New challenges in the evaluation of Smart Cities

MULTI-SECTOR

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In the recent Smart Cities debate, appropriate metrics are required in order to establish the contribution that ICTs are making toward sustainable development of cities.

The European Union has placed great faith in the transformative power of Information and Communication Technologies (ICTs). These digital technologies are being expected to deliver against a wide range of EU policy imperatives. These relate not just the achievement of the so-called Knowledge Society, but also to implementation of Sustainable Development (SD). Given the breadth and depth of these ambitions, it is difficult to exaggerate the importance of successful exploitation of ICTs to the delivery of SD in Europe (Lombardi et al., 2009).

There is an implicit assumption in the current debate on ICT, which is reflected in a number of significant policies and strategies put forward for achieving SD in cities, that the implied 'soft transformation' from resource-intensive traditional industries towards much more resource-efficient knowledge and service industries of a dynamic information society will contribute to achieving more SD (Deakin, 2010). This assumption has not been proved yet and new metrics are needed to measure progress, that is to establish the contribution that ICTs are making to overall social and economic progress as well as to environmental advancements (Lombardi, 2011).

Smart Cities evaluation problem

Particularly evident is the problem in the recent Smart Cities debate where the absence of any commonly agreed terminology to describe ICT-driven innovations and developments has left the community without the vocabulary to discuss such matters and agree upon what they mean (Torres et al., 2005). According to Deakin (2009) this debate has been hampered, not so much with the need to agree on a standard representation of e-service developments, but by the lack of a robust statistical base to measure them. For instance, it is often claimed that some cities are smart in the way they use ICTs to develop e-services. Claims made about their use of ICTs to innovate and develop e-services testify this. Recent surveys of these developments, however, also serve to raise a number of questions about whether such ICT-driven innovations are smart and whether cities should be creating opportunities for online services offering 24/7 access (Lombardi et al., 2009).

Smart cities evaluation framework

The triple helix model has recently emerged as a reference framework for the analysis of knowledge-based innovation systems. It relates the multiple and reciprocal relationships between the three main agencies in the process of knowledge creation and capitalization: university, industry and government (Etzkowitz, 2008).

In order to explore the concept of Smart City, a revised triple helix model has been recently proposed by Lombardi et al. (2011). It involves the civil society as one of the key actors, alongside the university, the industry and the government (Etzkowitz and Zhou, 2006). This advanced model presupposes that the four helices operate in a complex urban environment, where civic involvement, along with cultural and social capital endowments, shape the relationships between the traditional helices of university, industry and government. The interplay between these actors and forces determines the success of a city in moving on a smart development path.

This framework has been used for classifying Smart City performance indicators and for structuring an ANP, Analytic Network Process (Saaty, 2005), an exercise aimed at investigating the relations between Smart Cities components, actors and strategies to which the Smart Cities are moving to. This exercise has been conducted within a focus group, involving a number of experts in different disciplines.

Smart Cities' components

Although there is no agreement on the exact definition of a Smart City, a number of main dimensions of a Smart

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City can be identified through literature review and includes: smart economy; smart mobility; smart environment; smart people; smart living; and smart governance (Komminos, 2002; Giffinger et al., 2007; Shapiro, 2008; Van Soom, 2009). These dimensions connect with traditional regional and neoclassical theories of urban growth and economic development. In particular, the dimensions are based on theories of: regional competitiveness, transport and ICT economics, natural resources, human and social capital, quality of life, and participation of citizens in the governance of cities.

The term Smart City is not used in a holistic way but with reference to various aspects which range from ICT-districts to smart inhabitants in terms of their educational level. In addition, the term often refers to the relation between city government and citizens (e.g., good governance or smart governance). There is often a strong reference to the use of modern technology in everyday urban life, which includes innovative transport systems, infrastructures and logistics as well as green and efficient energy systems. Additional 'soft factors' connected to urban life for a Smart City include: participation, security/safety, cultural heritage. In conclusion, the literature review reveals the following main dimensions (or clusters of aspects): Smart Governance (related to participation); Smart Human Capital (related to people); Smart Environment (related to natural resources); Smart Living (related to the quality of life) and Smart Economy (related to competitiveness).

