‘Science of the City’: Towards a Higher Quality of Urban Life

Editorial Introduction

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1 CITIES IN PERSPECTIVE

We live in the ‘urban century’, a new epoch in the geographical history of our world marked by an ongoing urbanisation, in both the developed and in the developing world. This period, called by Kourtit (2014) the ‘*New Urban World*’, means that at present the majority of the world population lives in urban areas, a radically new phenomenon in the history of mankind. And this trend towards more and bigger cities does for the time being not come to a standstill. It is even foreseeable that by the middle of this century more than 70 percent of all people on earth will live in cities.

It is noteworthy however, that this contemporaneous urbanisation trend does not lead to an identical or uniform development pattern of cities (see Duranton, 2007). In recent studies (see e.g., Martin, et al., 2016; Moretti, 2013; Storper, 2013), it has even been argued that the post-industrial era has prompted a great heterogeneity or even divergence between cities, in terms of their industrial orientation, their cognitive base, their innovativity and creativity, their connectivity profile, and their specialisation. The *‘New Urban World’* is apparently characterized by heterogeneity in the development of cities.

The pluriform spectrum of modern cities in our world calls for a thorough reflection on the changing nature of urban agglomerations (Scott and Storper, 2015; Kourtit, Nijkamp and Stough, 2015). In particular, it is increasingly argued that the dynamic performance of cities in the ‘urban century’ is mainly driven by its knowledge base (Rabari and Storper, 2015). The knowledge-based society has manifested itself more and more as a cognitive potential in urban agglomerations

acting as intellectual and creative power centres in spatial networks of our world (Neal, 2014). In a recent article, Donald (2014) takes this argument even further and argues that the currently rapidly evolving digital era will create a new interface between the human mind and our world. This cognitive revolution which is omnipresent leads to collective cognitive power by a new networked elite. It goes without saying that this radical change in the mind constellation of our world will create deep footprints on the urban world. The concentration of intellect, knowledge and creativity in urban areas will make cities international hubs of innovating and economic power and global impact, provided at least such cities are able to manage their internal dynamic challenges (Angel, 2012; Merrifield, 2014; Taylor, 2004).

It is also noteworthy that the demarcation line between cities, urban agglomerations, metropolitan areas and rural areas is gradually becoming fuzzy and is sometimes disappearing, for instance, in The Netherlands. Consequently, there is no single and unambiguous analysis framework for grasping the complexity of the modern urban world. Cities, however, share in most cases – in addition to spatial-demographic features such as density and proximity – one basic characteristic, viz. social, economic, cultural or political symbiosis (Lufkin, Rey and Erkman, 2016). This holds for the internal mechanism of cities, often referred to as urban social capital (see Westlund, 2014), but also for the broader network linkages of cities (see Neal, 2014). Cities are socio-economic network constellations and at the same evolutionary organisms: they are 'work in progress'.

It seems thus plausible that the evolution of modern city systems is characterised by at least two forces, namely, internal and external symbiosis and a strong knowledge (or cognitive) base. This necessitates a new scientific reflection on the nature and functioning of cities in the *'urban century'* (see also Storper and Scott, 2016). A synthesis of the scientific harvest of new ideas on the science of the city – in relation to the human mind shaping the city – is provided in the present special issue. This collection is the result of an Advanced Brainstorm Carrefour (ABC) on the 'Science of the City', organized by ***The Regional Science Academy*** (TRSA) at the University Federico II in Naples, in March 2016. The various contributions by authors from all over the world will first now be presented.

2 A PLURIFORM PANORAMA

The historical, sometimes revolutionary division of labour has prompted the birth of cities, by organizing human activities in a settlement pattern that was no longer directly linked to primary natural resources. Since then, two archetypal symbiotic spaces were formed, the first one providing knowledge and tools, and the latter one food for the survival of cities, produced beyond the necessities of rural people (Jacobs, 1969). From the outset, this special issue on the *'Science of the City'* starts in *futuro* and highlights the recent changes and foresights on the future of cities in North America and Western Europe, in the framework of a so-*called cognitive-cultural capitalism.* In this context, Allen Scott (on City and Society, Article 1)

provokes a discussion about the city of today and the appearance of a new division of labour and also about the changing configuration of intra-urban production. Out of the ruins of the mass production system, the post-industrial development is driven by digital technologies and a labour force of highly-qualified intellectual workers. The city today is *"a network of many and sundry undertakings that are urban by virtue of their mode of spatial integration into a nexus of interdependent polarized land uses"*. The changing economic and social constitution of the city results in a new social restratification, the movement of new plutocracy of a high-level cognitive-cultural workers to gentrified central-city neighbourhoods, in contrast to the new servile class of low paid occupations needed to sustain the infrastructures and facilities of the urban system.

The typical functional interpretation of the urban context as a source of economic advantages in terms of agglomeration economies and external network linkages has only recently addressed the cognitive, relational and hierarchical dimensions of the urban "milieu". Such a new cognitive and cultural view allows a better interpretation of innovation and creativity processes, the economic and social divide, as well as the spatial division of labour between city and countryside (on City and Business, Roberto Camagni, Article 2). This gives rise to the question of a continuing as well as changing role of the city, and of the importance of its post-industrial urban environmental qualities, able to attract new forms of business, modern industries and services and highly-mobile creative and knowledge classes. Indeed, the subsequent article of João Romão (on City and Culture, Article 3) continues by explaining the dimension of culture and creativity of the contemporary cities as places where scale and variety meet together, making them attractive to creative companies looking for efficiency benefits related to proximity and co-location. Culture, creativity and gentrification mechanisms create the uniqueness and appeal of urban centres. On the other hand, the stratification existing in a creative production process or cultural production can enhance the social conflicts and spatial heterogeneity expressed by differences in living conditions. A *Common Pool of Resources* approach is then accentuated for a more balanced share of the benefits of city life by means of participatory city planning.

In both cities and rural areas, the interest of all citizens and their quality of life are a main aim of the urban and regional policy. Juan Carlo Martín and Christian Stalin Viñán (on Region and Quality of Life, Article 4) study in this context the subjective well-being of the citizens of regions in Ecuador, using a survey based on the European Social Survey that comprises eight different dimensions of quality of life. Fuzzy logic and an ideal solutions approach enables them to discover the new elements of the spatial heterogeneity as well as the dependence of the quality of life on public services as the basis for the social welfare, education and health system.

Health – or, more broadly, wellbeing – does not only have an individual meaning, but also a meaning as a common good. Several studies show significant differences in health situation among the countries or regions; higher urbanisation appears to correlate in general with better human health, much like health and wealth. Among

main factors determining the health of the population is income and wealth, but also the quality of the environment, access to health care services and wellness conditions. The health depends a lot also on people themselves, their biology, genetics, education and individual and collective life styles. However, Peter Nijkamp and Karima Kourtit (on City and Health, Article 5) argue that the occurrence of geographic or area-based health differences is firmly rooted in the framework of an urban-rural dichotomy, but they also claim that much more conceptual and empirical research is needed to understand the singularities of this complex overall pattern.

The extensive rise in population of cities is causing an expansion of the urban built areas to the surrounding countryside. Locations near open and green spaces are popular for living, but nature causes also new externalities in cities, as wild animals or plant species tend to permeate the urban green and grey spaces. The relationship between nature and cities is indeed rather complex (on City and Nature, Daniel Broitman, Daniel Czamanski and Maria Toger, Article 6). The study of wild boars in Haifa is an example of challenges for many cities, as urban green spaces are attractive for both people and nature.

The presence of nature should be accordingly integrated into city planning to strengthen its environmental sustainability, but also to cope with external shocks and hazards caused by the interaction of natural and human systems. Modern cities are supposed to be not only smart, green, creative or innovative, but complex organic urban systems on all accounts must be resilient to effects of global shocks such as climate change or financial crises. High adaptive capacity (on City and Resilience, Oto Hudec, Article 7) can be only reached by integrating land and strategic planning with risk management, combining technological expertise, digital solutions and social science.

City planning deals always with high uncertainty (such as external shocks) and works and plays with future scenarios; a 3D visualization of the intervention into urban space should be taught already in primary schools. In this context, Geocraft is a tool for children or adults connected to real spatial data infrastructures providing an interactive virtual 3D environment, wherein real-time city planning impact models can be invented and run to design future scenarios and their impacts. The article (on City and Games, Henk Scholten, et al., Article 8) describes the experiences with high-school students on planning water management, land use, or urban spatial planning with the aim to develop creative spatial, digital and community skills.

Digital technology calls for an intelligent use of a wealth of information and big data on the city operation and its development, facilitating a drastic transition of the city management to unsuspected options and possibilities. An intelligent city (i-city) (on Sustainable *i*-City, Karima Kourtit, Article 9), goes beyond the smart city concept proposing *new urban analytics* as an entirely new model of monitoring, examining and managing city daily-life patterns, utilising all possible information resources such as cameras, sensors, GPS data, GSM data, parking

data, etc. Modern i-cities are expected to combine highly professional data management with solid cognitive expertise and innovative strategic visioning and planning.

The Internet as a General Purpose Technology is a key infrastructure positively influencing the productivity of the firms. Broadband Internet access can be assumed to be an important factor in boosting economic growth, as it reduces production costs and has a capacity to increase the market share for products or services. Jitendra Parajuli and Kingsley Haynes (on City and Infrastructure, Article 10) study the relationship between broadband infrastructure and new firm formation on the examples of two large US states - Florida and Ohio. However, the results of OLS and GWR models are ambiguous, not consistent across space. Hence, the authors recommend to take into consideration the local spatial dynamics while formulating infrastructure and economic development policies.

The last part of this special issue offers scientific contribution on a special case of a special city – Naples. Three articles provide a challenging task to implement a Historic Urban Landscape (HUL) approach to conservation, protection and valorisation of UNESCO cultural heritage in cities. Regarding the extreme complexity of a city, the HUL approach recognizes the landscape as a living heritage (or organism) and looks for a mutual symbiosis of conservation and development. Clearly, the HUL is mainly conceptual approach and thus, there is a question how to operationalize it. Therefore, Antonia Gravagnuolo and Luigi Fusco Girard (on Naples City and Heritage, Article 11) propose provisional methodology of UNESCO HUL approach highlighting innovative and interdisciplinary tools, adapted to different local contexts. Another experimental evaluation (Paola Carone, Pasquale De Toro and Alfredo Franciosa, on Naples City and Health, Article 12) considers the Health Impact Assessment applied to a HUL approach. In accordance with the previously mentioned concepts of i-cites and integrated city planning, Luigi Fusco Girard, Maria Cerreta and Pasquale De Toro (on Naples City and Strategy, Article 13) adopt a Spatial Decision Support System methodology integrating Geographic Information Systems, Multivariate Analysis and Multi-Criteria Evaluation, with the aim to initiate a new governance system exploiting territorial synergistic and symbiotic conditions. In this context, homogeneous zones are identified through numerous indicators, which enable activating of circular processes of a triple-helix cooperation and generating new value creation chains.

The case studies on of the metropolitan city of Naples offer a variety of innovative, multi-dimensional tools and instruments for screening, monitoring, evaluating, planning and implementing science-based urban strategies, in accordance with recent UNESCO guidelines on territorial governance, accentuating and developing pluri-disciplinary knowledge on the ‘Science of the City’ in the articles of this special issue.

3 RETROSPECT AND PROSPECT

"But we believe that the problem of human settlements is a general and fundamental problem in our new dynamic world and that it must be viewed and studied in such a way that it will, in common with all great scientific disciplines, transcend our local differences." (Delos Declaration, Doxiadis Associates, Athens, 1963, pp. 22-23).

We live in the *'urban century'*. And in the future an increasing number of people will live in urban areas, up to an expected share of 70 percent of the world population by the year 2050. Most likely, cities will be the engines of growth and prosperity, the catalysts of innovations and creativity, the melting pot of different cultures and the focal points of social networks. Various disciplines have tried to come to grips with the complexity and dynamics of cities, in particular, urban economics, urban geography, urban planning and architecture, and urban sociology. But the insights and findings on the 'why' and 'how' of the urban orientation of our societies differ vastly. There is by no means a uniform conceptual framework on the genesis and persistence of our *'urban century'*, nowadays often called the *'New Urban World'*.

Cities have in the course of history become the most common settlement pattern all over the world. From a rural society a few centuries back, our world has moved into an urban world. And this trend will continue in this century; hence, the nowadays popular expression *'the urban century'*. The explanatory disciplinary backgrounds of their historical mass urbanization are manifold. For example, Economics has explained this urban trend from the perspective of agglomeration theory. Sociology has found the source of urbanization in network behaviour and social motives of people, including social capital. And urban architecture has regarded the management of the urban landscape and the form of the built environment as a major stimulus for city formation and development. Finally, urban planning has given the impression that regulatory systems on land use and spatial amenities have been decisive for our *'urban century'*.

The fundamental question raised in this special issue was: Is the modern city a disconnected amalgam of various different – sometimes mutually contrasting – forces, or is there a unifying conceptual framework that is able to explain the 'why' and 'how' of the *'New Urban World'*? The answer to this question calls for a fundamental reflection on the roots and effects of the modern city characterized by sustainability features. The focus in this special issue is, therefore, not only on economic, social and planning determinants, but also on architectural, ecological and mobility dimensions of modern cities. Consequently, in this special issue major attention is paid to urban landscapes, urban environments, urban regeneration and revitalization, and creative urban 'ambiances', seen from the perspective that the *'city is the home of man'* (Ward, 1976).

To come to grips with this challenging effort, the development of strategic visions on urbanisation, historical insights, new paradigms and innovative Imagineering exercises on the essence of a city will be needed. Clearly, such contributions need

to transcend monodisciplinary borders and to offer challenging perspectives on the future of the settlement patterns on our planet.

The main future challenge is of course to develop a unifying conceptual and methodological framework for a better understanding of urban evolution, with a view to the identification of smart policy response and fascinating research needs on future urban issues, in the light of the important global challenges that will be decisive for our urban futures.

In order to explore further the unknown future of the *'urban century'*, it is also important to address the challenges put forward in the *'2030 Agenda'* of the UN General Assembly (September 2015) – which provides a historic vision for improving the living conditions of our society – as well as the *Paris COP 21* document (2015) (followed up by the Marrakech COP 22 agreement) – which makes a convincing plea for a de-carbonization of local, regional and national economies in order to improve current and future quality of life. These documents call for a strong scientific orientation on urban issues: all (or at least the majority) of the 16 + 1 strategic goals (and the resulting 169 targets) in this document - from health to employment, from energy to well-being, to land and food, to welfare services and social housing - have to be realised within the physical space of cities and territories.

In the New Urban Agenda (UN Habitat, 2016) many operational approaches and tools are proposed for making cities "inclusive, safe, resilient and sustainable" through improving decision making processes at local level. "The future of humanity and of our Planet lies in our hands" (Agenda 2030, par 53): it will be shaped and anticipated in cities.

This may lead to the need for *urban sustainability science* as a unifying "principle" or framework connecting important policy issues such as climate change, environment, poverty, safety, dense urbanisation, knowledge creation and spill-overs, etc. Another new challenge for the 'city of the future' is its design and architecture, in which the 'urban landscape' (historical and present) is regarded as an important resource of local development. The scientific and academic community should be strongly engaged with the implementation of the SDG's of the Agenda 2030: sustainability depends on *integrated* hard and soft sciences research.

At the end, a final observation has to be made: it is pertinent to move our cognitive ability forward, especially with respect to developing a think tank dialogue that will reach out across disciplines and interest groups and that will develop radically new views on the city – where it is going – where it should be going – what needs should be put forward – and what mechanisms are available – so as to get those articulated needs on both the world research and policy agenda. We may conclude that city science is not an isolated scholarly island activity on the modern city. It ought to be positioned in a broader context of frontier ideas on international knowledge acquisition and dissemination on human settlement patterns on a sustainable globe.

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Urbanization, Work and Community: The Logic of City Life in the Contemporary World

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ABSTRACT

Purpose: I initiate the discussion with a statement about cognitive-cultural capitalism and its concentration in large global cities. This is followed by an argument to the effect that the specificity of the city resides in the manner in which the diverse social phenomena that it contains are brought into a composite pattern of spatial integration. With these preliminaries in mind, I examine the economic structure of the city in cognitive-cultural capitalism, with special reference to the emergence of a new division of labor and the changing configuration of intra-urban production space. This account leads directly to consideration of the restratification of urban society and its effects on neighborhood development and social life. The final section of the paper picks up on the notion of the Common in cognitive-cultural capitalism and offers some speculative remarks regarding the implications of this phenomenon for the economic and social order of cities.

Methodology/Approach: Historical and geographical narrative combined with appeals to the theory of political economy.

Findings: Cognitive-cultural capitalism is emerging as a dominant force of social and economic change in the twenty-first century. This trend is also evident in new patterns of urbanization that are emerging on all five continents. These patterns reflect dramatic shifts in the structure of urban production systems and the significant restratification of urban society that has been occurring as a consequence.

Research Limitation/implication: The paper is pitched at a high level of conceptual abstraction. Detailed empirical investigation/testing of the main theoretical points outlined in the paper is urgently called for.

Originality/Value of paper: The paper offers an overall theoretical synthesis of the interrelationships between cognitive-cultural capitalism and processes of urbanization.

Category: Research paper

Keywords: capitalism; cognitive-cultural economy; Common; global city-regions; urbanization

1 THE HISTORICAL CONTEXT

I seek to address some basic questions about urbanization in the twenty-first century, with particular reference to the new forms of work and life that are emerging in large cities all over the world but most of all in the advanced capitalist economies of North America, Western Europe and Eastern Asia.

The economic logic of capitalism revolves centrally around a process of accumulation, namely, an incessant drive to reinvest the profits from production, hence inducing continual but intermittent rounds of development and growth. Accordingly, the technological foundations, sectoral make-up, norms of market competition, labor relations, and locational alignments of capitalism also go through many shifts in form and substance. Definite combinations of these variables sometimes stabilize for longer or shorter historical periods in identifiable socio-technical phases of development or regimes of accumulation. These phases are not always clearly differentiated from one another, but three particular cases are noteworthy for their distinctiveness as well as for the specific patterns of urbanization associated with them (Scott, 2011). The water- and steam-driven mills characteristic of the classical factory and workshop system in Britain in the nineteenth century gave birth to the traditional working-class industrial town. The fordist mass production system that reigned in the period from the beginning of the twentieth century down to the 1960s and 1970s lay at the core of the metropolitan areas of the Manufacturing Belts of North America and Western Europe. Since the end of the twentieth century a new species of capitalism founded on digital technologies and a labor force of highly-qualified intellectual workers has been gathering momentum and is bringing in its train some remarkable new shifts in the form and substance of urbanization.

The new capitalism emerged out of the ruins of the mass production system at the end of the twentieth century, and was initially identified as a “post-fordist” regime of accumulation. This designation is still in wide use, but has been giving way in recent years to more affirmative labels that identify early twenty-first century capitalism in terms of its basic digital technologies, its proliferating network structures of economic and social life, its foundations in the cerebral and affective human capital of the workforce, and its apparent capacity to generate high levels of economic and social innovation. Perhaps the most dramatic sign of the advent of this regime was the changeover from the dominant electro-mechanical technologies of fordism to the computerized modes of

productive activity that became common after the late 1970s. This transformation made it possible to automate swaths of standardized and algorithmic work across virtually all sectors of the economy and to bring an enormous number of new and upgraded products onto the market. Equally, the introduction of computerized technologies into the workplace had the effect of magnifying the capacities of intellectual labor by augmenting the cognitive and cultural talents of the individual worker by means of the exceptional powers of calculation, information management, and communication unleashed by digitization. For this reason, I have suggested elsewhere that the term "cognitive-cultural capitalism" represents an especially appropriate way of referring to the new economic and social arrangements that are taking shape on all sides today. This term has the merit of referring explicitly to the fundamental role of both cognition and culture in the foremost segments of productive work in the capitalism of the early twenty-first century. As such, it also refers by implication to a core group of sectors focused on outputs such as high-technology devices, software, advanced financial and business services, and symbolic-cum-experiential products such as film, music, electronic games, and fashion, all of which depend in important ways on labor inputs marked by high levels of intellect and empathy, and all of which have strong proclivities to locate in major urban areas.

2 WHAT IS THE CITY?

As a matter of principle, we may begin with the proposition that cities are everywhere and always phenomena whose form and functions mirror the wider social formations within which they are embedded. This organic relationship is bound up with the necessary spatiality of all social outcomes, and above all with the deeply-rooted urge in countless kinds of human activity to converge together in dense geographic clusters. This urge is especially robust in capitalism, which can only be efficiently (i.e. profitably and competitively) organized when selected groups of producers agglomerate together in association with adjacent labor markets. In the purely analytical as opposed to historical order of enquiry, what we might call "proto-urban clusters" materialize in this way, though they only become recognizably urban as a host of other social phenomena, such as residential neighborhoods, transport networks, shopping districts, and relevant arrangements of collective action are also brought within the vortex of agglomeration. In a more historical order of enquiry, urban development is manifest as a path-dependent process in which cities evolve through recursive marginal accretions of new economic and social substance over time. In this manner, cities in capitalism emerge from the social and property relations of the prevailing regime of accumulation. Cities, however, do not simply spring forth as dependent excrescences of the regime of accumulation, for they play a critical role in the social reproduction of capitalism, not only by promoting economic efficiency and competitive advantage, but also by securing continuity of social life and labor market relationships via their built forms and physical infrastructures.

As argued at length in Scott and Storper (2015) these fundamental aspects of cities in capitalism are reflected in intra-urban processes that in the first instance can be understood in terms of an abstract logic revolving around the notions of density and proximity within an agglomerated mass of social and economic activities. In the second instance, they are expressed in patterns of land use and associated human interactions as represented by conjoint production, residential and circulation spaces forming an *urban land nexus*, i.e. the internal functionally integrated fabric of the city. These essential attributes of urbanization, together with their dependent daily and weekly rhythms of human mobility, constitute the essential specificity of the city in capitalism and separate it as a *sui generis* object of study from the rest of society. The city, then, is a network of many and sundry undertakings that are *urban* by virtue of their mode of spatial integration into a nexus of interdependent polarized land uses; and while networks of this sort are never bounded by a precise outer boundary, they are nonetheless always recognizable by reason of their endogenous locational and functional interactions relative to a dominant centre of gravity. Furthermore, given their dense, polarized, and spatially integrated character, cities are foci of massive land rent generation and they are thus also major arenas of what Harvey (1978) has identified as critical secondary circuits of monetary and financial flow. In view of these diverse attributes of urbanization in capitalist society, cities are invariably sites of social conflict focused on the problems, predicaments, and injustices that grow out of the tensions internal to this peculiar mode of spatial integration and that partly shape the urban question as a circle of scientific *and* political concerns.

That said, we still cannot properly identify the urban question in the current conjuncture without also considering three important fields of action representing the framework of institutional order and political contestation in the cities of contemporary capitalism. In the first place, firms and households constitute a domain of civil society in which decision-making and behaviour are individualized, rooted in private property, and regulated by markets. In the second place, this domain of purely private interests is complemented by formal and informal agencies of governance and coordination with mandates to address urban problems and to manage the course of local development by means of collective action. In the third place, a distinctive communal arena, or Common, springs from the shared character of urban life. The Common is a form of social reality that lies beyond the bounds of individual private ownership, though it may be encroached upon by private interests and it is frequently regulated by agencies of governance with powers to extend or limit its contents and range. Thus, at any given moment in time there are always deeply seated political collisions between those elements of civil society that want to appropriate parts of the Common for their own private use and those that want to preserve or enhance it as a free and open asset. Since the Common has special and expanding influence in the cities of cognitive-cultural capitalism some further commentary on this topic is apposite at this stage.

In a first round of identification, the Common can be described as an interlocking amalgam of externalities, resources, and cultural or intellectual assets that accrue to the city and that are freely available to all. A more extended definition would include different kinds of joint property regimes as proposed by Ostrom (2010), where selected groups of citizens dispose of so-called "common-pool resources" from which others are excluded. In the present paper we will be concerned with cases of both types, but with a clear emphasis on the former where ownership restrictions of any sort are entirely non-existent. The contents of the Common are extremely heterogeneous, comprising as they do various kinds of spillover effects, tangible and intangible resources such urban infrastructures or local economies of scale and scope, and a sort of free-floating protoplasm composed of information, knowledge, behavioural codes, and traditions, and while they frequently have beneficial effects, they can also impose social costs as in the case of polluted air or congested streets. The important point is that the benefits and costs of the Common are privately absorbed but do not involve countervailing payments for value received or compensation for any injuries undergone. The whole can be seen as a *Common* by analogy with the Common or waste land that was open to all members of the village community for pasturing livestock in the agricultural economy of pre-Enclosure England. Moreover just as the traditional Common was subject to the risk of overgrazing, many but by no means all of the benefits of the urban common today are susceptible to exhaustion by overexploitation so that decisive collective remediation is often required to restore at least some of its positive value.

The conventional view of the Common is that it constitutes a realm of market failure, as for example in urban areas where positive and negative spillover effects circulate through the city without benefit of market mediation, or where public goods are supplied in order to secure the continued urban viability. A related and explicitly marxian line of attack focuses on the Common as a field of "general intellect," i.e. a source of freely-circulating epistemic assets, and above all useful knowledge inputs to private firms (see, for example Moulier Boutang, 2007). A more general definition is provided by Hardt and Negri (2009, p.251) who identify the Common in the context of the city as a spatial concentration of "people living together, sharing resources, communicating." A vast extension of the Common has taken place over this last couple of decades as a direct effect of the development of cyberspace, and this new facet of social reality is pregnant with implications for all aspects of urban development in the context of intensifying globalization.

3 THE ECONOMIC CONSTITUTION OF THE CITY

Despite occasional claims to the effect that the final paroxysm of capitalism is just over the horizon, it continues to evolve irregularly forward in recurring waves of spatial intensification and spread. In its latest incarnation as a cognitive-cultural socio-economic formation, capitalism has not only become insistently

global, but has also deepened its roots in large metropolitan areas. This is not to say that capitalism has been taken over in its entirety by cognitive-cultural forms of production and work activity, or that it is based solely in large cities. That said, the leading edges of growth, innovation, and economic transformation in contemporary society are emphatically concentrated in the sectoral formations identified in the first section of this paper as constituting the core of the cognitive-cultural economy, and these are located in city-regions all across the world, with places like New York, Los Angeles, London, Paris, Tokyo, Shanghai, Singapore, Bangkok, Mexico City, and Buenos Aires, to mention only a few, clearly in the vanguard. Cities like these are the principal motors of global capitalism in the twenty-first century.

The leading sectors of this new economic order are drawn to city-regions by reason of their multiple interdependencies and labor market needs as well as by their proclivity to generate significant learning, creativity and innovation effects (including entrepreneurship) when they locate jointly in spatial agglomerations. Firms in these sectors actually cluster together not just at the broad level of the individual city but also at a much more detailed level within intra-urban space where they form what earlier generations of economic historians and geographers, such as Allen (1929), called specialized "industrial quarters." The factors underlying this tendency to agglomeration have been investigated by numerous regional development theorists, and may be summarized in three key points.

- Units of production in the cognitive-cultural economy frequently work together in many-sided networks. The efficiency of these networks is in numerous instances enhanced when the parties involved are located in close proximity to one another, especially when transmission of tacit knowledge by means of face-to-face dialog is common.
- Firms in the new economy typically employ workers endowed with intellectual and creative skills. A large pooled supply of these workers at locations adjacent to workplaces is an essential complement to production.
- Information exchanges between firms in cognitive-cultural production clusters tend to enhance know-how, and thus help to stimulate informal innovation. This tendency is manifest in the relatively high levels of patenting that characterize large urban areas today (Feldman and Florida, 1994; Ó'hUallacháin, 1999).

These three sets of variables, together with the physical infrastructure of the city, not only reinforce agglomeration but also constitute critical foundations of the competitive advantages of any given centre. As such, they have always played a significant though variable role in processes of capitalist urbanization, and especially in the new economy where so much of the production system is marked by high levels of vertical and horizontal disintegration, where labor markets are splintered into many different niches, and where informal innovation is an important mechanism of product and process change. The play of these

variables is such that the more any cluster grows the greater the stock of agglomeration economies that partly constitute the Common. To be sure, diseconomies are also invariably generated by growth, but when these significantly threaten overall efficiency, agencies of collective action typically intervene to dampen their negative effects. On these bases, large cities and city-regions in many different countries function as communal springboards facilitating the capacity of producers in the cognitive-cultural economy to contest national and global markets.

There is, however, another side to this image of success, for the same cities and city-regions in cognitive-cultural capitalism almost always abound with large cohorts of low-wage and politically-marginalized service workers. Unlike the old urban working class in the cities of fordist capitalism, these workers are not primarily employed in manufacturing industry. Rather, they are pre-eminently engaged in occupations like taxi-driving, restaurant work, janitorial activities, para-medical functions, home repair, gardening, and child-minding, to mention only a few exemplary cases. Their principal role in these occupations is to sustain the infrastructures and facilities of the urban system and to support the domestic and personal needs of the more affluent fractions of the citizenry. Occupations like these are notorious for their low and generally decreasing wages as well as for their extreme precariousness. Still, and even if low-wage service workers usually lack formal qualifications, it would be incorrect to suppose that they are devoid of meaningful cognitive-cultural capabilities, for they are frequently called upon to exercise much discernment, resourcefulness, self-awareness, and flexibility in the fulfilment of their jobs. Indeed, precisely because these jobs require considerable initiative on the part of the labor force and also frequently entail a negotiated interface with others, they cannot (unlike routine manufacturing activities) be consolidated into large standardized units of operational activity and dispatched to low-wage locations in the world periphery.

The two-speed employment systems that characterize large cities in capitalism today thus operate not as functionally separate worlds, but as the interdependent units of a unified whole. On the one side, high-level cognitive-cultural workers in these cities are engaged in the production and commercialization of contrived outputs for world-wide markets. On the other side, a host of low-wage service workers in the same cities secure the essential social and economic conditions under which the upper half of the system is able to function effectively. A vivid illustration of these remarks can be discerned in the division of labor in and around the gleaming office towers of the financial districts of London, New York, and Tokyo where one army of extravagantly-paid employees is engaged during the daytime in high-profile business and financial operations, while at night another army composed of minimum-wage workers takes over in order to prepare the same buildings for the next day's work.

In the more skilled and highly-paying reaches of the urban economy, firms tend to play insistently on product registers involving short runs of output (sometimes customized) with exclusive quality, performance, and design attributes. These

product qualities are often firm-specific in that they reside in the expertise of the individual firm, but they may also have place-specific features that reflect the unique traditions, craftsmanship, and reputational assets embedded in the urban Common. Examples of products that bear the stamp of their place of origin are motion-pictures in Hollywood, aerospace in Toulouse, financial services in London, and *haute couture* in Paris. In each of these cases, localized concentrations of technical know-how and human sensibility occupy an important place in production and hence in helping to ensure the competitiveness of outputs. Products with unique features like these are also susceptible to legal safeguards offering protection from competition by means of copyright, trademarks, certificates of geographic origin, and other forms of branding.

Because of their often idiosyncratic firm- and place-specific traits, and no matter whether they depend on explicit legal protection or not, the products of the new economy increasingly face one another on markets that are subject to the rule of monopolistic or oligopolistic competition as formulated by Chamberlin (1933). Goods and services that compete in this way are generically similar to one another, but are differentiated by their detailed design specifications such that each firm- or place-specific product commands a distinctive market niche. Thus, while it is entirely correct to affirm that economic competition has become greatly intensified under contemporary conditions of globalization and neoliberal policy orthodoxy, this is far from representing a wholesale return to traditional *laissez-faire*. For the same reason, there are grounds for scepticism in regard to the analysis proposed by Rifkin (2014) who conjectures that digital technologies and the Internet of Things (including three-dimensional printing) are leading to the emergence of a society in which positive prices will virtually disappear because the possibility of reproducing unlimited quantities of outputs at close to zero marginal cost is imminent. Rifkin (2014) suggests that a kind of collaborative Common will steadily supplant competitive capitalism and that this will then lead on to the formation of an extensive sharing economy. This idea finds an echo in the work of Benkler (2003) who argues that the Internet will eventually liberate the production of culture and information from commercial interests. A further echo is to be found in the more politically radical theses proposed by Vercellone and Negri (2008) to the effect that general intellect is now maturing to the point where it heralds the advent of new modalities of production and value and the imminent emergence of an extended logic of social cooperation. There is, to be sure, a very unstable boundary between the digital Common on the one hand, and private producers with their portfolios of intellectual property rights on the other, but some tempering of these speculative arguments about the radical retreat of capitalism is surely in order. Thus, whereas cooperation, sharing, and open-source inputs to production and social life are unquestionably pushing the boundaries of the Common outwards, the equally dramatic upsurge of Chamberlinian competition, branding, and intellectual property regimes in all their different forms means that private firms, no matter how much they are caught up in the Common, can exert varying degrees of monopolistic or oligopolistic market control and thus can extract positive prices

from consumers even in the extreme case of zero marginal cost. Much of the digital realm, in any case, can only be accessed by means of web sites and applications created and held by private profit-making firms with established intellectual property rights, and increasing numbers of these firms have significant ownership advantages. In a word, and for the reasons adduced, any claims about the deliquescence of the individual capitalist firm under pressure from an expanding Common must remain extremely theoretical to say the least, especially given the fact that the Internet itself is daily opening up an enormous number of new entrepreneurial opportunities.

A more evident consequence of the widening diffusion of digital technologies in capitalist society is the weakening of the forces of agglomeration in at least some sectors of the economy. As communications networks with embedded computers become ever more powerful, any need for complementary producers to locate in close proximity to one another is apt to be diminished by the substitution of electronic interactions for more personalized encounters. The net effect, all else being equal, is that many firms find it increasingly attractive to relocate in more decentralized, lower-cost locations. Similarly, improved digital technologies facilitate communications between the different internal departments of given firms, thereby opening up potential future scenarios of accelerated geographical disintegration not to mention vertical and horizontal disintegration in the corporate economy, conceivably making it possible for fragmented units of production to boost their command of Chamberlinian monopoly powers via increasing specialization and individuation. Still, as Taylor, et al. (2013) suggest, the spatial fragmentation of corporate functions (notably in the advanced business and financial services sector) frequently leads not so much to unbridled dispersal as it does to the allocation of different units of the firm to different urban agglomerations. For the present, at least, the leading sectors of contemporary capitalism continue overwhelmingly to cluster in major cities, which in their turn continue to develop and grow apace. This persistent urban expansion is also partly sustained by the tendency of the cognitive-cultural economy to give birth to new sectors of production that help to maintain a rising tide of agglomeration forces.

Precisely because of this unrelenting pattern of growth, large cities in contemporary capitalism have become vortexes of rent generation and upwardly spiralling land prices, a phenomenon that has been much accentuated of late by the steady internationalization of property speculation. More to the point, land rent is generated collectively out of the dynamics of the Common (i.e. as an effect of relative location) but is privately appropriated by individual property owners. At the same time, the resurgence of land rents in the principal cities of cognitive-cultural capitalism is bound up with striking changes in urban skylines, above all in central business districts where the advanced financial, banking, and business service activities of the new economy are typically concentrated. Not the least of the discernible changes occurring in the central areas of these cities is the insistent intensification of land uses via the constantly increasing height and

density of buildings. As Sklair (2010) has observed, the grandiloquent architecture of a large proportion of these buildings offers a sort of symbolic reflection of the bombastic spirit of the international corporate organizations that occupy them. Moreover, rent in the cognitive-cultural economy is by no means confined to land, but is also now prominent in the sphere of production, for the rise of Chamberlinian competition has made it increasingly possible for firms to earn significant super-profits on their outputs, and these are in important respects coming to displace normal profits as the main source of revenue from production in many segments of the new economy.

4 THE SOCIAL CONSTITUTION OF THE CITY

Much has been made in recent years about the formation of a new plutocracy – the one-percent – in contemporary capitalist society, and much political protest has been justifiably directed at the spectacularly widening income inequalities that are the principal symptom of this condition. Yet as serious as this situation may be, and notwithstanding its insistent documentation in the media, it tends perhaps to obscure a much more pervasive social divide in contemporary urban society between high-wage cognitive-cultural workers on the one hand and low-wage service workers on the other. A bipartite social cleavage has always existed between the upper and lower income groups in capitalist cities, but it has become greatly accentuated of late years as the cognitive-cultural economy has taken firm hold over urban affairs.

In the immediate post-War decades, in North America and Western Europe, the fundamental division of labor in production was identifiable in terms of a cohort of white-collar managerial, technical and professional workers on the one side, and a cohort of blue-collar manual workers on the other. This twofold split was in turn replicated in the social and physical fabric of the metropolis where it assumed, incompletely but distinctly, the form of a spatial partitioning of neighbourhoods, marked on each side by distinctive processes of family life and social reproduction. Today, as the cognitive-cultural economy moves ahead, a very different division of labor and a corresponding restratification of urban society – together with a derivative spatial division of neighbourhoods -- are making their historical and geographical appearance in major cities. For one thing, the highly-qualified and (usually) highly-paid workers who constitute the prestigious upper tiers of the cognitive-cultural labor force can no longer be described as being equivalent to the bureaucratic/professional white-collar fraction typical of fordism. To an even lesser extent can they be cast as a troop of conformist organization men (cf. Whyte, 1957). Rather, the upper tier now constitutes a new kind of class formation made up of men and women variously endowed with high levels of human capital in regard not only to functions such as analytical thinking and judgment, but also fluency of ideas, social perceptiveness, flexible attitudes, imaginativeness, aesthetic sensibility, and capacities for interaction with others, as well as substantive knowledge and

expertise in fields such as technology, medicine, business, policy analysis, and the arts (cf. Gouldner, 1979). For another thing, low-wage service workers are now replacing the blue-collar production workers who once dominated the lower half of society in large capitalist cities. These service workers are a major element of the new economy where they perform crucial but poorly-paid tasks that underpin the social reproduction of the upper half of the labor force and that help to maintain the functional fabric of the city. Hence they constitute what we might refer to as a "new servile class," a designation that is underscored by their precarious job prospects, and, in so many cases, by their status as socially marginalized immigrants from the peripheries and backwaters of global capitalism. The bottom end of this class gives way in numerous cities to an underclass of casual day workers, street vendors, the long-term unemployed, the unemployable, the homeless, and the chronically ill who, as Standing (2011) has noted, eke out a precarious living on the fringes of urban society and who, in the burgeoning metropolitan areas of the Global South often constitute a disconcertingly large fraction of the total population.

Above all the generally elevated and relatively secure remuneration of high-level cognitive-cultural workers contrasts sharply with the low and much more precarious wages of the new servile class. For example, in Los Angeles County in the year 2012, the ratio of the median wage and salary income of a representative group of cognitive-cultural workers to a representative group of low-wage service workers was just above six to one (cf. Scott, 2012). This is a high multiple by any standard, and the fact that it is based on aggregate measures certainly conceals a significant range of more extreme cases. Indeed, the true multiple is probably considerably higher than six to one since much information for illegal immigrants -- who are strongly represented in the new servile class -- is not captured in official statistics. Moreover, with the increasing prevalence of two-income families in advanced capitalist societies absolute differences in family income between the upper and lower halves of the labor force are greatly magnified, and this translates in turn into notably widened differences with respect to life chances and the quality of overall social life. A marked consequence of this state of affairs is that the children of high-level cognitive-cultural workers are typically socialized -- in their families, in their neighbourhood schools and communities, and in adjoining urban spaces -- into a highly privileged set of expectations and prospects. The children of the new servile class, by contrast, are much less favoured, and they face many more hurdles in any effort to gain access to the higher echelons of society. There are profound generational implications in this condition, not only in terms of the reinforcement of the great income divide in twenty-first century cities, but also in terms of the differential social and psychic rewards of urban life for members of the upper and lower occupational strata, especially where these differences intersect with racial identities.

These inequalities in urban society are compounded by the educational system at all levels of instruction. Primary and secondary schools located in rich and poor

urban neighbourhoods typically display wide variations in the matter of teacher quality and pedagogical practices, and this alone results in substantial social discrepancies, especially concerning access to university-level education and the credentials required for entry into well-paid professional work. Access to advanced education is all the more important because colleges and universities are becoming more and more attuned in their teaching pursuits to the needs of the new economy (and in many cities this means adaptation to the needs of the local economy). A signal indicator of this intensifying trend is the accelerated growth of professional-education programs in universities and allied institutions in fields as diverse as engineering, medicine, law, public health, business, information studies, journalism, public policy, social work, film and television, and architecture, to mention only some of the more obvious cases. This turn to vocational training – frequently at the expense of more critical modes of enquiry -- is an indication of the increasing focus in institutions of advanced education on turning out certified individuals who are then able to move more or less seamlessly into the cognitive-cultural labor force as technocrats, managers, policy analysts, health specialists, human resources workers, cultural intermediaries, and all the rest. Coin (2013) has referred to this development in terms of the "neoliberal reform" of higher education in the twenty-first century. The same neoliberal logic is evident in the proliferation of money-spinning branch-plant campuses deployed by universities in the global North to major cities in the global South.

