VU Research Portal

An advanced triple-helix network model for smart cities performance

Lombardi, P.; Giordano, S.; Caragliu, A.; Del Bo, C.; Deakin, M.; Nijkamp, P.; Kourtit, K.

2011

document version

Early version, also known as pre-print

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Lombardi, P., Giordano, S., Caragliu, A., Del Bo, C., Deakin, M., Nijkamp, P., & Kourtit, K. (2011). *An advanced triple-helix network model for smart cities performance*. (Research Memorandum; No. 2011-45). Faculty of Economics and Business Administration.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:

vuresearchportal.ub@vu.nl

An advanced triple-helix network model for smart cities performance

Research Memorandum 2011-45

**Patrizia Lombardi
Silvia Giordano
Andrea Caragliu
Chiara Del Bo
Mark Deakin
Peter Nijkamp
Karima Kourtit**

An Advanced Triple–Helix Network Model for Smart Cities Performance

Patrizia Lombardi, Silvia Giordano, Andrea Caragliu, Chiara Del Bo,
Mark Deakin, Peter Nijkamp, Karima Kourtit

Corresponding address: VU University, Faculty of Economics and Business Administration,
Department of Spatial Economics, p.nijkamp@vu.nl

Pn434etal

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-governance, 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 cities 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, Kortrijk, 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
<i>Original Triple Helix</i>	University	University (% people aged 20-24 enrolled in tertiary education)
<i>Original Triple Helix</i>	Industry	Industry (Number of companies per 1,000 pop.)
<i>Original Triple Helix</i>	Government	Government (% labour force in government sector-L to Q: Public administration and community services; activities of households; extra-territorial organizations)
<i>Revised Triple Helix</i>	Learning	Learning (labour force with ISCED 5 and 6 education)
<i>Rvised Triple Helix</i>	Market	Market (Per capita GDP)
<i>Revised Triple Helix</i>	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 SCRAM 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 Jolliffe-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 biodiversity and carbon reduction measures are not only linked to social mobility, but also connected to the economic costs of the "learned" workforce 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-governance, 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-Governance	Economical 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.

REFERENCES

Authored book:

- Etzkowitz, H. (2008). *The triple helix: university-industry-government innovation in action*. London, UK: Routledge.
- Etzkowitz, H., Leydesdorff, L. (2002). *Universities and the Global Knowledge Economy NIP: A Triple Helix of University-industry-Relations*, Continuum International Publishing Group Ltd.
- Etzkowitz, H. (2008) *The Triple Helix: University, industry and Government*, Routledge, London.
- Florida, R. (2002). *The rise of the creative class: and how it's transforming work, leisure, community and everyday life*, New York City, New York,: Basic Books.
- Heilbrun, J., and C.M. Gray, *The Economics of Art and Culture*, Cambridge University Press, New York, 1993
- Saaty, T.L., (2005), *Theory and Applications of the Analytic Network Process*, RWS Publications, Pittsburgh.
- Vogel, H., *Entertainment Industry Economics*, Cambridge University Press, New York, 2001

Chapter in an edited book:

- Deakin, M. (2009) The IntelCities Community of Practice: the eGov services model for socially-inclusive and participatory urban regeneration programmes, in Reddick, C. ed., *Research Strategies for eGovernment Service Adoption*, Idea Group Publishing, Hershey
- Deakin, M. (2010) SCRAN: the SmartCities (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.
- Deakin, M. (2010). SCRAN's development of a trans-national comparator for the standardization of egovernment services. In Reddick, C. (Ed.), *Comparative e-government: an examination of e-government across countries*, Springer Integrated Series in Information Systems.
- Lombardi P., Cooper I, Paskaleva K & Deakin M. (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.
- Nijkamp, P., & G. Cohen, Opportunities and Pitfalls of Local e-Democracy, In U. Allegretti (Ed.), *Democrazia Partecipativa*, Firenze University Press, Firenze, 2010, pp. 200-215.

Journal article:

- Caragliu, A, Del Bo, C. & Nijkamp, P. (2009). Smart cities in Europe. *Series Research Memoranda 0048*. from <http://ideas.repec.org/p/dgr/vuarem/2009-48.html>.