Assessing the Smart City's performance

Sixty indicators have been selected from literature review including EU projects' reports and Urban Audit dataset and indicators selected from statistics of the European Commission, European green city index, TISSUE, Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment and Smart Cities ranking of European medium-sized cities. These have been classified in the five aforesaid clusters of Smart Cities components. Furthermore, a number of relations between these indicators have been identified by way of an Analytic Network Process (ANP), an advanced version of the Analytic Hierarchy Process (AHP). The ANP model consists of clusters (i.e., groups of homogeneous elements of a decision problem), elements (i.e. nodes of the network), interrelationship between clusters, and interrelationship between elements. It allows interactions and feedback within and between clusters and provides a process to derive ratio scales priorities from the elements (Saaty, 2005).

The final ANP model is a structured network composed by the six aforesaid clusters (Smart Governance, Smart Human Capital, Smart Environment, Smart Living and Smart Economy) in each of the four helices of University, Industry, Government and Civil Society, acting as a "control hierarchy" for this model. Each clusters include a number of indicators which are connected and have relationships between them. As an example, Figure 1 shows the relationships identified in the Civil Society sub-network. One can recognized there are two kinds of interdependences: one between elements (indicators) related to different clusters ("external" connection) and one within the same cluster ("internal" relation). The latter one is identified as a "loop". Among the external connections, there are either mono-directional relationships, when one indicator is depending on another, or bidirectional relationships, when the dependency between indicators is reciprocal. An example of bidirectional relationship is the one connected the Smart Human Capital cluster with the Smart Living one by means of indicators such as "Museums visit per inhabitant", "Theatre & cinema attendance per inhabitant" and "Total book loans and other media per resident".

Pilot evaluation of the EU Smart cities visions

The above model has been used for evaluating the four EU policy visions of Smart Cities by 2050, as derived from the

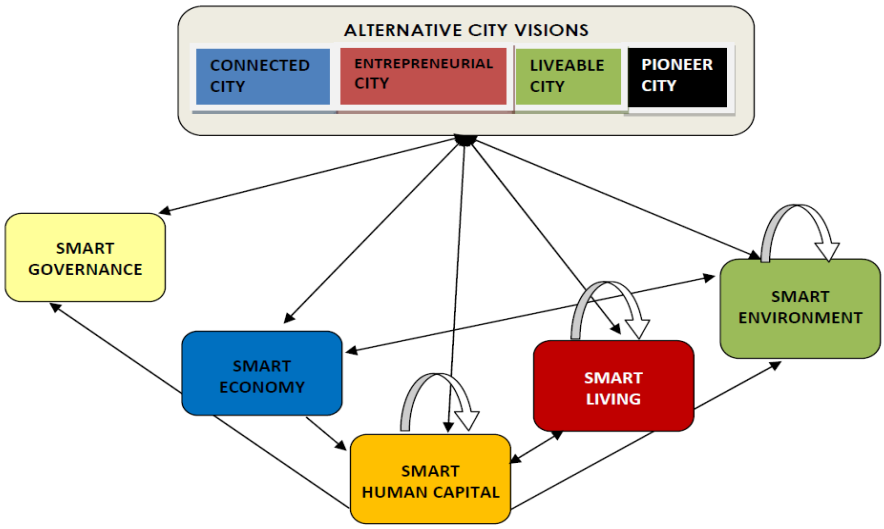

Figure 1 | The Civil Society sub-network

"Urban Europe" Joint Programme Initiatives (Nijkamp, Kourtik, 2011):

- *The Connected City* (smart logistic & sustainable mobility). The image of a connected city refers to the fact that in an interlinked (from local to global) world, cities can no longer be economic islands in themselves ('no fortresses'), but have to seek their development opportunities in the development of advanced transportation infrastructures, smart logistic systems and accessible communication systems through which cities become nodes or hubs in polycentric networks (including knowledge and innovation networks).
- *The Entrepreneurial City* (economic vitality).This vision assumes that in the current and future global and local competition, Europe can only survive if it is able to maximize its innovative and creative potential in order to gain access to emerging markets outside Europe; cities are then spearheads of Europe's globalization policy.
- *The Pioneer City* (social participation & social capital). This vision refers to the innovative 'melting pot' character of urban areas in the future, which will show an unprecedented cultural diversity and fragmentation of lifestyles in European cities; this will prompt not only big challenges, but also great opportunities for smart and creative initiatives in future cities, through which Europe can become a global pioneer.
- *The Liveable City* (ecological sustainability). The final vision addresses the view that cites are not only energy consumers (and hence environmental polluters), but may – through smart environmental and energy initiatives like recycling and waste recuperation – act as engines for ecologically-benign strategies, so that cities may become climate-neutral agents in a future space-economy; cities in Europe are then attractive places to live and work.

