a real-time (or prompt) response is offered to citizens' and businesses' needs as well as to emerging risks and dangers.

On the other hand, there is another concept – deeply scrutinized in this Volume – the urban resilience. A resilient city is able to tolerate disruptions before reorganising around new set of structures and is able to anticipate, prepare for, respond to and recover from a disturbance (Drobniak, 2012). This can be achieved via several long-term strategies or by mid-term or short-term programmes and task forces; where applicable supported by new technologies – technologies related to Smart City.

Having this in mind it is worth focusing on theoretical linkages between the concept of Smart City and achieving urban resilience. The question pinpointed in the title is a synthesis of a methodological approach presented in the paper, which should be treated as a starting point to further empirical studies.

1. The urban context

Utilizing the concept of Smart City becomes a serious business and policy challenge, especially though urban areas are expected to continuously grow in the forthcoming years. McKinsey claims that for market analyses and technolo-

gical development scenarios one needs to assume that by 2050 70% of World's population will live in heavily urbanised areas (Bughin, Chui, Manyika, 2010). The forecasts by United Nations show that by 2050 85% of Europeans will live in urbanised areas (Caragliu, Del Bo, Nijkamp, 2011). Moreover the European Commission assumes that Europe is one of the most urbanised continents – contemporarily two thirds of Europe's population live in urban areas; and the ratio is expected to grow. In the European perspective it will be the urban growth to determine future economic, social and territorial development and as such shall be supported by the EU policies (Cities of Tomorrow, 2011; Investing in Europe's Future, 2010). The trend scenario delivered by ESPON shows that by 2030 the current European growth pentagon is going to expand and cover areas as far as: Dublin, English Midlands, Stockholm, Madrid, Barcelona, Budapest, Katowice and Cracow, Warsaw and Lodz (Scenarios on the territorial future of Europe, 2007).

Implementation of Smart City concept shall not be limited neither to the administrative borders of a given city nor to criteria differentiating 'town' and 'city'. Anyway it is worth remembering that usually by cities we understand bigger towns (at least 50,000 population) characterised by urban lifestyle and specific specialised or prestigious public services or infrastructures available. Moreover – as Smart City refers very often to analysing loads of data and managing big structures using the systemic approach – in Europe it is relevant to consider Smart City solutions an instrument supporting development of Functional Urban Areas Cities of tomorrow, 2011) or Metropolitan European Growth Areas (Scenarios on the Territorial Future of Europe, 2007).

2. Defining Smart City – research based approach

Smart City for the moment is more a brilliant idea, a concept, than a theory (theoretical approach) itself. Therefore there is no agreed definition of Smart City neither set of indicators that could clearly distinguish smart and non-smart cities. In general Smart City is a kind of buzz word that refers to implementing ICT in metropolitan services. A study by S. Allwinkle and P. Cruickshank (Allwinkle, Cruickshank, 2011) revealed that the idea emerged in break of centuries from "intelligent city" characterised by:

– "the application of a wide range of electronic and digital technologies to communities and cities;
– the use of information technologies to transform life and work within a region;
– the embedding of such ICTs in the city;

– the territorialization of such practices in a way that brings ICTs and people together so as to enhance the innovation, learning, knowledge, and problem-solving that the technologies offer".

This kind of approach is also widely referred to as "wired city".

A transition from "intelligent" into Smart City concept is related to adding social and human capital aspects as well as sustainability (Hollands, 2008). As such it becomes a wide urban planning approach that integrates all possible "smarts", offering a kind of paradigm shift. One of the most popular exemplifications of this attitude is based upon a study by R. Giffinger (Giffinger et al., 2007) who claim that Smart City can be disaggregated into: smart living, smart environment, smart mobility, smart governance, smart people, and smart economy. The open question remains whether we really face a paradigm shift or just observe a good branding for already known issues? Especially though, as it was pinpointed by A. Caragliu, Ch. Del Bo and P. Nijkamp (Caragliu, Del Bo, Nijkamp, 2011), "[…] the characteristics proper to a smart city that tend to be common to many of the previous findings as follows":

– the utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural, and urban development;
– an underlying emphasis on business-led urban development;
– a strong focus on the aim of achieving the social inclusion of various urban residents in public services;
– a stress on the crucial role of high-tech and creative industries in long-run urban growth;
– profound attention to the role of social and relational capital in urban development;
– social and environmental sustainability as a major strategic component of smart cities.