- Cohen W., and Levinthal, D. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*: Vol. 35, No. 1, 128-152.
- Fusco Girad, L., Lombardi, P., Nijkamp, P. (2009) Creative Urban Design and Development (special issue), *International Journal of Services Technology and Management*: Vol. 13, No. 2/3/3, pp.111-115
- Deakin, M. (2009). A Community-based approach to sustainable urban regeneration. *Journal of Urban Technology*: Vol. 16, No. 1, 91-110.
- Etzkowitz, H., Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations, *Research Policy*: Vol. 29, No. 2, pp. 109-123.
- Gabe, T.M., Growth of Creative Occupations in U.S. Metropolitan Areas, *Growth and Change*, vol. 37, no. 3, 2006, pp. 396-415
- Hollands, R. (2008). “Will the real smart city please stand up?”, *City*, 12 (3), 303-320.
- Lee, L., Tan. X. and Trimmi, S. (2006) Current practices of leading e-government countries, *Communications of the ACM*, 48, (10): 100-104.
- Lombardi P. Cooper I. (2009). The Challenge Of The eAgora Metrics. *International Journal Of Services Technology And Management*: Vol. 13, No. 2/3/3, pp. 210-222.
- Markusen, A., Urban Development and the Politics of a Creative Class, *Environment & Planning A*, vol. 38, no. 10, 2006, pp. 1921-1940
- Paskaleva-Shapira, K. (2008) Assessing local e-governance in Europe, *International Journal of Electronic Governance Research*, 4, (4): 17-36.
- Pratt, A., The Cultural Industries Production System, *Environment & Planning A*, vol. 29, 1997, pp. 1953-1974.
- Torres, L., Vicente, P., Basilio A. (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, Retrieved February 25, 2009, from <http://www.smartcities.info/research-briefs>.

Published proceedings:

Caragliu, A., Del Bo, C. and Nijkamp. P. (2009) Smart Cities in Europe, paper presented to the *Creating Smarter Cities Conference*, Edinburgh Napier University, March 2009.

Web site:

Smart Cities is a North Sea Intereg 4B project (2007-2013)

<http://www.northsearegion.eu/ivb/projects/details/&tid=84>

Smart cities – Ranking of European medium-sized cities, Centre of Regional Science, Vienna UT, October 2007. Retrieved November 25, 2010, from <http://www.smart-cities.eu>

Quality of Life in Twelve of New Zealand’s Cities, Report 2007. Retrieved November 25, 2010, from <http://www.qualityoflifeproject.govt.nz>

ADDITIONAL READING SECTION

- Amin, A. and Roberts, J. (2008) Knowing in action: beyond communities of practice, *Research Policy*, 37: 353–369.
- Berger, C. Möslein, K., Piller, F. and Reichwald, R. (2005) Cooperation between manufacturers, retailers, and customers for user co-design: learning from exploratory research, *European Management Review*, 1:70-87.
- Binder, T., Brandt, E. and ; Gregory, J. (2008) Design participation(-s) – a creative commons for ongoing change, *CoDesign*, 4, (2): 79–83
- Campbell, F. and Deakin, M. (2005) Cities as leading examples of digitally-inclusive knowledge societies: the e-citizenship course, representative users ,pedagogy and engagement matrix, in Osborne, M. and Wilson, B., *Making Knowledge Work*, Stirling, Stirling University.
- Curwell, S., Deakin, M., Cooper, I., Paskaleva-Shapira, K., Ravetz, J. and Babicki, D. (2005) Citizens expectations of information cities: implications for urban planning and design', *Building Research and Information*, 22, (1): 55-66.
- Deakin, M and Allwinkle. S. (2006) The IntelCities community of practice: the e-learning platform, knowledge management system and digital library for semantically-interoperable e-governance services, *International Journal of Knowledge, Culture and Change Management* 6, (3):155-162.
- Deakin, M and Allwinkle, S. (2007) e-Topia, SUD and ICTs: the post-human nature, embedded intelligence, cyborg-self and agency of digitally-inclusive regeneration platforms, *International Journal of the Humanities*, 5, (2):199-208.
- Deakin, M. (2007) e-Topia, SUD and ICTs: taking the digitally-inclusive urban regeneration thesis full circle, *Journal of Urban Technology*, 14, (3): 131-139.
- Deakin, M. (2011) From Intelligent to Smart Cities: CoPs as organizations for developing integrated models of eGovernment Services, in Melih, B., *City Competitiveness and Information Science*, IGI publisher, Hershey.
- Deakin, M. and Allwinkle, S. (2007) Urban regeneration and sustainable communities: the role of networks, innovation and creativity in building successful partnerships, *Journal of Urban Technology*, 14, (1): 77-91.
- Deakin, M., Van Isacker, K. and Wong. A. (2004) *Review of the IntelCities Knowledge Capture Requirements Using a S.W.O.T. Analysis*, Edinburgh, Napier University.
- Ellis, D., Oldridge, R., Vasconcelos, A. (2004) Community and Virtual Community, *Annual Review of Information Sciences and Technology* 38, 146–186.
- Figueria, J., Greco, S., Ehrgott, M. (Eds.) (2005), *Multiple Criteria Decision Analysis. State of the Art*, Springer Science, New York.
- Graham, S. and Marvin, S. (1996) *Telecommunications and the City*, London, Routledge.
- Johnson, C. (2001) A survey of current research on online communities of practice. *Internet and Higher Education* 4, 45–60.
- Josefsson, U. (2005) Coping with illness online: the case of patients online communities. *The Information Society*, 21, 143–153.
- Lombardi, P. and Curwell. S. (2005) INTELCITY Scenarios for the City of the Future. In D. Miller and D. Patassini, *Beyond Benefit Cost Analysis*, Aldershot, Ashgate.
- Mitchell. W. (2000) *e-Topia: Urban Life, Jim But Not as You Know It*, Cambridge Massachusetts, MIT Press.

