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An Advanced Triple-Helix Network Model for Smart Cities Performance

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ABSTRACT

Focusing on a subset of European cities belonging to the SmartCities (inter) Regional Academic Network (SCRAN), i.e. Bremerhaven, Edinburgh, Groningen, Karlstad, Kortijk, Kristiansand, Lillesand, Osterholz, Norfolk, this chapter will offer a decision network model built around an analytical hierarchy able to verify whether the development of cities with in North Sea Region is smart.

It aims to offer a profound analysis of the interrelations between the components of smart cities, including the human and social relations connecting the intellectual capital, wealth and governance of their regional development.

The chapter demonstrates that the inclusion of the abovementioned relations in the analytical hierarchy framework is significant, as it allows, for the first time, the opportunity for this network model to capture the triple helix of a smart urban or regional development and to verify whether the transformation of cities it ushers in is not merely based on an index of intellectual capital, but also on a measure of wealth creation whose standards of governance are smart.

Keywords: Analytic Network Process, triple-helix model, e-Government, smart cities, sustainable community development.

INTRODUCTION

The past centuries have shown an increasing dominance of cities in the global economic landscape. But it is not the sheer population members that count, but the functional leadership of cities in a modern world. Cities are not just geographical settlements of people, they are also the ‘home of man’ (Ward 1976). They reflect the varied history of mankind and are at the same time contemporaneous expressions of the diversity of human responses to future challenges. A great example of the way urban architecture reflects and shapes the future can be found in Dubai, a city that has deliberately left behind its old history and has decided to shape and pursue a spectacular new urban design and improvements in lifestyle ‘livability and economic viability’. In doing so, it tries to find a balance between economy, technology, society and culture by deploying new urban cultural space as an open innovation action platform for future greater efficiency (by facilitate and support better planning and decision making, improving processes) and accelerated socio-economic growth and by continuous improvement through innovation and mobilizing all resources for smart governance and elite lifestyles in the city. Dubai intends to become a symbol of creative architecture, a really smart city.

Dubai is not an exception, but acts as a trend setter. Actually, modern urban planning shows an avalanche of varying initiatives focused on creative urban development, in particular by centering on culture and acts as multi-faceted cornerstones for innovative development of the city. Consequently, it has become fashionable to regard cultural expressions like arts, festivals, exhibitions, media, communication and advertising, design, sports, digital expression and research as signposts for urban individuality and identity and departures for a new urban cultural industry (see Florida 2002, Scott 2003). ‘Old’ cities like London, Liverpool, Amsterdam, Berlin, Barcelona, New York, San Francisco, Sydney or Hong Kong witness a profound transformation based on smart and creative cultures. This new orientation does not only provide a new dynamism for the city, it also has a symbolic value by showing the historical strength of these places as foundation stones for a new and open future. Clearly, blueprint planning of the city has become outdated. Hence, the creative sector has become an important signpost for modern urban planning and architecture, with major implications for both the micro structures of the city and its macro image towards the outer world. Smart cities may act as a catalyst in a complex society; they make previous functions outdated and replace these by fit-for-purpose designs.

Since Florida’s (2002) ideas on the creative class, the creative industry and the creative city, an avalanche of studies has been undertaken to study the features and success conditions of creative environments (see e.g., Fusco Girard *et al.,* 2009; Gabe, 2006; Heilbrun and Gray, 1993; Hesmondhalgh, 2002; Landry, 2003; Markusen, 2006; Power and Scott, 2004; Pratt, 1997; Scott, 2003; Vogel, 2001). Despite several empirical studies, however, an operational conceptualization of creative infrastructures has as yet not been developed and calls certainly for more profound applied research.

In responding to this call, the authors of this chapter want to suggest a city is “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., 2009, p.6). Furthermore, cities can become “smart” if universities and industry support government’s investment in the development of such infrastructures.

In moving towards such a representation of smart cities, this chapter’s attempt to operationalize the concept of creative infrastructures will take on the notion of triple helix as a starting point. As the main exponents of the triple helix, Etzkowitz and Leydesdorff (2000) offer a particularly insightful critique of so-called “mode 2” accounts of innovation, but limit their representation of the model to those institutional relations surrounding “University, Industry and Government” involvement in the knowledge economy of regional systems. Here attention focuses on the production of knowledge by Universities and Industry as an index of intellectual capital. That tied up in the artifacts of innovations which are patented by industry and licensed in line with the standards laid down by Government to regulate such developments.