Anyway the authors provide a sound working definition of Smart City by stating that: We believe a city 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 (Allwinkle, Cruickshank, 2011).

3. Defining Smart City – business based approach

There is no doubt that first of all Smart City shall be considered as a bundle of serious business models offered and adapted by global hi-tech players to cities across the World. It is the market, not advances in urban studies, that drives the notion of Smart Cities.

Smart City is mainly associated with a product and communication strategy of IBM, launched after the company had switched from personal computers production to delivering IT solutions for users who need large computing capability. Being a part of "Smarter Planet" (IBM, 2012) initiative the concept involves following focus areas: analytics, banking, buildings, business agility, cities, cloud computing, commerce, communications, computing, education, energy, food, government, healthcare, oil and gas, products and services, public safety, rail, retail, security and resilience, social business, sustainability, traffic, transportation systems, water. The main assumption of IBM reads: The city is a microcosm of the major challenges and opportunities facing the planet today – intensified and accelerated. Here, all man-made systems come together and interact with one another (Smarter Cities, 2009). The basic typology of interacting systems is presented in Table 1.

Table 1

Smart City systems, according to IBM

System	Focus
City operations systems	City services
City user systems	People
	Businesses
City infrastructure systems	Water
	Communication
	Energy
	Transport

Source: Author's selection based upon: (Smarter Cities, 2009).

Within the IBM's logic, these interactions are made possible thanks to three characteristics of smart solutions that are (Smarter Cities, 2009):

– instrumented (event capture and filtering for timely response);
– interconnected (any to any linkage of people, process, and systems);
– intelligent (deep discovery, analysis and forecasting).

According to this logic, some examples concerning transformation towards smarter systems are presented in Table 2.

Table 2

Exemplary transformations towards Smart City, according to IBM

System	Elements	Instrumentation	Interconnection	Intelligence
City services	– Public service management, – Local government administration	Establishment of local authority management information system	Interconnected service delivery	Immediate and joined-up service provision
People	– Health and education, – Public safety, – Government services	Patient diagnostic and screening devices	Interconnect records for doctors, hospitals and other health providers	Patient driven preemptive care
Business	– Business environment, – Administrative burdens	Data gathering on use of specific online business services	Interconnect stakeholders across city's business system	Customised service delivery for businesses
Transport	– Cars, roads, – Public transport, – Airports, seaports	Measuring traffic flows and toll use	Integrated traffic, weather and traveller information services	Real-time road pricing
Communication	– Broadband, wireless, – Phones, computers	Data gathering via mobile phones	Interconnect mobile phones, fixed line, broadband	Information for consumers on city services in real time, on their own time
Water	– Sanitation, – Freshwater supplies, – Seawater	Gather data for water quality monitoring	Interconnect businesses, ports, energy users of water	Real-time quality, flood and drought response
Energy	– Oil, gas, – Renewable, – Nuclear	Fit sensors to gather data on usage across the energy system	Interconnect appliances and devices between energy consumers and providers	Optimise the use of the system and balance use across time

Source: (Smarter Cities, 2009).

Having in mind similar functional areas (compared to IBM) the other important ICT player – Ericsson – focused on ICT infrastructure and enablers. According to Ericsson the main technical components of Smart City are (Höller, Ljungberg, Williams, 2009):

– an underlying ubiquitous ICT infrastructure (high-speed internet access, wired and wireless; sensor and actuator deployments everywhere);
– an ICT service enablement suite (smart media service enablers; city-wide "open" access to sensor and actuator services).