- Muller, D. and Patassini, D. (Eds.) (2005), *Beyond Benefit Cost Analysis*, Ashgate, Aldershot (Hampshire).
- Nikolaus, F., Keinz, P., and Schreier, M. (2008) Complementing Mass customization toolkits with user communities: how peer input improves customer self-design, *Journal of Product Innovation Management*, [25 \(6\)](#): 546-559.
- Orr, J. (1996). *Talking About Machines: An Ethnography of a Modern Job*, New York, IRL Press an imprint of Cornell University Press.
- Saaty, T. L. and Vargas, L. G. (2006), *Decision Making with the Analytic Network Process*, Springer Science, New York.
- Saaty, T., (2001), *The Analytic Network Process*, RWS Publications, 4922 Pittsburgh, PA 15213
- Wenger, E., (1998). *Communities of Practice: Learning, Meaning, and Identity*, Cambridge, Cambridge University Press.
- Wenger, E., (2000). Communities of practice and social learning systems, *Organization*, 7, (2), 225–246.
- Wind, J., and Rangaswamy, A. (2001). Customerization: The next revolution in mass customization *Journal of Interactive Marketing*, 15, (1): 13-32.

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. For 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).

2007-1	M. Francesca Cracolici Miranda Cuffaro Peter Nijkamp	Geographical distribution of enemployment: An analysis of provincial differences in Italy, 21 p.
2007-2	Daniel Leliefeld Evgenia Motchenkova	To protect in order to serve, adverse effects of leniency programs in view of industry asymmetry, 29 p.
2007-3	M.C. Wassenaar E. Dijkgraaf R.H.J.M. Gradus	Contracting out: Dutch municipalities reject the solution for the VAT-distortion, 24 p.
2007-4	R.S. Halbersma M.C. Mikkers E. Motchenkova I. Seinen	Market structure and hospital-insurer bargaining in the Netherlands, 20 p.
2007-5	Bas P. Singer Bart A.G. Bossink Herman J.M. Vande Putte	Corporate Real estate and competitive strategy, 27 p.
2007-6	Dorien Kooij Annet de Lange Paul Jansen Josje Dijkers	Older workers' motivation to continue to work: Five meanings of age. A conceptual review, 46 p.
2007-7	Stella Flytzani Peter Nijkamp	Locus of control and cross-cultural adjustment of expatriate managers, 16 p.
2007-8	Tibert Verhagen Willemijn van Dolen	Explaining online purchase intentions: A multi-channel store image perspective, 28 p.
2007-9	Patrizia Riganti Peter Nijkamp	Congestion in popular tourist areas: A multi-attribute experimental choice analysis of willingness-to-wait in Amsterdam, 21 p.
2007-10	Tüzin Baycan-Levent Peter Nijkamp	Critical success factors in planning and management of urban green spaces in Europe, 14 p.
2007-11	Tüzin Baycan-Levent Peter Nijkamp	Migrant entrepreneurship in a diverse Europe: In search of sustainable development, 18 p.
2007-12	Tüzin Baycan-Levent Peter Nijkamp Mediha Sahin	New orientations in ethnic entrepreneurship: Motivation, goals and strategies in new generation ethnic entrepreneurs, 22 p.
2007-13	Miranda Cuffaro Maria Francesca Cracolici Peter Nijkamp	Measuring the performance of Italian regions on social and economic dimensions, 20 p.

2007-14	Tüzin Baycan-Levent Peter Nijkamp	Characteristics of migrant entrepreneurship in Europe, 14 p.
2007-15	Maria Teresa Borzacchiello Peter Nijkamp Eric Koomen	Accessibility and urban development: A grid-based comparative statistical analysis of Dutch cities, 22 p.
2007-16	Tibert Verhagen Selmar Meents	A framework for developing semantic differentials in IS research: Assessing the meaning of electronic marketplace quality (EMQ), 64 p.
2007-17	Aliye Ahu Gülümser Tüzin Baycan Levent Peter Nijkamp	Changing trends in rural self-employment in Europe, 34 p.
2007-18	Laura de Dominicis Raymond J.G.M. Florax Henri L.F. de Groot	De ruimtelijke verdeling van economische activiteit: Agglomeratie- en locatiepatronen in Nederland, 35 p.
2007-19	E. Dijkgraaf R.H.J.M. Gradus	How to get increasing competition in the Dutch refuse collection market? 15 p.