All of these changes are profoundly interwoven with many visible adjustments in the social geography of the urban milieu. They are especially manifest in the restructuring of residential space that has been occurring in North American and Western European cities in the context of the demise of fordism and the upsurge of cognitive-cultural capitalism. Perhaps the most striking instance of these adjustments is the insistent colonization by high-level cognitive-cultural workers of residential areas close to the centre of the city. Large numbers of these workers continue to live in their traditional habitat in suburbia, but many have been increasingly settling in gentrified central-city neighbourhoods in recent decades. Gentrification has been accompanied by the out-migration of large numbers of the low-wage residents – including the remnants of the old blue-collar working class – who in the United States and many countries of Europe traditionally occupied the majority of central-city neighbourhoods. Much of this out-migration can be accounted for by the disappearance of nearby manufacturing jobs, but much of it is also due to inflation of housing prices as high-level cognitive-cultural workers have increasingly moved into residential districts close to downtown areas. The most vulnerable low-wage residents of these districts – i.e. those occupying rental accommodation – have been particularly burdened by rising real estate values. Numerous families that formerly lived in the urban core have thus been under considerable pressure to relocate to other areas, notably to nondescript neighbourhoods in intermediate zones of the city and to those parts of suburbia where cheap housing is available.

The trends described above reflect the comprehensive social restratification that has occurred in major cities of cognitive-cultural capitalism of late, though this does not tell the whole story. In addition, we must carefully weigh the effects of the changing economic character of central city areas. Above and beyond the loss of manufacturing jobs in these areas there have been enormous increases in employment opportunities for high-level cognitive-cultural workers as advanced sectors such as finance, business services, media, advertising, and fashion and design have grown apace at central city locations. Recent rounds of expansion of high-wage jobs at these locations have stimulated the demand for locally-accessible housing by well-paid cognitive-cultural workers, especially those with demographic profiles like young professionals, cohabiting couples, metrosexual singles, two-income middle-class households, people in same sex unions, and apartment sharers (Haase, et al., 2010). Concomitantly, the qualitative attributes of many inner-city residential areas have been transformed by relentless rehabilitation or reconstruction of the local housing stock and by public investment in local amenities. The growing presence of high-income residents in inner city areas has also stimulated the growth of shopping, entertainment, and cultural facilities so that there is an increasing interpenetration of the spaces of work, social reproduction, and leisure in these parts of the city. This trend provides a sort of echo in urban space of what, according to Fumagalli (2011), can be seen as the increasing erasure of the difference between work-time and life-time in the space of personal existence in capitalism today.

To be sure, sundry analysts -- probably the majority -- invoke the rent-gap theory devised by Smith (1982) as the most plausible explanation of these changes. This theory claims that actual land rent in inner city neighbourhoods dominated by low-income families tends to be quite modest whereas the *potential* rent that the same areas can command is relatively high. In Smith's account (1982), upper-income individuals accordingly seize on the opportunity to turn these potential values into actual gains by redeveloping and occupying properties within the inner city. In so far as it goes, this theoretical description of gentrification probably captures part of the process, especially in its early stages, but it can only be partially true at best since it overlooks two crucial questions: Why did low-income residents dominate these locations for so long despite their hypothesized high potential rents? As a corollary, what accounts for the precise historical timing of gentrification? These crucial questions can only be dealt with when we revise the rent-gap theory so as to accommodate the factor of locational change in intra-urban employment patterns as described earlier. Of course, gentrification was first observed in London by Glass (1964) more than half-a-century ago, long before cognitive-cultural capitalism had started to make its decisive entry on the scene. However, this apparent historical inconsistency with the analysis proposed here can plausibly be accounted for by reference to the post-War growth of London as a major international financial and commercial centre leading to this early expansion of housing demands in the inner boroughs by a well-heeled workforce. London thus appears to have been a precocious but explicable

forerunner of trends that became much more pervasive towards the end of the twentieth century.

Merrifield (2014) has used the felicitous phrase "neo-Hausmannization" to refer to gentrification and its associated syndrome of exacerbated socio-economic bifurcation in the city. Indeed, in parallel with the case of Paris in the mid-nineteenth century, upgrading of the physical fabric of central areas of the city in cognitive-cultural capitalism has recreated many old urban injustices in new guises, notably the disproportionate burden of social and economic costs that has been thrust on low-income renters who can easily be ejected from properties destined for redevelopment. At the same time, the social fabric of those low-income neighbourhoods that remain in inner-city areas has been subject to erosion as a result of the growth of employment in central business districts and persistent gentrification, thereby further undermining the viability of these neighbourhoods as foci of family life and social reproduction for less privileged members of urban society. These continuing socio-spatial disruptions are amplified by the proliferation of gated communities in contemporary cities in flagrant repudiation of the intrinsically collective order of urban space. The net effect of this overall developmental model as it has unfolded in the most advanced cities of cognitive-cultural capitalism in the twenty-first century is the remarkable contrast between the glamour and extravagance of their most opulent sections and the squalor of their darker underbellies (Currid-Halkett and Scott, 2013).

The inequities of large cities assume different forms at different times but they are an intrinsic component of urban realities in all versions of capitalism, and, as noted, they remain very much part of the urban question today. As Harvey (2012) shows, these inequities lead systematically to political pressures that function as flash-points of social protest. Concomitantly, overt demonstrations of urban discontent are ready to burst forth over and over again into the streets of the city, as represented in the very recent past by the Occupy Movement that emerged on the heels of the recent financial and housing crisis. These demonstrations are usually tilted towards the redress of genuine injustices, but there has also been a troubling recrudescence of more regressive protest movements and violence in advanced capitalist cities of late, more often than not in some direct or indirect relation to the increasing ethnic and cultural diversity of urban social life as global capitalism runs its course. Two illustrations of this trend are the Pegida Movement that has recently come to the surface in Germany, and the widening jihadist threat in European cities. By its very nature, urbanization can always be counted on to generate and magnify expressions of political dissatisfaction, if only because it entails conspicuous social and economic differences between individuals who live together under conditions of extreme proximity, density, and interaction. The city, in brief, offers an opportune environment for the propagation of social passions and a ready-made stage for the mobilization of political energies whatever their inner motivation.

5 THE URBAN COMMON

We have already seen that the city is the site of an enormous Common comprising a multitude of heterogeneous phenomena ranging from simple land-use externalities, through urban-wide agglomeration economies, to the intangible epistemic and cultural resources embedded in the urban milieu generally. Obviously, with the development of cyberspace, the scalar dimensions of many (but by no means all) segments of the Common now extend far beyond any single urban area and in numerous instances are nothing less than global. More accurately, perhaps, we should say that as cyberspace develops, the Common takes on the shape of a global network punctuated by strong localized articulations coinciding above all with major global cities.

Mainstream economics refers to the assets and liabilities that make up the contents of the Common as cases of "market failure," signifying that they are not internalized within private property arrangements and are not susceptible to exchange on competitive markets. This terminology, however, grants far too much, by implication, to the market as a normative ideal of social organization. The Common does not stand simply as a collection of aberrant or abnormal secondary outcomes relative to the market. Rather, it is a complementary form of social reality that is subject to its own specific structural logics and that produces its own specific kinds of effects. To be sure, these logics are not always fully rational in social terms, as the classical case of overgrazing on the village common lands in pre-industrial Britain makes clear. More generally, while the Common usually offers public benefits, it also sometimes imposes politically unacceptable costs on urban society, and sometimes holds potential assets that cannot be fully harvested in the absence of appropriate action. When conditions like these become critical, agencies with responsibilities for collective management and coordination will typically seek to impose remedial measures. Much of contemporary urban planning and policy can be understood as a response to predicaments of these sorts, as, for example, where collective action is called for to control harmful externalities (such as pollution) or to promote development (e.g. by ensuring more orderly production of agglomeration economies). By the same token, privatization is by no means the only way of responding to the problems of the urban Common, and in many cases is not even technically feasible.

Already, in the cities of nineteenth century industrial capitalism numerous problems pertaining to the Common were clearly apparent. In the burgeoning manufacturing centres of nineteenth century America and Europe, above all, malfunctions of the Common were a frequent occurrence. Breakdowns in regard to the physical and social environment (residential neighbourhoods, transport systems, public health, land use conflicts, and so on) not only threatened the competitive advantages of cities but also imposed heavy costs on individual workers and families. The challenges posed by these early manufacturing centres were not limited to the purely material aspects of urban life, for they also related to important facets of human consciousness and behaviour, and hence had an

important bearing on the smooth adaptation of workers to the conditions of industrial-urban existence. The Common was deeply implicated in this matter. Factory owners in particular were vociferous about the deleterious influence of the social atmosphere of cities on workers' conduct and factory discipline. Marx wrote in several texts about this question and about the difficulties faced by capitalists in securing the subsumption of workers into the constraints and rhythms of the factory. Indeed, the stubbornness of the problems of large industrial centres in the nineteenth century induced many individual capitalists to seek out alternative models of urban work and life by establishing planned factory towns where they could free themselves from the irrationalities of unrestrained urbanization processes and exert monopoly control over the urban environment and simultaneously supervise the conduct of their workers. Paternalistic capitalists like Robert Owen, Sir Titus Salt, and George Pullman, for example, enthusiastically pursued this course of action by setting up factories and adjacent workers' settlements in New Lanark, Saltaire, and Pullman, respectively. However, this privatized approach to questions of defective urban development and the domestication of the human animal in nineteenth century capitalism could never become a society-wide solution if only for the evident reason that agglomeration processes operate with such force in market-based, competitive systems of production. As Benevolo (1971) has shown, modern town planning emerged as a means of at least partially taming the chaos of spontaneous urbanization in capitalism and of securing the social value of the Common.

Even today, the Common continues to exert considerable effects on patterns of socialization and habituation among the citizenry. Hardt and Negri (2009) have argued that the growth of the Common over the twentieth century and into the twenty-first has proceeded to the point where it has now steadily and inexorably become implicated in biopower relations across the whole of advanced capitalist society. Of course, this extension of the Common derives in important ways from modern media and information flows whose range far exceeds the bounds of the urban. But these biopower relations are also deeply rooted in the modern city, which, to paraphrase Hardt and Negri (2009), has become a site of human subsumption that complements and extends the disciplining influence of the workplace. The city shapes the life-world of the great majority of the citizenry through the ordered rhythms and routines of daily existence and the habituated responses that ensure its systematic operation. Accordingly, the mediatic environment, the workplace, and the city act – imperfectly but powerfully -- as mutually reinforcing instruments of social consent. The fact that the contents of the media derive so frequently from the cognitive-cultural industries that themselves are an integral part of the new urbanization almost certainly imparts a degree of consistency to their essential meanings. Indeed, much if not most of the culture we consume these days is produced by capitalist firms in the guise of profit-earning commodities. This contention is not intended to resuscitate the old nightmare script of the Frankfurt School with its claims about the wholesale stupefaction of the working class by means of the knowing manipulation of

popular culture by capitalist enterprise. It does, however, point to some of the historically-constructed conditions that help to bring work, life, and consciousness in cognitive-cultural capitalism into some sort of effective alignment and that facilitate the formation of tacit acquiescence to the broad architecture of prevailing social arrangements (Peters and Bulut, 2011). There is every reason to suppose that the urban dimensions of this alignment will further stabilize as embedded sensors and information-gathering agencies in the digital city increase their monitoring of huge swaths of urban existence while at the same time pumping more and more data into the Common (Rabari and Storper, 2015). These developments will not only make it possible to boost the efficiency of urban public services, but also and more ominously perhaps to facilitate mass surveillance in the city.

At the same time, we must acknowledge the contradictory role of the Common not only as an instrument of biopower, but also as a source of new ideas and trends. However, in the core cities of cognitive-cultural capitalism, this role is almost always directed to pragmatic ends focused on innovation as a means of promoting competitive advantage. Hall (1998) has shown in considerable detail that urban areas have invariably been concentrated foci of innovative impulses, and the cities of cognitive-cultural capitalism appear to be unusually well endowed with the capacity to generate new economic opportunities. This predisposition ranges from the inventive dynamism of advanced high-technology industrial districts to the creative capacities of many cultural industry clusters in the large cosmopolitan centres of the global economy. These kinds of situations are related to the abundance of information and modish ideas (in varying states of systematization) that circulate freely through urban space, but they are in a more fundamental sense a reflection of the peculiar status of the city as a dense integrated grid of stimuli and responses, or what we might call a "creative field." In other words, the city operates like a vast communications network whose operational nodes coincide with individual workers, units of production, business associations, educational institutions, NGOs, municipal agencies, cultural infrastructures, and the like, all caught up with one another in structured interactions that pass through the Common and that sometimes result in concrete innovations.

This latter aspect of the city has taken on some importance in cognitive-cultural capitalism, where systematic ecologies of innovation rooted in the creative field (as in the classic case of Silicon Valley) have come in part to displace the old top-down fordist model of R&D-based innovation. This shift has stimulated much recent research into the creative potentials of cities, with the currently fashionable theory of the "creative city" being one of its more conspicuous recent declinations. This theory has evolved in significant ways out of a vision of the city, formulated originally by Richard Florida (2004), as a privileged playground of the "creative class." Florida's definition of this class (i.e. all individuals with a bachelor's degree or better) is in some respects convergent with that of the high-level cognitive-cultural workforce as identified in the present paper. The central

thesis of the vision is that members of the creative class can be induced to migrate to cities by means of public investments in cultural and leisure amenities of various kinds, and that this will lead on to superior developmental outcomes in economic and cultural life. Proponents of the theory claim that it offers a powerful antidote to urban decline. However, as numerous critics have pointed out, its superficial plausibility dissolves away in the face of the unwarranted privilege that it accords to amenities (as opposed to jobs) in influencing the migratory movements of high-level cognitive-cultural workers (cf. Scott, 2014). Certainly, there are genuine analytical puzzles in regard to the creative potentials of cities, but these can never be adequately assessed without considered evaluation of local production capacities and the prospects for employment of suitably qualified workers. Creative city theory has attracted much attention, and large numbers of the urban elite all around the world have claimed it as their own, not only because of its cheerful (but questionable) theoretical claims and the city-marketing rhetoric that it provides, but also perhaps on account of the manner in which it covertly legitimizes the reallocation of urban public spending in ways that are congenial to the interests of those in the upper reaches of urban society (cf. Kraftl, 2014). Understandably, no popular political movement to date has sought to mobilize the citizenry under the banner of this vision.

6 FINALE: THE CITY IN COGNITIVE-CULTURAL CAPITALISM

The argument developed in these pages presents a picture of the city in capitalism as a spatial entity that emerges in the first instance as an agglomeration of production activities together with local labor market structures and a variegated palette of residential neighbourhoods. This constellation of land uses and human interactions is actively moulded by three main lines of force, namely, (a) individual firms and households whose actions are in important ways shaped by markets, (b) agencies of collective action that provide coordination and management services in the interests of urban viability, and (c) a Common composed of public assets, liabilities, and cultural resources that remain external to the market but are of great significance to the viability and livability of the city. These building blocks provide a generic language of urban analysis in capitalism, though their specific substantive logic and empirical expressions vary considerably from one historical and geographic situation to the next. Consider, again, the cities of cognitive-cultural capitalism in comparison with those of the fordist period. Patterns of urbanization in these two cases differ dramatically in regard to modalities of economic production, organization and the division of labor. Their dominant forms of social stratification and residential space deviate sharply as well. Additionally, the urban Common is probably now more extensive and variegated than it was in fordism while it has also become more closely implicated in the biopolitical power relations of capitalism. And whereas agencies of collective coordination and management in the city are still dominated by municipal government, a vast diversity of civil groups (such as

business organizations or neighbourhood associations) providing specialized forms of social regulation are now increasingly intruding in both major and minor ways into the affairs of large metropolitan areas.

The manifestly short period of historical time during which the development of the cognitive-cultural city has come about means that anticipations in regard to future developments are liable to be especially untrustworthy, and this in its turn makes political advocacies doubly hazardous. In the light of the foregoing analysis, however, three outstanding issues call urgently for immediate attention while helping to point the way towards a politically-progressive alternative vision of the city in cognitive-cultural capitalism. First, then, as demonstrated here, the cognitive-cultural economy in major cities is associated with the resurgence of a host of specific externality effects – above all, agglomeration economies of scale and scope -- with major impacts on localized competitive advantage. The evident deduction is that very much more effective urban governance arrangements are required in order to ensure that the quantity and quality of these effects are optimized as far as possible. Second, as cognitive-cultural capitalism has tightened its hold over major world cities and as the restructuring of social life in these cities has moved ahead, a significantly deepening bifurcation of incomes and life chances has also occurred. In contrast to this trend, the demands of democratic even-handedness and social justice suggest that the rewards and penalties of life in the city must be radically redistributed. A due regard for the likelihood of damaging urban disruptions arising out of this bifurcation also points to this policy goal. Third, the competitive temper of these cognitive-cultural times is an ideal breeding ground for the possessive individualism and narcissism that appear to be rampant in cities today. Castells (2013) has made the related remark that interrelationships between urban dwellers are becoming more and more depersonalized as web-based exchanges substitute to an ever growing extent for direct social interaction. Hence, despite the theoretical claims made in some quarters to the effect that the so-called creative class thrives on urban milieux where tolerance, openness, and social diversity are prominent, it is probably more accurate to say that any preferences of this sort, to the degree that they really exist, are more apt to be a reflection of indifference as opposed to forthright social engagement. The recovery of more immediate forms of social cohesion together with the consolations and pleasures of community is therefore also an important desideratum in any reform of the city in the interests of more meaningful and rewarding modalities of urban existence.

All that being said, the transcendence of capitalism and the advent of a future collaborative society alleged by Rifkin (2014) and others to be imminently in the offing -- at whatever spatial scale we care to imagine -- remains far from assured. If the arguments in the present paper are correct, the current situation is one where important shifts in social organization and many potential advances in the quality of work and life in cities are occurring, but the atrophy of capitalist social and property relations does not look as if it might be among them.

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The City of Business: the Functional, the Relational-Cognitive and the Hierarchical-Distributive Approach

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ABSTRACT

Purpose: The main purpose of the paper is to highlight some limits of the traditional theoretical interpretation of the relationships between the city and economic activities. This interpretation usually makes reference to two elements: agglomeration economies, cumulatively generating gains in efficiency and consequently in competitiveness and attractiveness and external connectivity, linked to multiple networks of both physical and immaterial nature. This approach, mainly functional and geographical, nowadays looks quite reductionist and overlooks crucial aspects of the urban realm that explain urban economic success The first aspect concerns the social and cultural nature of the main inter-personal and inter-institutional relationships taking place inside the city, conducive to crucial processes of cooperation, collective learning, creativity and innovation. In addition to this, the growing concentration on (mainly large) cities of command and control functions which not only witnesses the presence of their political power – underlined by a growing literature in geography and political science – but also widely determines income distribution in space, at the local, national and global scale. The functional interpretation of the city should be complemented by a relational-cognitive and hierarchical-distributive approach. The latter one is particularly interesting for the interpretation of the development of 'monopolistic' cities which operate on economic functions in which they can benefit from a captive market: capital cities and art cities in particular.

Methodology/Approach: While the first part of the paper is mainly theoretical, it presents also an empirical side in the second issue, namely the destiny of medium-sized cities. The last section of the paper concerns a logical turnaround: 'cities as businesses' where high surpluses are generated in the real estate field,

taking advantage of the economic success of the cities themselves and appropriating a consistent share of the generated profits in the form of land rents.

Findings: The traditional view is that medium-sized cities cannot take full advantage of agglomeration economies and therefore will necessarily show lower growth rates in the long term. This paper argues against this view, on both theoretical and empirical grounds, looking at the evidence of European cities in the last twenty years. In many countries, this process should be more appropriately taxed in order to allow sustainable and socially equilibrated development: a fairer sharing of these surplus-values between private and public parties is justified by the collective nature of urban externalities.

Originality/Value of paper: The implications of the arguments presented here are relevant on both the interpretative and policy ground. The sources of urban economic success are not linked only to functional or efficiency elements but also to cultural-psychological and to power elements. The former ones require subtler policy strategies and the latter more appropriate policy tools oriented towards the widely ignored challenge of income distribution in space.

Category: Research paper

Keywords: interpretation of cities; agglomeration economies; urban competitiveness; income distribution in space; large vs. medium cities

1 INTRODUCTION

From the beginning of history and civilization there have been cities where the organization of human activities were not linked to primary or natural resources, in strict relationship with the complementary spaces, the 'countryside'. Cities "were born from the most ancient and the most revolutionary division of labour: countryside and agriculture on the one side and the so-called urban activities on the other" (Braudel, 1979, p. 547; author's translation). He goes on to say that "cities are kinds of electrical transformers: they emphasize tensions, accelerate exchanges, continuously stir human lives" (ibid.). Between these two archetypal spaces, profound relationships were established. While cities provided the knowledge and tools, the countryside provided the food for the survival of cities. This was produced in addition to the necessities of rural people (Jacobs, 1969). These relationships were never just functional ones as they implied a mutual dependency. There was the subsistence on one side and productivity-enhancing inputs of an institutional, economic and cognitive nature on the other. These were easily exploited by the stronger partner in terms of control and income distribution (Camagni, 1992).

Business, viewed in the widest sense as the production and exchange of goods and services, and cities have always been inseparable. The urban context has supplied the necessary preconditions for economic success. In other words, the internal labour and goods markets, long-distance and nowadays global

accessibility, fast information circulation, density of knowledge-intensive services and last but not least, the presence of power élites.

The aim of this paper is to highlight this natural linkage between business and the city today. It intends to highlight the relevant natures and roles of cities and therefore the theoretical conceptualizations that are more appropriate in interpreting this mutual attraction.

On the economic front, although not including the last 60 years of regional science, economists were traditionally reluctant to include space (and cities) as a relevant dimension of the economic process. Rather, they favoured the dimension of time. Even in the case where the urban context was examined – for example in the "new urban economics" of the 1970s and 1980s - it was mainly examined through the application of the economist's method and tools to the city. This was done in preference to an analysis of the 'urban' as an original organizational model of economic and social activities and an interpretative paradigm of reality (Camagni, 1992). For a long time, the analysis of the economic advantages of the urban context relied upon functional interpretations in terms of agglomeration economies and external network linkages. It has only been recently that this reductionist approach has been overcome and replaced by the inclusion of the relational, cognitive and hierarchical dimensions of the urban "milieu" (Crevoisier and Camagni, 2000; Camagni, 2001; Cusinato, 2016a). This is called here the cognitive and cultural paradigm. These dimensions, going beyond the purely functional ones, have enabled the consideration and interpretation of such processes such as innovation and creativity, territorial control, spatial division of labour between the city and countryside as well as the social and also spatial divide likely to emerge as a consequence of the development of the new cognitive and cultural paradigm.

However, it has not only been the economists that have overlooked the original role of the urban context and denied the possibility of a generalization of the 'urban' as a socio-economic nexus. Geographers and scholars who are tied to the idea of a multiplicity and differentiation of cities (Abrams, 1978) argue that no relevant Marshallian and 'milieu' effects come from agglomerations (Amin and Robin, 1991; Amin and Thrift, 2002). On the other hand, other geographers and scholars have argued that "agglomeration as process and outcome goes far beyond the question of the technical foundations of economic geography, for it is a quasi-universal feature of human existence" (Scott and Storper, 2015, p. 6). In short, this group argues that agglomeration is too persistent a phenomenon in history to be just a casual outcome of spatially diverse forces. As Braudel says, "a city is always a city, wherever located, in both time and space. (…) Cities speak necessarily the same fundamental language: their continuous dialogue with the countryside, the first requirement for daily life; the provision of people (…); their self-respect and willingness to distinguish from other cities; their necessary position at the centre of short and long-distance networks; their relationships with suburbs and other cities" (Braudel, 1979, p. 548, author's translation).

Those of Marxian heritage deny theoretical autonomy to the urban context and downgrade it to the mere stage on which history, capitalism and class struggles act. In fact, the extraction of surplus-values from labour and money circulation have little to ask from the spatial dimension. A Lacanian psychologist and a sociologist spoke about the city as a "hollow form beneath which history develops", recognizing that "we too did not escape this contempt and spoke about the 'city' to mean social production relationships, productive forces, capital and even State" (Fourquet and Murard, 1973, p. 36, author's translation). The Marxist literature focused on the late Marx of Das Kapital would have naturally ended with this same conclusion. However, a much more interesting inspiration would have come from the consideration of the young Marx of the Economic and Philosophic Manuscripts of 1844 and more particularly of the German Ideology where the "contradiction" between the city and countryside is presented: "The greatest division of material and mental labour is the separation of town and country. This antagonism begins with the transition from barbarism to civilization (…) and runs through the whole history of civilization to the present day" (Marx and Engels, 1970, p. 49).

Within the Marxist tradition, it is also possible to find signs of self-criticism about overlooking the relevance of space and the urban milieu. As David Harvey wrote, "urbanisation has always been about the mobilization, production, appropriation and absorption of economic surpluses. To the degree that capitalism is but a special version of that, we can reasonably argue that the urban process has more universal meaning than the specific analysis of any particular mode of production" (Harvey, 1989, p. 53).

This paper deals with the interpretation of the economic role of the city and the nature of its relationship with business at large. The recent evolution in the interpretation of cities will be examined first in section 2. This will show how a purely functional and geographic approach would be a reductionist one. Rather, it should be complemented by a relational-cognitive approach, emphasizing collective learning and cooperation processes and by a hierarchical-distributive approach, underlining command and command functions and their influence on income distribution between the two spatial archetypes; the city and the countryside. A second, related issue answers the questions; which city-sizes are we speaking about? Can we agree that mainly large, extra-large and mega cities are the drivers of economic development today? Can we accept that agglomeration economies mean not just a superior efficiency of large cities but also a superior potential for growth? Are there different elements, beyond pure size, that can drive urban development? These will be addressed in section 3. In section 4, monopolistic cities are examined. These are those cities that, by history, nature or human decision, host some specific and rare assets and functions. They benefit from a captive market but also suffer from lower incentives to ameliorate and innovate. In section 5, a different perspective is proposed; the city as a business. This analyses the flow of real estate surplus-values which follow from urban transformations and which turn continuing

changing urban externalities into land rents (in many cases hardly hit by local taxation). Some conclusions, both theoretical and policy-oriented, follow in section 6.

2 THE ROLE OF CITIES: THE FUNCTIONAL-GEOGRAPHICAL, THE RELATIONAL-COGNITIVE AND THE HIERARCHICAL-DISTRIBUTIVE APPROACH

Which characteristics of the urban environment attract business, and in particular modern industry and advanced service activities? Which roles may be specifically assigned to the city and what particular form do they assume in present times? The widely-accepted answer to this question points out the following two elements: "one of the central features of urbanization has always been its efficiency-generating qualities via agglomeration" and the fact that "cities have always functioned as nodes in systems of long-distance trade" (Scott and Storper, 2015, p. 5). Agglomeration economies account for the possibility of exploiting scale economies in production and local public services, numerous positive externalities linked to the development of a large and diversified pool of specialized labour, easy inter-personal communication and pecuniary externalities due to the presence of diversified ancillary industries and subcontractors, urbanization economies coming from the presence of public spaces, services and infrastructure. The presence of efficient external transport and communication networks allow accessibility and global connectivity. Most of these advantages are likely to counterbalance and overcome the diseconomies coming from congestion, emissions, social conflict and higher land prices of the larger cities. In a previous paper, this author labelled this view as the result of a functional approach, considering the double geographical dimension of places and networks (or stocks and flows) (Camagni, 2001).

This functional-geographical approach is by no means sufficient to account for the profound nature of cities. In fact, it should be complemented by two other approaches that could be indicated as the relational-cognitive and hierarchical-distributive approach. The first approach refers to the city as a 'milieu'. In other words, a system of actors and activities characterized by the high density of relationships; the sharing of languages, behavioural and cognitive codes, values, representations and a sense of belonging. All these characteristics facilitate cooperation, synergies, ex-ante coordination and collective action for the private supply of commons, reduction of uncertainty through socialized transcoding of information and last but not least, processes of collective learning (Camagni, 1991a and 2001). Emile Durkheim's concept of 'dynamic density' was applied to the urban milieu to explain its potential for the creation and valorization of knowledge through the transmission of formalized information coupled by the access to informal and undetermined information whose pertinent content is unknown ex-ante (Rémy, 1999). The process that follows is one of 'exploration' and possibly of innovation, when "the city becomes a place of non-intentional

convergence among a plurality of individual and collective trajectories ending up in a solidarity of effects" (Rémy, 2000, p.41).

More recently, the symbolic aspects of the urban milieu have been inspected through a hermeneutic approach. This highlights the relevance of public physical spaces symbolically recognized and appropriated by a local community in an identitarian way. It generates emotion, atmosphere and even affection and, through this, reflexive forms of learning, creativity and knowledge creation (Cusinato, 2016b; Camagni, 2016a). Along similar lines, Ron Martin has sketched the cultural bases of the competitive city. He started from the presence of cultural infrastructure, facilities and assets on one side and of social networks and shared values on the other. The cumulative cycle of the attraction of the creative and knowledge classes is triggered and ends in the development of a new cultural economy of creative, symbolic and knowledge-intensive industries (Martin, 2006).

Interestingly enough, in a dialectical and evolutionary sense, these 'virtuous' outcomes might end up in a new likely and already partially visible divide in social and also spatial terms. The new cultural and cognitive economic paradigm which is emerging nowadays might generate a new social polarization between a class of workers endowed with intellectual and creative skills, operating on symbols and codes and a class of low-waged manual and service workers. From a spatial perspective, this social polarisation may result in the striking confrontation of new rehabilitated and glamour neighbourhoods and clusters, hosting creative production activities as well as residential, cultural and leisure activities mainly located in the inner city. Next to this, would be the displaced peripheries left in squalor conditions, hosting the lower and impoverished lower-middle classes (Scott, 2015).

The second approach complementing the functional one in the interpretation of the economic roles of the city may be called the hierarchical-distributive one. It has to do with the issues of territorial power relations, the selective location of activities in the city and the non-city and the spatial distribution of income. In the words of the historian Marcel Roncayolo, the city is not only, in functional-geographical terms, "the topographic and social device that guarantees the highest effectiveness to exchange among men" but, in economic and hierarchical terms, "presents itself, in different degrees, as the place from which territorial control is established" (Roncayolo, 1990, p. 27 and 29; author's translation).

In Plato's Republic it was possible to find the intuition of the imperialistic role of the city on the countryside in purely economic terms. As long as the city remained attached to its primary needs, an equilibrated specialization and exchange with the countryside took place. When, in the course of time, it became "feverish" and turned to its secondary needs and developed a full array of service activities from health to justice, arts and leisure, it needed a wider hinterland to feed its citizens and consequently it "went to war" (Plato, 1990, p. 62-3). In Marxian terms, the city-countryside relationship turns into a "contradiction"

(Friedman, 1969) and the economic space becomes a 'relational space' of both functional and hierarchical interactions (Camagni, 1980). In pure economic terms, the privileged condition of the city appears in three different ways. Firstly, as a location of specific, selected and high-ranking industries (the top ones referring to high-tech research and production, specialized producer services and finance) and functions (corporate headquarter and command-and-control ones), giving rise to a new, worldwide hierarchy of globalized cities (Sassen, 1991; Castells, 1992; Scott, 2001; Taylor et al., 2007). Secondly, as a control-space on the social division of labour and thirdly, as the ruling space on income distribution through the determination of the relative prices of urban vs. rural productions (terms-of-trade) (Camagni, 1992, Introduction[1].

Among the specifically urban activities, complementary to the rural ones against which they are at least partially traded, top directional activities according to Adam Smith can be found concerning government, order, security and liberty, but also technology, administration and infrastructure management. The public share of these activities is financed through taxation, i.e. through power relationships. The private share - encompassing services addressed at the upgrading of rural productivity (or nowadays, of the productivity of decentralized industrial activities), namely technological, organizational, financial and commercial services - finds the rationale for an urban location in its information-intensive and knowledge-intensive nature. This is priced through the market[2], a market of which is particularly sensitive to the scarcity of supply and to monopolistic conditions.

[1] Once again, the functional and locational aspects of activities and functions were widely analyzed, but much research work "has tended toward the impressionistic" (Alderson and Beckfield, 2004, p. 812). This has collected rankings of cities in terms of population size, high-tech employment, and counts of top corporate headquarters, turnover or employment, passenger traffic in airports. More interesting developments are reached through network analysis, using a relational space approach, still applied on the geographical distribution of large companies' subsidiaries, controlled or hosted by cities. This allows approaching a picture where power and control are present with the "hierarchical division of labour between geographical regions corresponding to the vertical division of labour within the firm" (Hymer, 1972, p. 114). Urban power and prestige can be calculated through network algorithms (Alderson and Beckfield, 2004), but their socio-economic effects along the (world) urban hierarchy are still widely unknown.

[2] In Adam Smith's *Wealth of Nations*, a perfect description can be found of the unbalanced fixation of relative prices between city and countryside, taken from the medieval and renaissance times. "The government of towns corporate was altogether in the hands of traders and artificers, and it was the manifest interest of every particular class of them to prevent the market from being overstocked, (…) which is in reality to keep it always understocked. Each class was eager to establish regulations proper for this purpose, and was willing to consent that every other class should do the same. In consequence of such regulations, indeed, each class was obliged to buy the goods they had occasion for from every other within the town, somewhat dearer than they otherwise might had done. (…) So that in the dealings of the different classes within the town with one another, none of them were losers by these regulations. *But in their dealing with the country they were all great gainers; and in these latter dealings consists the whole trade which supports and enriches every town*" (Smith, 1976, p. 102, emphasis added). "The inhabitants of a town, being collected into one place, can easily combine together (…). The inhabitants of the country, dispersed in distant places, cannot easily combine together." (Smith, 1976, p. 103-4)

This structural representation of the city-countryside unbalanced relationship can have a dynamic and evolutionary version. One can claim that the city has changed through time, always hosting the crucial and strategic functions of each development stage. Power, religion and astronomy in ancient times; security, market and hydraulic public works in medieval times; handicraft and industrial activities in modern times; tertiary activities in the twentieth century; information-intensive and knowledge-intensive activities nowadays. In all cases, the monopoly of these activities represented the main 'business' of cities and the source of their wealth. Braudel has called this the "growing tyranny of cities" (Braudel, 1977, p. 16) and John Friedmann (1986) has referred to the present world cities as the "major contradiction" of globalised capitalism, namely "spatial and class polarization" and rising "social costs at rates that tend to exceed the fiscal capacity of the state" (p. 76-77).

Can we forecast any sort of "vengeance of the countryside" as a consequence of the pervasive, non-space-sensitive effects of information technologies and the internet? I personally have doubts on this; the use-capability of information is still very space-selective and the evolving process sketched here is destined to be continuously replicated both in space (new forms of the north-south divide) and time (the ongoing revolution of creativity and knowledge-intensive activities) (Aydalot and Camagni, 1986).

3 WHICH CITY-SIZE ARE WE SPEAKING ABOUT?

So far, the paper has focused on the concept and the main conceptualizations of the city. But if we come to the real world, a relevant question emerges; what typologies of cities do these abstract interpretations fit better? And in particular, which city-size are we mainly speaking about? By and large, the answer is that all typologies and all sizes, as the archetypal, interpretative description of cities refer to some structural denominator fitting all geographical manifestations albeit to different degrees. But in principle, agglomeration economies present a continuous expansion, at increasing or decreasing speed along with city size. The quality of activities hosted, according to the main models of urban hierarchy, also presents an ever increasing pace passing from lower to higher urban ranks. Urban land rents in the centres of cities of different size are proportional to the size itself, and the differential of urban land rents at the urban border with respect to rural rents, the expression of an 'absolute' land rent, is once again proportional to city size and the consequent agglomeration economies.

If we agree with this view, the large and extra-large cities appear as the best performing and the most successful representatives of the category. Indeed, empirical evidence concerning GDP per capita and level of salaries confirm this result (Nijkamp and Kourtit, 2013). But the present debate on cities and their role in economic development goes much beyond this statement. Large cities are presented as also the most dynamic spatial contexts and the ones on which one

should bet in policy terms if the main goal is boosting economic growth (World Bank, 2009; Glaeser, 2011).

Yet, it is difficult to agree to this last view. The claim that per capita productivity levels, thanks to agglomeration economies, are higher in large cities than in smaller ones is totally acceptable and accepted. However, saying that because of that, large cities are due to develop faster than the others implies an unacceptable logical shortcut. The mistake lies in the fact that a size-derivative (of productivity with respect to urban size) is a static relationship and should not be read as a time-derivative (of productivity with respect to time) (Camagni et al., 2016). As Henderson (2010) puts it, the "association between urbanization and development (…) is an equilibrium not causal relation" (p. 518) and "urbanization per se does not cause development" (p. 515).

A possible theoretical justification of the link between urban size, agglomeration economies and growth was given years ago by Paul Krugman (1991). Krugman suggested that higher urban productivity means higher attractiveness of both economic activities and households which will be conducive to higher growth. However, a counter argument could be that firms considering a large city for a potential location do not look at its gross per capita productivity but rather at net per capita productivity, discounting locational costs from production advantages. This latter indicator is much more homogeneous along city sizes than the gross indicator as a large city implies higher costs for both individuals and firms.

Recent empirical evidence in Europe has confirmed our view (Camagni and Capello, 2015). Recent Eurostat data on GDP in European metro areas has shown that medium and small ones developed more than larger ones in the period 1995-2009, and only with the advent of a crisis, in the most recent period, large cities show, on average, a slightly higher resilience (Fig. 1 and 2).

An interesting econometric analysis was run on the same sample of metro cities, in search of the determinants of urban performance in both a static and a dynamic setting (Camagni et al., 2016). The level of net urban benefits – measured by unit land prices - depend on urban size, as expected, but also on what was called "borrowed size", i.e. the demographic size of the wider spatial context (Meijers et al., 2016), supplying a wider labour and goods markets to single cities; on the quality of the economic activities hosted, measured by the share of top functions hosted, both in the single metro areas and in the wider spatial context (that we called "borrowed functions"); and, last but not least, on the capability of joining large cooperation networks, measured by the presence of local business in EU Framework Programmes of applied research.

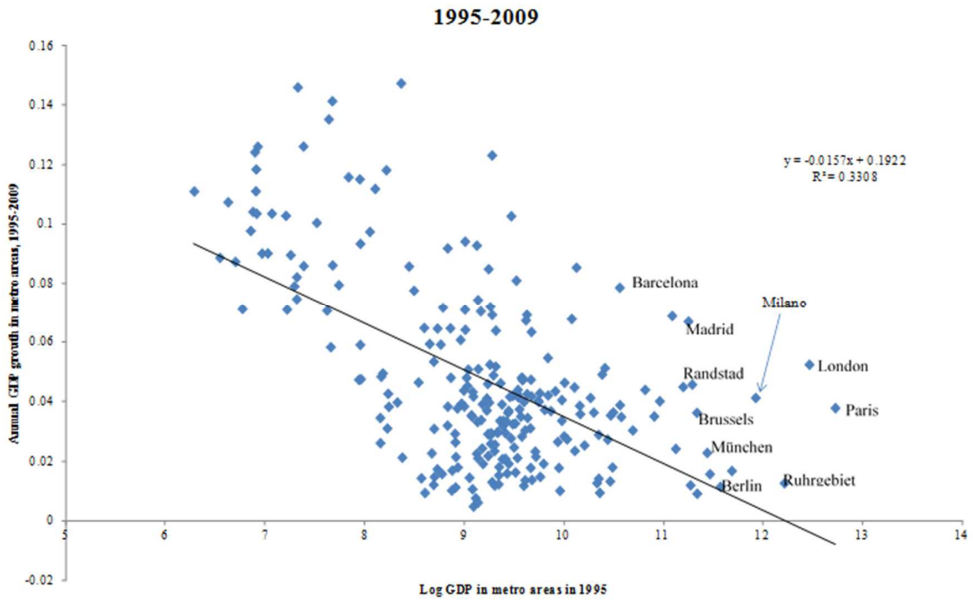

Figure 1 – Average Annual GDP growth – Eurostat Metro Areas, 1995-2009

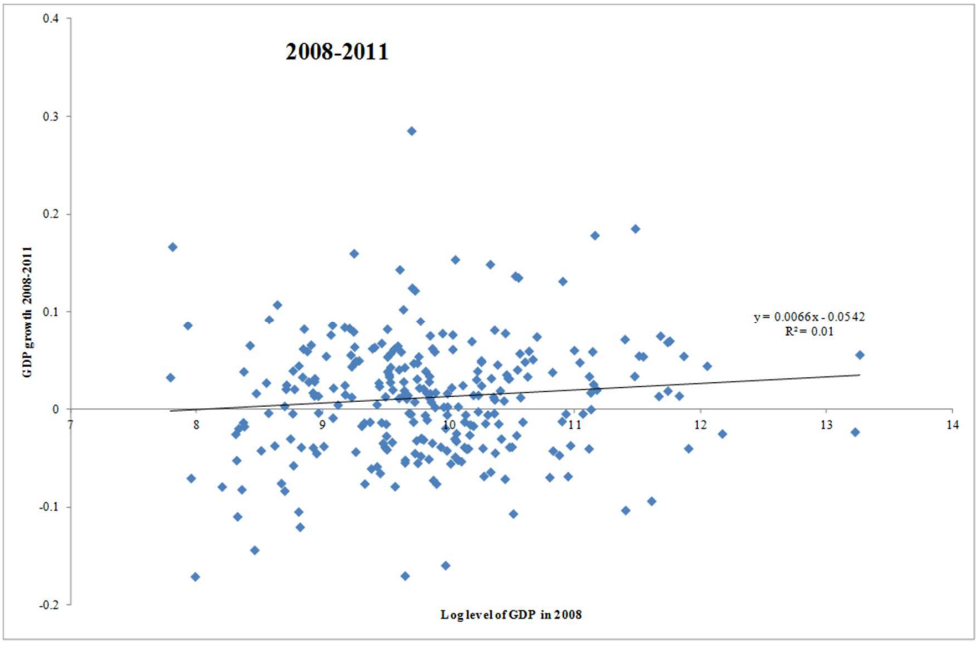

Figure 2 – Average Annual GDP growth – Eurostat Metro Areas, 2008-2011

More interestingly, on the dynamic side, the growth of net urban benefits on a time span of 15 years was not found to be statistically associated at all to the initial size of the metro areas. This was in contrast with some expectations from the literature but in line with our expectations. Rather, it depended on the growth

of the share of the top functions hosted in the single metro areas and in the wider urban context; on the growth of demographic "borrowed" size and on the density of international cooperation networks. In the evidence, at least in the spatial and time segment considered, the true driving forces of development reside in the dynamism of the city-system in which the single metro areas are included and in the quality and innovation capability of this system, rather than in the static agglomeration economies generated by the mere initial urban size.