While offering many critical insights into the political economy of the triple helix, it is also noticeable these studies reveal little about either the social-basis of University, Industry and Government involvement, or the technical infrastructures of their regional innovation systems (Deakin 2010, p. 4).

Governmental bodies, universities and firms understand each other only when the social and intellectual soil connecting them is fertile for knowledge flows. Hence, the need for local authorities to invest not only in pure *e-gov* and ICT smart solutions, but also in “contour conditions” that determine the final return to such infrastructure investments. In this view, eGovernment can be seen as a :

- component of a smart city;
- way to improve connectivity and social inclusion of citizens;
- chance to cost-effectively reform a city’s public sector.

The inclusion of social aspects and contour conditions will into the triple helix shall offer critical insights into the transformation cities are currently experiencing as part of their drive to become smart , and offers fertile ground for those seeking to magnify the returns from the types of ICT investments currently underpinning the development of eGovernment services.

Taking this form it shall offer a more profound analysis of the interrelations between smart cities components, including the human, social and intellectual capitals connecting the cornerstones of the triple helix. This analysis of the triple helix shall then be augmented using the Analytic Network Process to model, cluster and begin measuring the performance of smart cities. The model obtained allows interactions and feedbacks within and between clusters, providing a process to derive ratio scales priorities from elements (Saaty, 2005). This model offers a more truthful and realistic representation, based on a network system, and appropriated for supporting policy makers. This model exercise will require a participative process, involving with a bottom-up process all the main interested stakeholders.

1. BACKGROUND

The increasing interest and debate on Smart City and the extensive literature on this subject have lead to the identification of a number of main sectors associated with this term, such as economic development, environment, human capital, culture & leisure, e-governence, as well as components or ‘soft factors’, such as: “smart economy”, “smart mobility”, “smart environment”, “smart people”, “smart living”, “smart governance“ (http://www.smart-cities.eu).

This chapter specifically focuses on the role of governance in the development of Smart Cities and measures some cites are taking to be smart in meeting the good governance challenge smart cities pose. The analysis is based on an extensive case-study for European countries and regions bordering the North Sea, addressing innovation and technology policies of the cities. The European cities involved in this exercise are those belonging to the SmartCities (inter) Regional Academic Network (SCRAN), i.e. Bremerhaven, Edinburgh, Groningen, Karlstad, Kortijk, Kristiansand, Lillesand, Osterholz, Norfolk.

It is often claimed that some cities in Europe are smart in the way they use of information and communication technologies (ICTs) to develop e-Gov services. Claims made about their use of ICTs to innovate and develop e-Government services online services testify to this. Recent surveys of these developments, however, also serve to raise a number of questions about whether such ICT-driven innovations are smart and if cities should be creating opportunities for online services offering 24/7 access. As Torres et.al. (2005) have noted, the absence of any commonly agreed terminology to describe such developments has left policy makers without the means to discuss such matters and agree what they represent.

In an attempt to overcome this and begin to understand what such developments mean (Torres et.al 2005) and others (for example: Lee, 2006; Lombardi *et.al*, 2009; Deakin, 2009) have sought to develop a user-centric and customer-focused terminology capable of supporting a standard classification of the e-Gov service developments in question (Deakin, 2010). Having made headway with this standardization of e-Gov service developments, attention has now begun to turn towards the question of what it means for cities to be smart. Others have taken a more ‘measured’ approach and sought to use the indicator sets currently available as the statistical base for analyzing what smart city developments of this kind contribute to sustainable urban development (Torres, 2005; Caragliu et al., 2009).

However, answering this question has also been hampered, not so much with the need to agree a standard representation of e-Gov service developments, but by the lack of a robust statistical base to measure them by. For some this has resulted in a desperate cry for the ‘real smart city to stand up’, explain what it means for a city to be smart and how the e-Gov service developments embarked upon to gain such a standing can be measured (Hollands, 2008; Caragliu et.al. 2009; Deakin, 2010).