2008-1	Maria T. Borzacchiello Irene Casas Biagio Ciuffo Peter Nijkamp	Geo-ICT in Transportation Science, 25 p.
2008-2	Maura Soekijad Jeroen Walschots Marleen Huysman	Congestion at the floating road? Negotiation in networked innovation, 38 p.
2008-3	Marlous Agterberg Bart van den Hooff Marleen Huysman Maura Soekijad	Keeping the wheels turning: Multi-level dynamics in organizing networks of practice, 47 p.
2008-4	Marlous Agterberg Marleen Huysman Bart van den Hooff	Leadership in online knowledge networks: Challenges and coping strategies in a network of practice, 36 p.
2008-5	Bernd Heidergott Haralambie Leahu	Differentiability of product measures, 35 p.
2008-6	Tibert Verhagen Frans Feldberg Bart van den Hooff Selmar Meents	Explaining user adoption of virtual worlds: towards a multipurpose motivational model, 37 p.
2008-7	Masagus M. Ridhwan Peter Nijkamp Piet Rietveld Henri L.F. de Groot	Regional development and monetary policy. A review of the role of monetary unions, capital mobility and locational effects, 27 p.
2008-8	Selmar Meents Tibert Verhagen	Investigating the impact of C2C electronic marketplace quality on trust, 69 p.
2008-9	Junbo Yu Peter Nijkamp	China's prospects as an innovative country: An industrial economics perspective, 27 p
2008-10	Junbo Yu Peter Nijkamp	Ownership, r&d and productivity change: Assessing the catch-up in China's high-tech industries, 31 p
2008-11	Elbert Dijkgraaf Raymond Gradus	Environmental activism and dynamics of unit-based pricing systems, 18 p.
2008-12	Mark J. Koetse Jan Rouwendal	Transport and welfare consequences of infrastructure investment: A case study for the Betuweroute, 24 p
2008-13	Marc D. Bahlmann Marleen H. Huysman Tom Elfring Peter Groenewegen	Clusters as vehicles for entrepreneurial innovation and new idea generation – a critical assessment
2008-14	Soushi Suzuki Peter Nijkamp	A generalized goals-achievement model in data envelopment analysis: An application to efficiency improvement in local government finance in Japan, 24 p.
2008-15	Tüzin Baycan-Levent	External orientation of second generation migrant entrepreneurs. A sectoral

	Peter Nijkamp Mediha Sahin	study on Amsterdam, 33 p.
2008-16	Enno Masurel	Local shopkeepers' associations and ethnic minority entrepreneurs, 21 p.
2008-17	Frank Frößler Boriana Rukanova Stefan Klein Allen Higgins Yao-Hua Tan	Inter-organisational network formation and sense-making: Initiation and management of a living lab, 25 p.
2008-18	Peter Nijkamp Frank Zwetsloot Sander van der Wal	A meta-multicriteria analysis of innovation and growth potentials of European regions, 20 p.
2008-19	Junbo Yu Roger R. Stough Peter Nijkamp	Governing technological entrepreneurship in China and the West, 21 p.
2008-20	Maria T. Borzacchiello Peter Nijkamp Henk J. Scholten	A logistic regression model for explaining urban development on the basis of accessibility: a case study of Naples, 13 p.
2008-21	Marius Ooms	Trends in applied econometrics software development 1985-2008, an analysis of Journal of Applied Econometrics research articles, software reviews, data and code, 30 p.
2008-22	Aliye Ahu Gülümser Tüzin Baycan-Levent Peter Nijkamp	Changing trends in rural self-employment in Europe and Turkey, 20 p.
2008-23	Patricia van Hemert Peter Nijkamp	Thematic research prioritization in the EU and the Netherlands: an assessment on the basis of content analysis, 30 p.
2008-24	Jasper Dekkers Eric Koomen	Valuation of open space. Hedonic house price analysis in the Dutch Randstad region, 19 p.