Ericsson's perspective encompasses four building blocks of Smart City (Höller, Ljungberg, Williams, 2009):

– ubiquitous high-speed internet infrastructure (servers, routers, switches, IP access: mobile, WMAX, fibers, cables);
– smart media service technologies (connections, payments, synchronization, play, interactions, subsrcibing to or publishing media, management services, location services, web access and mobile platforms);
– sensor and actuator instrumentation (utility infrastructures, buildings and houses, fixed transport infrastructure, mobile infrastructure – all connected to the common IP infrastructure via existing access infrastructures in buildings, cellular, radio meshed networks);
– city wide access to sensor information (application enablement thanks to secure and reliable access to sensor and actuator information services for multiple players and efficient information sharing across "verticals").

Cities involved in establishment of this kind of infrastructures need to face technical challenges of: vast amount of data, high degree of automation, concurrent optimisations, real time control and unified access to data. Moreover, information enablement calls for aggregation and collection of data, directory services, data brokering and service composition, information federation, privacy and integrity protection, access policy enforcement as well as accounting and revenue systems. Anyway these characteristics are not specific to Smart Cities. They will remain the same for all operators dealing with vast data packages.

Finally, it is worth pinpointing that urban areas are nowadays becoming equal to military sector as creation and pilot areas for new technological solutions. It is closely related to a new logic behind public service delivery (characterised by growing expectations concerning: efficiency, effectiveness, sustainability, prosumerism, etc.) and to emerging immunology or terrorist threats in the areas of high population density. Both premises make Smart City technologies one of possible focal points of achieving urban resilience. Foresights on urban trends in a fairly clear way show this link between technological capacity of cities and their ability to react to changing circumstances. A concise review of approaches presented by leading business think tanks is presented in Table 3.

Table 3

Smart and resilient cities, according to IBM, RAND, and McKinsey

Think Tank	**IBM**	**RAND Corporation**	**McKinsey**	**IBM**
1	2	3	4	5
Key message	Six significant forces are simultaneously reshaping societies and governments around the world	Top future technology applications	Ten tech-enabled business trends to watch	Innovations that have the potential to change how people live, work and play in cities around the globe over the next five to ten years (2010-2014-2019)

Table 3 cont.

1	2	3	4	5
Elements creating the context of smart/ /resilient city	– Changing demographics, – Accelerating globalization, – Rising environmental concerns, – Evolving societal relationships, – Growing threats to social stability and order, – Expanding impact of technology	Selected future technologies: – Cheap solar energy collection, conversion, and storage, – Wireless communications, – Communication devices for ubiquitous information access anywhere, anytime, – Chemical, biological, radiological, nuclear (cbrn) sensor networks in cities, – CBRN sensors on emergency response technicians, – Secure video monitoring, – Biometrics as sole personal identification, – Ubiquitous radio frequency identification tagging of commercial products and individuals, – Unconventional transport, – Improved diagnostic and surgical methods, – Monitoring and control for disease management, – Cheap autonomous housing	Producing public good on the grid: – Wired cities, – Smart grids, – Embedded sensors, – Cloud computing	– Cities will have healthier immune systems, – City buildings will sense and respond like living organisms, – Cars and city buses will run on empty, – Smarter systems will quench cities' thirst for water and save energy, – Cities will respond to a crisis – even before receiving an emergency phone call

Source: Author's selection based upon Government 2020 and the Perpetual Collaboration Mandate (2008); Silberglitt, Antón, Howell, Wong et al. (2006); Bughin, Chui, Manyika (2010); Next 5 in 5, IBM (2009).

4. Policy support to Smart Cities

In terms of achieving certain technological levels mentioned above, implementation of the Smart City concept needs specific policy actions that will provide a push effect, e.g. in an European dimension. A scrutiny over the current EU policy documents clearly shows that at the moment it is the energy efficien-

cy context that drives support to what we could call conversion into smarter urban systems. Looking into the Europe 2020 (Communication From The Commission, 2010), strategy one can only find these elements of Smart City there that are directly linked to energy issues with no *expressis verbis* reference to the idea of Smart City. Anyway the other key policy proposals provide a slightly wider perspective and the main findings have been summarized in Table 4.