Therefore, medium and smaller cities may count on many levers in order to boost their economic development, overcoming their deficit in demographic size, and on other specific tools and strategies like engaging in strategic and participatory planning or following a strategy of focusing on one or a few specialization fields. This justifies the continuous interest of business for these classes of cities.

4 THE MONOPOLISTIC CITIES: ART CITIES AND CAPITAL CITIES

The multiple theoretical approaches to the nature of cities illustrated in section 2 of this paper convey an important conceptual message; the different dimensions under which cities can be interpreted define different roles which are strictly interwoven, reinforcing each other and singularly necessary. The relational and cognitive nature of cities cannot blossom unless proximity and agglomeration elements are present. Their hierarchical power does not find its roots in power relations or imperium decisions (as perhaps could have happened in the past or in socialist regimes) but rather in functional elements defining urban excellence in top-ranking activities. The natural advantages of global accessibility can be highly reinforced by the presence of the ruling classes well positioned inside strategic decision making processes.

Moreover, the urban leadership condition in advanced sectors and functions is constantly challenged by technological progress pushing towards spatial diffusion and pervasiveness. The capability of imposing monopoly prices and advantageous terms-of-trade for its services, traded with the external spaces, is continuously compressed by the intense competition among cities themselves. Therefore, the general control position of the single cities, present at different degrees along the urban hierarchy, must be constantly defended, renewed and conquered through effective intentional efforts. It cannot be exploited in order to retain structural monopoly rents.

There are notable exceptions, however. There are cases in which monopoly conditions and consequent monopoly rents are manifest. This is in the case of art cities which present unique and astonishing cultural assets and heritage. It is also in the case of capital cities which exercise the government functions in conditions of institutional monopoly. In these cases, monopoly conditions in captive markets give rise to huge monopoly rents. This brings wide advantages to

the related filières of activities and lobbies and to real estate operators and owners.

In the former case, of art and tourist cities, monopoly rents spread pervasively inside the economic fabric, but also some relevant costs do: the negative externalities of the presence of tourists, generating increasing costs of living for residents and congestion costs; the cost of suffering as a result of the priority given to tourism activities over inhabitants needs by local administrations. And finally, the generalized reduction of incentives towards urban innovation and urban efficiency which is perhaps the greatest cost.

The case of capital cities is slightly different. They are generally rich and expensive with an attractive labour market and dense international interactions. However, given their large relative size, they often witness the coexistence of top services and advanced infrastructure on one side with poor neighbourhoods and social deprivation on the other. Moreover, the presence of power and power élites may degenerate in widespread corruption. The risk of lower incentives for structural change and innovation is lower than in the preceding case, as status pride, attention to power symbols and prestige by politicians and availability of public resources can keep the spectrum of decline away.

5 THE CITY AS BUSINESS: THE REAL ESTATE CITY

At this stage it is difficult to resist the temptation of a totally different interpretation of the city. By this, as the object (and not the subject) of private (but also of compliant public) decisions. The city as a business itself, in the field of real estate and construction. This subject would require a full article or even a series of books but some relevant reflections linked to the previous theses can be proposed in short.

Cities, and in this case mainly large cities, have been and still are a Mecca for the real estate business. In fact, as a consequence of a virtuous interplay of the different roles played – as agglomerations and network nodes, as relational spaces and milieus, as places of territorial control – conducive to economic and demographic success, cities have provided a steady growing demand for residential and office spaces in the entire post-war period. This has generated a continuous rise in building prices well beyond pure construction costs (at least up to the recent crisis), consequent profits, capital gains and huge transformation rents coming from land-use changes.

The main message that emerges is that it is a collective and cumulative development process. These interacting processes of urbanization of people, of wide public investments and pervasive public services and of private investments in economic activities determine an increase of purely private values, namely land and floor-space values with two relevant income distribution effects:

- an enormous increase in incomes (rents) and capital gains in the hands of real estate owners and developers. This is especially in the case of physical urban transformation, of changes in land uses and of provision of new internal and external public transport infrastructure. It is worth being reminded that land rents were considered as 'un-earned incomes' by all classical economists (and by the neoclassical economist Alfred Marshall) (Camagni, 1992, ch. 9)[3];
- the reduction of profits on production activities as a consequence of the rise of rent costs, as in a prey-predator dynamic model where rents are the predator and profits are the preys (Camagni, 2016b). The production activities on whose economic success the city previously based its development are continuously jeopardized by the increase in land rents eroding the fruit of the success itself.

The logical consequence in policy terms is the necessity of recapturing, to the public domain or sharing between the private and the public, the surpluses gained in urban transformations. These are the surpluses through taxation and/or planning negotiations. In the case where the new tax revenues were reinvested in urban services and infrastructure, a sort of win-win condition could emerge where all stakeholders might gain. By this, the citizens in terms of urban welfare, builders in terms of public works and infrastructure expenditure, developers and estate owners in terms of value increase of the housing stock thanks to improvement of urban quality and economic actors as taxation could reduce overbuilding and land value bubbles. This strategy could be summarized in the slogan - very popular in Italy twenty years ago, but never really accepted in operational planning – 'building the public city through a fair distribution of surplus values originated by the transformation of the private city'.

This suggestion is shared by UN Habitat (2015, 134-137)[4] particularly as a means to reduce corruption in real estate deals; the message was recently completed it in the UN Habitat document *The city we need 2.0* (UN-Habitat, 2016) with the plea to avoid "poorly regulated real estate markets that create speculative bubbles and financial crises".

[3] Interestingly enough, the level of land rents can be utilized as an indicator of the economic effects of the power and control functions exercised by large cities, as part of the surplus values extracted in the relationships with the external world. These surpluses generate urban growth, cumulative agglomeration economies and the possibility of paying for benefitting from these urban externalities.

[4] See the Recommendation D3b of the Vancouver Declaration: "The unearned increment resulting from the rise in land values resulting from change in use of land, from public investment or decision, or due to general growth of the community must be subject to appropriate recapture by public bodies (the community), unless the situation calls for other additional measures such as new patterns of ownership, the general acquisition of land by public bodies" (UN-HABITAT, 1976).

6 CONCLUSIONS

This paper analyses the direct and natural relation between business – intended widely as the production and exchange of goods and services – and cities, through the lenses of the spatial division of labour between two archetypal worlds. These are the city and the 'countryside' dear to classical economists and to the Marxian tradition.

The role of cities is traditionally inspected in regional science through a functional approach, underlining the specificity of their specialization and relying on the concepts of agglomeration economies and network externalities in order to understand their competitive advantage. Superior efficiency and global connectivity explain why cities have always been the driving forces of development and trade and the gateways for the internationalisation of entire national territories.

But the other two approaches to the interpretation of the nature of cities add new significant dimensions. While still crucial in economic terms, the relational-cognitive approach and the hierarchical-distributive approaches respectively highlight innovation and creativity processes on the one side and wealth and territorial control on the other. The first approach goes back to the evolutionary interpretations of such relational spaces such as specialized local systems and innovative 'milieus' developed in the early 1990s. It is easily transposed to the urban milieu ten years after, based on collective learning processes and socialized reduction of uncertainty. More recently this approach has been accompanied by a host of thorough analyses on the spatially selective processes of creativity development and knowledge creation.

The second approach analyses - or better should analyse in more depth given the relevance of the issue – the way in which the relative prices (the terms-of-trade) between productions of the city and the countryside are determined and the wider problem of spatial distribution of wealth and power. The international literature on globalization processes and world cities is approaching a similar problem at the world scale. It emphasizes the command and control functions of large cities and the potential for determining new forms of spatial and class polarization. A monopoly element is always present in the sectors (hi-tech and advanced services) and functions (top-management, financial, strategy and research functions) that the city attracts and develops. This is not necessarily as a consequence of mere power relationships but rather of their rarity, newness and their interaction-intensive and knowledge-intensity nature.

In some cases, a pure monopolist condition may also appear which is linked to historical or institutional factors. It is the case of art and tourist cities and of capital cities that, thanks to the presence of a captive market, receive large advantages in terms of employment, income and wealth. These advantages are at least partially counterbalanced by disadvantages coming from negative externalities of excessive tourism and lower incentives to innovation and urban efficiency.

A final glance is given to a last dimension, empirically relevant, that of the city itself intended as a business, and in particular a real estate business. Huge rents, and related corruption practices, are appropriated privately by land owners and developers. This exploits the economic (and consequently demographic) success of cities which derives from 'the general development of society' – as classical economists put it – and more directly from collective, public-private processes, interactions and investments. Rents as costs are paid by households and by companies. Thus, they should be adequately taxed and given back to the urban community in terms of enhanced public services and public goods.

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Are Creative Cities Good Places for Creative People? Notes on the Social Conditions for Cultural Production in Contemporary Economy

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ABSTRACT

Purpose: This paper discusses the social conditions for cultural production in contemporary cities, in the context of a globalized economy, with rising importance of the integration of cognitive, symbolic and emotional elements into tradable products and services. Although the agglomeration dynamics of creative activities in urban contexts and the social or spatial inequalities related to processes of urban reorganization in Post-Fordist societies have been analysed in the last years, the interrelations between these aspects still lack adequate investigation and empirical analysis.

Methodology/Approach: By synthetizing diverse theoretical contributions related to different levels and interactions arising from creative activities, their transformations into tradable products (commodification) and some of their spatial implications in the urban context (agglomeration, externalities, identity, place branding and gentrification), the article emphasizes the different benefits obtained by the agents involved in this process, potentially contributing for increasing social conflicts and to a process of cultural homogenization with negative implications on the uniqueness and authenticity of places.

Findings: Benefits arising from the externalities generated by the agglomeration of cultural production and creative activities can be framed within the "Common Pool of Resources" approach, suggesting that a more balanced share of the benefits can be obtained by means of participatory processes for city planning and development.

Research Limitation/implication: The paper is based on a conceptual approach and further empirical research can be useful in order to test the formulations proposed.

Originality/Value of paper: This analysis leads to the identification of different questions for further research, by combining quantitative analysis for the measurement of cultural and creative externalities and modelling processes for the distribution of benefits arising from cultural production, with qualitative analysis related to participatory processes of urban planning and monitoring.

Category: Research paper

Keywords: culture; creative economy; externalities; common pool of resources

1 INTRODUCTION: CULTURE, ECONOMY AND THE CITY

An increasing integration of cultural and symbolic values into tradable goods and services is a major characteristic of contemporary economies, with a significant expansion of the culturally oriented economic sectors. For the purposes of this study, focused on the social conditions for cultural production in contemporary cities, the formulation proposed by Scott (2007) to classify the contemporary economy – cognitive capitalism – is particularly useful, once it emphasizes the social contradictions and conflicts arising from a double process of commodification of culture: culture is growingly produced under a commodified and market oriented form, while commodity production (goods and services) increasingly integrates aesthetic and semiotic meanings.

For this author, this process of intensification of cerebral and affective labour in the modern economy is one of the central characteristics of the current stage of capitalism development, oriented to processes of monopolistic competition (due to the unique characteristics of products with embedded symbolic values), where cultural products and technology intensive manufacturing and services are the leading sectors, digital technologies constitute its technological foundations and labour relations tend to be more flexible, unstable, deregulated and precarious, which constitute a critical aspect for some contemporary social conflicts in urban context. Additionally, due to the attractiveness arising from agglomeration effects, the economy of contemporary cities also includes large numbers of workers with low-wages and low-skills, often arriving from less developed countries.

The analysis of cultural production requires a prior definition of culture, a broad concept often used with different meanings in different contexts. The definition proposed by UNESCO (2009) is adopted in this work: “a set of distinctive spiritual, material, intellectual and emotional features of society or a social group, that encompasses, not only art and literature, but lifestyles, ways of living together, value systems, traditions and beliefs”. This involves a broad set of economic activities (related to the production of goods and services) and social involvement (participation in cultural initiatives). The concept of Culture Cycle model is also considered, emphasizing the social dynamics of cultural production, referring to the “practices, activities and necessary resources required to transform ideas into cultural goods and services and to reach consumers,

participants or users", involving activities related to creation, production, dissemination, exhibition-reception-transmission and consumption-participation. This also includes the related domains of recreation and leisure ("partially cultural" activities) and the transversal domains of education and training, archiving and preserving or intangible cultural heritage.

These collective processes of transformation of ideas into cultural goods and services (symbolic value creation) can be observed by looking into the three layers proposed by Cohendet, Grandadam and Simon (2010): the "underground", involving artists and creators; the "upperground", formed by firms and public institutions; and the "middleground", the places and spaces where "underground" and "upperground" come together. Places are often public and not market-driven sites, activating relations between people and constituting physical platforms for building a common identity. Spaces are defined as cognitive platforms of knowledge, both local and global, where ideas can flow between communities. Thus, the "middleground" is the level where cultural and creative externalities are produced and accumulated.

The analysis of the dynamic relations between these layers of the process of cultural production clearly helps to understand the social conditions and conflicts arising from the creative activities in contemporary economies, through the creation, dispute and appropriation of externalities and monopoly rents generated by the distinctive characteristics of creative outputs. Some implications of these dynamic and conflictual processes on the urban structures will be analysed in the following sections. Although the agglomeration dynamics of creative activities in urban contexts (e.g., Florida, 2002; Van Geenhuizen and Nijkamp, 2012) and the social and spatial inequalities related to processes of urban reorganization (e.g., Doucet, 2014, in his introduction to a special issue focused on the analysis of different contemporary processes of urban gentrification) in Post-Fordist societies have been broadly analysed in the last years, the interrelations between these aspects still lack adequate investigation and empirical analysis.

This analysis offers a contribution to overcome this research gap, by identifying different questions for further research, combining quantitative methods for the measurement of cultural and creative externalities and modelling processes for the distribution of benefits arising from cultural production, with qualitative analysis related to participatory processes of urban planning and monitoring. The concepts and relationships under analysis are represented in Fig. 1: cultural production and externalities contributing for the agglomeration of creative activities are framed within the concept of "Common Pool Resources", while processes of appropriation of benefits through market dynamics are essentially commercially driven within the private realm, potentially generating social and spatial inequalities and implying public policies in order to preserve the characteristics of inclusive urban communities, along with their identity and creativity.

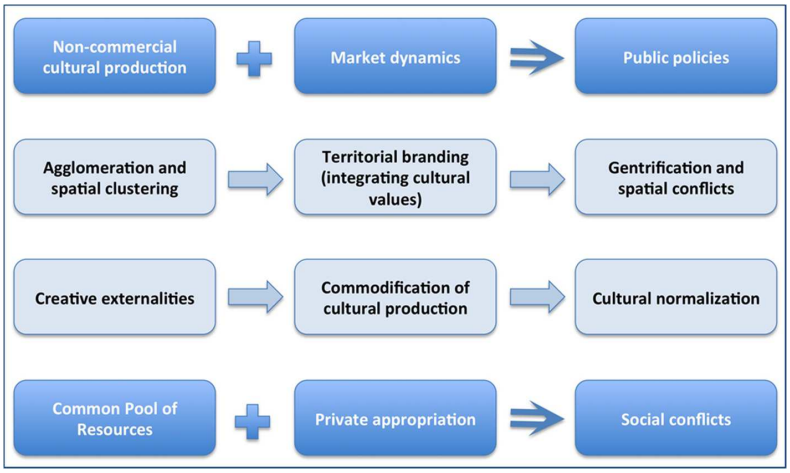

Figure 1 – Conceptual framework

2 METHODOLOGY: A CONCEPTUAL FRAMEWORK FOR THE ANALYSIS OF CULTURAL PRODUCTION IN CONTEMPORARY CITIES

2.1 Creative externalities and community identities

Contemporary cities are places where scale and variety come together, as a result of agglomeration effects, by attracting creative individuals and companies in search of externalities and efficiency benefits related to proximity and co-location. This process of spatial clustering of cultural industries is followed by creative individuals, migrating from peripheral to core cultural centres (e.g., Scott, 2008). In a globalized world, increasing competition for the attractiveness of skilled labour, efficient companies and investment flows also reinforces the role of governance and public institutions, aiming at the achievement of new forms of competitive advantage arising from the production and dissemination of knowledge and creativity.

In this sense, culture and creativity potentially create and/or reinforce the uniqueness and authenticity of urban centres, often being used for value creation through branding strategies for city or product commercial promotion (Okano and Samson, 2010). Even if the characteristics and qualities of a given product are normally specific to each firm, they are also the result of the evolution of a local economy, with its particular traditions and reputation. One example of this process of linkage between products and places is the "Place in Product" marketing approach, by relating creative goods and services to places where its production is notorious (Currid-Halkett and Scott, 2013). This process of commodification of culture and creativity often leads to processes of gentrification in urban areas, as a result of the concentration of creative activities,

the creation or reinforcement of a unique and distinctive image of the place, the consequent competition for location and the related inflationary processes.

These processes of gentrification include transformations of urban space related to cognitive-cultural economic development, social transformation, functional changes and re-imaging through new symbologies (Scott, 2016). The same author (Scott, 2007) refers that this type of transformation in the urban space occurred in different contemporary cities, corresponding to the migration of former industrial workers to peripheral areas of the city, while the centre is occupied by new commercial or residential buildings, normally with an high status and high costs, benefiting from the creative agglomeration effects of the area and enhancements on the quality of infrastructures and urban amenities. In that sense, the presence of creative communities in a degraded urban area can be seen as a first sign of a gentrification process (Harvey, 2012).

A concrete analysis of one of these processes is offered by Avdikos (2015) for the neighbourhood of Kerameikos-Metaxourgeio, in the centre of the Greek city of Athens, in the beginning of the XXI century. By occupying unused former industrial building and warehouses, creative newcomers (the "underground") developed a particular and intense atmosphere that was followed by the "middleground" – the creation of places and spaces for cultural interaction, generating local creative externalities – and leading to the establishment of creative enterprises ("upperground"), mostly constituted by self-employed or very small firms, in a first stage. These dynamics generated a continuous flow of events and projects, quickly contributing for the creation of an identity related to the uniqueness of the creative environment. As a result, Kerameikos-Metaxourgeio achieved a status of notoriety, attracting private real estate investments and public interventions in the public spaces. During the period of economic crisis of 2007-2009, rents in the area have kept the pre-crisis levels or increased by 10-20 %, while an average fall of 30-50 % was observed in other areas of the centre of Athens. By then, the creative individuals and communities that had been at the beginning of the redevelopment process could not afford to live in that area.

In fact, as mentioned by Harvey (2012), the extraction of land and property rents is the most important means for the appropriation of urban areas: although the land rent is the result of a collective action performed at community level, eventually reinforced by public investments in infrastructures and amenities, the appropriation of the rent benefits is normally private, benefiting real estate companies and investors in the housing market. Keeping in mind the three levels of cultural production proposed and applied by Cohendet, Grandadam and Simon (2011) in different urban contexts, the "underground" ignites the creation of a creative atmosphere in an urban area, acting as a local repository of creative externalities within the "middleground". The creation of a local symbolic capital related to authenticity and uniqueness of the place generates monopoly rents, which are unequally appropriated by the "underground" and the "upperground" through their interaction within the "middleground". This is, in fact, a part of the

"appropriation problem" related to the Common Pool Resources, to be discussed in the Fourth Section of this paper.

This inequality in the appropriation of benefits between the "underground" and the "upperground" relies on their different positions within the production process and control of the means of production: the "underground" is mostly constituted by independent individuals, generally with precarious or informal labour relations, being paid according to the projects they get involved, even if their work is often exploratory and not easily tradable in the markets; on the other hand, the "upperground" includes private firms and public institutions with financial resources and/or political power to influence and to decide about the structure and organization of urban areas. This dynamical process or urban transformation – arising from the development and agglomeration of creative activities and the resulting externalities – reveals how the power and practices of real estate entrepreneurs tend to capture the benefits generated by the individuals whose common effort helped to develop a creative neighbourhood.

As Harvey (2012) points out, "the better the common qualities a social group creates, the more likely it is to be raided and appropriated by private profit maximizing interests". This calls for new forms of coordination between cultural and economic dynamics, market regulation, public investments and urban planning, in order to benefit society as a whole and also to preserve the creative and identitarian characteristics of the neighbourhoods. Thus, the research gap and lack of empirical studies regarding these interrelations constitute an obstacle for the implementation of informed public policies.

2.2 Spatial inequalities and social conflicts

This social conflict arising from creative production – and its spatial implications - in contemporary cities can also be seen as a process of homogenization of culture, in which the symbolic capital of an area (related to its authenticity and uniqueness) generated by the creative externalities and spillovers created by cultural producers and creative agents ("the undergound") is tendentially destroyed (through a process of normalization) by market or institutional forces and branding strategies (the "upperground"), implying an unequal distribution of benefits related both to the extraction of symbolic values and to the processes for its future creation.

Thus, cultural production can enhance the social conflicts emerging in contemporary cities, where it is also visible a tendency for higher inequalities, spatially expressed by the differences in living conditions in central, well equipped, residential areas (sometimes functioning as "close" spaces, with restricted access) and large suburban, peripheral areas, with low levels of infrastructures, where low skilled workers attracted by the job opportunities in the cities tend to concentrate. Davis (2006) proposes a detailed analysis of the global expansion of these suburban and unqualified areas of social exclusion, as a

characteristic of the contemporary processes of urban development, which promote an unprecedented human settlement in urban centres.

The unequal social conditions faced by the citizens living in central or peripheral urban areas are related to what Scott (2007) defines as multiple negative externalities, related to high mobility costs, lack of infrastructures, difficult access to a large number of public and private services, etc. In addition, many of these suburban residents are migrants, often with language barriers to adaptation, low professional and social skills, poor integration in local networks and, eventually, lack of a legal residence status. Thus, the social inequalities expressed in the spatial inequalities in the occupation of the city also raise problems of democracy, through the limitations that are often imposed to an effective citizenship of these parts of the population. Consequently, cultural diversity, often seen as an advantage for the creative economies, can also be seen as the reflex of economic, social and political inequalities.

In this sense, cities can be seen as a stage for the major social and economic conflicts of contemporary societies, where new types of political actors emerge – the "contested cities", as expressed by Sassen (2010), pointing out that frequent unorganized episodes of violence and "delinquency" emerge in contemporary cities (even in the most developed economies) as a form of political protest. As an important consequence for urban sociology, this author suggests, studying contemporary cities is more than studying the urban aspects: it is a very effective way to analyse the major socio-economic transformations of this era, by integrating aspects related to the new information technologies, the relations between transnational and translocal dynamics and different types of socio-cultural diversity. Another analysis of the contradictions and conflicts in contemporary cities, more oriented to the processes of cultural production, is proposed by Citroni (2016), highlighting the processes of political mobilization within creative communities.

In fact, much of the social processes that can be observed at the city level today are not strictly urban phenomena, but global structural socio-economic transformations (including economic processes, labour relations, migration flows, social conditions, industrial, commercial and financial globalization or technological innovation), which have deep implications on urban dynamics. While the national sphere seems to lose importance in the context of contemporary globalized economies and societies, with increasing economic and political integration at supranational levels, the local sphere of the cities seems, on the contrary, to acquire a new and more significant role in economic, social, institutional and political terms.

In a context of generalized deregulation, flexibilization and informalization of labour relations – with the consequent loss of importance of traditional forms of political organization and representation, like the unionized workers – the public space of many cities emerges today as the terrain for new forms of social mobilization and protest. Squares in different countries become notorious at

international level as spaces for political protests: Syntagma (Athens, Greece), Tahrir (Cairo, Egypt), Taksim (Istanbul, Turkey) or Tiannamen (Beijing, China) are just some recent examples. In the same way, slogans globally used in political protests, like "Take the Streets" or "Occupy" clearly claim the request for the public space as a terrain for political conflict. An analysis of the growing importance of cities and public spaces as the stages for political mobilization and confrontation in contemporary societies is proposed by Harvey (2012).

These new forms of mobilization, politization and confrontation in public urban spaces seem to be related to very broad structural societal transformations, including those aspects that are clearly out of the strict scope or urban policies. Nevertheless, the particular implications of agglomeration of creative activities in urban centres, the rents generated by their uniqueness and their utilization in branding strategies and the gentrification processes arising from the commercial dynamics and unequal appropriation of benefits (which were the result of a collective action based on common resources) reinforce the importance of public policies at the city level in order to avoid the social and spatial imbalances resulting from these processes.

2.3 Culture and the City of Commons

This approach to the creative externalities and spillovers clearly relates to the concept of "Common Pool Resources". As Scott (2016) suggests, competitive advantages of cities largely rely on freely available public assets and cultural resources, external to markets and not controlled by private ownership or policy and managerial institutions. In fact, cities can be seen as factories for the production of the "Commons" (Harvey, 2012). Nevertheless, despite its importance, mainstream economic theories do not address the question of the Commons sufficiently, generally defining it as a "market failure", out of the scope of the current theorizations on market dynamics or policy regulation.

According to the mainstream approaches to economic systems, firms and households, whose activities are regulated by markets and rely on private property, are the basic unit for decision-making and economic behaviour. Collective action, on the other hand, is ensured by governance institutions, legally legitimized for the social and political regulation of urban areas. In this context, all the communal aspects of urban life, related to the dynamics of a local community to generate the externalities that promote the identity, quality of life and attractiveness of an urban area, are almost completely excluded from the analysis of economic or urban science.

An exception to this lack of attention within contemporary economic science is the work of Elinor Ostrom (2008a; 2008b), who defines the "Common Pool Resources" as including natural and human constructed resources for which it is difficult (although not impossible) to limit access and to define recognized users while excluding others. Often, these are "open-access resources", with free use, which are likely to be overused and potentially destroyed. Being available under

diverse and evolving property regimes (private, state, communal or open access), these common resources are normally indivisible (with boundaries difficult to delineate), implying subtractability (rivalry among potential users) and nonexcludability. This implies that the use of a common resource can reduce the amount available for other users, but the exclusion of (additional) users is very difficult or even impossible.

General problems related to the Common Pool Resources are the "free ride" (related to degradation or exclusion due to overuse by some users), investment incentive (lack of incentives for preservation), appropriation (which group of users has rights over a given resource). In particular for this case, the appropriation problem applies to the rents generated by cultural and creative activities reinforcing the uniqueness of an urban area: while used in "place-branding" strategies, these rent tend to be appropriate by real estate agents of housing and land owners, after being the result of the creative work of individual agents that do not benefit from it (at least in similar or equal conditions).

Considering the characteristics of these types of resources and the difficulties to measure their value, regulate their usage, share their benefits or even to model their dynamic exploitation, Dietz, Ostrom and Stern (2008) emphasize the importance of implementing, at the local level, governance systems based on adaptive resource management and participatory processes, pointing out some key characteristics (wide participation, community knowledge-based, continual monitoring, flexible policy design and frequent review of management practices) and principles (specificity - actions adapted to different situations, circumstances and contingencies; and precautionarity - diversification of options, conservation of resources and avoidance of waste; subsidiarity - empowerment of individuals and communities for decision making at local level) for its implementation. Although this type of analysis emerged with a strong focus on the usage and management of natural resources, the growing economic importance of information, knowledge and interaction in contemporary cities justifies the application of these theoretical conceptualizations in urban contexts.

3 CONCLUSION: QUESTIONS FOR THE SCIENCE OF THE CITY

This paper aimed at combining different concepts and theoretical contributions related to cultural production and urban dynamics in order to show how the generation of creative externalities in an urban context is mostly a collective process, developed through the interactions arising within a community and creating or reinforcing agglomeration effects, through the attractiveness resulting from the uniqueness, authenticity and creative spillovers developed in a place. On the contrary, the appropriation of the benefits arising from these externalities is mostly a private process, often benefiting other individuals and entities (the "upperground") than those who contributed for the development of a creative atmosphere (the "underground").

This process can be analysed through the lens of the "Common Pool Resources" approach, emphasizing the communal character of the production of creative externalities, the "appropriation problems" related to the characteristics of these resources (subtractability, nonexcludability, "free ride") and the role that participatory processes of urban management and monitoring can have in order to ensure a more egalitarian process for sharing benefits, to promote social cohesion and, in a final instance, also to keep the uniqueness and authenticity of the creative environment, avoiding the processes of cultural homogenization arising from the commodification of creative activities and the progressive transformation of creative externalities into land rents.

In this context, the main contribution of this analysis is to raise a set of crucial questions, with relevant policy implications, leading to the formulation of a systematic conceptual framework for the analysis of the generation of creative externalities, as a resource commonly produced at community level, and its relation to the social dynamics of appropriation of benefits, in order to promote more inclusive cities, while preserving their creativity and authenticity in the long run. These questions, requiring further empirical research, can be summarized as:

- How to measure and to quantify externalities from creative activities?;
- How to model and to implement fair processes for sharing benefits?;
- What are the implications on city planning, as these are not strictly urban questions?;
- How to integrate urban studies with the analysis of other determinants of social life (like labour conditions or social, institutional and political representation)?.

The answer to these questions requires a more detailed and sophisticated economic analysis of the "Common Pool Resources", combined with socio-political analysis of the societal transformations that influence and shape contemporary cities. As stressed by Scott (2007) more attention should be given, at policy level, to internal processes of the system of cognitive and cultural production, as an effort to reinforce social cohesion, effective solidarity within urban communities and democratic participation. Instead, we are witnessing a process of increasing inequalities and injustices in many metropolitan areas, which, at the same time, contribute to a cultural homogenization though the commodification of creative products and the gentrification processes of urban areas.

These problems achieve an even higher relevance if they are framed in a broader analysis of urban development, also taking into consideration the unbalanced relations between the city centres and the peripheral suburbia, the inequalities between high and low skilled workers or the differences in democratic

participation, institutional representation and active citizenship within urban communities. In this sense, multidisciplinary approaches to the Science of City can have an important role as contributing for more balanced, democratic and creative societies.

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Fuzzy Logic Methods to Evaluate the Quality of Life in the Regions of Ecuador

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ABSTRACT

Purpose: The aim of this paper is to propose a methodological framework that calculates a synthetic indicator of satisfaction of citizens of the nine geographical areas of planning and development of Ecuador (zones).

Methodology/Approach: The methodology is based on fuzzy logic and the degree of similarity to ideal solutions. The information is obtained through the application of a structured survey based on the European Social Survey to the Ecuadorian society. The analysis is based on eight different dimensions of satisfaction, namely: (1) Life; (2) Economy; (3) City Government; (4) Transparency; (5) Education; (6) Health System; (7) Roads; and (8) National Government.

Findings: The results obtained help different stakeholders to have important insights about how the citizens' quality of life and satisfaction depend to some extent on important public services that form the pillars of the social welfare, education and health system. However, our results also suggest that other areas of Ecuador can also benefit from the improvement of the policies developed by the local governments.

Research Limitation/implication: An important research limitation is based on the limited number of segment variables used in the study, the geographical zones. Thus, an important venue for future research can be envisaged including other interesting traits analyzed by other scholars, like access to the internet, the social class or the size of the city.

Originality/Value of paper: The analysis of individual satisfaction and citizens' quality of life is paramount by the existing interdependence with social cohesion that exists nowadays in Ecuador.

Category: Research paper

Keywords: satisfaction; quality of life; social welfare; fuzzy logic; TOPSIS

1 INTRODUCTION

According to the World Health Organization (WHO), quality of life is the perception that an individual has of their social relationships and their relationship with their environment[1]. Slottje, et al. (1991) argue that concepts such as quality of life (QOL), individual or social welfare are subjective multidimensional constructs. Zhu (2001) does not define the QOL but nevertheless determines how to calculate it, by a finite set of dimensional attributes that can be measured objectively and is finally weighted by some metric. Slottje (1991) conducts a review of the literature on the QOL and concludes that the basic needs measured by a set of variables that analyse the level of health and education are not sufficiently determined by the variable gross domestic product per capita. Ram (1982) was one of the first authors to argue that the QOL cannot be analysed by a single indicator as the GDP per capita, not only because of the intrinsic difficulties of the measurements of these indicators, but rather by the existing philosophical digression between income and welfare. Tonon (2015, p.11) associated QOL with "life satisfaction for enjoyment, to" do what I like "and, in doing so, with the possibility of personal fulfillment". Also, individual satisfaction is associated with democracy of the people, either because of their orientation, the relationship with the regime, or the implemented economic system (Berggren, et al., 2004; Kestilä-Kekkonen and Söderlund, 2015).

There are numerous studies that have analysed the relationship between poverty, health and education in isolation, and they all come to the conclusion that there is a causal relationship between them. However, since some previous work as Burkett (1985), it is known that high levels of industrialization and per capita income are not sufficient or necessary condition to meet the basic needs of the population. So sometimes, QOL is studied not only under the perspective of the basic needs of the population but also to what extent these basic needs are or are not fulfilled. Thus, for example, Azizi, Momeni and Taghinia (2011) analyse the basic needs of the population of Tehran with a disability according to the following dimensions: (1) residence; (2) food; (3) energy; (4) economic resources; (5) facilities; (6) equipment; (7) communications; (8) education.

In spite of the general consensus that the QOL cannot be measured by a simple economic indicator per capita, most international organizations do still use one single indicator to see if the living conditions of citizens have improved or not. For example, the OECD Better Life Index serves to rank the performance of OECD countries across a number of social, environmental and other indicators that include eleven different categories (Petrosillo, et al., 2013). Bloom, Craig and Malaney (2001) argue that the construction of robust indicators to measure

[1] This concept is not quite precise, so it is necessary to try to complete it with an empiric work.

the QOL is very problematic because there is no consensus on how to measure the theoretical concept that encompasses the QOL. Rahman, Mittelhammer and Wandschneider (2011) delve more on this difficulty separating four different areas: (1) the method for calculating the QOL itself; (2) the dimensions of human existence that must be included in the analysis; (3) when making an individual or group analysis; and (4) how to deliver results that have a practical value for the stakeholders who need to use them, for comparing these on individuals, groups or dynamically.

On the second point mentioned above, it can be said that variables such as life expectancy, literacy levels and indicators of mortality and morbidity have been used in many of the empirical studies that analyse the QOL. Two composite indicators that have been analysed and have some prestige in this literature are the human development index (HDI - human development index) that performs United Nations through the program unit development and the physical indicator of the quality of life proposed by Morris (1979). These two alternatives were a step forward considering more dimensions of the QOL, but are subject to other problems related to the arbitrariness of the weights chosen when determining the metric.

It has already been discussed above as the QOL has been studied in relation to economic growth. It has been tried, without much success, to obtain a decisive causal relationship between the QOL and economic growth. In addition, there are different currents about which economic growth that increases inequality does not improve the QOL of individuals, although it is not easy to determine how to prioritize the needs of the different segments of the population (Mayne and Hakhverdian, 2016). Other studies analyse aspects that influence negatively on the QOL of some individuals, such as political oppression, gender or ethnicity, may decrease with economic growth (Boone, 1996). Thus, when the demands of these disadvantaged groups are addressed, representative democracy is strengthened and governments can perform better, since the political and ideological consistency is achieved in the social elements (Gómez Vilchis, 2014; Mayne and Hakhverdian, 2016). Democratization allows citizens to trust their governments and to participate most in electoral processes. But this does not happen at all time, since each country has historical, cultural and institutional differences, and, therefore, the calculation of the democratic satisfaction level is not straightforward (Ezrow and Xezonakis, 2016).

This article contributes significantly to the branch of literature that analyses the QOL. A method based on fuzzy logic and ideal solutions are proposed in order to determinate the QOL in the nine geographic areas of planning and development in Ecuador (Fig. 1). The dimensions considered when determining the QOL of citizens are as follows: (1) life; (2) the economy; (3) the city government; (4) transparency: (5) education; (6) the health system; (7) roads; and (8) the national government. Three main contributions to the literature are made: (1) on the one hand, the QOL of the nine geographic areas in Ecuador is calculated for the first time; (2) they are obtained individually for each geographic region so it can be

seen the best and the worst score for every attribute considered, which allows to obtain the greater or lesser observed heterogeneity; (3) the elasticity of the QOL is obtained regarding each of the dimensions analysed to see what dimensions are considered more or less important in Ecuador. These results are crucial for different social agents when determining the best course to improve the QOL of Ecuadorian citizens.

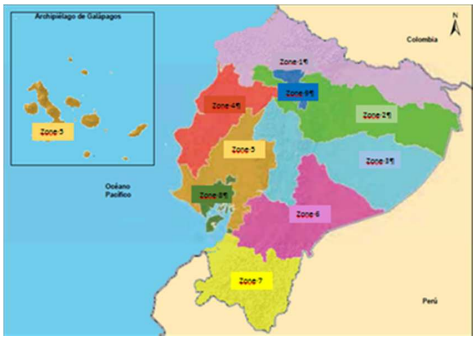

Figure 1 – Administrative Ecuadorian zones

The rest of the present article is structured as follows. The second section reviews the literature describing previous studies that have analysed the QOL of citizens. In the third section, the dataset and the structured survey, based on the European Social Survey applied to the Ecuadorian society, are explained. In the fourth section, the fuzzy logic methodology is presented and the ideal solutions to calculate the QOL are obtained. The fifth section shows and analyses the results, and finally, the sixth section concludes presenting new future research avenues.

2 LITERATURE REVIEW

Tonon and Rodriguez de la Vega (2016) attribute the study of QOL to Pigou, in the early 30s, when he first referred to the need to quantify public spending in relation to social services. Then, several authors, mainly in the Nordic countries, have proposed a series of analysis in relation to the QOL, such as standard conditions of life, social needs and satisfaction, which were the embryo of what is now known as the welfare state. In the 70s, Estes introduces the concepts of social progress index or national social vulnerability index to measure the capacity of social services to satisfy the basic needs of citizens (Estes, 1999). In the 90s, the ISQOLS (The International Society for Quality of Life Studies) is created, a non-profit society in order to promote studies of the QOL from a multidisciplinary approach that includes diverse fields such as politics, social aspects, medicine or environment.

Dasgupta and Weale (1992) argue that the QOL should be studied for five different reasons: (1) it is needed an aggregate to determine in a macro level the results of the economic policies of a country; (2) to compare results at different territorial levels, ethnic groups or different time horizons; (3) to compare the

social welfare dynamically at different time points; (4) to analyse the conditions of life standard that supports an economy according to the different economic measures that support it; and (5) to assess changes that occur when new economic measures are introduced.

Two of the most used indexes in this type of studies -the human development index and the physical quality of life index, are now analysed. The first is developed by United Nations and is used to analyse the QOL of the nations since 1990, and while it has been criticized the GDP per capita is the preferred one because it shows in a better way some aspects of the basic needs of the citizens (Haq, 1995). The dimensions that conform the index are: (1) life expectancy; (2) academic instruction; (3) income per capita. The second was proposed by Morris (1979) as a weighted average of the following variables: literacy, infant mortality with less than a year and life expectancy. These three variables are assumed to reflect a distribution related to the wealth of nations that is internationally comparable. Both indices have been criticized because of the uniform weights used for each of the three variables involved.

There are many cities that have established objective and subjective data collection systems that allow them to study the QOL of citizens. In most cases, the systems become true barometers that measure the satisfaction of citizens on the main aspects that influence the life of the citizens. One of the most developed systems today is the Urban Audit Eurostat system that collects information from more than 300 indicators for a set of 357 European cities. The variables collected baseline information on demography, housing, health, crime, work, rent, utilities, education, environment, tourism, ICTs and culture (Feldman, 2008).