2009-1	Boriana Rukanova Rolf T. Wignand Yao-Hua Tan	From national to supranational government inter-organizational systems: An extended typology, 33 p.
2009-2	Marc D. Bahlmann Marleen H. Huysman Tom Elfring Peter Groenewegen	Global Pipelines or global buzz? A micro-level approach towards the knowledge-based view of clusters, 33 p.
2009-3	Julie E. Ferguson Marleen H. Huysman	Between ambition and approach: Towards sustainable knowledge management in development organizations, 33 p.
2009-4	Mark G. Leijssen	Why empirical cost functions get scale economies wrong, 11 p.
2009-5	Peter Nijkamp Galit Cohen-Blankshtain	The importance of ICT for cities: e-governance and cyber perceptions, 14 p.
2009-6	Eric de Noronha Vaz Mário Caetano Peter Nijkamp	Trapped between antiquity and urbanism. A multi-criteria assessment model of the greater Cairo metropolitan area, 22 p.
2009-7	Eric de Noronha Vaz Teresa de Noronha Vaz Peter Nijkamp	Spatial analysis for policy evaluation of the rural world: Portuguese agriculture in the last decade, 16 p.
2009-8	Teresa de Noronha Vaz Peter Nijkamp	Multitasking in the rural world: Technological change and sustainability, 20 p.
2009-9	Maria Teresa Borzacchiello Vincenzo Torrieri Peter Nijkamp	An operational information systems architecture for assessing sustainable transportation planning: Principles and design, 17 p.
2009-10	Vincenzo Del Giudice Pierfrancesco De Paola Francesca Torrieri Francesca Pagliari Peter Nijkamp	A decision support system for real estate investment choice, 16 p.
2009-11	Miruna Mazurencu Marinescu Peter Nijkamp	IT companies in rough seas: Predictive factors for bankruptcy risk in Romania, 13 p.
2009-12	Boriana Rukanova Helle Zinner Hendriksen Eveline van Stijn Yao-Hua Tan	Bringing is innovation in a highly-regulated environment: A collective action perspective, 33 p.
2009-13	Patricia van Hemert Peter Nijkamp Jolanda Verbraak	Evaluating social science and humanities knowledge production: an exploratory analysis of dynamics in science systems, 20 p.

2009-14	Roberto Patuelli Aura Reggiani Peter Nijkamp Norbert Schanne	Neural networks for cross-sectional employment forecasts: A comparison of model specifications for Germany, 15 p.
2009-15	André de Waal Karima Kourtit Peter Nijkamp	The relationship between the level of completeness of a strategic performance management system and perceived advantages and disadvantages, 19 p.
2009-16	Vincenzo Punzo Vincenzo Torrieri Maria Teresa Borzacchiello Biagio Ciuffo Peter Nijkamp	Modelling intermodal re-balance and integration: planning a sub-lagoon tube for Venezia, 24 p.
2009-17	Peter Nijkamp Roger Stough Mediha Sahin	Impact of social and human capital on business performance of migrant entrepreneurs – a comparative Dutch-US study, 31 p.
2009-18	Dres Creal	A survey of sequential Monte Carlo methods for economics and finance, 54 p.
2009-19	Karima Kourtit André de Waal	Strategic performance management in practice: Advantages, disadvantages and reasons for use, 15 p.
2009-20	Karima Kourtit André de Waal Peter Nijkamp	Strategic performance management and creative industry, 17 p.
2009-21	Eric de Noronha Vaz Peter Nijkamp	Historico-cultural sustainability and urban dynamics – a geo-information science approach to the Algarve area, 25 p.
2009-22	Roberta Capello Peter Nijkamp	Regional growth and development theories revisited, 19 p.
2009-23	M. Francesca Cracolici Miranda Cuffaro Peter Nijkamp	Tourism sustainability and economic efficiency – a statistical analysis of Italian provinces, 14 p.
2009-24	Caroline A. Rodenburg Peter Nijkamp Henri L.F. de Groot Erik T. Verhoef	Valuation of multifunctional land use by commercial investors: A case study on the Amsterdam Zuidas mega-project, 21 p.
2009-25	Katrin Oltmer Peter Nijkamp Raymond Florax Floor Brouwer	Sustainability and agri-environmental policy in the European Union: A meta-analytic investigation, 26 p.
2009-26	Francesca Torrieri Peter Nijkamp	Scenario analysis in spatial impact assessment: A methodological approach, 20 p.
2009-27	Aliye Ahu Gülümser Tüzin Baycan-Levent Peter Nijkamp	Beauty is in the eyes of the beholder: A logistic regression analysis of sustainability and locality as competitive vehicles for human settlements, 14 p.