The results show that the Entrepreneurial City is the policy vision with higher priorities in all the sectors considered in the model, i.e. Universities, Government, Industry and Civil Society. This means that a high degree of entrepreneurial activities and a constant flow of new firm creation is a prerequisite for finding a new role within the new global economic landscape. Innovation and creativeness are thus the necessary ingredients for entrepreneurial cities in Europe.

Although the proposed evaluation model and pilot exercise still requires testing and further application with the participation of real city stakeholders, it offers a reflexive learning opportunity for the cities to measure what options exist to improve their performances. ★

References

Benner, C. (2003), 'Learning Communities in a Learning Region: the Soft Infrastructure of Cross-firm Learning Networks', *Environment and Planning A*, 35: 1809-1830.

Deakin, M. (2009), 'The IntelCities community of practice: the eGov services model for socially-inclusive and participatory urban regeneration programmes', In C. Riddeck (ed.), *Research Strategies for eGovernment Service Adoption* (Idea Group Publishing: Hershey), 83-104.

Deakin, M. (2010), 'SCRAN: the Smart Cities (inter) Regional Academic Network Supporting the Development of a Trans-National Comparator for the Standardisation of eGovernment Services' in Reddick, C. (ed.), *Comparative E-government: An Examination of E-Government Across Countries* (Springer Press: Berlin), 425-447.

Ezkowitz, H. (2008), *The Triple Helix: Universtiy, industry and Government* (Routledge: London).

Etzkowitz, H. and C. Zhou (2006), 'Triple Helix twins: innovation and sustainability', *Science and Public Policy*, 33 (1): 77–83.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N. and E. Meijers (2007), Smart cities – Ranking of European medium-sized cities (Centre of Regional Science, Vienna UT) <http://www.smart-cities.eu>, accessed November 25, 2010.

Komninos, N. (2002), *Intelligent cities: innovation, knowledge systems and digital spaces* (Spon Press: London).

Lombardi, P. (2011), 'Managing the green IT agenda', *Intelligent Buildings International*, 3 (2011), 41–45.

Lombardi, P., Cooper, I., Paskaleva, K. and M. Deakin (2009), 'The Challenge of Designing User-Centric e-Services: European Dimensions', In C.Reddick (ed.), *Strategies for Local E-Government Adoption and Implementation: Comparative Studies* (Idea Group Publishing: Hershey).

Lombardi, P., Giordano, S., Farouh, H. and Y. Wael (2011), 'An analytic network model for Smart cities' in F. de Felice and A. Petrillo (eds.), *Proceedings of the 11th International Symposium on the AHP*, Sorrento, Naples, IT, June 15 – 18.

Nijkamp, P. and K. Kourtik (2011), *Joint Programming Initiative (JPI) on Urban Europe. Global challenges and local responses in the urban century. A scoping document* (VU University Amsterdam).

Saaty, T.L. (2005), *Theory and Applications of the Analytic Network Process* (RWS Publications: Pittsburgh).

Shapiro, J. M. (2008), 'Smart cities: quality of life, productivity, and the growth effects of human capital', *The Review of Economics and Statistics*, 88 (2): 324-335.

Torres, L., Vicente, P. and A. Basilio (2005), e-Government Developments on Delivering Public Services Among EU Cities, *Government Information Quarterly*, 22: 217-238.

Van Soom, E. (2009), 'Measuring levels of supply and demand for e-services and e-government: a toolkit for cities', *Smart Cities Research Brief*, N. 3 <http://www.smartcities.info/research-briefs> accessed February 25, 2009.

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