Recent studies with disaggregated data analyse how the QOL influences market prices of homes in a hedonic way (Lora, 2016). The author argues that individual opinions of citizens on some aspects of cities and their own life can be very useful to identify and prioritize policy areas that citizens consider vital to their own development, from access to public transport, green areas or security itself (p. 273). Hoque, et al. (2016) analyse the introduction of the health card and how this produces greater satisfaction in the field of health. In addition, it is shown that also has an important impact on the health system itself in terms of time and cost of care, resulting in greater efficiency.

The internet access, namely the interconnection, plays an increasingly important role in the QOL of the individuals in our society. For a large part of the activities we do during our free time, such as watching shows or TV series, listening to music, listening to the radio, reading, playing a video game, or just surfing on the Internet, we need access to the Internet. Thus, access and digital literacy must be provided universally and should be incorporated into the agenda of all countries (Lissitsa and Chachashvili-Bolotin, 2016).

The last contemplated aspect in this review is the analysis of the QOL of social classes. The segregation of neighbourhoods may not be optimal as citizens of lower classes may favour having access to public services that are in the

neighbourhoods of wealthier classes (Cheung and Lucas, 2016; Cutler, Nuesser and Nyblade, 2013). This issue is of vital importance to the formation of school districts that may have an impact on the future development of citizens. Linares, et al. (2016) spatially analyse the composition of neighbourhoods and find that the configuration of neighbourhoods influences the QOL as citizens show non-random patterns of location. In their analysis, the authors conclude that smaller cities seem to show a better QOL. However, they do not indicate to what extent this result is generalizable.

3 DATA

This section shows the data obtained in 2015 through a survey adapted from the European Social Survey (ESS) that was administered to a group of Ecuadorian residents. The ESS is carried out since 2001 in Europe, and is characterized by a broad academic participation of different European countries, allowing homogenize the information obtained on issues that are very difficult to measure, and which have a high social interest. The ESS is adapted to the singularities of Ecuador to analyse different aspects of quality of life, individual satisfaction and democratic consolidation. Surveys are conducted at the level of the nine geographical areas of planning in Ecuador.

The survey covers different dimensions that influence individual satisfaction of Ecuadorian citizens, as trust in institutions, national identity, ethics, religion, ethnic component, nationality, political commitment, welfare, health, security, socio-political values, demographic composition, moral and social values, education, occupation and social capital. A random sampling by provinces with proportional allocation regarding the geographic area, gender, education level and age is done, to represent the population over 15 years living in private households.

It is emphasized that the survey implemented in Ecuador uses the Likert scale of 11 points (from 0 to 10) with verbal anchors at the ends, where 0 means that the person is not at all satisfied and 10 means that is extremely satisfied with the important public services and dimensions included in the survey.

Ecuador is located in the Northwest of South America, one of the smallest countries on the continent and bisected by the Equator from which comes its name. The internal political and social context of Ecuador currently reflects positions of confrontation. The analysis of the QOL can be considered crucial to understanding this. The QOL is analysed through the answers to the level of satisfaction, in relation with each of the eight dimensions considered in this investigation: (1) life; (2) the economy; (3) the local government; (4) transparency; (5) education; (6) the health system; (7) roads; (8) and the national government.

Tab. 1 shows the frequency of responses obtained in the individual satisfaction module in the nine zones analysed. It can be seen that about four hundred sixteen

Ecuadorian citizens answered to the pillars of the system of social welfare, the education and heath, mentioning that only two of the eight dimensions reach it all (416); that means that they have greater representability, the next five dimensions are in the middle range (411-414), finally the transparency dimension has a greater rate of no response (409). This may be due to two different facts, because the interviewed persons could have taken the decision not to make the effort, or because the transparency dimension is the most difficult to assess and the citizens did not know how to answer.

Table 1 – Responses divided by geographical zones and QOL dimensions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Zone 1	32	32	31	31	31	31	32	31
Zone 2	26	26	26	26	26	25	26	26
Zone 3	46	46	46	44	46	46	46	46
Zone 4	52	52	51	51	52	52	52	52
Zone 5	56	56	56	56	55	55	56	56
Zone 6	28	28	27	27	27	27	26	27
Zone 7	43	43	43	43	43	43	43	43
Zone 8	81	81	81	80	81	81	81	80
Zone 9	52	52	51	51	51	51	52	51
Total	416	416	412	409	412	411	414	412

Source and explanation: Own elaboration. (1): Life. (2): Economy. (3): Local Government. (4): Transparency. (5): Education. (6): Health system. (7): Roads. (8): National Government.

Tab. 2 shows the total of responses that each dimension obtained according to what Ecuadorian citizens answered, which means the frequency table of each one of the Likert states represented. It can be seen that the respondents answered to be very satisfied with the quality of life they have; while in the remaining dimensions the citizens express to have an adequate relation with the public services given to satisfy their basic needs. Certainly, the arithmetic mean of the values show the following relationship with the degree of individual satisfaction: first respondents report that they are very satisfied with the quality of life; so after Tonon (2015), it can be concluded that the citizens are satisfied with the material conditions (social welfare) and their psychosocial conditions (personal welfare); Now people feel moderate satisfaction to the road development that currently exists in the country, education, the economy of Canton, the central government and the health system; on the other hand, people in connection with the action of the municipal authority (Local Government) and his way of doing politics at the level of the municipalities of the nine areas, externalized little satisfaction. Listhaug (1984) finds that the personal satisfaction of individuals influences significantly and consistently the institutional trust.

Table 2 – Total responses by QOL dimensions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Extremely unsatisfied	9	17	35	28	9	12	4	23
1	2	5	9	3	5	10	3	8
2	3	21	21	20	9	20	6	21
3	9	23	23	24	22	28	13	32
4	13	31	41	44	34	40	34	32
5	32	75	61	73	58	62	52	51
6	40	72	65	62	59	57	51	41
7	93	87	56	66	97	87	75	64
8	98	59	51	48	71	64	89	50
9	47	15	24	19	28	17	50	38
Extremely satisfied	70	11	26	22	20	14	37	52
Total	**416**	**416**	**412**	**409**	**412**	**411**	**414**	**412**

Source and explanation: Own elaboration. (1): Life. (2): Economy. (3): Local Government. (4): Transparency. (5): Education. (6): Health system. (7): Roads. (8): National Government.

4 FUZZY LOGIC AND THE IDEAL SOLUTIONS

The linguistic term satisfaction is often vague. For example, linguistic expressions such as extremely satisfied, satisfied, normal, extremely unsatisfied and dissatisfied are interpreted as a natural representation of preferences, or judgments or perceptions of people. The proposed methodology to determine the level of personal satisfaction is based on studies of quality of service proposed by the literature. Lewis and Booms (1983) define the quality of service as a measure of how the service provided is adjusted to the consumer expectations and by a translation can determine how the QOL depends to some extent that public services meet the expectations of the citizens.

In this paper, the imprecise nature of the responses was analysed by a combined method that integrates the methodology of fuzzy sets with the technique of similarity to ideal solution TOPSIS[2]. This method has been applied in the area of business management (Hutchinson, 1998; Viswanathan, 1999; Xia, Wang and Gao, 2000), and is gaining acceptance in analysing the quality of service (Benitez, Martín and Román, 2007; Büyüközkan and Cifci, 2012; Choudhury, 2015; Karimi, et al., 2015; Sun and Lin, 2009; Tsaur, Chang and Yen, 2002; Yeh and Kuo, 2003).

[2] TOPSIS is an acronym that comes from the English following term: techniques for order preference by similarity of the ideal solution. It is about to establish an algorithm for extracting the relevant information by similarity to positive ideal solutions or difference of the negative ideal solutions.

Zadeh (1965) spelled out some basic results associated with the development of fuzzy sets. The origin of the theory is that many of the sets found in reality have no defined levels that clearly separate its membership function. In our case study, the existence of citizens who are not at all satisfied or extremely satisfied with their life shows this uniqueness. The concept of approximate reasoning based on uncertain perceptions have better development from fuzzy logic (Mamdani and Assilian, 1975; Zadeh, 1975)

In this work the triangular fuzzy numbers TFNs are used. These TFNs are defined by a triplet (a_1, a_2, a_3) of real numbers. Each linguistic term is characterized by a triangular fuzzy number to represent its approximate value range between 0 and 100[3], and denoted as (a_1, a_2, a_3), where $0 \le a_1 \le a_2 \le a_3 \le 100$. Tab. 3 shows the set of TFNs that have been chosen for this investigation. One can see that by removing the endpoints that served to anchor with verbal language the intensity scale, the range of all triangular numbers is equal to 20 and are centred on the most likely value symmetrically. Likewise, it is observed that the ends are degenerated TFNs at these points and have a lower degree than the previous on ten units. For each segment of analysis, the arithmetic mean of the TFNs is calculated according to the algebra of TFNs (Buckley, 1985).

The TOPSIS method needs a matrix of information of real numbers, so it is necessary to clarify the information obtained through fuzzy logic. There are multiple methods to achieve this goal, as for example, the "middle-of-maximum", "centre-of-area" and the "alpha-cut" method (Zhao and Govind, 1991).

In this paper, the average proposed by Chen (1996) using $v_{\tilde{A}} = (a_1 + 2a_2 + a_3)/4$ has been finally preferred. This method has a number of advantages over other proposals for its simplicity and because the prior establishment of a judgment of the investigator is not required.

Once the clarified matrix information is obtained, the application of the method TOPSIS (Hwang and Yoon, 1981; Zeleny, 1982), which is based on the ideal alternatives: positive and negative, is now possible. The positive ideal alternative is one that maximizes all the criteria associated with benefit and minimizes all the criteria associated with cost; whereas ideal negative alternative is based on the opposite logic. The optimal observation is the one that is closest to the positive ideal alternative and farthest from the negative ideal alternative. The ranking of alternatives in TOPSIS is performed taking into account "the relative similarity of any alternative to the observed alternatives."

[3] Other ranges as (0-7) o (0-10) are also valid.

Table 3 – Triangular Fuzzy Numbers TFNs. Representatives of the Likert scale

Linguistic term	TFNs
Extremely unsatisfied (0)	(0, 0, 10)
1	(0, 10, 20)
2	(10, 20, 30)
3	(20, 30, 40)
4	(30, 40, 50)
5	(40, 50, 60)
6	(50, 60, 70)
7	(60, 70, 80)
8	(70, 80, 90)
9	(80, 90, 100)
Extremely satisfied (10)	(90, 100, 100)
Source: Own elaboration	

The ideal solutions are computed as:

$$PIS = \left\{ \left(\max V_{ij} \middle| j \in J \right), i = 1,2,\ldots,m \right\} \tag{1}$$

$$NIS = \left\{ \left(\min V_{ij} \middle| j \in J \right), i = 1,2,\ldots,m \right\} \tag{2}$$

Where the positive *PIS* and negative *NIS* ideal solutions are the vectors of those segments that are the most and least satisfied with each of the dimensions considered in the study.

Once the ideal solutions have been obtained, the synthetic QOL for each zone is determined through (by) the Euclidean distances between ideal solutions and each segment vector, and the relative closeness to the positive ideal solution as:

$$S_i^+ = dist(V_i, PIS) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - PIS_j \right)^2} \quad i = 1,2,\ldots,m \tag{3}$$

$$S_i^- = dist(V_i, NIS) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - NIS_j \right)^2} \quad i = 1,2,\ldots,m \tag{4}$$

$$QOL_i = \frac{S_i^-}{S_i^+ + S_i^-} \quad i = 1,2,\ldots,m\,. \tag{5}$$

Thus, a set of alternatives can be ordered according to this ratio in descending order. This approach has been widely used in different contexts decision (see, for example, Athanassopoulos and Podinovski, 1997; Awasthi, et al., 2011; Bin, et al., 2015; Chang and Yeh, 2001; Chen and Hwang, 1991; Hossain, et al., 2015; Hou and Xiao, 2015; Mir, et al., 2016; Saeida Ardakani, et al., 2015; Yeh, Deng and Chang, 2000; Zeleny, 1998; Zlateva, Velev and Raeva, 2015). These examples come from different fields of social research, however, to our knowledge is the first time that is applied to analyze the QOL.

The methodology calculates also the elasticity to quantify the degree of sensitivity of the QOL towards changes in each of the dimensions considered in the analysis. The elasticity is usually understood or defined as the percentage change variation. In mathematical notation, the elasticity can be calculated for each segment *i* and each QOL dimension *j* as:

$$\eta_{ij} = \frac{\Delta\%QOL_i}{\Delta\%V_{ij}} = \frac{dQOL_i}{dV_{ij}} \frac{V_{ij}}{QOL_i}\,. \tag{6}$$

Elasticity values are usually obtained to help different stakeholders, like policymakers or politicians, to determine the most critical dimensions that determine the QOL. The knowledge of these dimensions is crucial and important to develop adequate policies that improve the QOL experienced by the citizens which is usually an important factor to achieve an adequate level of social cohesion.

5 RESULTS

Tab. 4 shows the positive and negative ideal solutions result of the analysis of the different segments analysed by socio-demographic variables. The table is divided into six columns. The eight dimensions investigated are shown in the first column. In the second and third, the value of the positive ideal solution and the segment with the greatest degree of individual satisfaction experienced are shown respectively. It is demonstrated that the higher frequency according to the segmentation carried out is literacy Centre (EBA) in most dimensions; excelling the satisfaction with their life and the road system and public works of the province.

Table 4 – Ideal solutions

Dimension	PIS	Segment	NIS	Segment	% Var
Life satisfaction	97.50	'literacy centre (EBA)'	2.50	'NSC'	3,800.00 %
Satisfaction. Economy	90.00	'literacy centre (EBA)'	2.50	'My city is the place to live (2).'	3,500.00 %
Satisfaction. Local Government	97.50	'NSC'	2.50	'My city is the place to live (2).'	3,800.00 %
Satisfaction. Transparency	97.50	'My city is the place to live (2).'	18.75	'My city is the place to live (3).'	420.00 %
Satisfaction. Education	90.00	'literacy centre (EBA)'	2.50	'My city is the place to live (2).'	3,500.00 %
Satisfaction. Health System	75.71	'Immigration affects the cultural life (10).'	2.50	'NSC'	2,928.57 %
Satisfaction. Roads	97.50	'literacy centre (EBA)'	39.29	'My city is the place to live (5).'	148.18 %
Satisfaction. National Government	90.00	'literacy centre (EBA)'	2.50	'NSC'	3,500.00 %
Source: Own elaboration					

Analysing the fourth and fifth columns, it is contemplated that the segmentation made for the city site to live appears more frequently. Finally, the sixth column records the change percentage between the ideal solutions allowing obtaining a classification of those dimensions of the QOL observed as more or less heterogeneous. You can see how satisfaction with their life and the Local Government are more heterogeneous, while dimensions on transparency and roads are more homogenous.

The TOPSIS indicator allows obtaining the synthetic degree of individual satisfaction for each of the analysed segments. Fig. 2 shows the results obtained for the total of citizens and, for each of the nine zones of Ecuador. It can be seen dividing by areas that the citizens from zone two corresponding to Napo, Orellana, and Pichincha are less satisfied with their QOL, followed by the opinions of the citizens of the ninth area that contains the Metropolitan District of Quito. While the extreme of citizens with a higher QOL observed is in the eight zone (the cantons of Guayaquil, Samborondon and Duran). The eighth zone is characterized by a point of confrontation between local and national government, so a dispute exists for making and inaugurate works that benefit society; they are also political leaders who are about three periods in their positions and it is considered the second most important area in number of voters so vital in national elections.

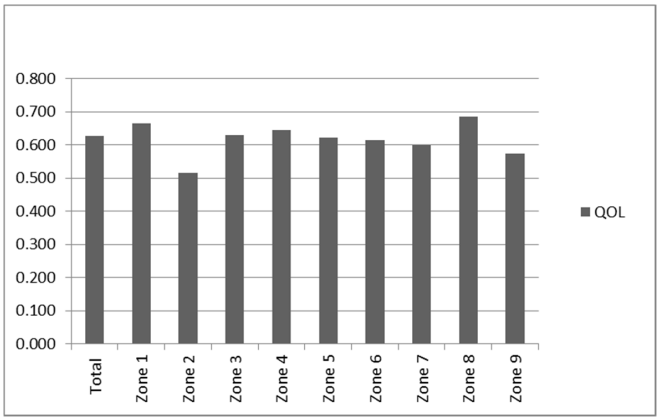

Figure 2 – Individual satisfaction. Total and by geographical zone

Tab. 5 shows the value of the elasticity of the QOL for the total of citizens analysed, and for each of the nine planning zones of Ecuador examined in this investigation.

Table 5 – Individual satisfaction Elasticity by geographical area

Dimensions	Total	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9
Life	0.167	0.153	0.209	0.164	0.157	0.169	0.167	0.172	0.161	0.185
Economy	0.138	0.137	0.151	0.138	0.133	0.138	0.135	0.132	0.140	0.138
Local Government	0.155	0.160	0.124	0.155	0.145	0.154	0.146	0.145	0.165	0.152
Transparency	0.141	0.147	0.113	0.142	0.138	0.140	0.137	0.132	0.154	0.131
Education	0.141	0.137	0.137	0.141	0.135	0.139	0.139	0.144	0.136	0.146
Health System	0.100	0.094	0.113	0.100	0.094	0.101	0.101	0.103	0.094	0.106
Roads	0.125	0.127	0.125	0.125	0.118	0.125	0.121	0.119	0.130	0.119
Central Government	0.140	0.137	0.138	0.141	0.133	0.142	0.141	0.137	0.142	0.133
Source: Own elaboration										

It can be seen that the QOL is inelastic with respect to each of the included dimensions, although the degree of magnitude is very different. For example, the first column shows that the respondents have a higher elasticity with respect to their subjective well-being or life and the local government, and less elasticity with respect to the health system and existing roads in the country. Analysing the specificities of the areas, it can be concluded that results vary imperceptibly at the level of each zone. Thus, for example, in the two, three, four, five, six, seven, nine will be more sensitive to changes experienced regarding to the satisfaction that people have with their respective life. Finally, the areas one and eight are more elastic towards the performance of the local government. On the contrary,

in areas one, three, four, five, six, seven, eight and nine will be less sensitive to changes experienced regarding the individual satisfaction with the health system, the same way that in the zone two in relation to the dimensions formed by the health system and transparency.

6 CONCLUSIONS

Our analysis is based on the European social survey, adapted to the Ecuadorian society, where QOL is measured by analysing eight dimensions that have great influence because some of them are the fundamental pillars of the social welfare system: (1) Life; (2) Economy; (3) The Local Government; (4) Transparency; (5) Education; (6) Health System; (7) The roads; and (8) the National Government. The first seven are more related to the local and provincial levels that are usually nearest to the citizens, while the last dimension corresponds to the work done by the Central Government at a national level.

This article presents a methodological proposal that calculates a synthetic index to measure the QOL of Ecuadorian citizens living in the nine areas of territorial planning. These indexes are needed to evaluate and make decisions on the provision that are offering the main public services, and how the QOL is affected by each of the analysed dimensions. This analysis is an appropriate tool to implement conducive policies that improve the citizens' QOL and enhance the consolidation of democratic societies.

The results allow to conclude that the road system, public works in his province and transparency have a higher level of individual satisfaction; at an intermediate level are the local economy, education and the work done by the central government; while the worst valued dimensions are education and transparency. The results are not homogeneous analysing each of the nine geographical areas. Thus, according to the zones, citizens who line in the areas eighth, first and fourth experience a higher QOL; while citizens of zone 2 and 9 experience the worst QOL. The results are interesting to analyse the present situation of Ecuador, considering that currently the Central Government has created new secretaries of state to improve the quality of life, and the country is less than a year from a National Government election.

This analysis is complemented by the sensitivity degree shown in elasticity values, which can be used as a guide for governmental entities with respect to the examined dimensions and will serve to improve the services provided, to thereby improve the Ecuadorians QOL. For example, in the zones two, three, four, five, six, seven, and nine the QOL is more sensitive to changes experimented regarding their own subjective life satisfaction. The areas one and eight show more elasticity towards the local government. On the contrary, in areas one, three, four, five, six, seven, eight and nine will be less sensitive to changes experienced regarding the individual satisfaction with the health system, the same way that in the zone two in relation to the health system and transparency.

These values raise the possibility that public services which form the pillars of the system of social welfare, education and health, propound that citizens improve their way of living by improving these two important dimensions. However, these results should be properly balanced as in other regions of the country, it is even more necessary to improve the work done by the local governments of these cantons. There must be an active work on the part of those involved to improve those dimensions that indicate a greater elasticity.

This study is not exempt from some important limitations, for example, it does not develop any causal relationship model to see to what extent the QOL affects or is affected by other variables. Another important drawback is based on the limited number of segment variables used in the study, the geographical area. Thus, an important venue for future research can be envisaged including other interesting traits analysed by other scholars, like access to the internet, the social class or the size of the city. Another future line of research is to extend and compare with data from the Barómetro de las Américas at the level of frontier countries that Ecuador has such as Colombia and Peru, countries with similar customs and traditions, while different economic models.

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City and Health: An Exploratory Overview of Research Issues

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ABSTRACT

The bottom line of welfare on our planet and its people is not only dependent on traditional economic measures, but also on knowledge and education and – last but not least – on human health. Human health is a critical factor for the welfare and prosperity of society. Many parameters appear to play a role in a health equation, even though the empirical measurement of health is fraught with many conceptual and empirical problems. As a consequence, we observe many disparities in empirical health conditions in a heterogeneous society; an appropriate definition and measurement of 'good health' are far from easy. Next to health disparities caused by a heterogeneity among the population, there is also an important geographical component in the spread of health patterns of the population as a result of differences in environmental quality-of-life, spatial density, quality of and access to health care facilities, and social stress conditions. From this perspective, geography matters in the field of human health. Although geographic differences in health conditions are not the only reason for people to reside or stay in a certain place, they are certainly an important decision parameter, often in combination with wellness conditions and environmental quality conditions. The aim of the present paper is to provide an overview of the literature on the geography of health and wellness, while the study is concluded with some lessons for research and policy.

Purpose: The aim of the present paper is to provide an overview of the literature on the geography of health and wellness.

Methodology/Approach: Literature review. We will outline the geography of human health, through a concise literature survey of the geographical patterns in human health outcomes to address the general research findings on spatial differences in health in relation to urban-rural patterns of life.

Findings: The measurement of human health is fraught with many difficulties, as it is often not clear whether a correction is made for supply factors (such as health care facilities) or for individual characteristics of the people concerned (such as age or gender). In the social-medical research literature this has led to an increasing popularity of meta-analytic methods.

Research Limitation/implication: Meta-analysis may be seen as a collection of quantitative research techniques that aim at providing a synthesis of previously undertaken impact studies in a given field. Clearly, and ideally, both the response and the moderator variables would have to be identical, but in reality this is not the case. Besides, the quality of the research may be difficult (often reflected in the quality of the journal in which the results are published), while also the contextual conditions may be completely different (such as physical-geographical conditions or socio-economic or poverty conditions). This makes the results of meta-analytic studies somewhat ambiguous, but nevertheless it is a valuable method that may shed more light on the determinants of health outcomes.

There is clearly a case for more detailed spatial data on individual health situations. There may be a self-selection (or sorting) mechanism in the locational decisions of households so that there is a need for a more systematic data collection and analysis in this area.

Originality/Value of paper: The paper aims to unravel the various forces that determine human health, in particular from the spatial perspective of places of residence.

Category: Research paper

Keywords: human health; disparities; health patterns; spatial density; environmental quality conditions

1 INTRODUCTION

The welfare of a country or region is not only dependent on traditional income measures (such as GDP per capita), but also on knowledge and education and on human health. These ingredients are also found in the conventional HDI (Human Development Index) advocated by the UN. Clearly, human health is a critical factor for the welfare perception of society, even though the empirical measurement of health is fraught with many problems. Is the measuring rod of health made up of average life expectancy of young children (or conversely by child mortality), by the rate of death from terminal diseases, or by the average recovery rate from serious diseases, etc.? Clearly, many parameters play a role in any health equation. There is a wealth of literature on factors that determine the health of the population: individual and collective lifestyles, income and wealth, education and culture, access to and use of health care services, human biology and genetics, and the quality of the daily environment. As a consequence, we observe many disparities in health conditions in a heterogeneous society (see

e.g., Aroca, 2001; Dahlgren and Whitehead, 2007; Illsley and Le Grand, 1993; Preston, 1975). Clearly, an appropriate definition of 'good health' is far from easy. According to the WHO, health is related to a state of complete physical, social and mental wellbeing, which is more than the absence of disease or infirmity. The health state of a person is in general a function of both internal factors (e.g., habits, food, water quality, behaviour) and external or environmental factors (e.g., social conditions, ecological quality, organization of the health care system).

It goes without saying that the health situation of a person, of a community or of a region depends evidently on total health expenditure (both private and public), which cover inter alia the supply and use of health care services, nutrition provisions and emergency aids. Higher income groups and countries tend to spend more on health expenditures, while the opposite holds for low-income groups or countries. To trace countries with the highest health situation in the world, Bloomberg Rankings developed a so-called health scores (see map in Fig. 1). This map suggests that OECD countries are in general the healthiest countries, comprising inter alia Singapore, EU countries, Australia, Japan and the USA/Canada. Many African countries and several Asian countries appear to have the worst health conditions. This map shows that Economic and health conditions are clearly correlated.

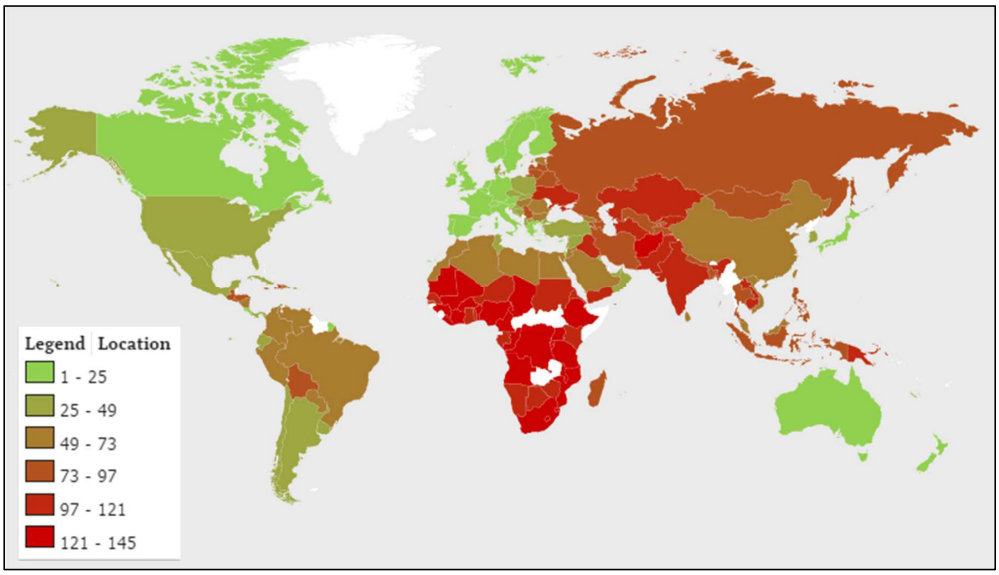

Figure 1 – The World's Healthiest Countries (Source: United Nations, World Bank, World Health Organization, 2012. Available at:<https://knoema.com/lhlddbb/the world-s-healthiest-countries>)

In general, health and wealth appear to be two mutually correlated phenomena. The same holds for life expectancy at birth. Disparities in national incomes on

our planet appear to be decisive for differences in the health situation in these countries.

It is noteworthy that - next to the health disparities caused by heterogeneity among countries and their population - there may also be an important local-geographical component in the spread of health patterns of the population, caused by differences in environmental quality-of-life, spatial density, quality of and access to health care facilities, and spatial social stress conditions. It is obvious that local or regional quality of air or water may be decisive factors for human health (as is witnessed in many developing countries), but also the local vicinity of medical care infrastructure and of outdoor and indoor sports facilities may play an important role in the health statistics of a country or region. Consequently, the geography of human health deserves due attention in health care policy and management and in related scientific research (see also Modranka and Suchecka, 2014; Jawoska, 2014).

As a consequence of the rising interest in human health in modern welfare states, new support facilities are increasingly designed and implemented, especially in the domain of health-leisure amenities and wellness amenities. Health and wellness tourism is nowadays on a rising edge and may open up many new markets for international tourism so that new forms of smart geographic specialisation are emerging. This is particularly reflected in eco-tourism, health tourism and wellness tourism.

In conclusion, geography matters in the area of human health. It is therefore, an important question whether living in cities or in rural areas makes a difference for the health condition of a person. Clearly, geographic differences in health conditions are not the only reason for people to reside or stay in a certain place, but they are certainly an important decision parameter, often in combination with wellness conditions and environmental quality conditions.

The aim of the present paper is to provide an overview of the literature on the geography of health and wellness. We start in Section 2 with a review of urban health and wellness issues as part of a broader exploration of geographical health differences. The subsequent section will address the general research findings on spatial differences in health in relation to urban-rural patterns of life. In Section 4 we will offer findings from a recent meta-analytical study, while the paper is concluded with lessons for research and policy.

2 THE BROADER HEALTH CONTEXT

On the hierarchical Maslow ladder of human needs, health has always assumed a prominent place, next to shelter. In recent times, human health is increasingly regarded from a broader welfare perspective, so that also elements from quality of life, environmental sustainability, food quality, safety, poverty conditions, social justice, and general feelings of well-being (including sometimes even social community feelings) are taken into consideration. Consequently, the

external environment of human health is more and more addressed in recent social-medical research, which means an orientation of research towards general wellbeing research comprising a multidimensional and transdisciplinary social science-oriented approach (McCaig, 2005; Noble and Bronson, 2005). Consequently, livability, socio-economic welfare, sustainable modes of living, social conviviality, spatial vitality and resilience, cultural heritage, and physical/mental conditions are all constituents of this broad interpretation of human well-being, sometimes called a '*complex social value*' by Fusco Girard (1987) (see also Fusco Girard and Nijkamp, 1997).

Clearly, well-being and health are not only individual characteristics of an agent but have also features of a common good in a local or regional community (WHO, 1986; Thompson, 2007). We may quote here Sen (1999), who says: *"it often happens that the income level is not an adequate indicator of important issues such as the freedom to live a long time, the ability to escape from preventable diseases, the possibility of finding a decent job or to live in a peaceful community and free from crime"* (p. 6).

From a spatial perspective, Barton and Grant (2006) have mapped out the general architecture of the social and health characteristics of actors at the local level, in particular, the urban ecological and land use components (see Fig. 2). This health map offers a description of a variety of background factors and human health determinants. Its constituents will be used here as a framework to trace the impact of space on human health and wellbeing patterns.

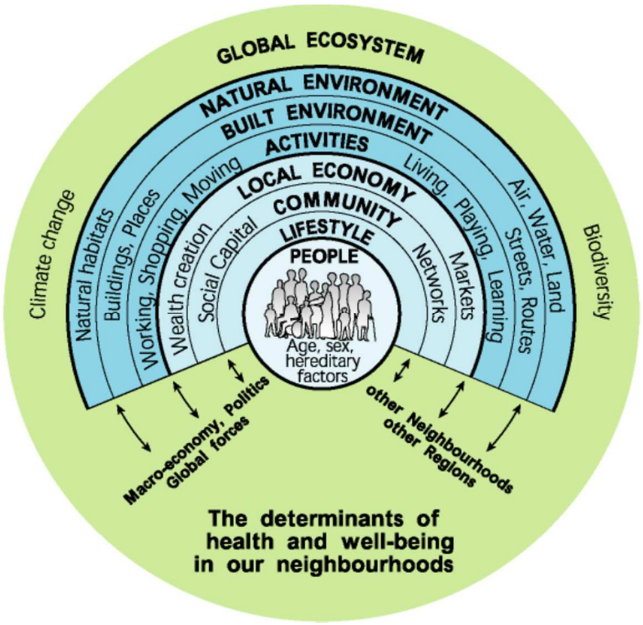

Figure 2 – The health map (Source: Barton and Grant (2006, p.2))

It should be made clear at the outset that the terms 'health' and 'wellness' stand for different things and may be different concepts, but the one concept cannot

really function without the other for providing an ultimate operational result for and significant impact on our well-being, productivity, happiness, quality of life and life expectancy. In the current context of globalization, the relevance of differences in degree of connectedness between spatial (scale) variation of health-related issues and conditions from a multidisciplinary perspective (e.g., public health, safety, ecological issues) plays a fundamental role and provides an indispensable base for tracing life conditions of individuals and community in any culture and society. It is therefore, pertinent to address human health questions that contribute towards the wellbeing, social innovation and sustainability of societies, including housing quality and social capital (see Mohnen, et al., 2011; Shaw, 2004).

At a global scale, a variety of environmental characteristics and external conditions in locations or urban systems of current societies is specific and place-based, and provides a multitude of influences of central importance for a proper understanding of the issues at hand. This calls for a conceptualization of different hierarchical levels of the complex multi-causality of population health and dynamics (e.g., physical circumstances, spatial factors, social context, economic conditions) and for a (re)shaping and (re)developing of the regulation of health and sustainability externalities that are conducive as a source of health innovation to the potential future of modern cities creating inclusive societies. Clearly, health conditions are normally shaped in a broader social and geographical context. We will now in particular address in Section 3 the geographic constituents of human health conditions.

3 SPACE AND HEALTH

Space matters in determining the health outcomes of individuals or groups in society: there are manifest differences in health in and between countries and regions. In a recent comprehensive study, Ishikawa, Kourtit and Nijkamp (2015) analyzed the significance of urban conditions for human health, with a particular view to the question why urbanization patterns may have specific implications for human health, all other things equal. Such contextual geographic or area-based differences may be ascribed to an urban-rural dichotomy, but the authors argue that the overall pattern is much more complex and that regional characteristics should be decomposed into more fine-grained components in order to trace more precisely which factors have a critical impact on health outcomes in a society. The authors also claim that the social determinants of human health (such as gender, race, wealth, income, social capital, support systems, etc.) have been rather well documented in a wide array of studies. But much less conclusive knowledge is available on the geography of human health. We will briefly summarize here some essential points made by the authors of the above mentioned comprehensive study.

The first source of methodological concern is the operational definition of health: this has various elements, such as: self-rated health (SRH), limiting long-term

illness (LLTI), mortality rates or morbidity rates (categorized according to the International Classification of Diseases (ICD) into: availability of and accessibility to health care facilities and health care utilities, degree of hospitalisation, prevalence of disease risk factors and health-related behaviours, life expectancy, preventive health check-up systems, etc. It goes without saying that the identification of significant geographic determinants in this wide array of health indicators is excessively complicated, leave aside the fact that in many cases no detailed spatial information is available.

Nevertheless, in their overview Ishikawa, Kourtit and Nijkamp (2015) were able to find 105 studies containing quantitative information on the existence of health inequality between urban and rural areas. There was however, no unambiguous conclusion, as both the definition of urban or rural was fuzzy (or not standardized) and a uniform, operational and precise measurement of human health was absent. For example, from their data it became apparent that in about 30 percent of their studies urban living led to positive health effects and in some 40 percent rural areas provided a better health outcome! Clearly, there was also much heterogeneity in the studies concerned, caused e.g. by gender, age, education, poverty, access to health care amenities, etc. The impact of psycho-social factors was even more hard to identify (see also De Mello-Sampayo, 2016).

It is clear that the simple distribution into urban-rural is very crude: living near an urban park may create different health conditions compared to living near an urban motorway, for instance. To care for a too rough categorisation, the notions of urban influence codes (UIC) and rural-urban continuum codes (RUCC) have been introduced, but the biggest problem here is of course the collection of a reliable and representative small-grid database.

An important problem is clearly formed by demographic self-selection. High-income people may move to green areas and enjoy better health conditions, which otherwise might have led to premature death. Thus, the consequences of the urban-rural dichotomy for human health results are difficult to measure in practice.

Interestingly enough, Ishikawa, Kourtit and Nijkamp (2015) were able to come up with several relevant, though tentative findings, sometimes in relation to environmental and land use differences. They argue that despite some ambiguity in findings it is possible to identify key elements that are decisive for health outcomes in relation to the urban/rural context or environment: (i) the urban environment leads to productivity spillovers that arise from human capital accumulation, which are proven to positively affect the regional health status. This is where economic and social capital may exert a joint impact; (ii) the physical environment (in particularly land use variables) may be beneficial to human health, if it reduces commuting costs and car dependency, or favours walking or bicycling. Such a mixed land use composition in cities mitigates the negative elements in high population densities (with less green areas); (iii) urban

proximity to health-care amenities favours of course also human health, especially in emergency cases. Clearly, urban land rents may be prohibitive to live close to such facilities, so that here also the income situation of residents plays a role. The claim of the authors that there is a need for a solid 'urban medico-metrics' ought clearly to be supported.

4 RESULTS OF A META-ANALYTICAL SYNTHESIS

In Section 3 we have outlined the geography of human health, through a concise literature survey of the geographical patterns in human health outcomes. Several of these analyses are based on case studies, often ad hoc or anecdotal in nature. But there are also many studies that try to come up with empirical estimates of the impact of the degree of urbanity or rurality (or of living in urban or rural areas) on human health. It was clear from the previous section that the measurement of human health is fraught with many difficulties, as it is often not clear whether a correction is made for supply factors (such as health care facilities) or for individual characteristics of the people concerned (such as age or gender). In the social-medical research literature this has led to an increasing popularity of meta-analytic methods.

Meta-analysis may be seen as a collection of quantitative research techniques that aim at providing a synthesis of previously undertaken impact studies in a given field. Clearly, and ideally, both the response and the moderator variables would have to be identical, but in reality this is not the case. Besides, the quality of the research may be difficult (often reflected in the quality of the journal in which the results are published), while also the contextual conditions may be completely different (such as physical-geographical conditions or socio-economic or poverty conditions). This makes the results of meta-analytic studies somewhat ambiguous, but nevertheless it is a valuable method that may shed more light on the determinants of health outcomes. For more details on meta-analysis we refer to Van den Bergh, et al. (1997) and Stanley (2001).

In the area of the geography of human health, a recent meta-analysis was carried out by Gheasi, et al. (2016). They address the question whether rural ways of living are healthier than urban ways of living. They perform then a meta-analysis by using a wealth of empirical studies on human health and the geographical differences of working and living. They find that the effects of regional or urban characteristics on health outcomes are inconsistent between different studies/countries. A relevant background factor that is critical for this lack of consistency in empirical outcomes stems from inconclusive definitions of such concepts as health, urbanism, rurality and urban-rural heterogeneity (e.g. inner-city areas). The authors then provide a systematic review of the prevailing literature on geography and health, based on a broad, but concise overview of the basic space-health mechanisms involved. Next, they develop a quantitative research synthesis based on a quantitative meta-analysis of previously published studies on self-rated/self-reported physical health conditions in both rural and

urban areas. The results from their meta-analytical regression analysis show that in general people living in urban areas appear to rate themselves slightly less healthier than people in rural areas. Such findings are very interesting and prompt the need for more underlying research on causality patterns at a detailed geographical scale.

Their results reflect clearly the need for further applied work. The authors argue that the geographical scale should be more fine-grained than the categories employed in their study. They also claim that various illness phenomena may be specifically related to given geographical areas or climatological conditions (e.g., malaria), so that general inferences are hard to draw. There is clearly a case for more detailed spatial data on individual health situations. Last but not least, there may be a self-selection (or sorting) mechanism in the locational decisions of households, so that there is a need for a more systematic data collection and analysis in this area.

5 CONCLUSION

Human health is increasingly assuming a high position on the needs ladder of people. Following Maslow's hierarchical principle, safety, shelter, health and welfare are basic constituents of the satisfaction of human beings. In real-world geographical space, these factors are of course intermingled, since the place where one lives may have specific environmental, social and economic conditions that shape the health outcomes of individuals or a community. It goes without saying that a thorough analysis of these complex relationships calls for a detailed individually-based and longitudinal health database, collected from different places at refined geographical scales.

Clearly, the supply side of health care amenities may also be essential for the human health outcomes. This does not only concern the type and quality of such medical facilities, but also their location and accessibility (including opening hours). And last but not least, the interface between demand for and supply of health care systems is a major research challenge due to the multi-causal nature of these relationships.

Our final conclusion is that for a thorough understanding of the urban and rural aspects of human health much more conceptual and empirical work is necessary. For the '*science of the city*', the explicit inclusion of human health – as part of a broader package of welfare and sustainability constituents – will no doubt lead to a more mature urban science.

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The Complex Interactions between Cities and Nature

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ABSTRACT

Purpose: Proximity to nature is highly valued by urbanites. They demonstrate higher willingness to pay for housing at locations near open and green spaces. But, nature in cities can generate negative externalities as well. The aim of this paper is to present the complex relationship between nature and cities and the possible negative influence of urban nature on property prices.

Methodology/Approach: The data presented in this paper include open spaces, the presence of wild animals and residential property values in Haifa, Israel. These data were analyzed to uncover spatial regularities and basic statistical relationships.