In doing so, the authors of this chapter adopt an extended Triple Helix to baseline the development of smart cities in terms of their traditional and contemporary roles: first as generators of intellectual capital, creators of wealth and regulator of standards (University, Industry and Government, respectively), then as cities that use such attributes to be smart in supporting the social learning, market-based entrepreneurial capacities and knowledge-transfer abilities which are needed to meet the requirements of their regional innovation systems.

Reporting on the outcomes of this evaluation, the chapter argues such transnational assessments are particularly important because the work published by Torres et.al. (2005) has defined those authorities responsible for promoting e-Gov service developments as 'steady achievers', not particularly innovative, or creative. This in turn tending to suggest that any evaluation of the developments underway within the North Sea Region have first of all: to discover what it is that makes them steady achievers' when compared against the more innovative, creative, vies-a-vies, smarter counterparts in mainland and Southern Europe. Then draw upon the outcome of this trans-national assessment to uncover what innovation and creativity is required in order for smart cities to develop across the North Sea Region.

The study is on-going and is currently exploring the possibility of measuring the environmental sustainability of smart cities by way of and through an ANP analysis.

2. SMARTCITIES METRICS DEVELOPMENT

Issues, Controversies, Problems

The triple helix model has emerged as a reference framework for the analysis of knowledge-based innovation systems, and relates the multiple and reciprocal relationships between the three main agencies in the process of knowledge creation and capitalization: university, industry and government (see for a recent overview Etzkowitz, 2008). In the context of the present analysis, we will focus on this model as a starting point for the assessment of the performance of smart cities. In order to link the evaluation of smart city components and the three main helices of the model, we propose a modified triple helix framework by adding another unifying factor to the analysis, namely by including the urban market and demand and contour conditions. While knowledge and innovation are determined and created by the interplay and relations of the three traditional helices, their use and accumulation are fostered by the interaction with the local market potential and contour conditions, which enable cities to create, diffuse and use new knowledge. In this sense, our advanced triple helix specification provides the link between the urban innovation system and the achievement of smart city development. The advanced model presupposes that the three helices operate in a complex urban environment, where market demand, governance, civic involvement and citizens' characteristics, 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. Our framework can be exemplified by the following figure (Figure 1) and can be operationalized by focusing on the measurement of the three main helices and the contour conditions and linking these to a smart city indicator.

The original triple helix analyzes the crucial role of the interplay between the three main helices of the innovation system, viz. university, industry and government (see Fig.1).

Figure 1: The original Triple Helix.

However, in this model scarce attention is paid to the output generated by, and the filters intervening in, the relations between each of the traditional triple helix axes. In this paper we suggest a modified version of the triple helix (Figure 2), where such filters are evidenced and contribute to our understanding of the nature of the innovation systems. In fact, we believe that the efficiency of the knowledge exchange among the actors of the triple helix is enhanced as the filters suggested in our model are effective. In particular:

- The knowledge stock generated by the interplay between universities and industry contributes to the generation of trustworthy relations between the two, and represents an asset for future learning performance (Cohen and Levinthal, 1990);

- Collective learning mechanisms take place, as universities and government bodies act together in searching for efficient public management solutions, causing the creative resonance mechanism at the basis of innovation processes;
- Finally, the thickness and efficiency of market institutions and actors are strongly related to the efficiency with which industry and government exchange information and generate innovative products and processes. This is probably the most strikingly absent element within the original triple helix approach, whereas the absence of market institutions and relations represents a crucial missing link in explaining innovation processes.

Figure 2: The revised Triple Helix.

According to this scheme, knowledge is the result of the interaction between University and Industry. In fact, as pointed out in Etkowitz (2002), the European Innovation System is relatively lagging in this respect, while laws fostering such interactions, as the Bayh-Dole Act in the US, may provide positive incentives for establishing successful research activities.

The interplay between University and Government produces what is here labeled as “Learning”. Public institutions learn from educational bodies ways to improve their performance and take advantage of a better educated workforce. At the same time, the university system benefits from an efficient management of public goods. The mutual reinforcement of this mechanism generates society-level learning.

Finally, an efficient market, based on well-defined rules and functioning institutions, is needed in order to guarantee a successful cooperation between public and private sectors. The interrelations between government and industry are multifaceted and complex, and are enhanced by local market conditions.