2009-28	Marco Percoco Peter Nijkamp	Individual time preferences and social discounting in environmental projects, 24 p.
2009-29	Peter Nijkamp Maria Abreu	Regional development theory, 12 p.
2009-30	Tüzin Baycan-Levent Peter Nijkamp	7 FAQs in urban planning, 22 p.
2009-31	Aliye Ahu Gülümser Tüzin Baycan-Levent Peter Nijkamp	Turkey's rurality: A comparative analysis at the EU level, 22 p.
2009-32	Frank Bruinsma Karima Kourtit Peter Nijkamp	An agent-based decision support model for the development of e-services in the tourist sector, 21 p.
2009-33	Mediha Sahin Peter Nijkamp Marius Rietdijk	Cultural diversity and urban innovativeness: Personal and business characteristics of urban migrant entrepreneurs, 27 p.
2009-34	Peter Nijkamp Mediha Sahin	Performance indicators of urban migrant entrepreneurship in the Netherlands, 28 p.
2009-35	Manfred M. Fischer Peter Nijkamp	Entrepreneurship and regional development, 23 p.
2009-36	Faroek Lazrak Peter Nijkamp Piet Rietveld Jan Rouwendal	Cultural heritage and creative cities: An economic evaluation perspective, 20 p.
2009-37	Enno Masurel Peter Nijkamp	Bridging the gap between institutions of higher education and small and medium-size enterprises, 32 p.
2009-38	Francesca Medda Peter Nijkamp Piet Rietveld	Dynamic effects of external and private transport costs on urban shape: A morphogenetic perspective, 17 p.
2009-39	Roberta Capello Peter Nijkamp	Urban economics at a cross-yard: Recent theoretical and methodological directions and future challenges, 16 p.
2009-40	Enno Masurel Peter Nijkamp	The low participation of urban migrant entrepreneurs: Reasons and perceptions of weak institutional embeddedness, 23 p.
2009-41	Patricia van Hemert Peter Nijkamp	Knowledge investments, business R&D and innovativeness of countries. A qualitative meta-analytic comparison, 25 p.
2009-42	Teresa de Noronha Vaz Peter Nijkamp	Knowledge and innovation: The strings between global and local dimensions of sustainable growth, 16 p.
2009-43	Chiara M. Traversi Peter Nijkamp	Managing environmental risk in agriculture: A systematic perspective on the potential of quantitative policy-oriented risk valuation, 19 p.
2009-44	Sander de Leeuw	Logistics aspects of emergency preparedness in flood disaster prevention, 24 p.

Iris F.A. Vis
Sebastiaan B. Jonkman

2009-45	Eveline S. van Leeuwen
Peter Nijkamp	Social accounting matrices. The development and application of SAMs at the local level, 26 p.
2009-46	Tibert Verhagen
Willemijn van Dolen	The influence of online store characteristics on consumer impulsive decision-making: A model and empirical application, 33 p.
2009-47	Eveline van Leeuwen
Peter Nijkamp	A micro-simulation model for e-services in cultural heritage tourism, 23 p.
2009-48	Andrea Caragliu
Chiara Del Bo
Peter Nijkamp	Smart cities in Europe, 15 p.
2009-49	Farook Lazrak
Peter Nijkamp
Piet Rietveld
Jan Rouwendal	Cultural heritage: Hedonic prices for non-market values, 11 p.
2009-50	Eric de Noronha Vaz
João Pedro Bernardes
Peter Nijkamp	Past landscapes for the reconstruction of Roman land use: Eco-history tourism in the Algarve, 23 p.
2009-51	Eveline van Leeuwen
Peter Nijkamp
Teresa de Noronha Vaz	The Multi-functional use of urban green space, 12 p.
2009-52	Peter Bakker
Carl Koopmans
Peter Nijkamp	Appraisal of integrated transport policies, 20 p.
2009-53	Luca De Angelis
Leonard J. Paas	The dynamics analysis and prediction of stock markets through the latent Markov model, 29 p.
2009-54	Jan Anne Annema
Carl Koopmans	Een lastige praktijk: Ervaringen met waarderen van omgevingskwaliteit in de kosten-batenanalyse, 17 p.
2009-55	Bas Straathof
Gert-Jan Linders	Europe's internal market at fifty: Over the hill? 39 p.
2009-56	Joaquim A.S. Gromicho
Jelke J. van Hoorn
Francisco Saldanha-da-Gama
Gerrit T. Timmer	Exponentially better than brute force: solving the job-shop scheduling problem optimally by dynamic programming, 14 p.
2009-57	Carmen Lee
Roman Kraeussl
Leo Paas	The effect of anticipated and experienced regret and pride on investors' future selling decisions, 31 p.
2009-58	René Sitters	Efficient algorithms for average completion time scheduling, 17 p.