Findings: The results reveal the expected presence of dominant positive externalities related to proximity to open and green areas. However, in certain areas and under certain circumstances, the nuisances generated by the presence of wild animals in close proximity to housing are correlated with lower property prices.

Research Limitation/implication: We demonstrate in this paper that that there is a complex relationship between nature and cities, albeit focusing our analysis on large mammals in cities only. Disentangling positive and negative externalities of urban nature is a challenging task. The paper presents an example of the potential difficulties that need to be dealt with in such analysis.

Originality/Value of paper: Through the case study, we show that there are good reasons to believe that there are both positive and negative externalities of nature in cities. To our best knowledge, attempts to disentangle both types of effects using property values do not exist in the literature.

Category: Research paper

Keywords: urban nature; property prices; positive and negative externalities; disentangling

1 INTRODUCTION

Traditional analysis of urban spatial evolution has been carried out at a crude geographic resolution and by means of coarse statistical data. Until recently cities tended to be viewed as continuous built up areas with little room for nature. Population growth in cities was presumed to cause the outer boundaries of urban built areas to expand into the surrounding countryside. All open areas within urban boundaries were presumed to be conscripted for and eliminated by infilling and by building waves around cities (Czamanski, Malkinson and Toger, 2014). Urban nature was viewed as an oxymoron. But, contrary to these crude analyses, cities are porous. In between buildings, there are back yards, private and public gardens and lots that are yet to be developed. Studies of urban clusters, defined as continuous built spaces (Benguigui, et al., 2000; 2001a; 2001b; 2004) carried out at a fine spatial resolution, confirm that while open spaces in cities do shrink in quantity, they persist and in the limit represent about a third of the urban land area. More importantly, their connectivity at least in some cities is robust (Czamanski, Malkinson and Toger, 2014; Toger, et al., 2015).

Open spaces in cities are highly appreciated by urbanites as well as have an intrinsic ecological value (Niemelä, 1999; McPhearson, et al., 2016). The proximity to greenspaces has been shown to improve human wellbeing and health (Tzoulas, et al., 2007). However, in addition to the positive externalities that they generate by producing ecosystem services, proximity to nature can generate negative externalities as well. In this paper, we add specific analysis to sharpen the consensus (McPhearson, et al., 2016) that the relationship between cities and nature is quite complex. Their balance is time and location specific. There is no easy way to sort out the positive and negative spatial effects.

The remainder of this paper contains 2 main sections (Methodology and Conclusion). In the Methodological Section, we present some evidence concerning variation in housing prices in relation to proximity to open spaces, initial analyses of the presence of wildlife in Haifa (Israel) and of the complexity of estimating the impact of the positive and negative externalities of nature by means of property values. In the Conclusion Section, we present discussion of our analysis and suggestions for future research.

2 METHODOLOGY

2.1 Open spaces and property values

Open spaces in cities serve as habitats of a rich assortment of species. Indeed, the highest species richness is on the fringes of cities and in particular in the sprawling urban neighbourhoods at the outer boundaries of cities (McKinney, 2008). Wealthier neighbourhoods are biologically more diverse (Leong, et al., 2016). The value of disturbed or created, novel ecosystems, and the services that they provide, is the subject of a burgeoning literature (Hobbs, Higgs and Hall,

2013). *Ecosystem services*, typically grouped into four broad categories, are crucial for human welfare (Corvalan, Hales and McMichael, 2005. *Provisioning services* contribute to the production of air, fuel, food and water. Regulating services control climate and diseases. *Cultural services* contribute to the human spiritual well-being and recreational activities. *Supporting services*, such as biodiversity, provide a basis for the other three types by enabling ecosystems to function by, for example, nutrient cycles and crop pollination.

There is extensive literature that presents evidence that people are willing to pay for proximity to open spaces and natural areas in order to benefit from these services. There is evidence of a positive premium in housing prices at locations near open and green spaces that are perceived as beneficial and attractive (Daams, Sijtsma and Van der Vlist, 2016; Earnhart, 2006; Irwin and Bockstael, 2001)[1]. Analyses aimed to estimate the effects of open spaces on real estate values have found that in general proximity to these amenities has a positive impact (Conway, et al., 2010; Lutzenhiser and Netusil, 2001). But, the influence of open space amenities on residential prices tends to decline with increasing distance (Asaber and Huffman, 2009; Jim and Chen, 2006). In addition, there is evidence that the quality of open spaces and green areas around certain property matters. For example, the perceived density of tree coverage influences differentially residential values (Netusil, Chattopadhyay and Kovacs, 2010; Mansfield, et al., 2005). In certain locations, not only the immediate surroundings are relevant. The quality of the landscape visible from property impacts positively on its value (Schläpfer, et al., 2015; Bourassa, Hoesli and Sun, 2004).

Extensive evidence points to various wild animal and plant species that are present in urban green and grey spaces (VanDruff and Rowse, 1986; Matthies, et al., 2013; Adams, 2006). There are coyotes in Tucson and Chicago, raccoons Cincinnati, foxes in London, wild boars in Riga, Berlin and Haifa, alligators in Palm Beach, moose and black bears in Montreal, cougars in El Paso, and more. As wildlife presence in cities increases, so does the frequency of human-wildlife conflicts such as direct damage to property, predation of pets, perceived and actual conflicts with residents, the spread of diseases and sanitation issues. While interactions with larger wild mammals tend to be overestimated by the media and the population in terms of frequency, the extent of danger and damage (Adams, 2006, real estate values in the vicinity are affected by the perceived rather than actual wildlife nuisance level.

2.2 Animals in cities

Recently we studied the presence of wild animals in the city of Haifa, Israel. The city of Haifa is located on the northern Mediterranean cost of Israel. Hosting about 280,000 inhabitants (ICBS, 2014), it is the third largest city in Israel. Its

[1] The extant literature ignores the negative externalities of proximity of nature to housing. It is our presumption that the various estimates reported could be the subject to misspecification errors.

urban area covers around 66 km^2 (Haifa municipality, 2008) along the slopes of the Mount Carmel, extending from the sea level to an elevation of 450 meters. Its hilly topography is characterized by downward slopes towards the Mediterranean Sea, intertwined by relatively deep and green valleys. These valleys penetrate deeply into the urban built fabric, and, spread out as green fingers within the built environment. They are an integral part of the city's open space network (Toger, et al., 2015). Fig. 1 includes a general view of the city of Haifa. The mountain ridge Carmel runs from the Mediterranean in the North-West, uphill towards the South-East which is the highest point in the area. The northern slope of the mountain is the most heavily urbanized area, and the valleys intertwined among residential areas all over the mountain are clearly discernible.

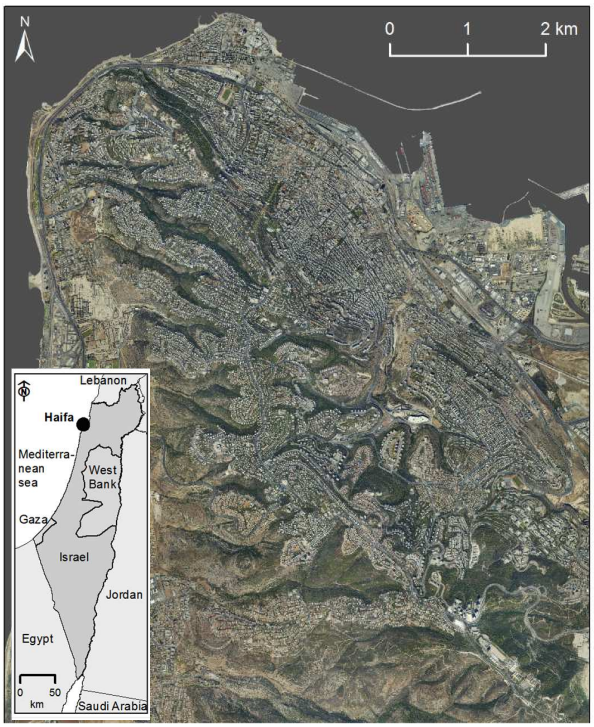

Figure 1 – General view of the Haifa area

To study the presence of wild animals, we utilized motion-sensor triggered cameras. Using the same sampling sites as in Matthies, et al. (2013), we observed activity of wild mammals in the open spaces of Haifa. In 2011 we detected 11 wild mammal species, including: golden jackal, Egyptian mongoose, striped hyena, Indian crested porcupine, beech marten, rock hyrax, wild boar, red fox, southern white-breasted hedgehog, European badger, and coypu (Toger, 2016). Jackals and wild boars were observed most frequently.

Figure 2 – Animals observed in Haifa using motion-sensor triggered cameras

Boars are frequently seen during night hours foraging for geophytes and acorns in backyards, turning compost and garbage bins upside down. They feature in traffic accidents and are linked to water contamination and spreading of certain diseases such as Escherichia coli, Salmonellosis and Swine influenza (Schierack, et al., 2009). Furthermore, because of their ability to survive in urban areas, boars outcompete some native and endangered species.

While most residents consider them a nuisance, there are those that seize the occasion and enjoy the interaction with nature in an urban environment (Barshaw, 2012). Recently the wild boars (*Sus scrofa*) received a lot of attention in professional and social media as a token nuisance animal in Haifa. Residents report addresses of observations of wild boars in the city to the municipality. The valleys in Haifa serve as habitat for wild boars as well as other species within the urban areas. In Haifa, as in many other cities, problems related to wild boars were reported in recent years (Cahill, et al., 2012; Licoppe, et al., 2013).

Haifa municipality systematically records observations reported by citizens about nuisances caused by wild boars. We compiled the reported data for the years 2011-2013. The data include address and date of 5,120 observations[2]. Using ArcGIS software (ESRI, 2012), the locations of these observations were geocoded. Since these complaints are the only evidence available about wild boars' location, we used a kernel density smoothing procedure in order to create a continuous surface of assumed "wild boars density function", and then normalized it to a range between 0 and 1. Fig. 3 (left) shows the normalized observed density of wild boars: Darker colours indicate the higher quartile (values between 0.75 and 1, the maximum), while lighter ones indicate the medium quartiles (0.5 to 0.75 and 0.25 to 0.5). The lower quartile and places where wild boars were not observed are not indicated in the map (blank areas).

In addition, we calculated a map of wild boars penetrable and impenetrable areas in Haifa. Using high resolution patterns of open spaces connectivity, we apply the concept of cost of animal movement in the city (Rudnick, et al., 2012) to calculate the *impenetrability* variable. The impedance (cost) to animal movement is defined as a combined measure representing disturbance from human infrastructures (roads, buildings, fenced areas, etc.) and energy expenditure of the animal. We relate it to the land-use/land-cover type, the most frequently used environmental variable in connectivity analysis studies (Zeller, McGarigal and

[2] The raw data about wild boars observations is a courtesy of Haifa Municipal Veterinary Dr. Y. Weiss.

Whiteley, 2012). The impenetrability variable was calculated as cost-distance (ESRI, 2012) to each point in the city from the closest open space cell over a cost surface. The cost (resistance, movement impedance) surface was derived from land-use/land-cover (LULC) dataset described in Toger, et al. (2015) with the cost of 0 for open spaces; 0.25 for gardens and parks; 0.5 for backyards and squares; 0.75 for roads, railroads and transportation space, and infinite cost for obstacles such as buildings, construction, industry, and water. The cost-distance impenetrability values were normalized to the range between 0 and 1, with open spaces being completely penetrable (value of 0) and obstacles completely impenetrable (value of 1). Fig. 3 (right) shows the results of the calculation. Dark red areas are virtually impenetrable for wild boars, whether because they are hermetically fenced (infrastructures, industries and civil or military facilities) or because they are densely built, and possible boars movement among them is highly improbable, or because they are far from the open spaces thus cost-distance value is very high. However, white areas are easily penetrable for wild boars, because of their closeness to open spaces, and, additionally, because the urban fabric in these areas is less dense (private houses, gardens, wider roads, abundance of available corridors, etc.).

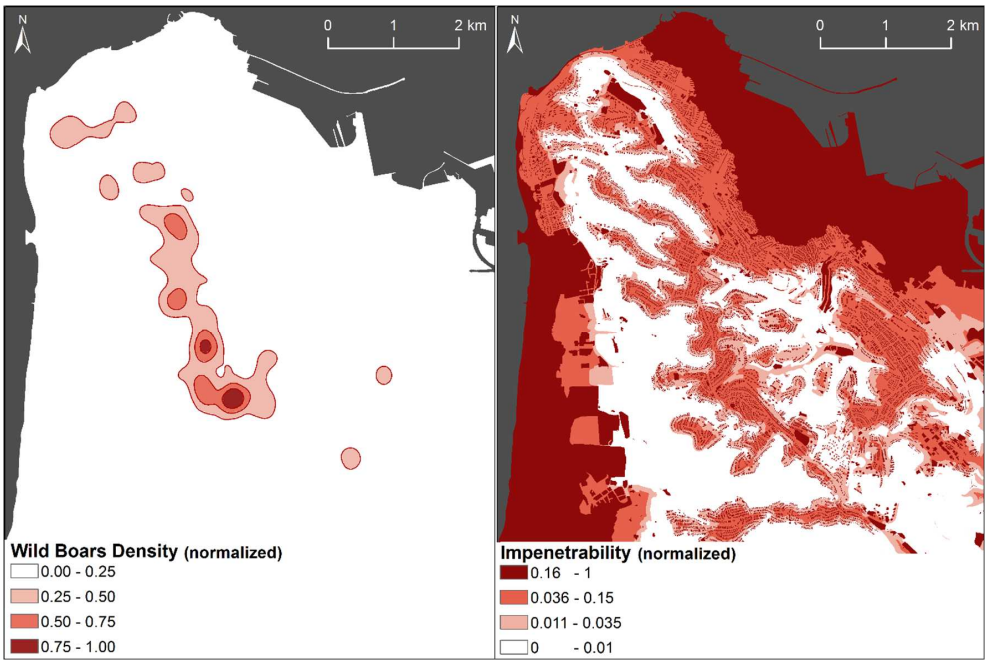

Figure 3 – Normalized observed density of wild boars (left) and penetrable areas for wild boars (right)

A simple visual comparison of fig. 3 right and left suggests that places with higher wild boars observed densities coincide roughly with built and residential zones surrounded by penetrable areas. The intuition is that wild boars penetrate

into the urban fabric preferentially in locations where a relatively easy retreat into safer open areas is possible.

2.3 The complex relationship of property prices and nature

In order to illustrate the relationship of various aspects of proximity to nature and property values, we use a dataset of 22,463 real estate transactions that took place in the city of Haifa during the period 2005-2014. The data include the price per square meter and several details about the properties transacted, such as a number of rooms, surface area and age.

In order to visualize the spatial morphology of residential prices in Haifa, we use again a kernel density smoothing procedure. We created a continuous and normalized surface with values between 0 and 1. Fig. 4 (left) presents the results. The highest dwelling prices quartile is located in the lower-right quadrant of the map, coincident with the highest topographic altitude of the urban fabric and the Mount Carmel. This area is also near one of the largest national parks in Israel, the Carmel Park, which limits with the city precisely there. Along the Mount Carmel ridge, in North-West direction, prices remain high (second and third quartiles), decreasing as the city approaches to the Mediterranean Sea and downwards along the southern and northern slopes. The lowest quartile is not shown in the map, but it includes mainly properties located along the shore, both in the West and in the North, where large infrastructures (roads, railways and harbors) are located.

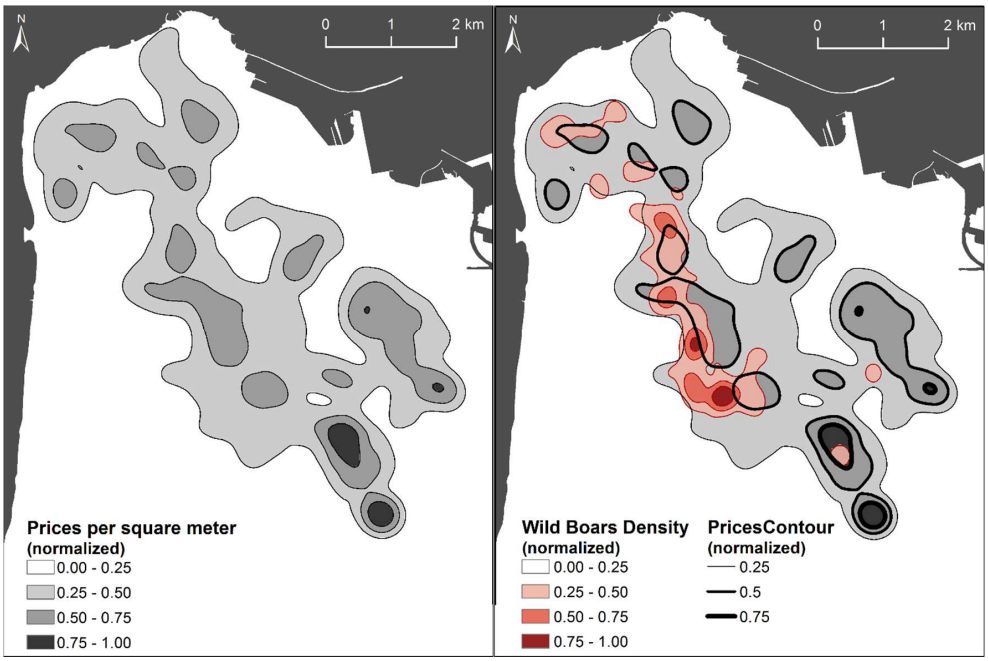

Figure 4 – Property prices (left) and overlap of wild boars' density and property prices (right)

We hypothesize that places with the intensive activity of wild boars are less attractive for urban dwellers, due to their associated nuisances. In order to create a visual feasibility test of our hypothesis, we combine the dwelling prices with the wild boars density in a single map. Fig. 4 (right) combines the features displayed previously in figures 3-left (boars' density) and 4-left (normalized property prices).

Fig. 4 (right) suggests that the presence of wild boars is insignificant in neighbourhoods with extremely low property prices. Only in neighbourhoods with property values in the upper three price quartiles, wild boars activity is high and generates significant volumes of complaints. At the same time, and as is evident from fig. 3, wild boars' presence is related to proximity to open spaces and to deep valleys in particular. Thus, the locations that are attractive for humans are attractive to wild boars as well. Humans prefer aesthetic and recreational values of these locations and boars seek available food in areas that are easily accessible to them. It is noteworthy that places with low property values are characterized by a lack of open and green spaces and by limited landscape quality and closeness to industrial and transport infrastructure. These are the factors that make them unattractive for wild boars, and therefore little or no activity is recorded there.

But, the correlation between locations that are highly attractive to humans and to boars is not perfect. The relationship is far from being simple. The highest price quartile areas, located at the South-East corner of the map (Fig. 4, darker black spots), do not coincide with the highest quartile of the wild boars density, located about 1.5 km North-East (the darker red spots). We presume that low intensity of boars does not constitute a problem for residents and does not affect the demand for housing. The impact on demand and prices of housing requires that the presence of boars exceed some unknown threshold values.

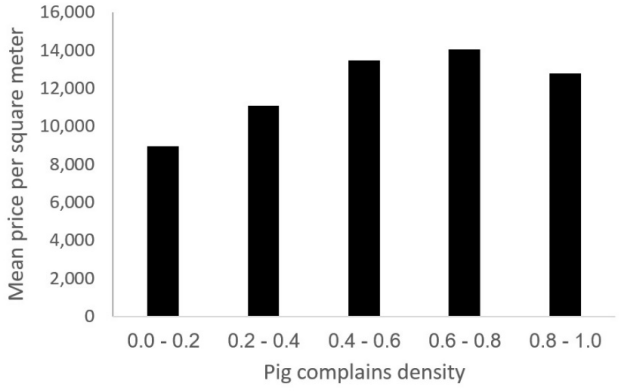

Figure 5 – Mean price per m^2 as function of wild boars' density

Real estate transactions can be grouped according to their location in different wild boars density areas. Since wild boars density spans between 0 and 1, this

variable can be divided in five sections of equal range. The ample majority of the transactions (21,494 out of 22,462) are located in areas almost unaffected by wild boars (range 0.0 - 0.4). Only the tiny minority of the transactions belongs to areas where the influence of wild boars is expected to be significant (968 out of 22,462). For each transactions group, we can calculate the descriptive statistics of its prices per square meter. Fig. 5 graphically shows the mean price per square meter as a function of wild boars' density.

The mean price per square meter increases steadily together with the boars' density. The first three columns in figure 5 indicate that the price increases by more than 20 %. The transition from range 0.4-0.6 to 0.6-0.8 is more moderated (an increase of around 4 %). However, when crossing to range 0.8-1.0 the trend changes suddenly and the price per square meter drops dramatically by almost 9 %.

Analysing real estate transactions according to their location and wild boars density areas reveals important differences between two main groups. The majority of these transactions (21,494 out of 22,462) occurred in areas with low wild boars impact (density range between 0.0-0.4). However, from the point of view of our research question, interesting phenomena should be found precisely in transactions located in places heavily influenced by boars. Focusing on the remaining 4 % of the dataset, we discovered that, related to that specific subset, the average price per square meter is lower than the average price found in its immediate surroundings (see fig. 5). Although this is not a demonstration that intensive wild boars presence pushes down property values, the analysis performed here suggests that there are good reasons to believe that there might be a connection between wild boar presence and lower property prices.

3 CONCLUSION

The well and widely documented higher willingness to pay for properties located near open spaces within cities is considered an expression of the positive externalities from nature experienced by urbanites. But as we illustrated here, in some cases, physical proximity to natural areas may be the source of negative externalities as well. These may result from nuisances caused by wild animals. Using data about property prices and wild boars' observations, we conclude that there are good reasons to suggest that this is the case in Haifa, Israel. However, disentangling mixed positive and negative effects of proximity to nature in urban areas is a complex task due to several types of challenges. At first sight, it seems that the same factors that attract humans to certain areas make them attractive for the wild boars too: nearby green and open spaces, abundant vegetation, closeness to valleys, etc. In addition, residential areas surrounded by wild boar habitat, become even more attractive to the boars because of the abundance of available food and the safety of nearby natural areas.

Assuming that a simple procedure for disentangling positive and negative effects could be conceived, an additional methodological challenge is posed by the fact that wild animals' nuisance effects are not necessarily linear. It seems that, in order to be perceived as a nuisance, wild animal's presence has to be noticeable, continuous and create some type of damage. Using different functions to model positive and negative effects may complicate the statistical model, but still, modelling curvilinear variables can shed light on the presumably non-linear relations between animal's presence and the nuisances caused by them. A simple solution would be to try different data transformations of one or both measurement variables and then perform a linear correlation of the transformed data. A more elaborated option is to explore the fit of a curvilinear regression using functions as exponential, power or logarithm. Other concerns relate to the quality of the data. Wild boar presence data used here are based on reports by citizens. One would expect fewer reports where there are less people. Boars observed in unexpected locations are more likely to get reported. In residential areas during work hours the probability of boar reports is lower. Moreover, the probability of boars being reported depends on population density per area which is heterogeneous.

It should be noted that our approach is conceptually different from the urban environmental perspective. Instead of focusing on the positive and negative influences of cities on their natural physical environments (as for example in Camagni, Capello and Nijkamp, 1998) we are interested in positive and negative influences of urban nature on urbanites' welfare. Our original contribution is to deal empirically with ecological disservices from nature, which affect negatively urban dwellers.

Despite the methodological issues in an effort to disentangle positive and negative externalities, the evidence we present suggests that estimates of the premium that people are willing to pay for proximity to green spaces may be the result of misspecification error. We cannot suggest at present whether the estimates should be bigger or smaller than reported in the literature (e.g. Bertram and Rehdanz, 2015). Given the methodological and policy challenges of sorting the complex interactions between cities and nature, there is a need for further research.

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Cities of Resilience: Integrated Adaptive Planning

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ABSTRACT

Purpose: to classify the definitions and approaches towards the concept of the city of resilience, to understand the reciprocal influences of academic research, resilience assessments and planning results as well as to identify the inconsistencies and formulate future research directions.

Methodology/Approach: explanatory analysis, literature-based work comparing definitions, principles, dimensions. Rationalised analytic reasoning and approaches which lead to formulating crucial research questions.

Findings: the definitions of city resilience are classified according to objects and fields. The differentiations in the sustainability and resilience concepts are indicated and an adaptive planning framework is described.

Research Limitation/implication: the main challenges are filling in the gap between the theory and practice of city resilience literature, dealing with the complexity, the implementation of complexity theory considering self-organisation.

Originality/Value of paper: the analysis contributes to the clarification of the main concept, classification of the main approaches and the formulation of open research questions and future trends.

Category: Research paper

Keywords: city of resilience; smart city; sustainable development; vulnerability; integrated planning

1 INTRODUCTION

Commonly recognisable qualities of resilient people are their inner strength, strong physical constitution, ability to leap back from failure and permanent

striving for self-improvement. The same features could almost be assigned to resilient cities through their ability to last, capacity to respond to shocks or crises (Newman, et al., 2009) and their goal of becoming more co-ordinated and integrated. The best cities of such kind are not only able to adapt to shocks, but also able to discover new opportunities and perform even better in spite of perplexing circumstances. In other words, individuals and/or cities at a time of disruption should avoid panicked responses and making decisions based only on short-term considerations. Rather, long-term planning, coordination and co-operation would be the preferable reaction and in terms of adaptive resilience, the reframing of possible threats as opportunities and a change of routine practice instead.

Resilience is a relatively new term used in urban planning discussions, academic research and practice. This has been especially due to the increasing attention paid to extreme and catastrophic events and their consequences (climate change, hurricanes, terrorist attacks, earthquakes, fires, oil spills, cybercrime, epidemics as well as economic crises). Urban agglomerations and areas exhibit a high concentration of populations, physical resources, industry and technology facilities, which all mean higher vulnerability and a risk of massive catastrophic losses.

In response to concerns about the increased risk of hazards and the high discernment of the population and institutions, the focus of researchers, decision makers and practitioners has led to the design of a new concept of resilient cities. The concept deals in general with a city's ability to anticipate and mitigate hazards, its minimisation of economic and social disruption and its capacity to enhance its adaptive capacity in the case of a crisis event. The city, which belongs to a broad category of complex and adaptive socio-ecological systems (Batty, 2008; Reggiani and Nijkamp, 2009), may build significantly on the resilience theory, which was developed earlier in the fields of biology, ecology and psychology (Perrings, 1998; Pimm, 1984). Resilience theory is embedded in complexity theory, which considers self-organisation as its over-riding organising principle (Folke, 2006; Batty, 2008).

Decision makers quickly adopt attractive new research concepts (e.g. the European Commission broadly uses the words "sustainable", "resilient" or "smart" even if their content is far from being clear or there is widespread misunderstanding or deformations of the meanings). The popular smart city concept is mostly used in relation to the use of digital technologies in everyday city life, building innovative energy and transportation systems and providing efficient services to citizens. These cities are those regarded to have developed innovative, green, environmentally friendly energy and water solutions as well as the use of integrated mobility systems to achieve secure mobility. In this way, the smart approaches can be recognised as a tool which possibly strengthens the resilience of a city and contributes to local or even global sustainability.

In comparison to the smart city concept, the resilience attribute is assigned to cities which are supposed to be able to cope with external shocks and hazards, demonstrating their high adaptive capacity. However, the concepts of smart and resilient cities have not yet been agreed on sufficiently. There are ambiguities in their definitions as well as concerns with regard to the applicability of resilience and smartness as theoretical constructs. There is still the need to find a reasonable content for the rather broad and blurred definition of resilience, to operationalize it and to find an evolutionary approach which can address the weaknesses in urban planning. Perhaps the move will go in the opposite direction. The positive experience of more than a few cities in supporting their resistance to external shocks and increase of their adaptive capacity will help to define city resilience more properly. More than clear is the understanding of the complexity of urban systems as organic ones (Jacobs, 1961), calling for the development of appropriate and interrelated sub-categories of the multidimensional concept as well as integrated procedures which would put together land and strategic planning, risk management, intelligent resource management, technological expertise, digital solutions and social science. This may only be the case if community resilience and adaptive capacity are stimulated and boosted by integrating human, social and economic capital.

2 INTERDISCIPLINARY APPROACHES TO RESILIENCE

Persons, populations or cities can be harmed by external shocks and can even die or disappear in the worst case scenario. The seminal paper on the behaviour of ecological systems (Holling, 1973) not only deals with their stability (the maintenance of a predictable world) but also with resilience (the need for persistence, the qualitative capacity to absorb and accommodate unexpected future events). In psychiatry/psychology, resilience refers to adaptation within the context of significant adversity; the positive adaptation of an individual is studied after exposure to a significant threat (Garmezy, 1991). In light of the resilience theory, the city as an urban system copes with exogenous disturbances.

In the beginning, research on city resilience focused on the bounce back from a crisis to the previous state or path (exact meaning of the Latin term resilio). However, the speed of recovery and the return to equilibrium are more typical for physical and engineering sciences and such a meaning refers to engineering resilience, as the time needed to return to a global equilibrium following a disturbance (Pimm, 1984). For ecosystems, including cities, another ecological definition of resilience should be applied (Holling, 1973). This has been described as the ability/capacity of a city to absorb disturbance while maintaining its functions, structure, identity and feedback (Lu and Stead, 2013; Walker and Salt, 2006). This definition can be taken forward another step where adaptive resilience considers positive structural and qualitative change, replacing ‘bounce back’ by ‘bounce forward’ (Folke, 2006; Simmie and Martin, 2010). Resilience is in that way shifted to evolutionary resilience and the new aspect of the

reasoning is transformation. However, this creates a serious ambiguity in the meaning of resilience, comprising both of "change" and "resistance to change" (Olsson, Galaz and Boonstra, 2014).

In the field of urban design, business and disaster management, another approach to resilience is advocated, which highlights readiness. This is referred to as anticipatory adaptability. The infrastructure designer should always take into account the future growth of a city, in order to add to the design the anticipatory adaptability to the risk of disasters and disorders. A disaster resilient city is able to reduce future hazards and its susceptibility to them. However, these functioning mechanisms and structures are predominantly built within the meaning of engineering resilience, as preparedness for prevention and adequate responses and recovery to expected or unexpected disasters and shocks (Wamsler, Brink and Rivera, 2013).

An impressive range of approaches to resilience shows its immense complexity and multi-disciplinarity. Therefore, numerous possible definitions and explanations of resilience exist. The object of study can be highly dissimilar (material, individuals, cities, ecological systems, etc.) as well as the field of study (material science, psychology, social ecology, economics, etc.), using object/field specific definitions of resilience. Thus, only a rather broad and flexible definition can serve as a denominator to very different meanings justifying particular interests and goals. Indeed, perhaps the goal should not be to unify all the approaches and to create a single theory - pluralism is an alternative, if no unified theories are available to explain a phenomenon (Olsson, et al., 2015). The following table (Tab. 1) provides a classification of both original and novel approaches. It also highlights economic resilience which has been discussed intensively due to the financial crisis 2007-2008 (Briguglio, 2009; Hassink, 2010; Lagravinese, 2015; Martin and Sunley, 2015; Modica and Reggiani, 2015).

Table 1 – Resilience types, objects and fields of study

Definition/ Type	Object and main fields of use	Sources
Engineering resilience	**Object:** material, physical system, network, economy. **Fields:** physics, material science, engineering (elastic range in which a system can be perturbed or deformed without losing the ability to return to its original form), computer science (network resilience), psychology, medicine (bounce back from adversity), international relations (security and critical infrastructure). **Economic resilience** (to recover from the shock).	Pimm, 1984; Folke, 2006; Walker, et al., 2006; Briguglio, 2009; Simmie and Martin, 2010.
Ecological resilience	**Object**: individuals, families, communities, socio-ecological systems, ecosystems, cities. **Fields:** ecology, environmental sciences, biology, social ecology (the level of disturbance that an ecosystem can absorb without crossing a threshold to	Holling, 1973; Gunderson and Holling, 2002; Martin, 2012; Modica and Reggiani, 2015.

Definition/ Type	Object and main fields of use	Sources
	a different ecosystem structure or state), psychology (positive adaptation). **Economic resilience** (shock has the power to change economic structures, and the return to pre-shock state or path is impossible – hysteresis).	
Adaptive or evolutionary resilience	**Object:** individuals, societal systems, cities. **Fields:** psychological sciences, organisational theory; capacity to undergo a successful change in structures, functions and behaviour. **Economic resilience** (shocks as 'gales' of creative destruction and 'competitive selection). Links to evolutionary economics and complex adaptive systems theory (modularity and redundancy).	Luthar, Cicchetti and Becker, 2000; Pelling, 2011; Davoudi, et al., 2012; Martin and Sunley, 2015.
Anticipatory adaptability	**Object:** individuals, firms, societal systems, cities. **Fields:** urban design, business studies, disaster management. **Economic resilience:** (to prevent the impacts by creating resilient economic structure).	Hamel and Välikangas, 2003; Norris, et al., 2008; Martin and Sunley, 2015; Mykhnenko, 2016.

The classification of the rather different views on resilience does not provide a basis for formulating a unified approach to measuring, assessing and promoting resilience as a key setting in strategic decision-making. This makes it all the more important to raise questions to clarify the relationship between resilience, sustainability and smartness and to interconnect the rich academic discussion with the parallel practice of policy-making.

3 RESEARCH QUESTIONS AND METHODS

The city of resilience, the resilient city or urban resilience are evolving constructs which need to be examined in the light of different fields of research (engineering, ecological, adaptive systems, urban planning, risk management, etc.) At the same time, it makes sense to find the position of resilience in relation to smart and sustainable city strategies. Hence, a literature-based work comparing definitions, principles, dimensions and approaches is firstly needed with the aim of defining reasonable research questions:

- What is the difference between sustainability and resilience?
- Are smart cities also resilient? What is the difference between smart, resilient and sustainable cities?
- Which definition of the city of resilience is the most suitable and in accordance with the methods of assessment and operationalization?
- How can the adaptive planning framework be described?

The literature research has identified the most influential studies and is used to compare the meaning of the concept across different disciplines. This serves as a basis for exploratory comparative analysis of the theory with the methods of assessment of a city's resilience (Resilient cities: a Grosvenor research report, and 100 resilient cities: Rockefeller Foundation). A shorter comparative analysis is also used to find and explain the similarities and differences between the theoretical basis, assessment methods and variables and practical experience. This makes it possible to foster a debate on the inconsistencies in the general resilience framework and to provide grounds for advocating co-ordinated and integrated approaches to planning and decision-making.

4 EVOLUTION OF ENVIRONMENTAL CONCEPTS OF SOCIO-ECOLOGICAL SYSTEMS

As with all new buzzwords, there is the natural question of which issue is being addressed or whether it is merely old content explained with different language to impress the audience. The concept of resilience is imported to urban theory from other fields such as ecology, physics and psychology. Yet, its meaning and application differs due to the object of study – the city as a complex societal system – being rather different. A mechanical application of the concept is hardly possible which subsequently generates a discussion on its proper meaning.

Metaphorically said – is resilience only a new word for the depleted term of sustainability? Before resilience, sustainability was the most related environmental mantra which was massively used. Over the years, efforts have moved from the first static approaches of environment protection to more systemic sustainability planning and more recently to resilience which also reflects dynamics. As inspired by Stumpp (2013) and Folke (2006), the development of the notions is explained in Tab. 2, differentiating roots and methodological insights:

Table 2 – Evolution of environmental concepts of socio-ecological systems

Local Environment protection (1890 -)	**Sustainability (1970 -)**	**Resilience (1990 -)**
Roots: response to smoke pollution during the Industrial Revolution.	**Roots:** energy crises 1973 and 1979, recognition of the dependence on non-renewable resources	**Roots:** disaster risk management and climate change
Insight: static	**Insight:** linear or circular	**Insight:** dynamic
Approach: protection measures to reduce the effects of human activity on the natural environment.	**Approach:** the growth of long-term consumption is **systemic, linear** (endurance of systems and processes not depleting natural resources) or **circular** (producing no waste and pollution).	**Approach:** attributes of complex adaptive system theory, panarchy as a hierarchical system with multiple interrelated self-organising elements, transformability as a capacity to create fundamentally new development trajectories.

Both sustainability and resilience are extensively used although unfortunately both have numerous interpretations and are hardly measurable. Resilience thinking is clearly close to the sustainability paradigm, pointing out the need for persistence, focusing on maintaining prosperous socio-ecological systems and sharing the system thinking. However, there is a substantial difference between the two terms. Sustainability is understood as a set of protection goals to maintain different forms of capital for future generations. In other words, to preserve and protect. It often fails at the process level if there is a need to adapt to current and future shocks or challenges. The complex dynamics also require adaptation and a set of approaches and procedures to cope with unpredictable change. The resilience of a city can therefore be understood as a single concept as well as an extension of the previous approach of sustainable urban development.

A rather different is the result of comparisons with the expansion of the smart city initiatives across the world, following the "urban labelling" phenomenon (Hollands, 2008). A well-chosen integrative metaphor can become an effective tool for the creation and implementation of innovative ideas (Pickett, Cadenasso and Grove, 2004). However, a shift from the original meaning of smart city (Caragliu, Del Bo and Nijkamp, 2011) as a strategic device for integrating modern urban production factors to the city branding field has made the concept fuzzier.

Miscellaneous assessment tools of urban sustainability, resilience and smartness focus on different domains, which can be common or different. The variables assigned to domains vary as well and their use is limited to the availability of data. To some extent, the composite indices in use address the same or similar issues. A distinctive aspect of smart cities is the use of modern technologies and the main fields of interest are energy, transport and ICT. Conversely, a comparison of the most important assessment systems confirms a greater emphasis of sustainability and resilience framework on the natural and built environment, water and waste management and energy (Ahvenniemi, et al., 2017). The assessment frameworks are not complementary, but a consensus exists only in the importance of the domain of well-being, health and safety. Smart assessment indicators cover, to a much larger extent, the economic and social aspects of a city.

5 EVALUATION AND PLANNING

The conceptual problem of resilience is discussed in a number of articles resulting in ambiguous conclusions and opinions all looking for the best possible definitions (Batty, 2008; Godschalk, 2003; Meerow, Newell and Stults, 2016; Newman, et al., 2009; Papa, et al., 2015; Pendall, et al., 2010). On the other hand, decision makers and practitioners have already started to design and implement resilient strategies in the context of local hazards and adaptation to climate change in light of their previous negative experience with earthquakes,

floods, tsunamis and drought (Rogers, et al., 2012). Successful attempts to evaluate city resilience have been undertaken in order to identify reasonable benchmarks and variables for cities and to share knowledge of best practices globally. Several influential civil society organisations have already declared their involvement in a resilience movement and started to finance and measure city resilience (Resilient cities: a Grosvenor research report and 100 resilient cities: Rockefeller Foundation). It is of interest to study how their approach relates to resilience theory definitions (Tab. 3).

Table 3 – Basis, qualities, approach and visions in city resilience evaluation

Organisation	Definition	Dimensions – qualities of resilience systems	Approach and vision
Grosvenor	**Engineering resilience:** the ability of a city to avoid or bounce back from an adverse event. Focus on vulnerability and adaptive capacity.	**Resilient Cities Research Report:** **Vulnerability**: climate, environment, resource, infrastructure, community; **Adaptive capacity:** governance, institutions, technical and learning, planning systems, funding structures.	**Model -** two indices of vulnerability and adaptive capacity; **Vision:** long-term stability and prosperity of cities, real estate business; **Novel aspects:** rates of population growth and impact on property pricing.
Rockefeller Foundation	**Engineering and ecological resilience combination:** the ability to recover quickly and effectively, ability to withstand shocks while still maintaining its essential functions.	**City Resilience Index** 1. **Reflective** 2. **Robust** 3. **Redundant** 4. **Flexible** 5. **Resourceful** 6. **Inclusive** 7. **Integrated**	**Model** – composite index - based on the analysis of the factors of resilience from many sources – literature, case studies, and cities. Joint learning of networked resilient cities; **Vision**: holistic cross-sectoral city; **Novel aspects:** urban planning and strategy, leadership and coordination.

Planning of resilience can be considered as improving the situation in the dimensions described in both indices. There are several respected models, e.g. Resilience Inference Measurement (Dept. of Environmental Sciences, Louisiana State University) (Fig. 1) which serves as a basis for the implementation of adaptive planning.