These three elements, viz. Knowledge, Learning, and their institutionalization within on the Market, represent the innovative component of our approach and form the contour conditions that magnify the returns to the original Triple Helix elements.

We adopt this original framework in order to analyze cities belonging to the SCRAN network, and assess the connections between Smart City development and this institutionalization of the

Triple Helix. As pointed out above, traditional “Smart City” definitions usually focus on digital services. While the original Triple Helix already suggests the need for a broader perspective, here we claim that this can be further improved by considering the contour conditions in each city. It is for this reason , we analyze Smart Cities through such an institutionally-grounded representation of the Triple Helix.

In undertaking this analysis, the research team has assembled a new data set, collecting information from the SCRAN cities. Among the data obtained, we identified one indicator suitable for each of the elements of the New Triple Helix. Data are described in Table 1.

Context	Element	Measure
Original Triple Helix	University	University (% people aged 20-24 enrolled in tertiary education)
Original Triple Helix	Industry	Industry (Number of companies per 1,000 pop.)
Original Triple Helix	Government	Government (% labour force in government sector-L to Q: Public administration and community services; activities of households; extra-territorial organizations)
Revised Triple Helix	Learning	Learning (labour force with ISCED 5 and 6 education)
Rvised Triple Helix	Market	Market (Per capita GDP)
Revised Triple Helix	Knowledge	Knowledge (Patent applications to the EPO per 1,000 inh.)

Table 1: New Triple Helix data.

The data are used to graphically represent the overall dimension of the Modified Triple Helix for the Smart Cities, in comparison with the average EU27 situation. This is done in Figure 3.

With respect to the traditional three helices Smart Cities are above the EU average. In fact, there is a higher percentage of young adults engaged in higher education, a higher share of labour force in the government sector and a higher intensity of firms per population.

While Smart Cities match the average EU performance in terms of the market, they slightly under- perform knowledge and learning when compared against the EU average. This allows us to conclude that, while the cities in our sample are indeed moving in the right direction, there is still room for improvement. The lag in terms of contour conditions may hamper the positive and rich endowment with traditional triple helix elements.

Toward a more sound measure of "Smartness"

This section connects the introductory remarks with the ANP analysis by linking the Triple Helix approach to the concept of Smart City. Previously Caragliu et al. (2009) has stated that traditional definitions of smart cities fall short of their ambition because they tend to ignore contour conditions around urban digital characteristics. A measure strictly deriving from their definition could be calculated as follows.

Indicators on each of the six axes identified as crucial to define urban smartness are collected from SCRAN cities. Namely, Percentage of households with Internet access at home; Proportion of households with broad band access; Length of public transport network; Proportion of population aged 15-64 with some college education living in Urban Audit cities; Green space (in m2) to which the public has access, per capita; Annual expenditure of the Municipal Authority per resident.

Spatial variance in terms of these indicators is then summarized with a Principal Component Analysis (PCA), whose first component (explaining 40% of total variance) is labeled "Smartness".

Principal Component Analysis (PCA) is a multivariate statistical technique aiming at identifying patterns in data and eventually compressing them by reducing the number of dimensions, each of which, orthogonal to the previous component, is the single subcomponent maximizing the original variance in the data. This process has the advantage of reporting the amount of variance in the data explained by each aggregate index. In practice, the original data is standardized, the covariance matrix is calculated, and eigenvectors and eigenvalues are computed. Eigenvectors are then ordered with respect to associated eigenvalues, from highest to lowest. The Principal Components, or PC (i.e. eigenvectors with the highest eigenvalues, which are linear combinations of the original variables) are then selected according to the Jollife-amended Kaiser eigenvalue criterion and examination of the proportion of variance accounted by the Principal Components. Besides, all components are built in order to be orthogonal to each other.

Figure 4 shows that this indicator is strongly related to urban digital characteristics. Therefore, while on the one hand extending traditional narrow definitions of urban smartness from sheer wired-ness to a more comprehensive view, it still focuses on ICTs. In Figure 4, the X-axis shows the rate of broadband penetration in Smart Cities, and the Y-axis the Smart Cities indicator above described. The two indicators have a Pearson's correlation index of 0.84, significant at all conventional levels.