2009-59	Masood Gheasi Peter Nijkamp Piet Rietveld	Migration and tourist flows, 20 p.
---------	---	------------------------------------

2010-1	Roberto Patuelli Norbert Schanne Daniel A. Griffith Peter Nijkamp	Persistent disparities in regional unemployment: Application of a spatial filtering approach to local labour markets in Germany, 28 p.
2010-2	Thomas de Graaff Ghebre Debrezion Piet Rietveld	Schaalsprong Almere. Het effect van bereikbaarheidsverbeteringen op de huizenprijzen in Almere, 22 p.
2010-3	John Steenbruggen Maria Teresa Borzacchiello Peter Nijkamp Henk Scholten	Real-time data from mobile phone networks for urban incidence and traffic management – a review of application and opportunities, 23 p.
2010-4	Marc D. Bahlmann Tom Elfring Peter Groenewegen Marleen H. Huysman	Does distance matter? An ego-network approach towards the knowledge-based theory of clusters, 31 p.
2010-5	Jelke J. van Hoorn	A note on the worst case complexity for the capacitated vehicle routing problem, 3 p.
2010-6	Mark G. Lijesen	Empirical applications of spatial competition; an interpretative literature review, 16 p.
2010-7	Carmen Lee Roman Kraeussl Leo Paas	Personality and investment: Personality differences affect investors' adaptation to losses, 28 p.
2010-8	Nahom Ghebrihiwet Evgenia Motchenkova	Leniency programs in the presence of judicial errors, 21 p.
2010-9	Meindert J. Flikkema Ard-Pieter de Man Matthijs Wolters	New trademark registration as an indicator of innovation: results of an explorative study of Benelux trademark data, 53 p.
2010-10	Jani Merikivi Tibert Verhagen Frans Feldberg	Having belief(s) in social virtual worlds: A decomposed approach, 37 p.
2010-11	Umut Kilingç	Price-cost markups and productivity dynamics of entrant plants, 34 p.
2010-12	Umut Kilingç	Measuring competition in a frictional economy, 39 p.

2011-1	Yoshifumi Takahashi Peter Nijkamp	Multifunctional agricultural land use in sustainable world, 25 p.
2011-2	Paulo A.L.D. Nunes Peter Nijkamp	Biodiversity: Economic perspectives, 37 p.
2011-3	Eric de Noronha Vaz Doan Nainggolan Peter Nijkamp Marco Painho	A complex spatial systems analysis of tourism and urban sprawl in the Algarve, 23 p.
2011-4	Karima Kourtit Peter Nijkamp	Strangers on the move. Ethnic entrepreneurs as urban change actors, 34 p.
2011-5	Manie Geyer Helen C. Coetzee Danie Du Plessis Ronnie Donaldson Peter Nijkamp	Recent business transformation in intermediate-sized cities in South Africa, 30 p.
2011-6	Aki Kangasharju Christophe Tavera Peter Nijkamp	Regional growth and unemployment. The validity of Okun's law for the Finnish regions, 17 p.
2011-7	Amitrajeet A. Batabyal Peter Nijkamp	A Schumpeterian model of entrepreneurship, innovation, and regional economic growth, 30 p.
2011-8	Aliye Ahu Akgün Tüzin Baycan Levent Peter Nijkamp	The engine of sustainable rural development: Embeddedness of entrepreneurs in rural Turkey, 17 p.
2011-9	Aliye Ahu Akgün Eveline van Leeuwen Peter Nijkamp	A systemic perspective on multi-stakeholder sustainable development strategies, 26 p.
2011-10	Tibert Verhagen Jaap van Nes Frans Feldberg Willemijn van Dolen	Virtual customer service agents: Using social presence and personalization to shape online service encounters, 48 p.
2011-11	Henk J. Scholten Maarten van der Vlist	De inrichting van crisisbeheersing, de relatie tussen besluitvorming en informatievoorziening. Casus: Warroom project Netcentrisch werken bij Rijkswaterstaat, 23 p.
2011-12	Tüzin Baycan Peter Nijkamp	A socio-economic impact analysis of cultural diversity, 22 p.
2011-13	Aliye Ahu Akgün Tüzin Baycan Peter Nijkamp	Repositioning rural areas as promising future hot spots, 22 p.
2011-14	Selmar Meents Tibert Verhagen Paul Vlaar	How sellers can stimulate purchasing in electronic marketplaces: Using information as a risk reduction signal, 29 p.