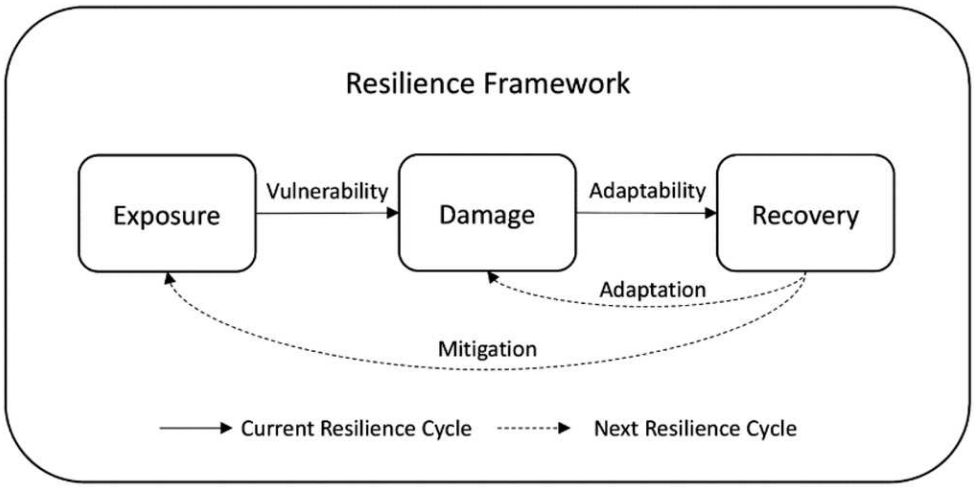

Figure 1 – Resilience Inference Measurement

However, there is still a gap between the theoretical ideas and what is done in cities. Recently, a conceptual framework for the resilient city and resilient community has been published (Jabareen, 2013). This attempts to fill in the gap between the theory and practice of city resilience literature whilst taking into account both the complexity and uncertainty.

6 CONCLUSION

The article has raised some open-ended questions in relation to resilience. The differentiation between the concepts of resilience and sustainability is only formulated from the viewpoint of linearity and dynamics. A more detailed distinction between the two notions is far from reaching the state of boundaries between two compact theories. However, there is a significant difference between resilience and sustainability on one side and smartness on the other. The framework of a smart city in the assessment models ensures greater concentration on the economic and social aspects, which highlights resilience as dealing more with the natural and built environment instead.

The efforts to build a single theory of resilience remain frozen in the current stage of development also due to the differences between the disciplines. Academic research does not yet provide appropriate methods of assessment and operationalization. Nevertheless, the approach is already anchored in urban planning based on past experience with the adverse impacts of climate change, hurricanes, terrorist attacks, earthquakes, epidemics and economic crises.

Peter Hall has highlighted the culture of improvement found in the heart of a city's culture as "the desire to experiment and innovate" explaining why some cities adapt more rapidly than others. The ability to recognise and evaluate culture and informal institutions remains one of the challenges also for cities.

The initiatives of civil society organisations, city planners and many resilient cities have moved forward the concept of resilience instead of sustainability. However, this is certainly not a minor task and the cost of resilience is high. Cities are networked, complex urban systems comprising of dynamic relationships between physical and social networks. As such, urban systems represent accumulation and congestion of physical, ecological, technical and social components. This implies a challenge for urban resilience planning; how to deal with the complexity, how to implement complexity theory models considering self-organisation as a principle as well as how to intensify the collaboration of experts from all fields and to enforce an integrated approach among, so far, only formally cooperating parties.

The adaptive planning framework can be described, operationalized and implemented by the decision makers and planners even without achieving a consensus in the theoretical and empirical literature. Since Hurricane Katrina in 2005 which devastated Gulf Coast cities and the Indian Ocean tsunami of 2004, efforts to identify hazards and to assess exposure and vulnerability have brought many positive examples of effective policy strategies, subsequently building the resilience of cities.

Nonetheless, a rather open research space still exists in the study of the factors of economic resilience (structural diversity, modularity, redundancy, self-organization, criticality) as well as what kind of economic structure can positively influence the city exposure and vulnerability to numerous types of future shocks (Martin and Sunley, 2015).

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Geocraft as a Means to Support the Development of Smart Cities, Getting the People of the Place Involved - Youth Included -

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ABSTRACT

Purpose: In this paper we present Geocraft, a Geo-ICT framework meant to provide the information needed to support the development of smart cities in an accessible and user-friendly way. We explored whether Geocraft could be an effective way to get the people of the place, especially youth, involved in geospatial issues.

Methodology/Approach: Geocraft is a virtual environment in which we import real geospatial data into the gaming environment of the popular computer game Minecraft[1]. In Geocraft, we can run real-time impact models to virtually simulate ánd visualise future developments and their implications, providing the user with relevant information during design processes. Geocraft is linked to Spatial Data Infrastructures (SDIs); data generated or added in Geocraft can upgrade existing databases and SDIs. In four use cases, Geocraft is used by children and high school students to address spatial planning challenges with the help of Geocraft.

Findings: Geocraft has an appropriate level of abstraction to effectively represent the real world. The use of Geocraft enhances insight in geospatial relations and can raise awareness and insights in a number of geospatial issues. Geocraft can be used to collect the ideas of citizens, in this case children, and engage them in urban planning issues to raise solutions that can reckon on public support. Geocraft can engage thousands of children working on the same geospatial project in the same online Geocraft world. Spatial scenarios designed in Geocraft can be effectively translated into a feasible spatial design and be

[1] Minecraft® is a trademark of Mojang. Mojang is not involved in this research, nor sponsoring it.

imported to the digital environment of professional designers. Moreover, Geocraft turned out to be a valuable educational tool to develop typical 21th century skills: communicating, finding and evaluating information, creating and innovating, collaborating and problem solving.

We conclude that as an easy to use smart visualisation tool, in which everybody can build future scenarios, Geocraft can be used to get the people of the place involved with geospatial issues.

Research Limitation/implication: We present *qualitative* research results. In the next step, we will investigate how statistically significant the improvements in learning skills are.

Originality/Value of paper: This paper presents a new digital environment facilitating citizen participation and educational processes. We use actual spatial data to transform physical reality into a parallel and playable virtual version of that reality. Herein we can simulate spatial processes and support collaboration. By doing so, we can provide unique visualizations of complex processes, raising insights across the borders of disciplines in an user-friendly way.

Category: Research paper

Keywords: citizen participation; spatial planning; smart cities; Minecraft; citizen science

1 INTRODUCTION - WHY RAISING THE REAL WORLD IN MINECRAFT?

In the Manifesto for Cities (World Urban Campaign partners, 2012), the UN declared that the battle for a more sustainable future will be won or lost in cities. In the next few decades, nearly three-quarters of world's population will live in cities. More than 60 percent of the built environment needed to accommodate these new urban dwellers has yet to be built. How we plan, build, and manage our cities now will determine the outcome of our efforts to achieve a sustainable and harmonious development tomorrow.

1.1 Smart cities and smart governance

A "smart city" is a city well performing in 6 characteristics. These characteristics are built on the combination of a smart economy, smart mobility, a smart environment, smart people, smart living and smart governance (Lazaroiu and Roscia, 2012). *Smart Governance* is about using the latest technology to facilitate and support better planning and decision making. It is about improving democratic processes and transforming the ways that public services are delivered (Kourtit, Nijkamp and Scholten, 2015). It cherishes, taps and utilizes the full potential of the collected experience, knowledge, talents and ideas of citizens who should be enabled to interact and work on creating enhanced cities and a better society.

Modern ICT technology offers local initiatives and urban policies many opportunities to cooperate and to take decisions collaboratively. In 2014, we (Lee, Dias and Scholten, 2014) have explored the notion of 'Geodesign thinking' whereby spatial technologies such as integrated 3D modelling, network analysis, spatial iteration modelling, visualisation tools and public participation are used to answer 'what if' questions to design alternatives on all kind of aspects (Steinitz, 2012). What we need as the next step in our exploration is a synergetic multidisciplinary approach, exchanging data and insights across the limits of disciplines. Moreover, we need all stakeholders to get involved, especially the people of the place.

The decisive role of the people of the place is emphasized a.o. by the UN-Habitat publication 'The City we Need' (2016). Surely the people of the place know the place the best; they have the highly valuable expertise and unique insights into local situations and possibilities. The daily urban activities of citizens contribute to the sustainable development of the city. Moreover, their engagement and participation are crucial for any successful plan (World Urban Campaign partners, 2016).

As we have entered the era of the Internet of Things, a growing wealth of sensor data has become available and interconnected (Van der Zee and Scholten, 2014). Digital technology evolves at an incredible speed. We think the main challenge lies in offering the available data - and the insights from data analysis - in a way end users can really work on building up smart cities in general and sustaining smart governance in particular.

So the question is: how to get the people of the place involved? We decided to address the children. Children are the adults of the future - the future inhabitants of the public space we design today. Moreover: through the children, the parents can be reached. By playing computer games, children train themselves extensively in geospatial skills. Minecraft is the second most sold video game (Tetris, released in 1984, still holds the first place). Minecraft has been sold worldwide more than 100 million times (Wikipedia, 2016). In The Netherlands, it is the most popular game among children in the age group 8 - 14 years (TwinQ, 2015). So we decided to import the real world in Minecraft. This georeferenced playable virtual version of the real world we call *Geocraft*[2].

1.2 Trends in spatial planning and citizen science

To be able to understand the usefulness of Geocraft in the pursuit of sustainable and healthy cities, first of all we need to understand current planning systems and current policy themes. From various points of view, we stand at the threshold of a new era with respect to the development and governance of cities.

[2] Geocraft® is a trademark of Geodan and GeoFort. It is not an official Minecraft-product; Geocraft is not certified by or associated with Mojang.

Citizen initiatives in spatial development are on the rise (Boonstra, 2015). After decennia of top-down ruling and dominance of big players in the market, local initiatives blossom, shifting governance towards a more bottom-up approach. The advantages of large business estates and top-down planning systems are no longer valid. At the same time, lots of cities face the limits of expansion; for example in The Netherlands, we foster the limited green areas left. The focus has shifted towards intensifying, improving and transforming existing urban areas. This means that values of people of the place become more important.

A distinction is made between citizen involvement through participatory planning and spontaneous civic initiatives, which are hard to fit in with formal planning procedures (Boonstra, 2015). Both forms of activities of people of the place are in line with the ideas of active citizenship. Spatial planning strategies must bridge the gap between these informal processes and the formal framework of the planning system. Top down planning strategies are converted into more bottom up planning strategies.

Amsterdam, like many other cities, has created an informal platform to facilitate different types of initiatives[3]. Civic enterprises are stimulated in many different ways. Actual themes are circular economy, sustainable energy, healthy living and cycling, local care systems, urban food, multi-functionality of public space and reliability of sustainable mobility and transport networks. Citizen initiatives can be undertaken by residents, entrepreneurs, artists, etc., in loose and informal structures. For both participatory planning and citizen initiatives, Geocraft can be of added value at low costs. This requires:

- Access to open SDIs (e.g. National Data Warehouse PDOK (Bregt, et al., 2005), Datalab of Amsterdam (De Kleijn, et al., 2014));
- Data collection tools (using social media and sensing technology);
- Spatial Analysis tools for describing and analysing the impact of these initiatives and scenario's developed by local communities;
- Tools which translate citizen initiatives into more formal planning processes;
- Instruments for formal assessment procedures, like scenario design modelling instruments (e.g. LUMOS, which is developed under the coordination of the Dutch Environmental Assessment Agency, see Stillwell and Scholten, 2001; Koomen, Stilwell and Bakema, 2007), strategic environmental assessments, societal cost-benefit analyses and tools to calculate business cases for spatial investments.

[3] see a.o. https://dezwijger.nl/.

1.3 Scheme of this paper

With Geocraft, we created a Geo-ICT framework based on the principle of Spatial Data Infrastructures (SDIs) to collect, visualise, analyse, design and share spatial scenarios in order to support smart governance. In section 2, Materials and Method, we describe how we did this and what is needed to maintain such a virtual environment.

Through internet technology, we can invite all citizens to join in, share their ideas and contribute to the design of future spatial scenarios. To investigate whether this is feasible, we started with four use cases wherein children address real world spatial planning challenges. These use cases are described in section 3. In section 4 we discuss the results. Next, we mention the power of serious gaming in Geocraft in part 5. We finish with our conclusions in section 6.

2 MATERIALS AND METHOD

In the next paragraphs, we describe what techniques we developed and used to perform the research we present in this paper. The technique and software of Geocraft are developed by Geodan[4], the use cases are planned and carried out by scientific researchers of the SPINlab[5] and the staff members of the GeoFort[6].

2.1 Geocraft – the real world in Minecraft

To facilitate children to play, work and design in the-real-world-in-Minecraft, we first had to import real geospatial data in Minecraft. A Minecraft world is a voxel based 3D environment made up of blocks of 1 m^3. Every block represents a certain Minecraft material, e.g. wool, brickstone and water. Some of these materials can be detailed more e.g. to define colour or type of bricks. A group of 16x16x16 of these blocks is called a chunk. The chunks of a 2D area of 512x512 blocks are stored in a region file. A Minecraft world consists of one or more of these region files depending on the size of the world.

In Geocraft, we can create worlds ranging in size from a neighborhood to the complete Netherlands (comprising over 1,000 billion blocks). Basically, all 2D and 3D geospatial data can be visualised. Different datasets of the same location can be added up, resulting in a more and more enriched view. This is illustrated by subsequent views on Bourtange, a fortified city at the north-eastern border of The Netherlands, see Fig. 1.

Potentially, all geospatial data of a specific geographical area can be added, including real-time sensor information from the Internet of Things. We can visualise data from different sources superimposed on each other. Not only

[4] Since 1985, Geodan is one of the leading Geo-ICT companies in Europe. http://www.geodan.com.
[5] Spatial Information Laboratory, Faculty of Economics, Vrije Universiteit Amsterdam, The Netherlands. http://spinlab.vu.nl/.
[6] GeoFort is an educational attraction in the field of cartography and navigation. http://www.geofort.nl.

concrete structures can be depicted, but also features like the amount of air pollution, traffic capacity, noise disturbance, energy labels, energy use and supply, flood risk, etc. The results of impact models can be superimposed on topographical data, 2D data can be combined with 3D data, etc. This results in an inventive representation of the city, visualizing the specific aspects of the city you want to analyse or display (see Fig. 2).

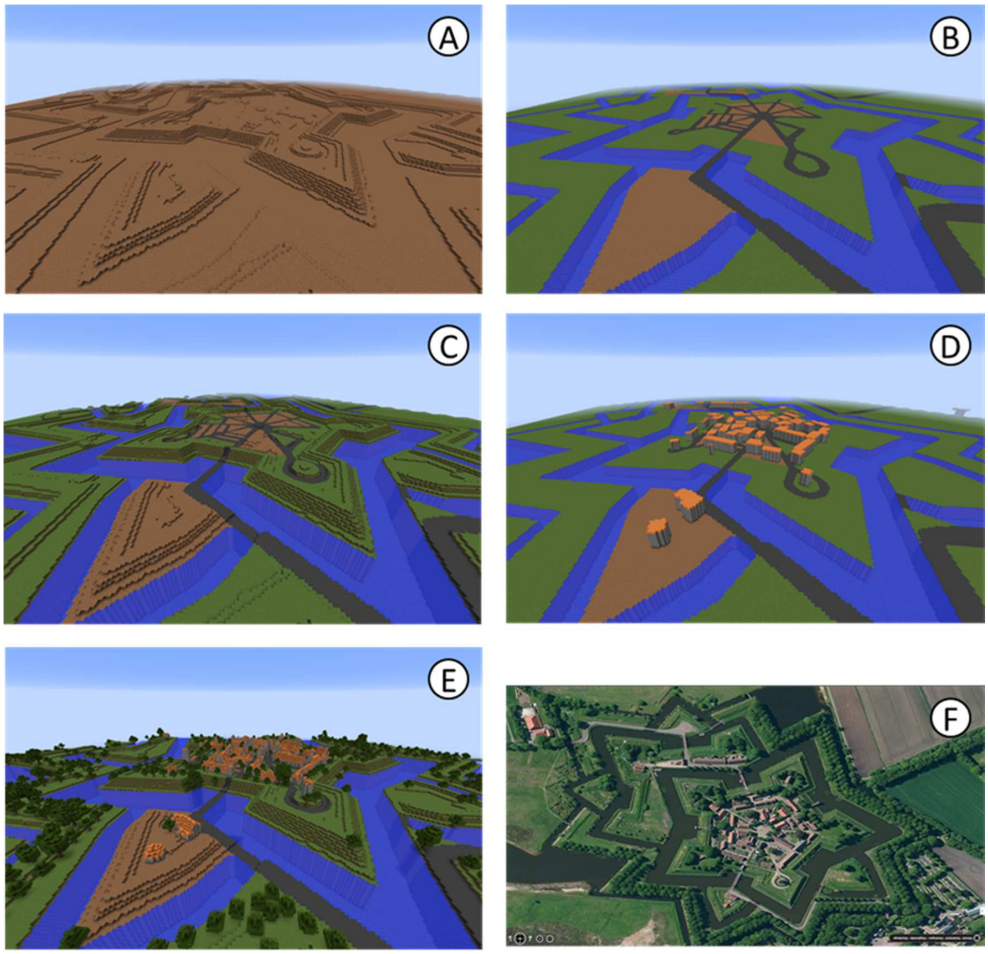
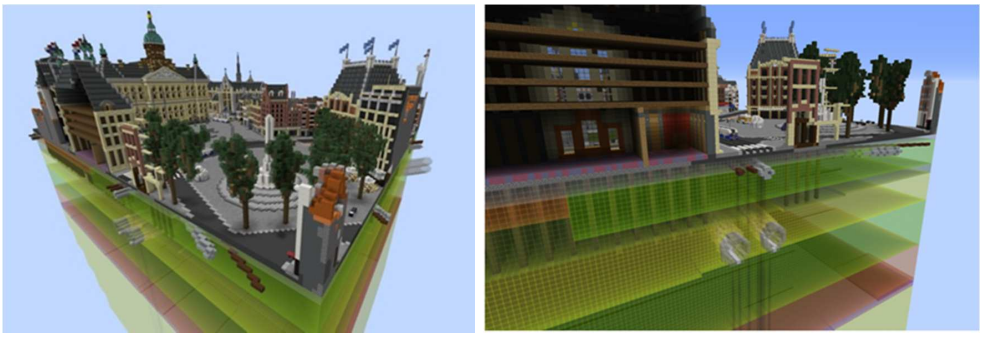


Figure 1 – Subsequent views of Bourtange, The Netherland; A: Surface Height transformed to Geocraf;. B: Topographic data transformed to Geocraft; C: Surface height and topographical data combined; D: Topographical data and 2D building data combined;the building height is averaged; E: 2D data (tree location, building footprints, topographical data) combined with 3D data (for surface height and buildings); F: Aerial photograph

2.2 SDI connected – possibility to provide real-time information during design processes and to export data to other SDIs

Geocraft is connected to spatial data infrastructures (SDIs). Lots of organisations and governments use SDIs; in The Netherlands, there is a national spatial data infrastructure (Grus, et al., 2009), which is maintained by the Dutch government. Many local governments developed their own SDI on top of that. For example *Datalab Amsterdam* maintains many open datasets and explores new applications for data which is collected by different stakeholders in this city. Geocraft can connect to these existing data and visualise them in the virtual world of Minecraft. Potentially, all geospatial data of a specific geographical area can be added to Geocraft, forming a 3D database of that area capable of visualising data from different sources superimposed on each other. Different geospatial data can be visualised by choice.



A *B*

Figure 2 – Dam Square in Geocraft (Amsterdam, The Netherlands), including the underlying stratigraphy; Amsterdam is build on Holocene and Pleistocene sediments, basically alternating layers of sand (yellow), clay (green) and peat (brown); B shows a detail of A, revealing the piles whereon the buildings are build to be supported by the so-called first sand layer; In addition, this view shows the sewerage system, service pipes and the underground tubes; All cubes in Geocraft measure 1 to 1 meter

Geocraft is a truly interactive smart world. You can integrate your own data, for example, models and plug-ins in Geocraft that can provide instant information during design processes. For example, we can use the *wind turbine planner* (Dias, 2016) developed by Geodan (Rafiee, et al., submitted). When placing a specific type of wind turbine in the virtual environment of Geocraft, the wind turbine planner provides instantly visualised information about the area suffering of noise disturbance, indicated in different noise levels depending on the distance to the wind turbine and the surroundings (see Fig. 3). You see exactly which locations in the area are affected in what extend. At the same time, you can get information on other relevant aspects. For example the costs of this specific kind of wind turbine, whether this wind turbine is suited for this specific location (e.g. current legislation), how much energy this wind turbine is expected to generate,

as well as the energy demand of the region. This way, impact analyses can provide results and relevant information during design processes as we illustrate in use case 3: *Transition towards sustainable energy in Zaandam* (see section 3.2.2).

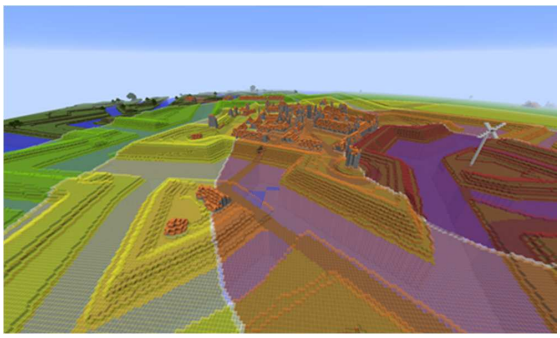


Figure 3 – The area suffering of noise disturbance after placing a specific kind of wind turbine; The purple area is most affected. Via pink and yellow zones the nuisance decreases towards the green area (Bourtange, NL)

Data generated in Geocraft can be exported to other SDI based applications. That can offer interesting opportunities: the intuitive user interface of Minecraft enables non-experienced designers to design spatial scenarios that subsequently can be exported to more specialized 3D virtual environments like those of professional designers (see use case *Designing the public space of Zeeburgereiland*, section 3.2.1). In addition, the user of Geocraft can select a specific type of data that revealed to be of significant relevance to a certain process and export these to another more specialized SDI based environment. For example to run more sophisticated models and more detailed impact analyses than the ones at the moment available in Geocraft.

2.3 The creation of a Geocraft world

In table 1, we provide an overview of the input data we used so far. We use a spatial-occupancy enumeration to convert this data to data that can be imported into the virtual environment of the popular Minecraft game. Spatial-occupancy enumeration is a special case of cell decomposition in which solids (in this case buildings and other spatial elements) are decomposed into identical cells arranged in a fixed, regular grid. These cells are often called voxels (volume elements), in analogy to pixels (Foley, et al., 1990).

The regular grid from Geocraft is north-south east-west oriented. This means that topographical elements (for example buildings) with an oblique orientation towards this grid (e.g. SW-NE) appear with 'jagged vertical surfaces' (see Fig. 4), whereas topographical elements with more or less north-south or east-west orientations appear flat, more similar to the way they look like in reality.

Table 1 – Examples of geospatial data that can be imported in Geocraft

Ground level data	Nation-wide point clouds (like AHN2 in The Netherlands)	
	DEM (Digital Elevation Model)	
2D topographic data	Distribution of land versus water, infrastructural elements like roads, houses, etc.	
	Landscape elements like trees or houses (like BAG data for buildings in The Netherlands)	
3D data	3D data models like Collada, BIM	
	Elements built by children, citizens or professional designers.	
	3D subsurface data	A voxel representation of subsurface data (like Geotop in The Netherlands)
		Underground infrastructure; e.g. tunnel tubes, piles, pipelines, wires, etc.
2D or 3D results from impact models	For example the area suffering noise disturbance after placing a wind turbine, or the amount of energy saved after furnishing houses with double-glass.	

Figure 4 – As a consequence of its SW-NE orientation, the surfaces of the buildings and the lines on the above street look jagged; the reality is represented well enough to be recognized by the people of the place (Dambrak, Amsterdam, NL)

Subsequently, we generate tiles according to the Minecraft scheme and map these raster files to the Geocraft region tiles. The first step, creating all needed raster files, only takes a few days on a single computer, even for a Geocraft world comprising the whole of The Netherlands. For the second step, the generation of the Geocraft region tiles, much more computer power is needed. For example: on a 4 core CPU machine, the creation of all region tiles of The Netherlands in Geocraft would require more than 100 days. However, this part of the process is suitable for parallel computing.

To create The Netherlands in Geocraft, per region file a distinctive set of 4 input raster files (building height, surface height, trees and land use) is used. This allows the processes to be executed independently of each other. In a cloud based parallel computing environment, the conversion of all raster files into Geocraft region files can be executed in less than a day depending on the amount of cores allocated to the process. We deployed this process in the Microsoft Azure Batch platform, see Fig. 5. We describe the procedures in more detail in our paper "The Netherlands in Minecraft – Methodology and usage" (forthcoming).

The Netherlands are approx. 300x200 km in size. On a scale of 1 meter is 1 block this results in a Geocraft world of approx. 300,000x200,000 blocks in size or 60 billion square blocks. As every Minecraft world is divided into region files of 512x512 blocks, The Netherlands will consist of 586x391 region files or 229.126 Geocraft region files. Each Geocraft region file is approx. 4 MB in size. The Netherlands in Geocraft will therefore be approx. 900 GB.

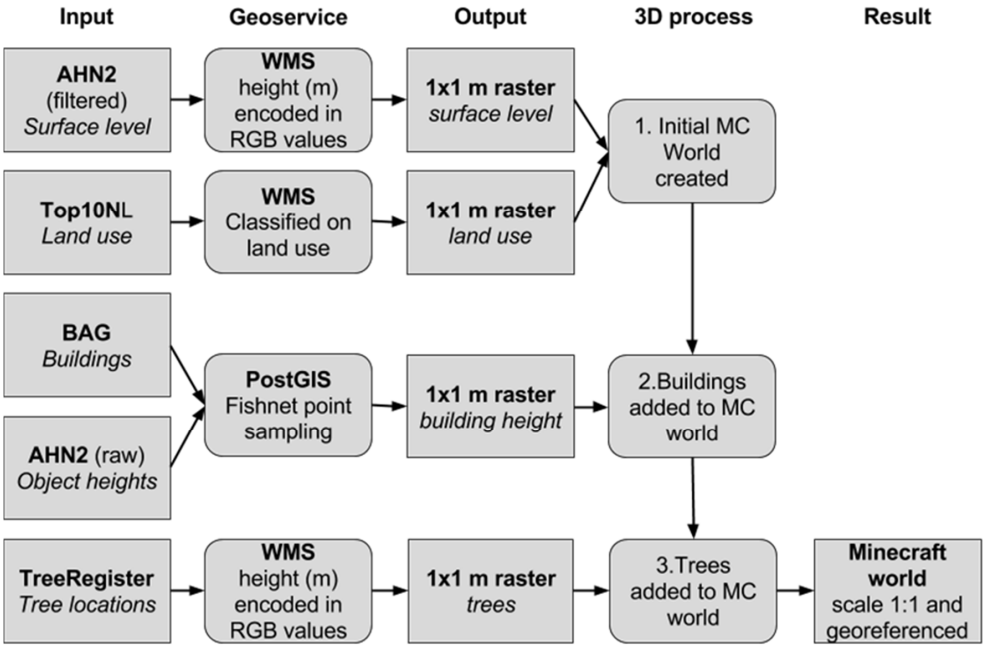


Figure 5 – From geospatial data to Geocraft world

The standard Minecraft server software offers little possibilities for managing the Minecraft worlds. Therefore, almost all Minecraft servers use modded Minecraft server software called Spigot. Spigot allows additional functionality and management options through plug-ins. Geodan developed plug-ins to add specific functionalities to Geocraft. We focussed on the connection with existing (spatial) data and services. An example is geocoding service used in GeoCraftNL. It allows people to teleport to a given address instead of entering coordinates. The geocoding plug-in takes the entered address and uses a web service from the GeodanMaps cloud environment to return the location of the

address. Another plug-in calculates the energy efficiency of projects built in Geocraft and compares these to the actual local energy consumption. Another plug-in tracks and traces people real-time and shows their location in Minecraft.

2.4 Hosting a Geocraft world

Using a local copy of a Geocraft world, no hosting is needed. The single-player mode of Minecraft is dependent on data stored locally on your computer. This can be useful, for example when you add a 3D model and want to check whether it is loaded correctly before making the world available to other users. As soon as you want to share a Geocraft world with others, you use the Minecraft multi-player mode and have to connect to the Minecraft server where this specific Geocraft world is hosted.

An example of a Minecraft server is the GeoCraftNL server, where people smarten up the basic contour lines of The-Netherlands-in-Minecraft by adding more detail and colour to mirror the real world, as described in paragraph 2.5. This server can be connected to through the address geocraft.nl. In principle, there is no limit to the amount of users you can give access to a Geocraft world, though there is a limit on the number of simultaneous users depending on the server configuration.

Another example of a Minecraft server is the one offered by the SPINlab of the Vrije Universiteit of Amsterdam to provide secondary schools (VWO level) with serious Geocraft games, addressing a variety of geospatial issues (see use cases). Setting up a server involves installing the Minecraft server software. The software can either be deployed on own servers or be hosted by a provider.

3 USE CASES

After importing the real world in Minecraft, we followed two pathways to introduce Geocraft to the Dutch children. Our partner *GeoFort* organized a nation-wide contest for Dutch children (see section 3.1), in an open Geocraft environment, that was accessible via the internet. Next, we offered Geocraft to high schools in a closed computer environment to enhance their education in spatial and geographical awareness[7]. We defined specific spatial issues and started 3 different high school projects wherein high school students address real world spatial planning challenges:

[7] The Vrije Universiteit Amsterdam (VUA) is one of the first universities that took a structural approach to determine how spatial methods and skills for informed spatial reasoning can be provided in the best possible way (since 1990, the VUA has a chair in Spatial Information Science). The VUA has a record in providing innovative education support to high schools in order to enhance the spatial insight of high school students and to raise awareness and insights in geospatial issues. Since 2004, we are involved with EduGIS - the SDI for educational purposes offering a.o. over 500 maps of The Netherlands, Europe and the world. Yearly, over 75,000 children make use of this platform. As a result, we have a strong liaison with several high schools (Van der Schee and Scholten, 2009).

- Designing the public space of Zeeburgereiland (see section 3.2.1);
- Towards more renewable energy and energy saving in Zaandam (see section 3.2.2);
- Future water management and land use of the Markermeer (see section 3.2.3).

Table 2 – Objectives of the use cases

Use case	Objective
The Netherlands in Minecraft	➢ Test whether the Minecraft level of abstraction allows for a realistic, recognizable representation of the real world. ➢ Test whether Geocraft can support thousands of users via the internet. ➢ Test whether it is possible to generate an organisational infrastructure supporting a Geocraft community that contributes to a common geospatial objective.
Designing the public space of Zeeburgereiland	➢ Test whether non-Minecraft users can intuitively use Geocraft. ➢ Test whether a spatial design created in Geocraft can result in a feasible design for urban development. ➢ Test whether a geospatial scenario build in Geocraft can contribute to citizen participation processes.
Transition towards sustainable energy in Zaandam	➢ Test the added value of Geocraft for education on geospatial issues. ➢ Test whether model generated input in Geocraft during designing raises an understanding in geospatial issues the users are not familiar with beforehand. ➢ Test whether model generated input in Geocraft raises understanding in the multi-criteria analysis. ➢ Test whether Geocraft can be a useful tool to contribute to a multi-stakeholder decision-making process.
Water management and land use Markermeer	➢ Test the added value of Geocraft for education on geospatial issues. ➢ Test the influence on team cooperation. ➢ Test the impact on the quality of the proposed solutions compared to working “the old way”. ➢ Test whether Geocraft users can incorporate insights of experts.

3.1 The Netherlands in Minecraft – thousands of children enhancing the virtual representation of The Netherlands

The educational attraction *GeoFort* organized a nation-wide contest for Dutch children which was announced on the national youth news channel (GeoCraft.NL, 2016a). Every Minecraft player can join the Geocraft.NL server online (GeoCraft.NL, 2016b). Geocraft players can find their way in the Geocraft.NL world by plug-ins made by Geodan and GeoFort: all the larger cities, towns and villages can be ‘warped’ by entering /WARP followed by the name of the place. The children are challenged to make The-Netherlands-in-Minecraft look as realistic as possible. The results were stunning, see Fig. 6 and GeoCraft.NL (2016c).

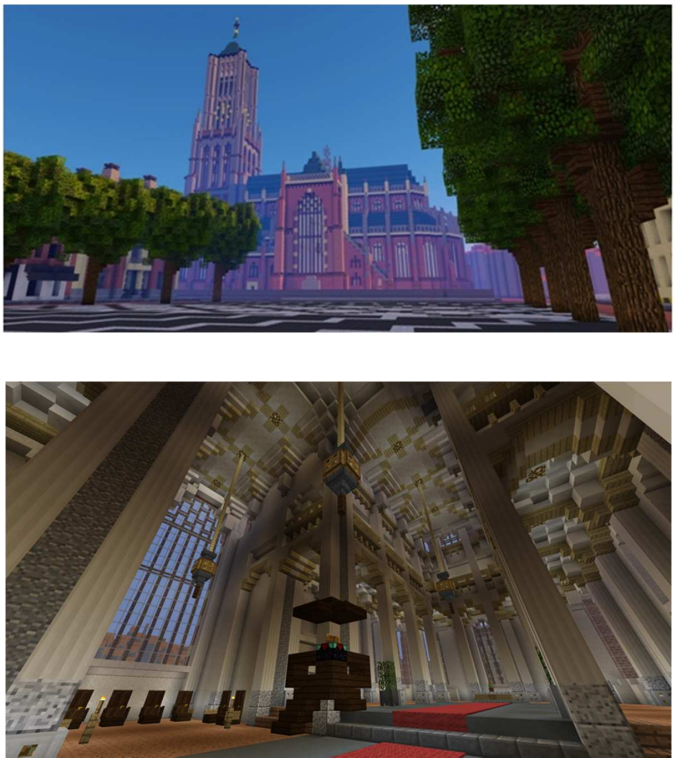


Figure 6 – The Eusebius church in Arnhem (The Netherlands), a marvellous example of Gothic architecture, very well represented in Geocraft

Over 20,000 Minecraft players have been building churches, fortresses, residences, schools, railway stations, hotels, shopping centers, town squares, etcetera.

3.1.1 The dawning of a virtual society

To make The-Netherlands-in-Minecraft look as realistic as possible, the Minecraft players had to turn the grey topographic elements imported from the topographical databases (e.g. buildings, traffic infrastructure, street furniture, etc.) into a realistic impression of the real world, using the Minecraft building blocks material, see Fig. 7. A description of the available tools in Minecraft to develop and create cities can be found in Kearney (2015).

On Geocraft.NL, collaboration and joint projects emerged spontaneously. Children communicate via the chat and initiate collective building projects, for example to finish the Dom Tower in Utrecht. The people of Vreeland joined efforts to add architectonic details to their town. The centre of Amsterdam is being collaboratively build by a group Minecraft players.

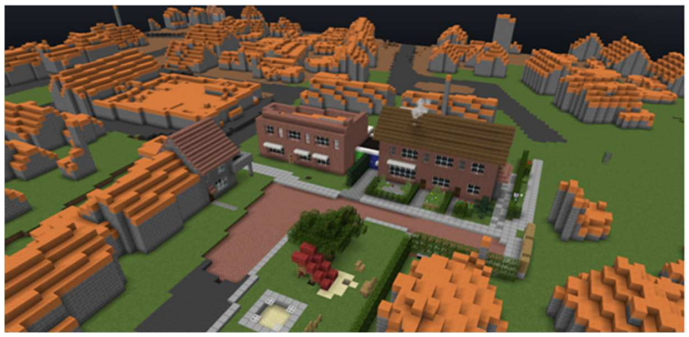


Figure 7 – Typical residential area, The Netherlands. Children enhanced the appearance of their own houses to make them look as realistic as possible (see in the middle of the depicted area); the grey buildings with orange roofs are how the data in Geocraft is offered; these residences are still waiting to get a more realistic appearance

The-Netherlands-in-Minecraft comprises over 1,000 billion blocks; it took some effort to oversee and regulate what the kids were doing. Initially, The-Netherlands-in-Minecraft were more or less immediately destroyed at the day of release. Volcanic flows emerged everywhere and many phallus symbols were raised. As in the real society, this virtual society needs regulations and administrative leadership.

3.1.2 The call for regulations and enforcement

Several measures had to be taken. First of all, The Netherlands had to be reloaded in Geocraft. Secondly, GeoFort developed a plug-in to register all Minecraft players; children who want to build in this Geocraft world have to register themselves as a GeoCitizen. A GeoCadastre and a hierarchic structure were established. The officials of the GeoFort themselves, maintaining and regulating this Geocraft world, have the highest ranks: 'Son of the King'. Adults spontaneously offering technical support and assistance are appointed 'Representatives'. All other officials are Minecraft playing children, who can apply for the job. GeoMayors give GeoCitizens rights to build on a limited area. GeoCommissionars of the King supervise Geomayors and have special building permits.

This hierarchic system worked for some time, but when some children started to berate one another, and others started to destroy buildings, it became clear that a penalty policy was needed. These rules are now clearly communicated to every GeoCitizen. Transgressing the rules, one might be muted, kicked or even banned. The Bijlmer Bajes (the jail of Amsterdam) was equipped to house delinquents spending their ban time.

3.1.3 Crowd sourced in-game management

In a year time, over 20,000 Minecraft players registered as GeoCitizen. GeoFort succeeded in establishing a partly crowded sourced in-game management, made

out of teenagers who successfully applied to the job of GeoMayor or GeoCommissionar. Now these voluntary officials fulfil over 650 positions, familiarizing GeoGuests and newborn GeoCitizens with the rules and possibilities of Geocraft.NL. They answer questions, explane how to do things and serve out building plots to newborn GeoCitizens.

Besides these daily active volunteers, a couple of GeoFort workers deal with the administration and server management of Geocraft.NL on a day to day basis. Occasionally, GeoFort has to upscale its support and maintenance capacity, to deal with the growing numbers of visitors and actors in this virtual society.

3.1.4 An immersive experience by using the Oculus Rift

In 2016, GeoFort organised several Geocraft.NL events, inviting the GeoCitizens to meet in real life. On such occasions, hundreds of Minecraft players game together. On one such occasion, the children could visit Geocraft.NL with the Oculus Rift for an immersive 3D experience. If not seated the children (and adults) tried to walk as if they were in a real city. The immersive experience of the oculus rift gave an immediate understanding of the dimensions. The Minecraft blocks were actually perceived as blocks of 1x1x1 meter and buildings looked as big as in real-life, see Fig. 8.

Figure 8 – Different building styles are well represented (above: Gelderseplein, below: Vissteeg, both in Rotterdam, the Netherlands)

The visitors immediately recognized familiar places like their own neighbourhood, see Fig. 9. The immersion and sense of dimensions improved the

orientation capabilities of the children. They better understood where they were and how to navigate to familiar places like home. Being immersed in Geocraft using the Oculus Rift, the children started to discuss things with each other like they were meeting in real life instead of in a virtual world (normally, children in Geocraft communicate via the in-game chat or chat services like Discord).

The challenge continues: GeoCitizens are invited to take screenshots of the buildings they are most proud of and send these to GeoFort. Weekly, GeoFort selects 'the building of the week'. Every day, The-Netherlands-in-Minecraft resembles reality more and more.

Figure 9 – People recognize immediately their own neighbourhood in Geocraft (Wijnhaven, Rotterdam, the Netherlands)

3.2 High school projects using Geocraft to address specific geospatial issues in a closed computer environment

We live in a three-dimensional world and lots of processes have a 3D component. We propose that these processes can be better studied and understood in a 3D environment. For the high school projects different servers were set up, hosting the study area. Every group worked on one of these servers in its own Geocraft world. The servers were unavailable for external Geocraft players or other groups within the school.

3.2.1 Designing the public space around IJburg high school on Zeeburgereiland

In Amsterdam, a former industrial area at the border of the city, Zeeburgereiland, is being redeveloped to form a lively residential area with space for sports, shopping, education etcetera. Four times a year, meet-ups are being organized to bring together different stakeholders, among which residents, entrepreneurs, and city officials, to discuss the development of this area (Pakhuis de Zwijger, 2016). At such a meeting the idea was born to use Geocraft to give the children a voice to express their wishes and ideas about the spatial design of the surroundings of the newly build IJburg high school. After all, they are the users of this place[8].

[8] This project was initiated and facilitated by consultancy agency 'BuurtPerspectief' and the SPINlab of the Vrije Universiteit Amsterdam.

The students already knew Minecraft or learned on the job. The students were divided into design teams to redesign the space around their school. They worked 4 sessions of 2 hours, one session per week. Each team got a simple instruction: change the current world into one you like! (Buurtperspectief, 2015a).

Figure 10 – Redevelopment site Zeeburgereiland, Amsterdam, The Netherlands; The IJburg high school is already in use, surrounded by wasteland and industrial remains; The students made a spatial planning design in Geocraft

Based on the input from the design teams, a professional urban planner amalgamated the different ideas of the students into one, feasible design, see Fig. 10 and Buurtperspectief (2015b). Not all objects created made it to the final design; explicit erotic street art and statues were not incorporated in the final design, or when several overlapping ideas were present (each group had a library) only one was picked.

This project adequately collected and inventoried the students' needs and wishes as users of the space, which were subsequently presented to the stakeholder meet-up. Using Geocraft, the students participated actively and were enabled to express definite wishes within the actual available space (such as the desired size of a football field, the preferred location of a skate park, etc.). This way, they

provided distinct input for the professional urban planner. The final design met the students' wishes, including a playground for kids, pop-up stores, leisure and places to meet, in- & outdoor activities. The students recognized the planner's design as their own design and would definitely support its realisation. At the moment of writing, the concrete realisation of parts of this design is being planned.