As noted earlier, success of National and Local Innovation Systems, represented in the New Triple Helix model, does not solely depend on ICTs, but on all characteristics of the local innovation environment. Therefore, Smartness and good positioning in terms of the revised Triple Helix do not necessarily coincide.

In order to make this statement evident we built an indicator of positioning in the New Triple Helix context, based on a PCA on the six indicators summarized in Table 1. The first Component explains around 40% of total variance in the data. In Figure 5 we plot the Smartness Indicator on the X-axis and the revised Triple Helix Index on the Y-axis for 9 SCRAN Cities.

The graph shows a vertical and an horizontal dashed line, corresponding to half distribution in terms of both indicators. In this way we identify four quadrants (first quadrant on the top right of the graph, to be read clockwise).

Figure 3: New Triple Helix for the Smart Cities.

Figure 4: Smartness penetration.

Figure 5: Smart Cities and the revised Triple Helix.

The first striking result is that no city scores high with respect to *both* indicators, highlighting a potential direction for future improvement. In quadrant II we observe cities scoring high in terms of ICT endowment, but relatively worse in terms of structural innovation-oriented characteristics. In quadrant IV the opposite happens, with cities showing a good performance of traditional triple helix elements, but less rich in terms of ICTs. Quadrant III, finally, shows two cities with potential for improvement along both dimensions. Notice that the graph is built solely on SCRAN cities data; as such, it tells nothing about relative positioning of the SCRAN cities with respect to potential competitors. In fact, as Figure 3 clearly shows, SCRAN cities score relatively high with respect to the EU average in most Triple Helix indicators.

The analysis presented in this Section shows some potential for cross-fertilization of the two areas of research, and stresses the importance of analyzing several dimensions of the urban environment in order to assess a city performance.

FUTURE RESEARCH DIRECTIONS

The results of the study illustrated in the previous sections has shown the analysis to baseline the development of smart cities in terms of their traditional and contemporary roles: first as generators of intellectual capital, creators of wealth and regulator of standards (University, Industry and Government, respectively), then as cities that use such attributes to be smart in supporting the social learning, market-based entrepreneurial capacities and knowledge-transfer abilities which are needed to meet the requirements of their regional innovation systems.

A further research currently being undertaken aims to establish the steps the same cities are taking to use the ICTs of e-government as a means to get "beyond the baseline". That is the steps they are taking to use ICTs as a means to develop their public services in line with the needs of information society and requirements this in terms places on the knowledge economy of smart cities. This "extended analysis" will also serve to highlight some of the "rich ecologies" that underpin the environmental sustainability of these service developments and upon which the "smartness" of their information society and knowledge economy in turn rest.

In particular, "green space", space dedicated to leisure and recreational use and the length of the public "transportation" data sets have been selected and used as a means to indicate how bio-diversity and carbon reduction measures are not only linked to social mobility, but also connected to the economic costs of the "learned" workface employed in knowledge production. Good performance along these dimensions indicate that city planners have taken steps towards greater sustainability and value not only technological and knowledge-related aspects of smart urban evolution, but are concerned with quality of life and aim at becoming green cities.

Figure 6 shows results from the evaluation of Smart Cities' performance in terms of eco-sustainability with respect to the urban European average. Authors have considered the square meters of green are each inhabitant has access to, the length in kilometres of public transportation and the area, in square meters, used for recreational sports and leisure. As can be inferred from visual inspection, Smart Cities can be also labelled as Green Cities, since areas devoted to recreation and green are above the European average, and the public transportation network's length is comparable to the other EU cities.

Figure 6 : An evaluation of Smart Cities' performance in terms of eco-sustainability with respect to the urban European average

This study is on-going and currently authors are exploring the possibility of identifying and measuring the relations between the Smart Cities components, including the environmental sustainability by way of and through an ANP model. The ANP is the first mathematical theory that makes possible to systematically deal with all kinds of dependencies (Saaty, 2005). This is helpful for highlighting the relationships between triple helix indicators and Smart cities components, specifically: economic development, environment, human capital, culture & leisure, e-governence, as highlighted in the Table 2 below. The source of data for this table are both literature review (including EU projects' reports and Urban Audit dataset) and indicators selected from the partner cities of the SCRAN project.