Table 4

Smart Cities in the EU policies

Policy document	**Fifth report on economic, social, and territorial cohesion**	**Europe 2020 Flagship Initiative Innovation Union**	**A Digital Agenda for Europe**
Reference to Smart Cities	[The EU could:] Extend both the scope and scale of financial engineering instruments: in terms of scope, to encompass new activities (e.g. sustainable urban transport, research and development, energy, local development, lifelong learning or mobility actions, climate change and environment, ICT and broadband); in terms of scale, to combine interest subsidies with loan capital or other forms of repayable financing	[One of further potential Innovation Partnerships so far examined by the Commission is:] Smart Cities – By 2020, and taking 2010 as a baseline, the aim is to support a number of pioneering European cities (with a total population of at least 20 million) in reducing their carbon emissions by more than 20%, increasing the share of renewable energy in the energy used for electricity supply, heating and cooling by 20%, and increasing end-use energy efficiency by 20%. The Partnership will demonstrate the feasibility of rapid progress towards the EU's energy and climate objectives at local level while showing citizens that their quality of life and local economies can be improved through investments in energy efficiency, renewable energy sources and energy system management solutions, including smart metering and use of ICT innovations as well as more efficient urban transport	Cooperation between the ICT industry, other sectors and public authorities is essential to accelerate development and wide-scale roll out of ICT-based solutions for smart grids and meters, near-zero energy buildings and intelligent transport systems. It is essential to empower individuals and organisations with information that will help them to reduce their own carbon footprint. The ICT sector should deliver modelling, analysis, monitoring and visualisation tools to evaluate the energy performance and emissions of buildings, vehicles, companies, cities and regions. Smart grids are essential for the move to a low carbon economy. They will enable active control of transmission and distribution via advanced ICT infrastructure communication and control platforms. For the different grids to work together efficiently and safely, open transmission-distribution interfaces will be needed

Source: Author's selection based upon: Investing in Europe's Future (2010); Europe 2020 Flagship Initiative Innovation Union (2010); A Digital Agenda for Europe (2010).

Nevertheless, it needs to be pinpointed that there is almost no direct reference to the concept named Smart City in the EU policy documents, even in the main contemporary document focusing on cities and urban policy (Cities of Tomorrow, 2011). Various elements of a Smart City are highlighted but it is

hardly referred to as a whole idea. There may be two reasons for that. The first – and quite obvious – is that the European Commission would rather refrain from using name that is widely associated with one business entity (IBM). The other is that it is to wide for setting up policy arrangements in terms of split into intervention types, focus areas, earmarking headlines, etc. As a consequence the policy makers may rather prefer to use more precise wording as: smart grids, smart metering, efficient urban transport, green cities and so on.

5. Implementing the Smart City concept

Summarizing the findings described above the two main notions behind implementation of the Smart City concept can be identified:

– the energy and environment notion (energy security, energy efficiency, sustainability), which is mainly promoted by international, national and regional policy makers (de Oliviera Fernandes et al., 2011; Mitchell et al., 2008);
– the ICT development notion (broadband, sensors, wireless access and monitoring, e-services, information society) which is mainly promoted by business entities, especially large infrastructure providers and operators.

These notions and actors play a key role in public service transition from "traditional" public services to smart services. There is also another interrelated notion referring strictly to foresight studies. It is an expectation that thanks to breakthrough solutions concerning ICT and environmental technologies the urban areas will be converted into sustainable or self-sustaining cities (territories) mainly in terms of water and energy (Siemens, 2010). Predictions encompass creation of city-gardens where both natural and technology-based processes will join together and create synergies to fully: reduce carbon footprint, accumulate and re-use water, achieve high energy performance, generate energy out of renewables or waste, etc.