3.2.2 Transition towards sustainable energy in Zaandam

Worldwide we strive for energy saving and a transition towards renewable energy (European Union, 2009; SER, 2013). In Geocraft, we developed a serious game challenging the students of the Zaanlands Lyceum to come up with the best solution for their own neighbourhood. In Geocraft, they had to design a future scenario in order to realize the most energy saving and the most renewable energy, considering both the costs, the amount of CO2 reduction, and the resulting energy supply in kWh/m^3. Hereto, they could take three measures. Geodan developed dedicated plugins so that for each measure, models in Geocraft calculated costs and benefits:

- Raise wind turbines, see Fig. 11. The higher the wind turbine, the more energy is generated. However, higher wind turbines are more expensive to set up. No more than 4 wind turbines could be raised;
- Implement solar panels, see Fig. 12. If the solar panels on a building generate more energy than the building consumes, overproduction is not rewarded;
- Apply thermal insulation, see Fig. 13.

Figure 111 – Geocraft wind turbine

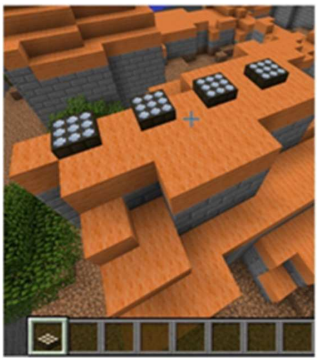


Figure 12 – Implementation of solar panels

During one lesson, the students could explore Geocraft. By removing and adding specific blocks, each design team could position solar panels, apply thermal insulation, or build wind turbines in their own Geocraft world. The next four lessons the students had to design a scenario to conserve as much energy as possible at the lowest costs in their virtual neighbourhood. Two times, the

students were enabled to run a model in Geocraft calculating the inferred results with respect to costs and benefits.

This project raised the students awareness of the energy consumption of different buildings, as different types of buildings in Geocraft have different energy labels, conform reality. They got a substantiated understanding of the potential energy measures in their own neighbourhood. We succeeded in simplifying spatial energy models in a representative and functional way, so that 14 year old students with no experience in this field could use the models ánd understand not only what they were doing but also the causes of the result of their choices. The students got a deeper understanding of the principles of physics, because they could interactively play with different options and apply them in a familiar neighbourhood.

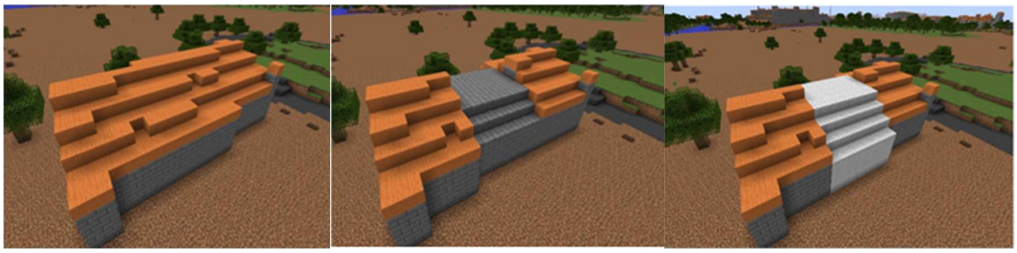


Figure 13 – Thermal insulation of a residence; first the outer layer is removed, then a white layer added

In addition, the students learned the meaning of a multi-criteria analysis. They got a feeling for the perspectives of different stakeholders; what is regarded to be the best solution totally depends on the chosen point of view. What is more important: a reduction of the costs of the consumer, a reduction of the costs of the energy supplier, CO2 reduction, or do you want to maximize sustainable energy production? During this project, the students had to tend different complex tasks to achieve a good result. They got a feeling how to address complex issues as a team and practised the required skills.

3.2.3 Water management and land use Markermeer

The Netherlands have a record of claiming land from water. For this purpose, between 1963 and 1976 a dike was raised between Enkhuizen and Lelystad, aimed at the creation of new land: the Markerwaard. However, over the decades agricultural production methods improved significantly, and in 2003 the Dutch government decided not to invest in new farmland anymore. Meanwhile, the waters in the closed off Markermeer area stagnate, resulting in a severely decreased water quality and heavily damaged ecosystem (Waterhout, Zonneveld and Louw, 2013).

The government decided to convert the area into an extensive nature reserve: a ‘future proof ecological system’. In addition, the area should provide recreation space to accommodate the nearby densely populated urban areas. Furthermore,

the opportunities to gain renewable energy and to raise freshwater food production should be explored. Potentially, the area is suitable to cultivate the Chinese mitten crab or usable algae. Sustainable energy might be generated by wind turbines, solar modules or by growing biomass (Gemeente Lelystad, 2015).

Over a 3 month period, the students worked on this project for 5 hours a week. Instead of 'an empty bathtub with stagnant water' the government aims for a variform area. The students had to design a spatial scenario to recover the damaged ecosystem and to optimize the combination of four objectives: recreation, food production, energy and most important: nature. After studying literature and gathering information from the internet, the students designed and eventually presented their solution in Geocraft, see Fig. 14.

Figuru 14.1 – Winning spatial design for the Markermeer, made by high school students of the Technasium at Lelystad, NL. They optimized the combination of four objectives: recreation, food production, energy and most important: nature

Figure 14.2 – The students designed a dike with a specific orientation in order to create a low energy shallow water area behind it, thus applying water management knowledge from experts

Hitherto in similar projects the students used photo collages, hand-made maps and scale models to present their solutions. The virtual visualisation of the designs improved them significantly: working in Geocraft effected a much higher level of detail and accuracy. However, this result was not the biggest gain:

Geocraft improved the learning and design processes remarkably (Kelderman, 2016).

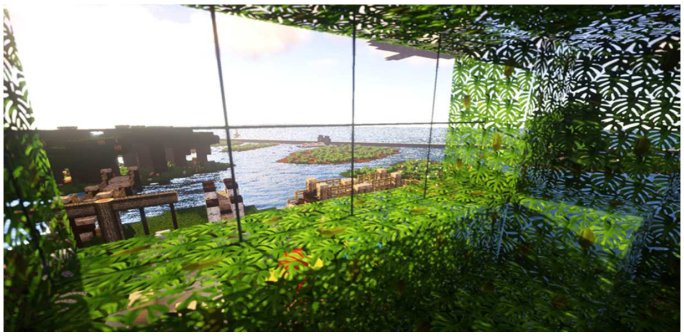


Figure 14.3 – The spatial design provides recreation spaces to accommodate the nearby densely populated urban areas

Geocraft provided an immersive experience. Instead of trying to understand the spatial relationships from descriptions and 2D maps, the students could walk around in the virtual representation of the studied area. Every spot could be approached and examined from every direction. Geocraft generated direct insight in scale size, dimensions and proportions. The students got an immediate look on the actual result while making changes; the impact of the changes revealed themselves at once. That made it a 'real experience' instead of a theoretical exercise.

Geocraft makes it very easy to modify the designs. This enables a 'sketching design process': students can try, modify, and renew their ideas without being confronted with considerable efforts coming along with making changes. As a result, the students obtained a higher creative freedom compared to 'the old way' of designing. Progressive insights could be accommodated much more easily.

Working in Geocraft advanced communication and collaboration processes within the design teams; working simultaneously in the same virtual environment necessitated tuning and adaption. Different subjects had to be amalgamated into a coherent joint design. Working isolated from one another was impossible, conflicting approaches revealed themselves at once. This provoked the substantiation of actions and decisions and coerced a more or less continuous exchange of substantive arguments. The students became much more aware of the impact of what they were planning to do. Problem solving thinking arose spontaneously; it was simply the only possible way to proceed.

Figure 14.4 – Area for fresh water food production (Markermeer, spatial design by high school students of the Technasium at Lelystad, The Netherlands)

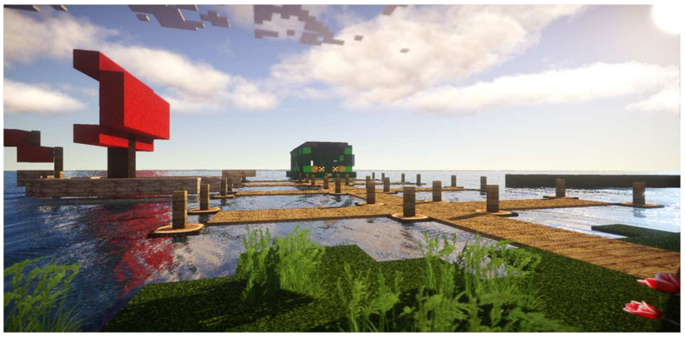


Figure 14.5 – Harbour area (Markermeer, spatial design by high school students of the Technasium at Lelystad, The Netherlands)

4 DISCUSSION OF THE RESULTS

Workshops in problem solving strategies might exhibit a poor learning transfer if carried out in more or less decontextualised training environments, which are insufficient related to real life (Kortmann, et al., 2016). To improve learning transfer, Herrington and Oliver (2000) have proposed so-called authentic learning environments (ALEs). ALEs are designed to enable learning experiences with real-world relevance. These use cases reveal that in Geocraft, we can simulate real world problems and raise real world strategies.

Please note that it is difficult to represent areas with large height differences.in Minecraft: the maximum height of a Minecraft world is 256 blocks or meters. There are plugins and technical measures to overcome some of the problems arising from the maximum height, like teleporting to a lower Minecraft altitude when entering a region with higher altitudes (the 'real' attitudes are translated to a lower Minecraft altitude). We did not have to deal with this, since in The Netherlands, there are no large heights differences.

4.1 Lessons learned from use case The Netherlands in Minecraft

We achieved the three objectives of use case 1 (see Tab. 2):

- In Geocraft, the real world is simplified to blocks from 1 to 1 meter. Use case 1 revealed this is an appropriate level of abstraction to be able to effectively represent the real world, as illustrated by figures 4 and 6-9. Even round forms (see Fig. 15) or surfaces with an oblique orientation towards the north-south east-west grid (see Figure 4), can be adequately mimicked despite the jagged surfaces. People recognize their own neighbourhood immediately, different building styles are recognizable represented (see Fig. 4, 6-9, 15).

Figure 135 – Round buildings too, can be adequately build with the 1 to 1 meter blocks of Minecraft (The Stopera, Amsterdam, The Netherlands)

- Over 20,000 Minecraft players registered as GeoCitizen and worked on the Geocraft.NL server through the internet. So we proved Geocraft can support thousands of users via the internet; we infer Geocraft can effectively be offered to the public for public participation processes.
- We succeeded in creating and maintaining a Geocraft.NL community working on a common geospatial project. Thousands of children joined the geocraft.NL server to make The-Netherlands-in-Minecraft look as realistic as possible. After more than a year, the project is still going on. Collaboration and joint projects emerged spontaneously. However, if you just setup a server and offer free access to everybody without restrictions, it will be a complete mess in no time. The-Netherlands-in-Minecraft were practically destroyed at the day of release, another notorious example is the Danish server which was partly blown-up within a month from the release (Prigg, 2014). We learned several organisational aspects have to be implemented in order to create a maintainable and controllable Geocraft service. To maintain and control a Geocraft world several roles must be filled in:

- The system administrator is responsible for supplying and upgrading the server hardware and backups, server user management, etc.
- The Minecraft server manager makes sure the Minecraft service software is up and running. He installs, updates and configures the necessary plug-ins. So basically he is responsible the functionality needed is available for the Minecraft players.
- In-game management keeps order and hands out claims.

Minecraft players are authenticated by services from Mojang. During a number of events and workshops, these services were down resulting in players not able to participate. It is possible to turn off this authentication for a Minecraft server. However this makes a Minecraft server extremely vulnerable to hackers as players can login with any username even that of an administrator. The authentication by the Mojang services is essential but availability is not guaranteed which could cause problems during events and workshops.

4.2 Lessons learned from use case Zeeburgereiland

The three objectives of use case Zeeburgereiland (see Table 2) are each met by a positive result:

- While designing the public space around their high school on Zeeburgereiland, non-Minecraft playing students learned on the job how to use this user friendly virtual building environment. Similar to LEGO bricks, all users intuitively understood how to use Geocraft blocks to adequately simulate reality and to easily design future scenarios.
- We demonstrated that spatial scenarios designed in Geocraft can be effectively translated into a feasible, practicable spatial design and be imported to the digital environment of a professional designer.
- The students recognized the planner's design as their own design and would definitely support its realisation. The design was presented to the stakeholders and part of the design is going to be realized indeed.

We infer that Geocraft can indeed be used to collect the ideas of citizens, in this case children, and engage them in a feasible way in urban planning issues to raise solutions that can reckon on public support. But we have to consider whether these results can be copied to the adult world. Adults did not train themselves so well in computer and gaming skills as the current generation children. And although there are adults playing Minecraft, many adults might not be attracted to use Minecraft. Especially adults without children playing Minecraft may be reluctant to participate in events or workshops involving Minecraft. This has to be investigated before we can conclude we can indeed effectively use Geocraft for citizen participation processes. Please note that the current children are the adults of the future.

We also learned that the workshop needs to be very well introduced and facilitated; giving some freedom attracted students that were interested in Minecraft and not in planning the area and they were more destructive than constructive. In addition, the squared structure meant that the students tended to build in a north-south or east-west orientation, to have straight buildings. In principle, this might form a severe disadvantage when inviting non-professionals to make spatial designs in Geocraft. However, in the use case Markerwadden this tendency was not so clear.

4.3 Lessons learned from use case Zaandam

Use case Zaandam showed that Geocraft can operate as a smart environment wherein real-time impact models can be run to virtually simulate and visualise future developments and their implications, providing the user with relevant information during design processes. We learned that by serious gaming in Geocraft, in a limited amount of time the students acquired a deep understanding in a complex issue they were not familiar with before.

Using Geocraft in the classroom showed to be an effective method to motivate students to crack their brains and raise solutions for a complex issue. Their efforts resulted in concrete 3D GIS designs that can be imported, visualised and analyzed in other computer environments. These designs could be presented to the real stakeholders. It would be interesting to compare the plans of the stakeholders with those of the students, and analyse the similarities and the differences.

By working on this case study, the students fully understood the meaning of a multi-criteria analysis. We conclude Geocraft is a good method to raise mutual understanding and share ideas in a multi-stakeholder process. We agree with Lenferink, et al. (2016) that the combination of game theory and geodesign provides added value for planning support by facilitating a realistic discussion, and negotiation that is strongly connected to real-life locations, and by aiming at designing a common, collaborative solution. Next time we might explore what choices the students make if given a specific goal to aim for; we can, for example, divide the students into design teams, each representing another stakeholder with a different concern: the government, the people of the place, the energy supplier and the operator of the electricity grid.

4.4 Lessons learned from use case Markermeer

In this use case too, we achieved what we aimed for (see the objectives in Tab. 2). From use case Markermeer, we learned that using Geocraft the learning content was transmitted much more effectively than before, because Geocraft provided an immersive experience (Kelderman, 2016). Moreover, Geocraft turned out to be a great tool to induce the typical 21th century skills (Trilling and Fadel, 2012) necessary to successfully complete the task: communicating, finding and evaluating information, creating and innovating, collaborating, and

problem solving. The students successfully incorporated insights of experts into their designs.

Working in Geocraft advanced communication and collaboration processes within the design teams. Moreover, this approach maximized the engagement of the students. Not only because they became much more aware of what they were doing, but also because they had great fun 'playing with Minecraft'. The supervising teacher takes the view that the results of the students improved significantly by using Geocraft (Kelderman, 2016). The next step is working with control groups to demonstrate that these improvements are statistically significant.

During this project, we became very aware of being dependant on good internet connections. Sometimes, the servers were down or somehow the internet connection failed, which made it impossible to proceed and to optimally use the dedicated education time. Moreover the technical support of the project has a price, as long as the necessary computer and internet facilities are not standard available. Another disadvantage of working in Geocraft, was that teachers found it more difficult to give guidance to the project and to discuss the mid-way results. Maybe this is inherent in working in a virtual world; on the other hand we do not know yet whether teachers simply have to get used to another way of judging and supervising. We have to execute more projects to be able to judge this.

5 POSSIBLE FURTHER APPLICATIONS

As an easy to use visualisation tool, Geocraft can be used as a strong communication tool to display and share ideas and plans. Geocraft can enable citizens to virtually concretize their ideas on for example urban planning or future land use. Geocraft can offer citizens the opportunity to communicate their ideas on geospatial issues towards authorities in an effective way and vice versa: governments can offer citizens the opportunity to virtually visit and examine future scenarios. Either through the internet in virtual reality or in situ by augmented reality (AR).

5.1 Augmented Reality and 3D sensors as a collaborative tool

The combination of AR, georeferenced 3D virtual worlds such as Geocraft and high precision satellite positioning such as Real Time Kinematic GPS (Mekik and Arslanoglu, 2009) or Precise Point Positioning (Bisnath and Gao, 2007) technology enables a host of new experiences. The real world can now be blended with the virtual world. Invisible aspects of the concrete world can be observed using a dedicated (georeferenced) virtual world as an overlay on top of the real world. These virtual overlays can contain all kinds of available geospatial data, for example sensor data on current phenomena such as heat distribution, concentrations of atmospheric particulate matter or chemical pollution levels. Not

only real time data can be visualized, but also predicted and modelled data (Geodan Research, 2016a).

With AR, these visualisations can be experienced in-situ - being at the actual location. That means otherwise invisible phenomena and future changes can be examined while considering the real, physical context. We envision this will raise insights in complex situations. These visualisations are not static views, as AR allows for hiding portions of reality and projects future plans as if they unfold on the spot at that very moment. With transparent AR glasses such as the Microsoft Hololens (Geodan Research, 2016b), discussing these plans with other AR glass users becomes natural as normal eye contact is preserved. Normal navigation such as walking around remains possible as the user is still grounded in reality, greatly enhancing the experience. These possibilities might provide a next step towards a synergetic multidisciplinary approach, effectively exchanging data and insights across the limits of disciplines.

5.2 Gaming gets really serious

Via the internet, children play all sorts of games in Minecraft. For example ‘conquer the flag’: two teams of children each build the best defence structure they can imagine, in only 5 minutes time. Then the battle begins. The team with the best defence structure, the best battle strategy and the best cooperation wins. Geocraft is a smart environment in which we can simulate the real world and raise real strategies and solutions for real problems. For example the battle against sea level rise, air pollution or noise disturbance. Teams can get a budget and an aim to strive for, and implement different options to achieve that aim, like we illustrated in use case Zaandam. Impact models can instantly supply information on the results of the used interventions. The team solving the problem with the best result against the lowest costs wins.

We envision serious gaming in Geocraft can help to reach optimal solutions for tomorrows problems. Game mechanics can effectively influence human behaviour towards cooperation, higher effectiveness and creativity (McGonigal, 2011; Van Boven and Fennema, 2014). We want to explore whether game mechanics can contribute to build a system of smart governance.

6 CONCLUSION

Geocraft provides an excellent interactive virtual 3D environment at a well-chosen level of abstraction to visualise, design and explore future scenarios, raising spatial insight and mutual understanding. It is a user friendly tool to facilitate effective participation and engagement of citizens, youth in particular (see for example use case ‘The Netherlands in Minecraft’). As such, it can be a powerful tool to support collaborative decision making (see for example use case Zeeburgereiland).

From the discussion of the results, we conclude that we presented clear evidence for the added value of Geocraft for education on geospatial issues. Geocraft advanced learning and design processes, and improved communication and collaboration (see all use cases). We infer that Geocraft is a very strong educational tool to raise awareness and insights in complex issues with a geospatial component (see for example use cases 'Zaandam' and 'Markermeer'). However, the statistical proof of the learning improvements still has to be delivered (forthcoming).

We think the use of Geocraft can contribute to a better urban future by facilitating the creation of high level solutions. Through internet interfaces, all urban actors can get a voice and communicate their insights and ideas. Geocraft could be a way for citizens' participation in spatial development and inspire them to take ownership of the city they inhabit.

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Towards a Sustainable *i*-City: Intelligent Transition Management of Digital Places

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ABSTRACT

Modern cities operate in a force field of great challenges. The introduction of digital technology may facilitate the necessary transition management of cities but calls also for a new and intelligent use of a wealth of information for coping with great many urban challenges. This paper provides an exploration of the various challenges and tasks of an intelligent city (*i*-city) faced with unforeseen challenges and an unprecedented supply of 'big data'. Professional data management based on solid cognitive expertise in this area seems to be a wise strategy of a modern *i*-city.

Purpose: This paper provides an exploration of the various challenges and tasks of an intelligent city (*i*-city) faced with unforeseen challenges and an unprecedented supply of 'big data'.

Methodology/Approach: The aim of this brief exploratory paper is to provide a sketch of the context and the force field of modern digital technology for urban areas. Our objective is to provide a positioning of Sweden – and in particular Stockholm – from the perspective of ICT use and digital technology use. Consequently, against the background of global and national ICT developments, the present paper will zoom in on Sweden and Stockholm as a reference case, so as to provide concrete and operational information in a benchmark exploration. At the end, some ingredients for a research and policy agenda will be offered.

Findings: The conclusion may be drawn that Sweden is an advanced Internet-rich country, in which the top of the hierarchy is dominated by Stockholm. Clearly, this city may be seen as a role model for others in the use of Internet activities. It is a typical example of a leading *i*-city.

Research Limitation/implication: The paper provides in a cascade form various relevant data on smart cities, from an international, national and local perspective, with the main focus on Stockholm.

Originality/Value of paper: Professional data management based on solid cognitive expertise in this area seems to be a wise strategy of a modern *i*-city.

Category: Research paper

Keywords: *i*-city; digital technology; transition management; intelligence; big data; strategic urban planning

1 INTRODUCTION

The far-reaching potential and pervasiveness of digital technologies and information systems have in recent years created unforeseen possibilities and challenges for creative urban policies, and have induced a radical transformation and drastic improvement of strategic urban planning, design and architecture in both developed countries and developing economies, with far-reaching implications prompting the need of new and unconventional urban policies. This force field is nowadays rapidly developing with a view to the enhancement of urban efficiency and competitiveness in order to ensure socio-economic progress and to maximize a sustainable urban quality of living and working, the so-called XXQ strategies (based on the '*XXQ*' principle; see Nijkamp, 2008) for (local) communities in a global playing field. Cities are nowadays in a state of flux; they are 'on the move', particularly as a result of digital technology use (see e.g., Ratti, et al., 2007; Townsend, 2013).

It is noteworthy that the use and implementation of new technological artefacts and communication inventions (e.g., social media, remote sensing, smartphones, androids, tablet computing, big data, cloud computing) effect also the daily life in cities (Latour, 1992; Waelbers, 2009; Verbeek, 2006). ICT offers the potential for enhancing external and internal bridging and bonding linkages between local and global communities, actors and spaces across a variety of networks (Ratti, et al., 2007) in combination of education, work, leisure, and social activities in the digital world. Our world is moving towards a multi-faceted and interconnected global system with interdependent digital communication, decisions, virtual actions and novel activities (Camagni, 1991; Batty, 2013; Nijkamp, 2016; Kourtit, 2016). The recent concept of the '*New Urban World*' heralds also the age of new urban ICT challenges.

The unprecedented wealth and use of new opportunities and the efficiency of radical digital technologies and information resources in our modern societies, that provide more and more raw materials for collecting 'big or bigger data' (see Kitchin, 2013; Kourtit, 2016), have as yet not been completely framed in an integrated metabolic urban system that is driven by a transition towards a sustainable development on a healthy winning edge and that is supported by an

effective action platform to the benefit of urban (sub)systems for various stakeholders, the so-called notion of *i*-cities (see also Kourtit and Nijkamp, 2015).

The *i*-city concept takes from granted that an intelligent city is able to use its manifold resources (both material and virtual) for a sustainable enrichment that goes beyond the standard use and the mission of a conventional smart city label in current urban policy, by identifying, monitoring and controlling a multiplicity of indicators and effects of '*grand challenges*' and by implementing technological initiatives and strategies to ensure and to offer a structurally improved quality of life in the city through intelligent solutions. Such intelligent solutions originate from the effective use of all cognitive (hardware, software, orgware, ecoware, know-how) resources in a city and are decisively driven by the unprecedented potential of modern ICT, in particular digital technology. In other words, an *i*-city operates on the basis of intelligent initiatives and solutions through the broad acceptance of digital technology in all constituents of the urban system

The above sketch of unprecedented future changes in the functioning and positioning of modern cities calls for a professional and informed transition management. The ingredients of this transition management are based on two pillars: (a) systematic mapping of the urban opportunities and impacts of modern technologies, with particular emphasis on digital technologies (or ICT, in general), leading to the need for a systematic urban technology impact assessment; (b) a comprehensive and integrated analysis of all varied data sources concerned in relation to the drastic role change of cities, leading to the need for urban 'big data' analysis and data mining. Clearly, digital technology and 'big data' go hand in hand.

The aim of this brief exploratory paper is to provide a sketch of the context and the force field of modern digital technology for urban areas. It is clear that the use and penetration of digital technology shows much variation across Europe. Our objective is to provide a positioning of Sweden – and in particular Stockholm – from the perspective of ICT use and digital technology use. Consequently, against the background of global and national ICT developments, the present paper will zoom in on Sweden and Stockholm as a reference case, so as to provide concrete and operational information in a benchmark exploration. At the end, some ingredients for a research and policy agenda will be offered.

2 THE BROADER ICT CONTEXT

The intelligent policy, strategy, transfer and management of digital information in a city are not developed in isolation from the rest of the country or the world. ICT is a pervasive technology that penetrates all regions of the world and all sectors of the industry, but of course, with varying degrees of acceptance and adoption. Normally, the acceptance and adoption of a new technology follow a

spatial-hierarchical pattern, from large urban glomerations to rural areas. This geographical pattern of the spread of innovations was already observed by Hägerstrand (1953) in his study on space-time dispersion of agricultural subsidies in Sweden. Clearly, in the context of information technology, the space-time acceptance and adoption rhythm is much faster, but yet there is much evidence that the fruits of new technologies are first reaped in larger urban agglomerations, which are in turn influenced by the technological development patterns in other regions or countries. In order to position the digital technology importance for a capital city like Stockholm in Sweden, it is therefore meaningful to provide a broader picture of digital technology evolution in Europe, through a series of informative pictures on recent developments.

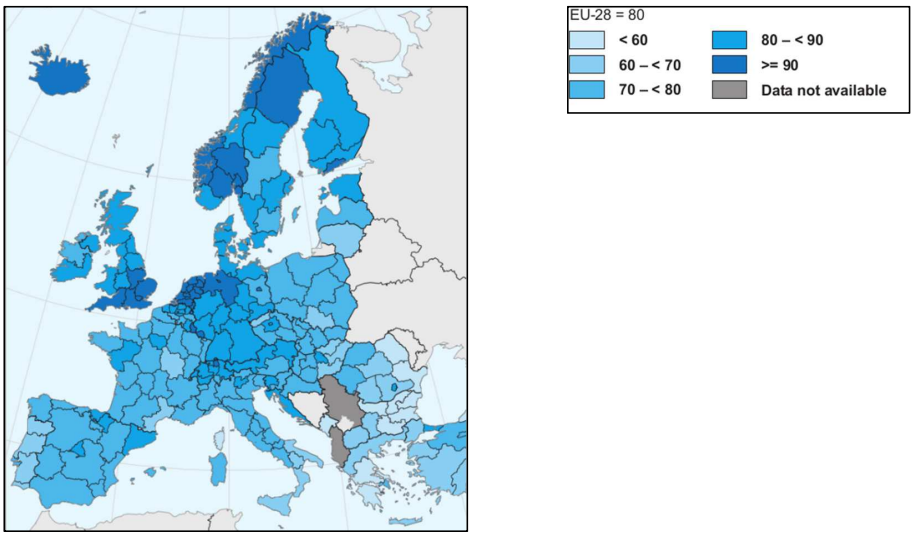

Figure 1 – Broadband connections in households, by NUTS level 2 region (Source: Eurostat, 2015)

We will first present here the broadband connections in households at a NUTS-2 level in Europe (see Fig. 1). This map leads to the following observations:

- Many Western European and Northern European countries have an above average availability of household broadband connectivity.
- The Central European and Mediterranean countries have a much lower achievement level for broadband connections.
- Large urban agglomerations (e.g., Greater London, Randstad Holland, Ile-de-France, Madrid, Stockholm, Helsinki) exhibit relatively high scores for household broadband connections.

It is thus clear that the Nordic countries – and their capital cities – have an above-average ICT potential.

The previous findings on the positive picture of Nordic countries are supported by an 'inverse' map of Europe, viz. people who never used Internet (see Fig. 2), as well as by a map showing the regular use of the Internet (see Fig. 3).

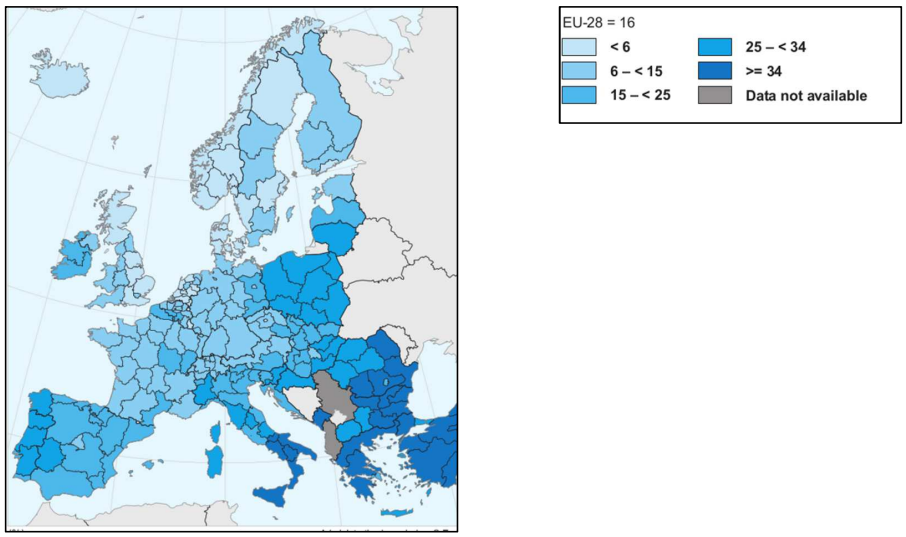

Figure 2 – People who never used the internet, by NUTS level 2 region, % of persons who never accessed the internet (Source: Eurostat, 2015)

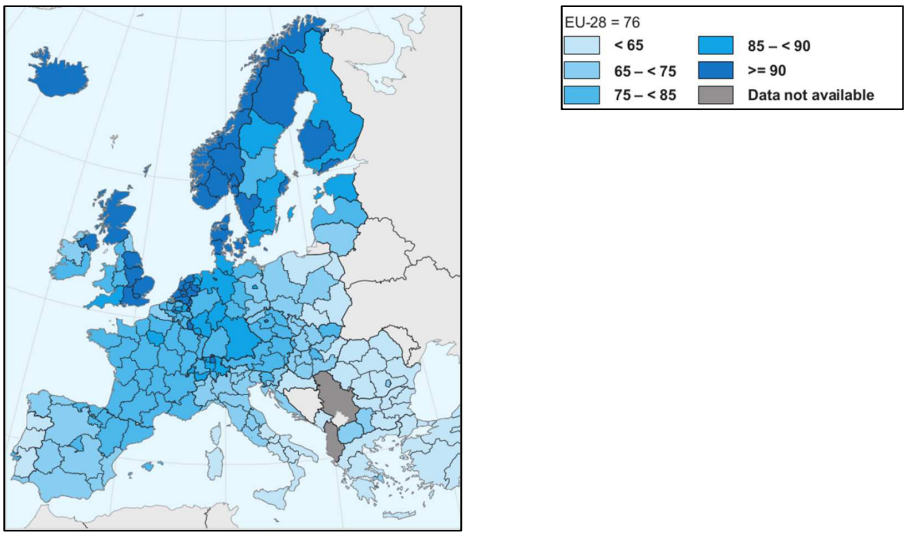

Figure 3 – Regular use of the internet, by NUTS level 2 region, % of persons who accessed the internet on average at least once every week (Source: Eurostat, 2015)

Consequently, there are significant discrepancies (spatial disparities), both between and within EU countries, in the adoption and use of the Internet (see

also Fig. 4). Apparently, Northern European countries belong to the high-performing ICT areas in Europe.

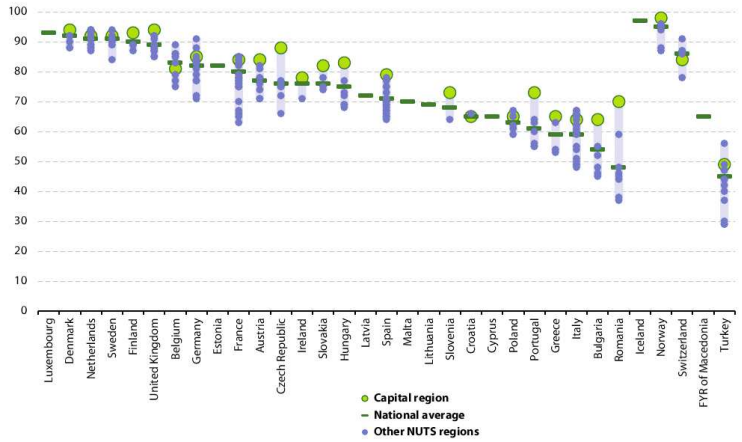

Figure 4 – Regional disparities in regular use of the internet, by NUTS level 2 region, % of persons who accessed the internet on average at least once every week (Source: Eurostat, 2015)

Finally, an almost similar pattern can be identified for the Internet use by public authorities in their communication with the public (see Fig. 5).

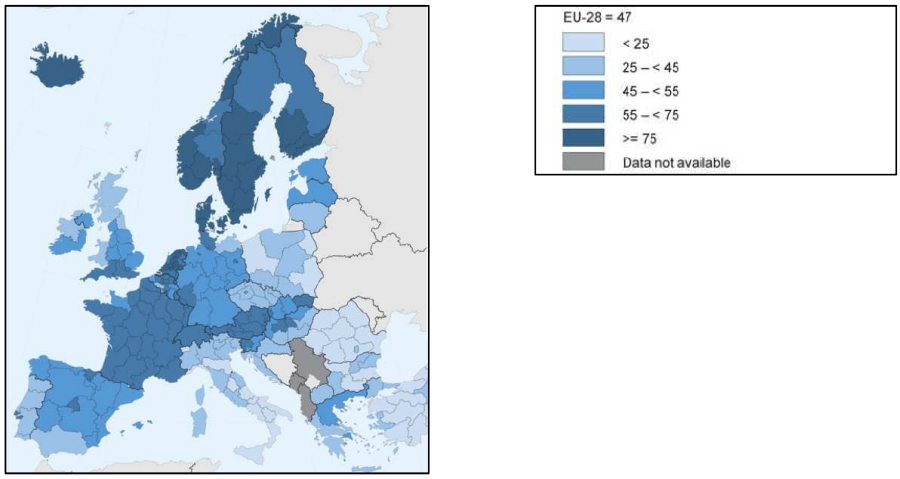

Figure 5 – Use of the internet for interaction with public authorities, by NUTS level 2 region, % of persons (Source: Eurostat, 2014)

It turns out that Stockholm is among the cities with the highest adoption rate of urban residents using the Internet for their interaction with public authorities. The previous observations are once more supported by Fig. 6, which shows that in all 5 relevant aspects of digital technology (connectivity, human capital, use of the

Internet, integration, digital public interaction) Sweden scores well above the European average. The generally strong position of the Nordic countries (Denmark, Finland and Sweden) is also visible from an analysis of the DESI-index (Digital Economy and Society Index) depicted in Fig. 7.

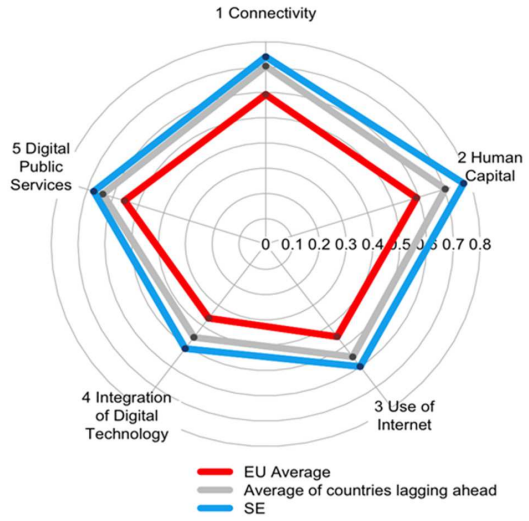

Figure 6 – Digital Economy and Society Index (DESI), Country Profile Sweden (Source: European Commission, Digital Agenda Dashboard, 2016)

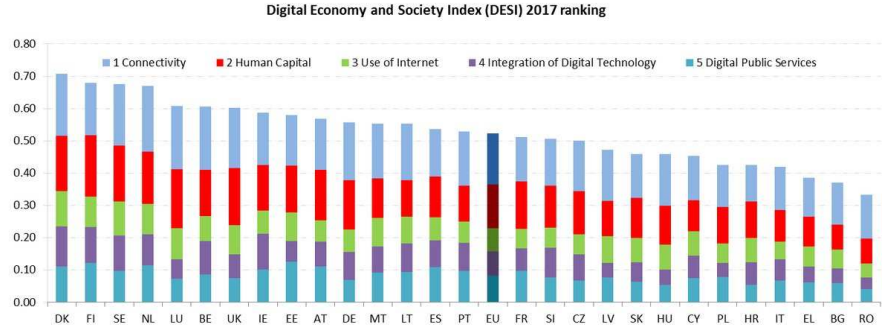

Figure 7 – Digital Economy and Society Index (DESI): A comparison of Denmark's, Finland's and Sweden's Digital Performance (Source: European Commission, Digital Agenda Dashboard, 2017)

The next question is now: how is digital technology performance distributed within the country of Sweden? If we focus now on the intra-country Swedish patterns of Internet access, it is noteworthy that this access is broadly distributed (with only an exception of the oldest age cohort) (see Fig. 8), while the Internet is used for various different purposes by citizens in their contact with public authorities (see Fig. 9).

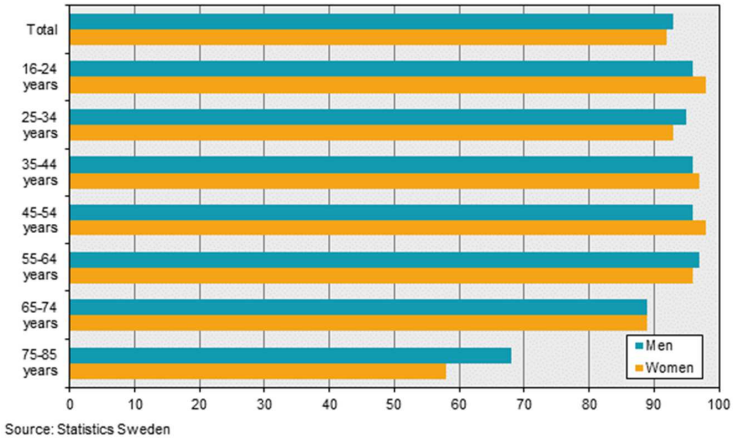

Figure 8 – Share of persons who have access to the Internet at home in Sweden, by age groups 16-85 years of age, shares in percent (Source: Statistics Sweden, 2016)

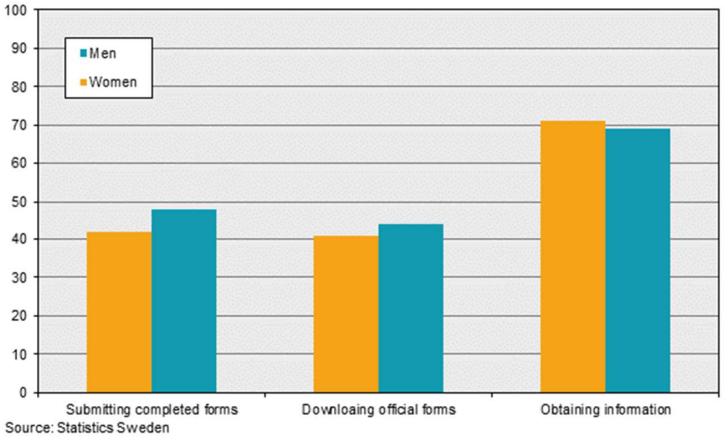

Figure 9 – Share of persons who used websites of public authorities by area of use (Source: Statistics Sweden, 2016)

At the national level of Sweden, Fig. 10 and Fig. 11 show again the strong position of Sweden: it has a broadly composed use of Internet activities in the country and may be seen as one of the European pioneers.