The assessment model is still to be developed and requires all the following steps:

1. Structuring the decision-making model. This activity involves an identification of the relationships between the elements constituting the decision problem. There are two possible modelling approaches to ANP: the BOCR (Benefits, Costs, Opportunities, Risks) approach, suggested by Saaty (2005), which allows to simplify the problem structuring by classifying issues into traditional categories of cost and benefit; and a free-modelling approach, which may better reflect the complexity of a problem.

2. Developing pairwise comparison of both elements and clusters to establish relations within the structure. In this step, a series of pairwise comparisons are made by participants to the decision making process (usually experts, managers and citizens representatives) to establish the relative importance of decision elements with respect to each component of the network. In pairwise comparisons, a ratio scale of 1-9 number is used (named, fundamental scale or Saaty' scale). The numerical judgments established at each level of the network form pair matrixes which are used to derive weighted priority vectors of elements (Saaty, 2001).

3. Achievement of the final priorities. To obtain the global priority vector of the elements, including the alternatives, the mathematical approach encompass the use of "supermatrices" (see also the glossary at the end of this paper). The supermatrix which contains the global priority vector, i.e. a long-term stable set of weights is obtained by raising to limiting power the weighted supermatrix.

Revised Triple Helix	E-Governence	Econmical Development	Human Capital	Culture & Leisure	Environment
	INDICATORS				
University	Number of knowledge centre (top research centres, top universities etc.)		Proportion of population aged 15-64 with secondary level education living in Urban Audit cities - % Proportion of population aged 15-64 with some college education living in Urban Audit cities - %		
Knowledge	Percentage of households with Internet access at home Proportion of households with broad band access	Proportion of employment in: -Culture and entertainment industry Employment rate in knowledge-intensive sectors	Foreign language skills	The number of public libraries Total book loans and other media per resident Theatre attendance (per year) Annual visitors to museums per resident	Ecological Footprint
Government	Number of administrative forms available for Number of administrative forms which can be submitted electronically Length of public transport network (km) Annual expenditure of the Municipal Authority per resident Proportion of municipal authority income from transfers from nat., reg., Debt of municipal authority per resident	Gross Domestic Product per head of city Proportion of employment in: - Commercial services - Transport and communication - Trade - Hotels and restaurants Number of unemployed Unemployment rate Median or average disposable annual household income New business registered in reference year (net entry rate)	Population density in Urban Audit cities Total Economically Active Population Political activity of inhabitants City representatives per resident Share of female city representatives	Proportion of the area in recreational sports and The number of theatres Number of museums Tourist overnight stays in registered accommodation in Urban Audit cities	Green space (m2) to which the public has access, per capita Area in green space (m2) Efficient use of water (use per GDP) Efficient use of electricity (use per GDP)
Innovation		R&D expenditure in % of GDP	Patent applications per inhabitant		
Industry	Number of local units manufacturing ICT products	Proportion of employment in: - Agriculture & fishery - Mining, manufacturing and energy - Construction All companies (total number) Companies with HQ in the city quoted on national stock market	Share of people working in creative industries		Rate of rycycled waste per total kg of waste produced

Table 2: Smart Cities components and indicators

The development of the above methodological steps entails the participation of the partner cities. For this shall also offer a reflexive learning opportunity for the cities and for them to calculate what options exist to improve their performance i.e. what courses of actions they can select from the rich ecology of their selection environments to become smarter. Studies of this type in turn offer the means for the Smart City partners to learn about these opportunities, the options that exist to improve performance and the courses of action open to smart cities and the rich ecology of their selection environments.

CONCLUSIONS

As briefly illustrated in the introduction of this chapter, smart cities' concepts have recently become rather fashionable. A main challenge of the modern creative fashion in smart cities is to translate creative and cultural assets and expressions into commercial values (value added, employment, visitors etc.), which means that private-sector initiatives are a sine qua non for effective and successful urban creativeness strategies. Consequently, an orientation towards local identity and local roots ('the sense of place'), a prominent commitment of economic stakeholders (in particular, the private sector), and the creation of a balanced and appealing portfolio of mutually complementary urban activities are critical success conditions for a flourishing urban creativeness strategy.