2011-15	Aliye Ahu Gülümser Tüzin Baycan-Levent Peter Nijkamp	Measuring regional creative capacity: A literature review for rural-specific approaches, 22 p.
2011-16	Frank Bruinsma Karima Kourtit Peter Nijkamp	Tourism, culture and e-services: Evaluation of e-services packages, 30 p.
2011-17	Peter Nijkamp Frank Bruinsma Karima Kourtit Eveline van Leeuwen	Supply of and demand for e-services in the cultural sector: Combining top-down and bottom-up perspectives, 16 p.
2011-18	Eveline van Leeuwen Peter Nijkamp Piet Rietveld	Climate change: From global concern to regional challenge, 17 p.
2011-19	Eveline van Leeuwen Peter Nijkamp	Operational advances in tourism research, 25 p.
2011-20	Aliye Ahu Akgün Tüzin Baycan Peter Nijkamp	Creative capacity for sustainable development: A comparative analysis of European and Turkish rural regions, 18 p.
2011-21	Aliye Ahu Gülümser Tüzin Baycan-Levent Peter Nijkamp	Business dynamics as the source of counterurbanisation: An empirical analysis of Turkey, 18 p.
2011-22	Jessie Bakens Peter Nijkamp	Lessons from migration impact analysis, 19 p.
2011-23	Peter Nijkamp Galit Cohen-blankshtain	Opportunities and pitfalls of local e-democracy, 17 p.
2011-24	Maura Soekijad Irene Skovgaard Smith	The 'lean people' in hospital change: Identity work as social differentiation, 30 p.
2011-25	Evgenia Motchenkova Olgerd Rus	Research joint ventures and price collusion: Joint analysis of the impact of R&D subsidies and antitrust fines, 30 p.
2011-26	Karima Kourtit Peter Nijkamp	Strategic choice analysis by expert panels for migration impact assessment, 41 p.
2011-27	Farook Lazrak Peter Nijkamp Piet Rietveld Jan Rouwendal	The market value of listed heritage: An urban economic application of spatial hedonic pricing, 24 p.
2011-28	Peter Nijkamp	Socio-economic impacts of heterogeneity among foreign migrants: Research and policy challenges, 17 p.
2011-29	Masood Gheasi Peter Nijkamp	Migration, tourism and international trade: Evidence from the UK, 8 p.
2011-30	Karima Kourtit	Evaluation of cyber-tools in cultural tourism, 24 p.

	Peter Nijkamp Eveline van Leeuwen Frank Bruinsma	
2011-31	Cathy Macharis Peter Nijkamp	Possible bias in multi-actor multi-criteria transportation evaluation: Issues and solutions, 16 p.
2011-32	John Steenbruggen Maria Teresa Borzacchiello Peter Nijkamp Henk Scholten	The use of GSM data for transport safety management: An exploratory review, 29 p.
2011-33	John Steenbruggen Peter Nijkamp Jan M. Smits Michel Grothe	Traffic incident management: A common operational picture to support situational awareness of sustainable mobility, 36 p.
2011-34	Tüzin Baycan Peter Nijkamp	Students' interest in an entrepreneurial career in a multicultural society, 25 p.
2011-35	Adele Finco Deborah Bentivoglio Peter Nijkamp	Integrated evaluation of biofuel production options in agriculture: An exploration of sustainable policy scenarios, 16 p.
2011-36	Eric de Noronha Vaz Pedro Cabral Mário Caetano Peter Nijkamp Marco Painho	Urban heritage endangerment at the interface of future cities and past heritage: A spatial vulnerability assessment, 25 p.
2011-37	Maria Giaoutzi Anastasia Stratigea Eveline van Leeuwen Peter Nijkamp	Scenario analysis in foresight: AG2020, 23 p.
2011-38	Peter Nijkamp Patricia van Hemert	Knowledge infrastructure and regional growth, 12 p.
2011-39	Patricia van Hemert Enno Masurel Peter Nijkamp	The role of knowledge sources of SME's for innovation perception and regional innovation policy, 27 p.
2011-40	Eric de Noronha Vaz Marco Painho Peter Nijkamp	Impacts of environmental law and regulations on agricultural land-use change and urban pressure: The Algarve case, 18 p.
2011-41	Karima Kourtit Peter Nijkamp Steeff Lowik Frans van Vught Paul Vulto	From islands of innovation to creative hotspots, 26 p.
2011-42	Alina Todiras Peter Nijkamp Saidas Rafijevas	Innovative marketing strategies for national industrial flagships: Brand repositioning for accessing upscale markets, 27 p.

2011-43	Eric de Noronha Vaz Mário Caetano Peter Nijkamp	A multi-level spatial urban pressure analysis of the Giza Pyramid Plateau in Egypt, 18 p.
2011-44	Andrea Caragliu Chiara Del Bo Peter Nijkamp	A map of human capital in European cities, 36 p.
2011-45	Patrizia Lombardi Silvia Giordano Andrea Caragliu Chiara Del Bo Mark Deakin Peter Nijkamp Karima Kourtiti	An advanced triple-helix network model for smart cities performance, 22 p.