Anyway, the mainstream discussion at the moment reflects the quoted academic approach by A. Caragliu, Ch. Del Bo and P. Nijkamp (Caragliu, Del Bo, Nijkamp, 2011), claiming that Smart City is something more than technologies itself. The Expert Working Group on Smart Cities Applications and Requirements established within the Net!Works European Technology Platform (Correia et al., 2011) stressed that in the heart of the Smart City concept is making ICT enabled services and applications available to the citizens, companies and authorities that are part of a city's system; aiming at increasing citizens' quality of life, and improving the efficiency and quality of the services provided by governing entities and businesses. This perspective requires an integrated vision of a city and of its infrastructures, in all its components. Thus social and gover-

nance issues become equal to technology and infrastructures. Several challenges emerge where these elements meet. They are related to:

– readiness to share and use data in a privacy context;
– setting up standards concerning city and citizens data gathering and aggregation across huge number of microscale installations;
– offering data security in a large system composed of numerous sub-systems;
– stability of the system and its positive impact on city transformation;
– creation of business models related to Smart City solutions that follow strategic objectives of urban growth as well as stabilize market or quasi-market fundamentals of public service delivery;
– technical skills within the society that enable all social groups to use infrastructures and platforms based upon mobile applications, remote access or cloud computing.

Having this in mind some phases or levels of achieving city smartness can be identified. An approach by the EU supported (FP7) project THINK – presented in Table 5 – can be used for this typology.

Table 5

Overview and illustration of the different levels of city smartness

	Conceptually		Examples	Smartness
First level of city smartness	Self-managing actions by city authorities	City authority as a public actor	– Public buildings (e.g. schools, social housing infrastructures, etc.), – Street lighting, municipal fleet	Lead by example
Second level of city smartness	City authorities managing private actors reluctance to act	City authority as a local policy maker	– Regulation: land-use (urban planning), building codes, city entrance charges, – Facilitation: info centers, trainings, subsidies	Govern the private urban actors
Third level of city smartness	City authorities managing coordinative actions	City authority as a coordinator	– Combined action with city-scale demonstration of innovative infrastructures that enable a smarter use of energy, in combination with actions from city authorities to promote the use of the associated services	Integrated approach

Source: (de Oliviera Fernandes et al., 2011).

Y. Alobaidan (Alobaidan, 2009) stresses the fact that various players of an urban area may have totally different understanding of smartness and in consequence may apply different definitions, measures and indicators. Nevertheless it is not only a game of definitions nor conceptual approaches, but an interplay of stakes as well. Keeping the right balance between the government, private sector and the end user is – according to Alobaidan – the biggest social challenge for a Smart City as well as coping with the technological evolution. The identified trade-offs refer to:

– revenue and profit incentives of private sector vs. social and economic motives of government;
– long-term plan vs. quick wins;
– incentives for each service provider vs. service quality to the community.

It is however of an utmost importance to pinpoint that these issues are not new in urban and regional studies. They have been a subject of multi-perspective and multi-level discussions for a long time already, since trends of: opening the markets in public services, contracting-out, privatisation, New Public Management, etc. emerged. In other words, in case of the Smart City concept, this is rather not the logic of public service delivery that changes but the mechanisms of delivery and the responsiveness on both supply and demand side.

6. Smart City and Resilient City – draft research agenda

As this paper is expected to match a wider scope of desk research summaries concerning urban resilience (included in the Volume), defining the latter concept directly here is not relevant. It is enough to highlight that there are different approaches to this idea; all within one non-economic definition by C.S. Holling (Holling, 1973) "[…] resilience is a measure of the persistence of systems and of their abilities to absorb change and disturbance and still maintain the same relationships between populations or state variables". Probably the most popular approach referring to urban resilience is related to capability to survive natural or man-made hazards, e.g. disasters, catastrophes, attacks, etc. (Ouyang, Dueñas-Osorio, Min, 2012; Campanella, 2006). There are several perspectives within this approach – some related to technical issues (infrastructural resilience) the other to simulations or economic (financial) analyses; finally there are perspectives bridging recovery of infrastructure and society after serious hazards. The other mainstream approach builds up upon the capability of economic and social tissues of the city to survive crises or sustain competitive advantage (Simmie, Martin, 2010; Girard, 2011). Again an array of inner perspectives varies from solid economy to co-existence of "creativity, sustainability and resilience for a human sustainable city" (Girard, 2011).