Smart cities offer through their agglomeration advantages a broad array of business opportunities for creative cultures, in which in particular self-employment opportunities and small- and medium-sized enterprises (SMEs) may play a central role in creating new urban vitality. Clearly, flanking and supporting urban conditions, e.g., local identity, an open and attractive urban 'milieu' or atmosphere, usage of tacit knowledge, presence of urban embeddedness of new business initiatives, and access to social capital and networks, provide additional opportunities for a booming urban creativeness culture and an innovative, vital and open urban social ecology. Urban creativeness presupposes an open and multi-faceted culture and policy supported by smart people.

This chapter has tried to answer to the following main question: “If smart cities build the capacity for information society and support civic engagement by way of eGovernment services and through their development, what role do the institutions underlying all of this play in the process?”

In answering to this question, the analysis has revised the notion of triple helix concept considering that governmental bodies, universities and firms understand each other only when the social and intellectual soil connecting them is fertile for knowledge flows. The revised triple helix model includes three elements, viz. Knowledge, Learning, and their institutionalization within on the Market which form the “contour conditions” that magnify the returns to the original Triple Helix elements.

A quantitative analysis was developed focusing on a subset of European cities belonging to the SCRAN network, using the revised representation of the Triple Helix, in order to assess the connections between Smart city development and this institutionalization of the Triple Helix.

The results obtained stressed the importance of analyzing several dimensions of the urban environment in order to assess a city performance. This is the reason why we have developed a further step of analysis, considering four clusters of indicators, interconnected in a network model.

An analytical network framework has to be used which allows the opportunity to capture the triple helix of a smart urban development and to verify whether the transformation of cities it ushers in is not merely based on an index of intellectual capital, but also on a measure of wealth creation whose standards of governance are smart.

This analysis requires the participation of each city representatives and it is the objective of our future work.

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KEY TERMS & DEFINITIONS

Analytic Network Process (ANP) is a more general form of the analytic hierarchy process (AHP) used in multi-criteria decision analysis. AHP structures a decision problem into a hierarchy with a goal, decision criteria, and alternatives, while the ANP structures it as a network. Both then use a system of pairwise comparisons to measure the weights of the components of the structure, and finally to rank the alternatives in the decision. See also: http://www.isahp.org/

Cluster. It is part of a network model, it a group of homogeneous elements (criteria or alternatives) of a decision making problem.

Creativity. It implies the creation of attractive cities that are desirable places to live, especially in terms of recreating those community values which are believed to produce a sense of citizenship.

e-Government Services: are internet technologies that act as a platform for exchanging information, providing services and transacting with citizens, businesses, and other arms of government. Examples include: i) Pushing information over the Internet, e.g: regulatory services, general holidays, public hearing schedules, issue briefs, notifications, etc.; ii) Two-way communications between the agency and the citizen, a business, or another government agency; iii) Conducting transactions, e.g: lodging tax returns, applying for services and grants; iv) Governance, e.g: online polling, voting, and campaigning.

Principal Component Analysis (PCA): is a multivariate statistical technique aiming at identifying patterns in data and eventually compressing them by reducing the number of dimensions, each of which, orthogonal to the previous component, is the single subcomponent maximizing the original variance in the data. This process has the advantage of reporting the amount of variance in the data explained by each aggregate index.

Smart city: a city where investments in the human and social capital of modern (ICT) communication infrastructures offer the intelligence to underpin economic growth and platform of wealth creation whose standards of governance support a high quality of living.

SmartCities project: an innovation network between governments and academic partners leading to excellence in the domain of the development and take-up of e-services, setting a new baseline for e-service delivery in the whole North Sea region. Fore more details see: http://www.smartcities.info/

Triple helix: universities, industry, government constitute the three helices that engage in knowledge production. Institutes of higher learning (colleges and universities) primarily represent academia in this paradigm. There are no restrictions on the types of industry (firm) involvement in triple helix innovation processes: i.e., industry may be represented by private corporations, partnerships, or sole proprietorships. Government may be represented by any of the three levels of government and their owned corporations: Federal (national), state (provincial), and local (municipal).

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