Even this very short review shows that both concepts, i.e. Smart City and Resilient City are operationalized on the basis of similar or even the same systems, having similar trajectories of development and similar dilemmas to be solved. Both of them can be either purely technical (core, traditional understanding) or societal (complex, modern understanding). Both of them apply to city users and urban public services not to individuals neither dispersed networks. As such the further studies over urban resilience in a context of Smart City could be focused on finding out whether there is a certain degree of correlation between cities getting smarter and more resilient. The idea is depicted on Figure 1.

HIGH RESILIENCE sound economic, social and infrastructural tissues of a city	Hypothesis on existing "quiet and good place to be" strategies	Scrutiny over "half-way" cities' strategies and actions	Hypothesis on existing strategies utilizing investments in smartness to achieve or sustain resilience
MEDIUM RESILIENCE well established city infrastructures, certain vulnerability to social and economic shocks	–	Scrutiny over "half-way" cities' strategies and actions	Scrutiny over "half-way" cities' strategies and actions
NO RESILIENCE vulnerability to social and economic shocks, basic and non-efficient infrastructures	–	–	Hypothesis on possible overinvestment and/or lack of integrity in approaching smartness
	BUSINESS AS USUAL public services or e-services delivered according to known standards and schemes, reacting local government, almost no integration and use of collective data	**MEDIUM SMARTNESS** certain level of e-services or intelligent solutions available for city users, responsive local government, partial integration and use of collective data	**HIGH SMARTNESS** plethora of public services delivered using the smart infrastructures and real-time interactions with city users, extend integration and use of collective data

a context of city users and urban public services

Figure 1. Smart City and Resilient City – research scheme

Utilizing the proposed matrix based upon two dimensions, i.e.:

– level of smartness (business as usual, medium smartness, high smartness),

– level of resilience (no resilience, medium resilience, high resilience),

allows identification of the two areas of future research. The first area may refer to testing hypotheses on possible existence of the three types of 'clear and coherent' urban strategies:

– strategies utilizing investments in smartness to achieve or sustain resilience (high smartness, high resilience);
– strategies focused on creating the quiet and good place to be (high resilience, no special care about smartness);
– strategies focused on whatever smartness, failing due to lack of integrity with local preconditions (high smartness, no anchorage in resilience).

The other area may be focused on scrutinizing strategies and actions of cities that seem to be somewhere "half-way" towards smartness or resilience in order to find out whether these strategic orientations are important to them and what are the expected trajectories of development.

The whole research scheme can be operationalized in different scales, comparing urbanised territories in regions, countries and internationally. A set of indicators decomposing the levels of smartness and resilience must be applied according to the wider scope of background studies and exact objectives of the planned comparative analysis.

Conclusions

Even though Smart City and Resilient City are quite "container words" they have slowly become anchored not only in business praxis but in regional and urban studies as well. One can select characteristics of both concepts and elaborate a precise research agenda upon both of them individually or – as it is proposed in this paper – jointly. The main idea behind this paper was to bring these concepts together and make it a starting point for future research and reflection concerning development strategies of cities that pursuit smartness and / or resilience. Further steps can be undertaken using the presented research scheme.

References

A Digital Agenda for Europe (2010): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission, Brussels, 26.8.2010, COM(2010) 245 final/2.

Cities of Tomorrow (2011). Challenges, Visions, Ways Forward. European Commission, Directorate General for Regional Policy, European Union, October, p. IV.

Communication From The Commission: Europe 2020 (2010). A Strategy for Smart, Sustainable and Inclusive Growth. European Commission, Brussels, 3.3.2010, COM(2010) 2020 final.

Europe 2020 Flagship Initiative Innovation Union. SEC(2010) 1161, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission, Brussels 6.10.2010, COM(2010) 546 final.

Government 2020 and the Perpetual Collaboration Mandate (2008). Six Worldwide Drivers Demand Customized Strategies. IBM Global Business Services, IBM Institute for Business Value, Somers N.Y., 2008.

Investing in Europe's Future (2010). Fifth Report on Economic, Social and Territorial Cohesion. European Commission, Directorate General for Regional Policy, European Union, November, p. XXIX.

Next 5 in 5, IBM, (2009).

IBM (2012): http://www.ibm.com/smarterplanet.

Siemens (2010): Pictures of the Future, Spring.

Scenarios on the Territorial Future of Europe (2007). ESPON Project 3.2, The ESPON Programme, pp. 26-29.

Smarter Cities (2009): IBM Global Business Services. Multimedia presentation, IBM Corporation.

Allwinkle S., Cruickshank P. (2011): Creating Smart-er Cities: An Overview. "Journal of Urban Technology", Vol. 18, No. 2, pp. 1-16.

Alobaidan Y. (2009): Smart City. From Dream to Reality, Presentation at "Intelligent Cities Conference 2009", 20 January.

Bughin J., Chui M., Manyika J. (2010): Clouds, Big Data, and Smart Assets: Ten Tech-Enabled Business Trends to Watch. McKinsey Quarterly, August, www.mckinseyquarterly.com.

Campanella T.J. (2006): Urban Resilience and the Recovery of New Orleans. "Journal of the American Planning Association", Vol. 72, No. 2, pp. 141-146.

Caragliu A., Del Bo Ch., Nijkamp P. (2011): Smart Cities in Europe. "Journal of Urban Technology", Vol. 18, No. 2, pp. 65-82.

Correia L.M. et al. (2011): Expert Working Group on Smart Cities Applications and Requirements White Paper. Net!Works European Technology Platform.

de Oliviera Fernandes E. et al. (2011): Smart Cities Initiative: How to Foster a Quick Transition towards Local Sustainable Energy Systems. Final Report, FP7 Project THINK, January.

Drobniak, A. (2012): Exploring the Urban Resilience Concept, Presentation Delivered at Regional Studies Association Research Network on Transition and Resilience for Post-Industrial Agglomerations in Central Europe Seminar, Katowice, 30th January 2012.

Giffinger R., Fertner C., Kramar H., Kalasek R., Pichler-Milanovic N., Meijers E. (2007): Smart Cities – Ranking of European Medium-Sized Cities. Research Report, Vienna University of Technology, Vienna.

Girard L.F. (2011): Multidimensional Evaluation Processes to Manage Creative, Resilient and Sustainable City. Aestimum 59, Dicembre, pp. 123-139.

Hollands R. (2008): Will the Real Smart City Stand Up? Creative, Progressive, or Just Entrepreneurial?, City 12:3, pp. 302–320.

Höller J., Ljungberg P., Williams F. (2009): Smart City Technologies, Presentation Delivered at Future Internet Assembly, Stockholm, pp. 23-24.

Holling C.S. (1973): Resilience and Stability of Ecological Systems. Annu Rev Ecol Syst, 4: pp. 1-23.

Mitchell W.J. et al. (2008): Mobility on Demand. Future of transportation in cities. Smart Cities, MIT Media Laboratory, June.

Ouyang M., Dueñas-Osorio L., Min X. (2012): A Three-Stage Resilience Analysis Framework for Urban Infrastructure Systems. Structural Safety 36-37, pp. 23-31.

Silberglitt R., Antón Ph.S., Howell D.R., Wong A. et al. (2006): The Global Technology Revolution 2020. In-Depth Analyses Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications, RAND Corporation.

Simmie J., Martin R. (2010): The Economic Resilience of Regions: Towards an Evolutionary Approach. "Cambridge Journal of Regions, Economy and Society", Vol. 3, pp. 27-43.