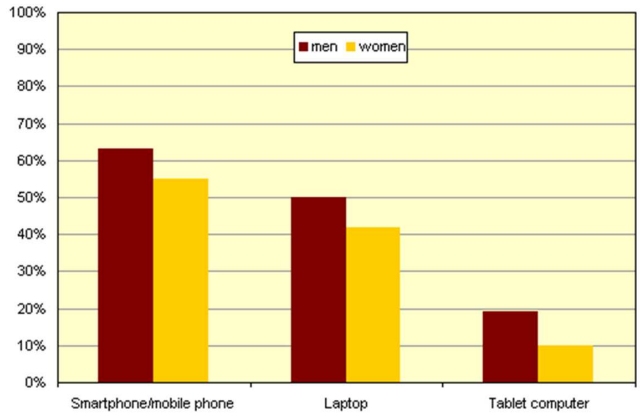

Figure 10 – ICT usage in households: different type of devices used for connection to the Internet away from home or work, first quarter 2012, percentage of persons aged 16-74 (Source: Statistics Sweden, 2012)

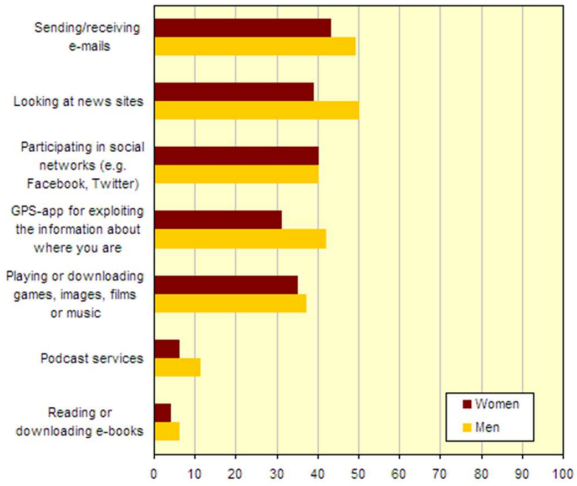

Figure 11 – ICT usage in households Internet activities carried out with a smartphone or other handheld device, outside the home or workplace during the first quarter 2012, percentage of persons aged 16-74 (Source: Statistics Sweden, 2012)

It is noteworthy that, if we zoom in on the spatial top of the urban hierarchy of Internet adoption in Sweden, viz. on Stockholm, we find again a confirmation of the high Internet penetration rate of households (see Fig. 12), but also of the business sector (see Fig. 13 and Fig. 14). It appears that in Europe Sweden is a high performer, while in Sweden Stockholm is a high performer.

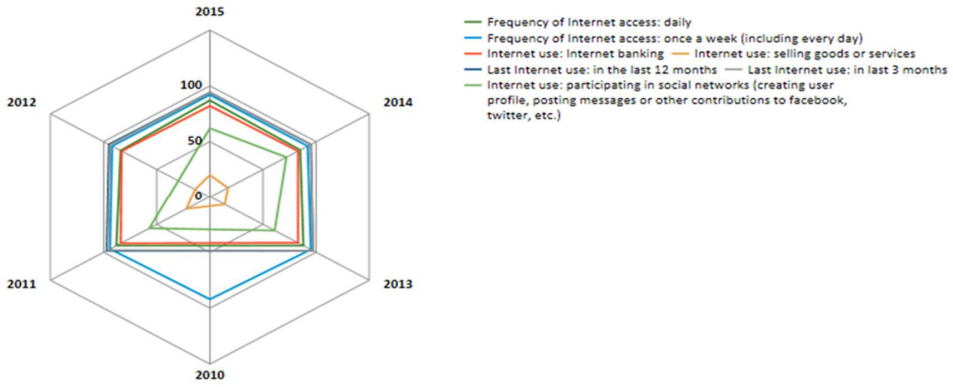

Figure 12 – Individuals who used the internet, frequency of use and activities in Stockholm (Source: Eurostat, 2010-2015)

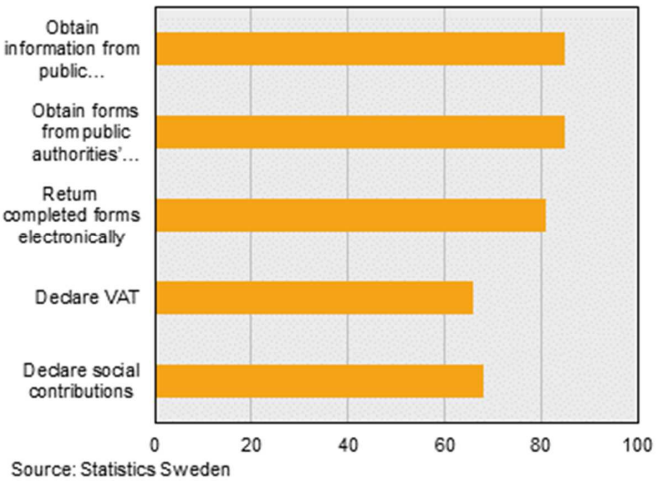

Figure 13 – Share of enterprises using the Internet for interaction with public authorities for different purposes (Source: Statistics Sweden,2015)

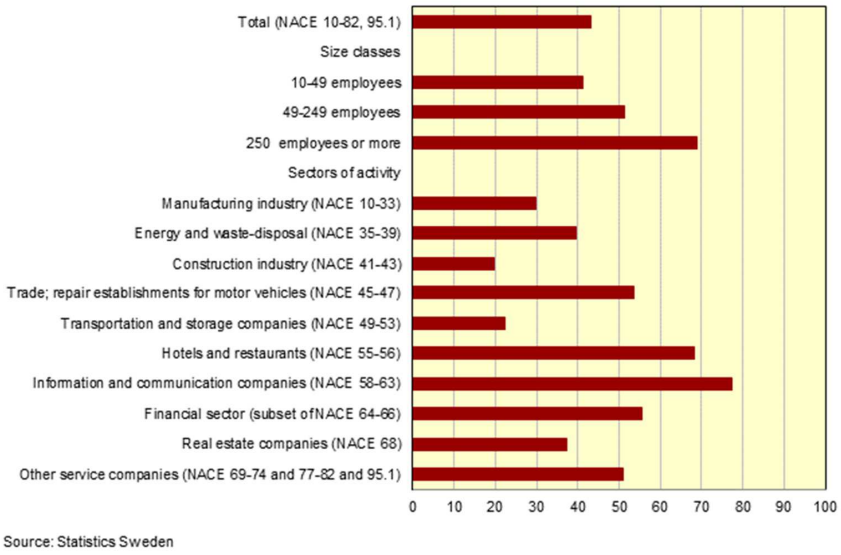

Figure 14 – Share of enterprises' that use social networks, by size class and sector of activity, 2013, 10 or more employees, percent (Source: Statistics Sweden, 2013)

The conclusion may be drawn that Sweden is an advanced Internet-rich country, in which the top of the hierarchy is dominated by Stockholm. Clearly, this city may be seen as a role model for others in the use of Internet activities. It is a typical example of a leading *i*-city. We will now offer some further considerations for a deeper reflection on the significance of digital technology for intelligent cities.

3 DIGITAL TECHNOLOGY AS URBAN INTELLIGENCE

The trend breach of digital technology calls for a *new urban analytics* (NUA) based on a combination of digital technology use and 'big data' analysis but does not make conventional information and data systems in cities obsolete or redundant. It adds an entirely new digital data dimension to such systems in order to incorporate also the fast changing and volatile space-time dynamics of the urban fabric. The merger of two tiers of information and data calls for adjusted techniques and research tools so as to extract evidence-based knowledge in support of strategic and pro-active urban planning. In the action arena of urban evolution – with slow and fast dynamics occurring at the same time – detailed geographically-oriented information and data are then needed, based on GIS technology dealing with geo-referenced and geo-coded data. This has led to the popularity of modern geo-science as a contemporaneous analytical framework for understanding the complexity of urban systems (Fischer and Scholten, 1994).

It should be noted that NUA is a constellation of an unprecedented and rich portfolio (or package) of hardware, software, infoware, ecoware and orgware so as to enhance the quality of urban life (see also the XXQ principle advocated by Nijkamp, 2008). NUA complies with the need for an integrated assessment, based on informed and scientifically valid information, in order to cope with the ever changing pattern of modern cities, either through unanticipated shocks or endogenous responses of a great many stakeholders. NUA seems to be a proper response to a wide variety of urban challenges through the use of modern digital information systems.

Finally, an effective implementation of the NUA calls for a professional urban information management, not as a hobbyist activity of a city official, but s a systematically organised cognitive task imposed on a knowledge division of a city council with the involvement of various stakeholders in the urban system that is fit for purpose. Clearly, such a structured and integrated information management calls also for 'big data' expertise, transparency, and alignment with the general city's vision and strategies, since one of the greatest handles in using a wide array of data sources is its quality and coherence control and steering. This is a *sine qua non* for any *i*-city, as otherwise 'big digital data' will lead to inconsistencies that may lead to an erosion of the necessary transition management of *i-cities* in the '*New Urban World*'.

4 SYNTHESIS: THE NEW URBAN ANALYTICS

It is noteworthy that in recent times cities have adopted new roles, viz. from a data user for urban planning to a data engine for research and management (Batty, 2003). Digital data production, analysis and application have become almost magical instruments to govern current complex city operations, e.g., in the field of mobility, public transport, safety and security, use of public amenities, access to public services, tourism, parking management, etc. 'Splintering urbanism' is a new phenomenon that reflects the geographical position and individual intersections of residents and visitors in a city (Graham and Marvin, 2001).

This calls – as mentioned above – for an entirely new model of examination and management of the daily-life patterns in cities, in the form of a *new urban analytics* (NUA). The sources of such data are manifold: camera's, sensors, GPS data, GSM data, parking data, etc. The identification, monitoring alignment, and management of the overwhelming complexity of daily urban patterns and interactions is one of the difficult tasks in an intelligent strategy for a city. The control of the manifold space-time signatures of citizens and visitors calls for intelligent solutions, on both the research and the policy side. The big challenge of such 'big data' systems is not so much the collection of all relevant data, but the systematic and integrated analysis of all such data from different space-time constellations in one coherent research and management framework. All such data act as real-time heartbeats of the city, and one of the greatest tasks in

modern and strategic urban planning is to monitor, analyse and forecast urban dynamics so as to create realistic conditions for smart and sustainable cities. This is the critical mission of *i*-cities.

From an empirical perspective, we have observed pluriform patterns in the adaptation and use of digital technology, across countries and regions. It turns out that countries and cities in Northern Europe have a high access to and use of ICT and digital technologies. Stockholm appears to be a typical high performer in the digital era.

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Spatial Heterogeneity, Broadband, and New Firm Formation

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ABSTRACT

Purpose: This paper examines the spatial heterogeneity associated with broadband Internet and new firm formation in a number of U.S. states.

Methodology/Approach: Both ordinary least-squares regression and Geographically Weighted Regression are used for the estimation purpose.

Findings: The global coefficient estimates of ordinary least-squares regression account for the marginal change in a phenomenon, but such a global measure cannot reveal the locally-varying dynamics. Using Geographically Weighted Regression, it was found that at the aggregate and economic sector levels, the association between single-unit firm births and the provision of broadband Internet varies across counties in Florida and Ohio.

Originality/Value of paper: There are numerous studies on broadband Internet in the U.S., but this is the first that explicitly examines broadband provision and new firm formation by taking into account spatial heterogeneity across countries.

Category: Research paper

Keywords: broadband Internet; new firm formation; spatial heterogeneity; geographically weighted regression; regional economy

1 BACKGROUND

Both hard and soft infrastructure (Haynes, 2006) are capital stocks of a nation or region (Nijkamp, 1986; Prud'homme, 2005) and generally impact economic growth and development positively. However, a dam becomes useful only after it is fully operational, a sewer system in a region cannot be useful to another region, or a natural monopoly can easily distort the market. That is, infrastructure's inherent characteristics, such as lumpiness, space-specificity, and

market failure (see Gomez-Ibanez, 2003; Prud'homme, 2005), often limit its effectiveness.

The Internet as a General Purpose Technology (GPT) is an important infrastructure in today's business environment (Bresnahan and Trajtenberg, 1995; David and Wright, 2003; Lipsey, Carlaw and Bekar, 2005; Ruttan, 2008). Businesses can collect, share, and disseminate information irrespective of distance and time as well as offer innovative solutions and recruit employee online (Angelides, 1997; Cappelli, 2001; Sharma, 2002). A real-time, collaborative environment helps to generate new capabilities, markets, and strategies that are important for growth (Austin and Bradley, 2005) and network (see Katz and Shapiro, 1985) and scale effects (see Arthur, 1990) increase the utility and value of a network. For instance, information networks as GPTs facilitate trade and factor service of skilled labor (Harris, 1998). Majumdar, et al. (2010) further noted that broadband Internet as a GPT positively influences the productivity of the firms by enabling better communications, high-speed business transactions, and efficient organization of production activities. In addition, since its commercialization, the Internet has offered not only virtual business models, such as Amazon.com, Craiglist, and eBay, but also compelled traditional businesses like Walmart, Toys R Us, Walgreens, Dell, and FedEx to adopt Web-based strategies for sales and services (Bakos, 1998; Griffith and Krampf, 1998). Small and medium enterprises are also making virtual presence a strategic necessity (Grandon and Pearson, 2004).

This paper proposes that because the Internet offers various business possibilities, entrepreneurs that render innovation into economic opportunities (Schumpeter, 1942) are likely to be attracted to regions that have broadband Internet infrastructure. Thus, in order to examine the relationship between new firm formation and the provision of broadband, two methods will be adopted. First, as with the earlier study (Parajuli and Haynes, 2012), with counties as the observation units, ordinary least-squares (OLS) models will be estimated for a number of U.S. states at the aggregate and economic sector levels. Second, since firm births are not consistent across counties and that spatial heterogeneity is likely to be observed, Geographically Weighted Regression (GWR) models will be calibrated. While the OLS estimates will give the global relationship, the GWR estimates will provide the local relationship for counties embedded in states.

2 LITERATURE REVIEW AND RESEARCH HYPOTHESES

While entrepreneurs are instrumental in innovation, job and wealth creation, productivity, positive spillovers, and alternate opportunities (Malecki, 1994; Acs 2006; Van Praag and Versloot, 2007), the entrepreneurial spirit is often influenced by physical and virtual networks (Florida, 1995; Nijkamp, 2003). Innovations are concentrated in regions with technological infrastructure (Feldman and Florida, 1994). In addition, producers (Fujita, Krugman and

Venables, 1999), foreign multinationals (Friedman, Gerlowski and Silberman, 1992), and new businesses (Holl, 2004) are located in a close proximity of transportation infrastructure. Moreover, information and communications technology (ICT) infrastructure not only permits innovations, but also self-reinforces new innovations (McQuaid, 2002). Based on these findings, the first research hypothesis is that new firm formation is positively related to the provision of broadband infrastructure.

According to Acs and Armington (2006), population growth functions as both supply and demand variables with reference to the entrepreneurial activities. As the population grows in a region, it supplies potential entrepreneurs, and also increases the demand of goods and services. Thus, regional variation in new firm formation is positively influenced by population growth (Guesnier, 1994; Reynolds, Miller and Maki, 1995; Armington and Acs, 2002; Acs and Armington, 2006). Sutaria and Hicks (2004), on the contrary, found that population growth was not positively significant in explaining new firm formation. However, they accepted the modeling limitations that could not capture the expected (positive) relationship between new firm formation and population growth. This leads to the second research hypothesis that new firm formation and population growth are positively related.

Innovative ideas and a higher disposable income are likely to foster business ventures. Butler and Herring (1991) noted that individuals that have access to a higher family income are likely to have higher employment opportunities. Armington and Acs (2002) and Lee, Florida and Acs (2004) observed a positive association between income growth and new firm births. Likewise, Reynolds, Miller and Maki (1995) found that the presence of greater personal wealth and firm formation are positively related to each other. That new firm formation and income growth are positively related is the third hypothesis.

A large firm is often dependent on smaller firms for specialty goods and services. This could be the reason why Sutaria and Hicks (2004) found a positive relationship between firm size and new firm births. However, Fritsch and Falck (2002) and Armington and Acs (2002) observed a negative association between firm size and firm formation. The negative association could be due to the existence of large firms and/or their branches that hinder new firm births (Armington and Acs, 2002). The fourth hypothesis is that new firm formation and mean establishment size are negatively associated.

Although the effect of unemployment is small, regions that have a higher unemployment level experience higher firm births. Reynolds, Miller and Maki (1995 and Acs (2006) suggested that as individuals cannot find jobs, they start new businesses as an act of necessity and desperation. Storey (1991) and Audretsch and Fritsch (1994) found both positive and negative associations; Sutaria and Hicks (2004) found a negative association; and Fritsch and Falck (2002) found no relationship between firm formation and unemployment. Since there is no clear understanding of the relationship between employment rate and

new firm formation, the fifth hypothesis is that there is a relationship between new firm births and the unemployment rate, but the direction of the relationship is indeterminate.

Financial capital that entrepreneurs accrue from various sources, such as personal savings, social contacts, venture capital organizations, and banks, is necessary for starting and sustaining nascent firms over time. In general, individuals with embedded relationships and networks in a local environment are most likely to get seed and long-term capital (Uzzi, 1999; Gompers and Lerner, 2001). Sutaria and Hicks (2004) noted that new firm formation is positively associated with the availability of local financial capital. In addition, Cooper, Gimeno-Gascon and Woo (1994) found that the level of capitalization contributes to the survival and growth of new business ventures. The next research hypothesis then is that new firm formation and the availability of local financial capital are positively related.

Government spending can have mixed effects on new firm formation. Entrepreneurs are often willing to sacrifice low initial earnings, but findings may be quite different in highly paid and less stressful work environments (Hamilton, 2000). If well-paid and less stressful (government) jobs are readily available, individuals might be attracted to them instead of pursuing innovation and self-employment. In addition, government investment crowds out private investment in the long-run (Spencer and Yohe, 1970) and government pork-barrel spending simply advances the reelection agenda of politicians instead of contributing to development (Cadot, Roller and Stephan, 2006). On the contrary, public spending in infrastructure is positive and significantly related to productivity (Aschauer, 1989; Munnell, 1990). Government contracts and welfare payments can also increase demand for new goods and services in region and create new business possibilities. Thus, the next hypothesis is that there exists a relationship between new firm formation and government spending, but the direction of the relationship is uncertain.

Saxenian (2002) and Hart and Acs (2011) suggested that regions that are culturally diverse are attractive to entrepreneurs. Lee, Florida and Acs (2004) and Audretsch, Dohse and Niebuhr (2010) found a significant positive relationship between cultural diversity and firm births. Thus, the eights hypothesis is that there exists a positive relationship between new firm formation and cultural diversity.

Spatial structures play an important role in regional economic activities (Markusen, 1996; Krugman, 1998; Fujita, Krugman and Venables, 1999). Knowledge spillover is more in cities where local competition and urban variety encourages employment growth (Glaeser, et al., 1992). Further, new businesses form in clusters that supply specialized inputs and require specialized infrastructure (Porter, 2000). Hence, agglomeration economies are important for entrepreneurial ventures (Acs and Varga, 2005). This leads to the hypothesis that diversified and agglomerated metro regions compared to non-metro regions are more likely to be attractive to new firms.

Spatial heterogeneity is associated with the spatially varying phenomenon. According to Lomi (1995), regional level analysis compared to national level analysis provides a better understanding of organizational founding and that neglecting the heterogeneity effects tend to overestimate the effects of founding rates. Stuart and Sorenson (2003), Li, et al. (2011), and Cheng and Li (2011) observed the variation in firm formation as well as employment generation in smaller regions embedded in a large region. We believe that this means it is necessary to do a lower level assessment to capture these issues of potential spatial heterogeneity. Hence, we explore the issue of heterogeneity at the county level.

3 RESEARCH DESIGN AND DATA

A global multiple regression model is given as:

$$y_i = \beta_0 + \sum_k \beta_k x_{ik} + \varepsilon_i \tag{1}$$

where y is the dependent variable, x's are the independent variables, β's are the parameters to be estimated, and ε is the independent and identically distributed error term with zero mean and a constant variance. The subscript i denotes the number of observations and k the number of independent variables.

By extending the global model given by Equation (1), the GWR model is written as:

$$y_i = b_0(u_i, v_i) + \sum_k b_k(u_i, v_i) x_{ik} + \varepsilon_i \tag{2}$$

where (u_i, v_i) denotes the coordinates of point i in space and $b_k(u_i, v_i)$ is the realization of the continuous function $b_k(u, v)$ at point i (Brunsdon, Fotheringham and Charlton, 1996; Fotheringham, Charlton and Brunsdon, 1998). This transformation allows us to estimate local parameters that vary across space.

Using the matrix notation, the coefficients in Equation (1) are estimated by:

$$\widehat{\boldsymbol{\beta}} = (\boldsymbol{X}^T\boldsymbol{X})^{-1}\boldsymbol{X}^T\boldsymbol{y} \tag{3}$$

However, for Equation (2), the coefficient estimates are:

$$\widehat{\boldsymbol{b}}(u_i, v_i) = [\boldsymbol{X}^T\boldsymbol{W}(u_i, v_i)\boldsymbol{X}]^{-1}\boldsymbol{X}^T\boldsymbol{W}(u_i, v_i)\boldsymbol{y} \tag{4}$$

where for a sample size of n, $\boldsymbol{W}$ (u_i,v_i) is a weight matrix of size $(n \times n)$ whose off-diagonal elements are zero and diagonal elements denote the geographical weighting of observed data for point i. Because of the weight matrix, the estimators are the weighted least-squares estimators. In addition, T and −1 denote the transposition and inversion of matrix, respectively.

The weight matrix, $\boldsymbol{W}$, is specified as a distance-decay function. In order to estimate the local parameters for a location i, the weight is given by:

$$w_{ij} = \exp\left(\frac{d_{ij}^2}{B^2}\right)^{-1} \tag{5}$$

where j is another point in space, d_{ij} is the distance between i and j, and B is the bandwidth of the kernel density function. At the regression point i, the weight is unity and decreases with distance. This implies that observations near i influence parameter estimation more than observations farther away from i. B can be fixed or adaptive based on the nature of kernel function and can be selected using a cross-validation approach or the Akaike Information Criterion (AIC) approach (Brunsdon, Fotheringham and Charlton, 1996; Fotheringham, Charlton and Brunsdon, 1998). Further, according to Fotheringham, Brunsdon and Charlton (2002), AIC can be used for selecting the true model from the competing models. The model with the smallest AIC value provides a better fit and the models are genuinely different if the improvement is greater than 3.

While the method of GWR allows for calibrating local parameters, it has a number of limitations. First, GWR regression estimates are sensitive to weighting schemes and bandwidth selection, and sample size. This often leads to less accurate estimates than OLS estimates. Second, the number of GWR coefficient estimates is large compared to the number of OLS estimates. Thus, it is not only computationally intensive, but also makes it difficult to report on all GWR estimates. Third, since samples overlap during the estimation and statistical analysis, the results should be treated with caution (see Ali, Partridge and Olfert, 2007; Li, et al., 2011).

Data for the study come from various sources. The raw, non-public single-unit firm births data are from the Census Bureau (CB). For 2006, the county level dataset contains single-unit firm births across the five-digit North American Industry Classification System (NAICS). The Federal Communications Commission (FCC) provides the number of high-speed service providers by zip codes. The raw data includes the number of holding companies that reported providing high-speed Internet service to at least one customer in the zip code of interest. If there are one to three companies reporting services to at least one customer in a zip code, the FCC does not report the number of service providers in that particular zip code, but indicates some provision exists.

The number of service providers at each zip code will be matched to its respective county by using the information on Zip Code Tabulation Area

(ZCTA). The online tool called Dexter provided by Missouri Census Data Center (MCDC) is used for matching zip codes and ZCTAs. Assuming that new firms will have a wide range of broadband choices in terms of price and services, for the provision of broadband in each county, the maximum number of broadband provider for 2006 will be used as the proxy for broadband access.

Population growth is the percentage change in population and personal income growth in the percentage change in per capita income from 2005 to 2006. Both of these indicators are obtained from the Bureau of Economic Analysis (BEA). Mean establishment size is the average number of employees in a firm in 2006 and is obtained from the CB. Other variables obtained from the CB include per capita deposit in dollars in local commercial and savings institutions in 2005 and serves as a proxy for locally available financial capital; per capita federal spending in dollars in 2006 indicates an additional source of capital; and the share of white population as a percentage of total population in 2006 is our negative proxy for diversity.

The unemployment rate, which is the share of unemployed labor force in percentage, is for 2006 and is obtained from the Bureau of Labor Statistics (BLS). Rural-urban continuum, which is available from the United States Department of Agriculture (USDA), is a categorical variable based on population size and ranges from 1 to 9. A dummy variable "metro" will be created using this categorical variable to separate metro (1 to 3) and nonmetro (4 to 9) counties.

Tab. 1 summarizes variables, their descriptions, expected signs based on research hypotheses, and data sources. Since firm births and the number of maximum providers are highly skewed, they are converted to their logarithmic equivalents and denoted by "logsub" and "logmxprov," respectively, in the OLS and GWR models.

Table 1 – Variable description

Variable	Description	Expected sign	Source
Dependent variable			
Firm birth (sub)	Number of single-unit firm births in 2006		
Independent variables			
Broadband providers (mxprov)	Maximum number of broadband service providers in 2006	+	FCC
Population growth (popgr)	Population change from 2005 to 2006 (in percentage)	+	BEA
Personal income growth (perincgr)	Per capita income change from 2005 to 2006 (in percentage)	+	BEA
Establishment size (estsize)	Mean number of employees in a firm in 2006	–	CB
Unemployment rate (unemprt)	Share of unemployed labor force in 2006 (in percentage)	?	BLS
Financial capital (fincap)	Per capita deposit in local commercial and savings institutions in 2005 (in thousand dollars)	+	CB
Federal spending (fedspnd)	Per capita federal spending in 2006 (in thousand dollars)	?	CB

Variable	Description	Expected sign	Source
White (white)	Share of whites in total population in 2006 (in percentage)	–	CB
Rural-urban continuum (metro)	Rural-urban classification based on population size (1 = metro counties and 0 = nonmetro counties)	+	USDA

4 EMPIRICAL FINDINGS

In an earlier study (Parajuli and Haynes, 2012), eight states – Colorado, Florida, Montana, New Jersey, Ohio, Oregon, South Carolina, and Wisconsin – were randomly sampled from the 48 contiguous U.S. states. In the aggregate level analysis, the association between the total number of new firm births and the maximum provision of broadband was examined using multiple regression models. Total new firm births in each sampled state were also disaggregated by the 2-digit NAICS codes and the same set of hypotheses was tested for the manufacturing (NAICS 31-33), finance and insurance (NAICS 52), and real estate and rental and leasing (NAICS 53) sectors. In general, the association between single-unit firm births and the provision of broadband was positive and statistically significant across sampled states at the aggregate and economic sector levels. Because of the space and data limitation, this paper only presents analyses of Florida and Ohio at both the aggregate and economic sector levels. Sectoral analyses are carried out for the construction (NAICS 23) and retail trade (NAICS 44-45) sectors.

In 2006, the association between new firm formation and the maximum number of service providers that reported providing high-speed (Internet) service to at least one customer for Florida and Ohio was 0.6572 and 0.5052, respectively, and that these values were statistically significant at the 5 % level of significance. As an example, in Florida, while Broward, Hillsborough, Miami-Date, and Seminole counties had the largest number of operators (19), Franklin County had at most five operators providing services to at least one customer. The counties with a large number of service providers also experienced a large number of new firm births – 7,571 (Broward), 3,770 (Hillsborough), 9,793 (Miami-Dade), 1,733 (Seminole). On the contrary, Franklin County had only 29 new firm births.

Table 2 – Multiple regression models, Aggregate (Source: Authors' calculations)

	OLS (Florida)	OLS (Ohio)
logmxprov	3.7655***	0.7714**
	(0.3198)	(0.3509)
popgr	0.0336	0.1042
	(0.0331)	(0.0754)
perincgr	-0.0007	0.0538
	(0.0321)	(0.0423)
estsize	-0.0451***	-0.0594***
	(0.0167)	(0.0169)

	OLS (Florida)	OLS (Ohio)
unemprt	0.0271	-0.1353**
	(0.1123)	(0.0648)
fincap	0.0401**	-0.0112
	(0.0162)	(0.0165)
fedspnd	-0.0464*	-0.0230
	(0.0271)	(0.0149)
white	-0.0035	-0.0890***
	(0.0081)	(0.0149)
metro	0.1138	0.6085***
	(0.2127)	(0.1507)
Constant	-2.7391**	12.9785***
	(1.2385)	(2.1863)
Observations	67	88
Adjusted-R2	0.9062	0.7696
Significant at *$p < 0.1$ level, **$p < 0.05$ level, and *** $p < 0.01$ level; Standard errors in parentheses.		

As shown in Tab. 2, in Florida, after controlling for other variables, for a 1 % increase in the provision of broadband services, there was almost 3.8 % increase in the single-unit firm births. In Ohio, the estimated coefficient of the maximum number of providers was positive and statistically significant, but the association between new firm formation and the provision of broadband was relatively smaller compared to Florida. Since the coefficient estimates are consistent with the expectation, this suggests that new firms are attracted to regions that have broadband provision.

The significance of other coefficient estimates, however, varies across models. In Florida, the mean establishment size is negative and statistically significant. These findings are consistent with Armington and Acs (2002) and Fritsch and Falck (2002). The coefficient of the availability of financial capital is positive and of federal spending is negative and statistically significant. Sutaria and Hicks (2004) had found a positive relationship between local bank deposit per capita and new firm formation. Although our expectation with the association between federal spending and new firm births was indeterminate, we found a negative and statistically significant association between them. This could have resulted due to the availability of well-paid jobs in the government sector, complacency among individuals due to grants and retirement spending, or crowding out of private investment by government spending as noted by Hamilton (2000) and Spencer and Yohe (1970).

In Ohio, mean establishment size, unemployment rate, and "white" as a proxy of diversity, were negatively associated with single-unit firm births. Our findings are consistent with Sutaria and Hicks (2004) in relation to financial capital and Audretsch, Dohse and Niebuhr (2010) and Lee, Florida and Acs (2004) in relation to diversity and new firm formation. Although the expected sign of the coefficient of unemployment rate was not obvious, it was found that in Ohio

there is a negative relationship between unemployment rate and new firm births and this finding is consistent with Sutaria and Hicks (2004).

In order to examine spatial heterogeneity, GWR models were calibrated using the *spgwr* package in R. Bandwidth of the fixed Gaussian kernel function was selected using the cross-validation approach and AIC scores were used for comparing the fit of models.

Table 3 – OLS and GWR models, Aggregate, Florida (Source: Authors' calculations)

	OLS	**GWR**				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	3.7655***	3.3400	3.7570	3.7020	3.8470	3.9730
popgr	0.0336	0.0294	0.0314	0.0329	0.0354	0.0372
perincgr	-0.0007	-0.0117	0.0012	0.0094	0.0190	0.0265
estsize	-0.0451***	-0.0529	-0.0515	-0.0483	-0.0454	-0.0412
unemprt	0.0371	-0.0144	0.0232	0.0406	0.0483	0.0533
fincap	0.0401**	0.0319	0.0327	0.0335	0.0351	0.0408
fedspnd	-0.0464*	-0.0522	-0.0390	-0.0352	-0.0337	-0.0284
white	-0.0035	-0.0183	-0.0071	-0.0032	0.0006	0.0055
metro	0.1138	0.0880	0.1059	0.1219	0.1444	0.2199
Constant	-2.7391**	-2.8350	-2.7180	-2.6520	-2.5180	-1.6750
Observations	67	67				
Number of nearest neighbors		3				
AIC	116.55	98.68				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

Tab. 3 shows the results of OLS and GWR models at the aggregate level for Florida. Based on cross-validation, it was found that for a regression point i only three nearest neighbouring counties have non-zero weights and that the weight decrease with the distance. Unlike the global OLS estimates, GWR estimates vary across counties. For instance, the global estimate of the provision of broadband is 3.76. However, the local estimates based on GWR vary from 3.34 to 3.97 and is shown in Fig. 1. Similarly, the goodness-of-fit values of the GWR model vary across counties and are shown in Fig. 2.

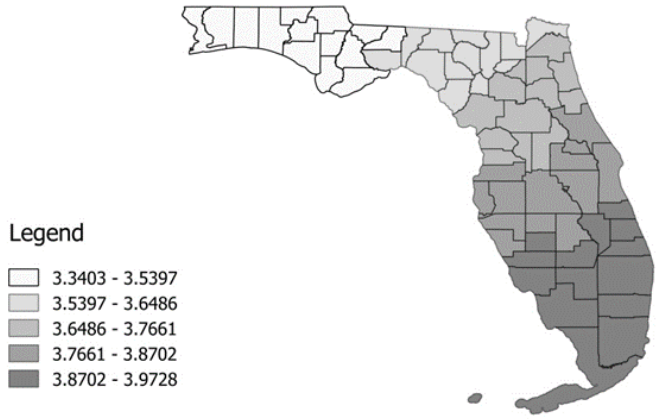

Figure 1 – GWR estimates of the provision of broadband, Aggregate, Florida (Source: Authors' calculations)

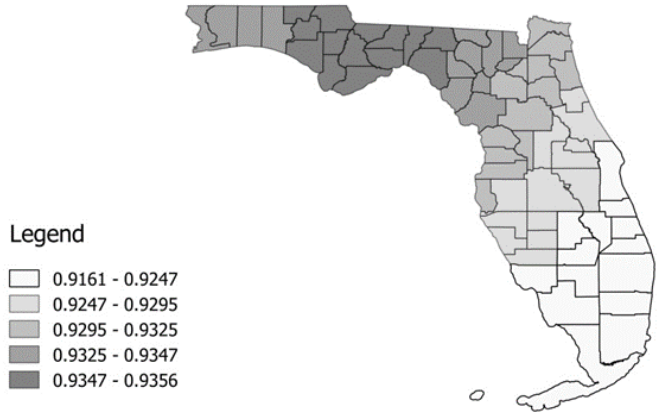

Figure 2 – Local R-squared values, Aggregate, Florida (Source: Authors' calculations)

The AIC value of GWR model (98.68) is smaller than the AIC value of OLS model (116.55). Thus, GWR model does not only reveal the local heterogeneity, but also provides a better fit compared to OLS model.

Tab. 4 shows the OLS and GWR estimates of Ohio at the aggregate level. As with the estimates of Florida, the GWR estimates of Ohio vary across counties. The larger AIC value of GWR model compared to OLS model suggests that GWR provides a better fit.

Table 4 – OLS and GWR models, Aggregate, Ohio (Source: Authors' calculations)

	OLS	GWR				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	0.7714**	0.1891	0.6316	0.9209	1.2590	1.7950
popgr	0.1042	-0.0430	0.0405	0.0980	0.1421	0.1986
perincgr	0.0538	0.0251	0.0451	0.0622	0.0961	0.1365
estsize	-0.0594***	-0.0642	-0.0560	-0.0484	-0.0432	-0.0379
unemprt	-0.1353**	-0.2228	-0.1824	-0.1272	-0.1042	-0.0360
fincap	-0.0112	-0.0201	-0.0127	-0.0098	-0.0077	-0.0033
fedspnd	-0.0230	-0.0629	-0.0281	-0.0179	-0.0152	-0.0005
white	-0.0880***	-0.0983	-0.0944	-0.0884	-0.0811	-0.0766
metro	0.6085***	0.2746	0.4292	0.4887	0.5303	0.6540
Constant	12.9785***	9.9850	11.1300	12.1100	13.2600	15.0900
Observations	88	88				
Number of nearest neighbors		1				
AIC	152.07	120.67				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

The results of OLS and GWR models for the construction sector of Florida are shown in Tab. 5. The fixed Gaussian kernel function gives non-zero weights for two nearest neighbours. In addition, the AIC of the GWR model (104.81) is smaller than that of OLS model (122.64), which suggests that the GWR model provides a better fit compared to OLS model.

Table 5 – OLS and GWR models, Construction, Florida (Source: Authors' calculations)

	OLS	GWR				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	3.4271***	3.3460	3.3600	3.3660	3.3800	3.3930
popgr	0.0539*	0.0452	0.0493	0.0540	0.0590	0.0683
perincgr	0.0162	-0.0102	0.0103	0.0205	0.0356	0.0565
estsize	-0.0537***	-0.0731	-0.0625	-0.0536	-0.0454	-0.0333
unemprt	-0.0938	-0.1058	-0.0813	-0.0762	-0.0706	-0.0619
fincap	0.0176	0.0097	0.0116	0.0155	0.0208	0.0317
fedspnd	-0.0291	-0.0409	-0.0359	-0.0337	-0.0309	-0.0275
white	0.0067	-0.0057	0.0038	0.0070	0.0101	0.0125
metro	0.3672	0.3435	0.3637	0.3722	0.3786	0.3912
Constant	-3.8443***	-4.9560	-4.3500	-3.8260	-3.2680	-1.9810
Observations	67	67				
Number of nearest neighbors		2				
AIC	122.64	104.81				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

For the logarithm of the maximum number of providers, the OLS estimate is 3.4271. The GWR estimators, however, range from 3.346 to 3.393 and each county has its own estimator as shown in Fig. 3. Since the OLS estimate is larger than the GWR estimates, it suggests that OLS overestimated the coefficient of the provision of broadband. The local goodness-of-fit values are shown in Fig. 4. These values are not directly comparable with the global R-squared value, but still suggest the variation in new firm formation explained by the independent variables in the GWR model.

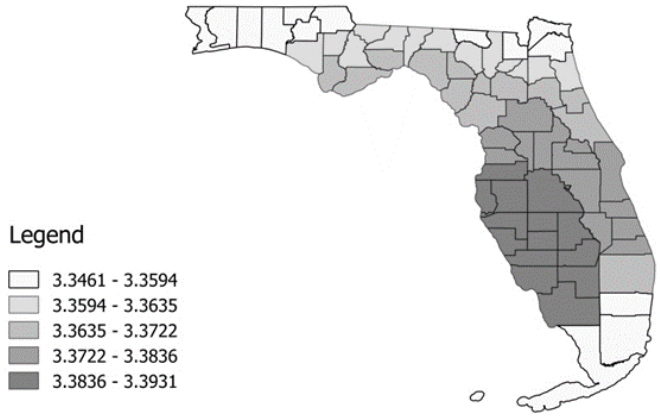

Figure 3 – GWR estimates of the provision of broadband, Construction, Florida (Source: Authors' calculations)

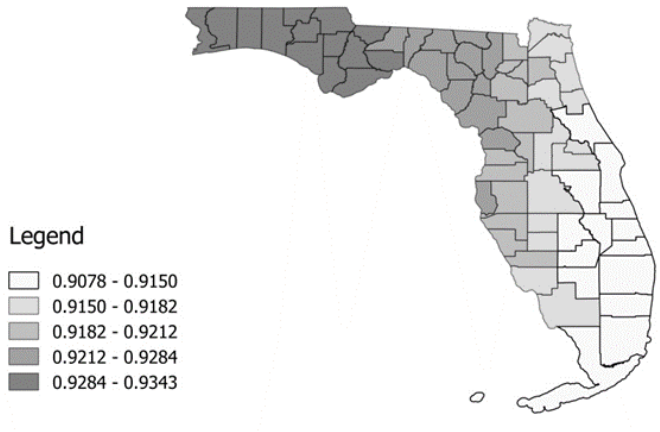

Figure 4 – Local R-squared values, Construction, Florida (Source: Authors' calculations)

Similarly, for the retail trade sector of Florida, the results of OLS and GWR models are shown in Tab. 6. While the OLS coefficient estimate is 3.8803, the GWR estimates of the logarithm of the maximum number of providers ranges

from 3.5630 to 4.1510. The AIC value of 130.40 associated with the GWR model suggests that it is a better fit in explaining the variation in single-unit firm births compared to the OLS model. Fig. 5 and Fig. 6 show the distribution of the GWR coefficient estimates of the service provision and local goodness-of-fit, respectively. As before, both these figures suggest that estimators and R-squared values vary spatially.

Table 6 – OLS and GWR models, Retail trade, Florida (Source: Authors' calculations)

	OLS	**GWR**				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	3.8808***	3.5630	3.6890	3.8080	3.9740	4.1510
popgr	0.0445	0.0270	0.0344	0.0405	0.0525	0.0705
perincgr	-0.0258	-0.0292	-0.0214	-0.0182	-0.0160	-0.0147
estsize	-0.0356*	-0.0471	-0.0442	-0.0407	-0.0348	-0.0285
unemprt	0.0689	0.0153	0.0562	0.0736	0.0838	0.0907
fincap	0.0490**	0.0374	0.0390	0.0403	0.0434	0.0558
fedspnd	-0.0534	-0.0560	-0.0510	-0.0444	-0.0400	-0.0303
white	-0.0097	-0.0193	-0.0103	-0.0080	-0.0074	-0.0071
metro	0.0501	-0.0580	-0.0166	-0.0267	0.0981	0.3034
Constant	-4.9709***	-5.0650	-4.9310	-4.8000	-4.6480	-4.9709
Observations	67	67				
Number of nearest neighbors		4				
AIC	146.04	130.40				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

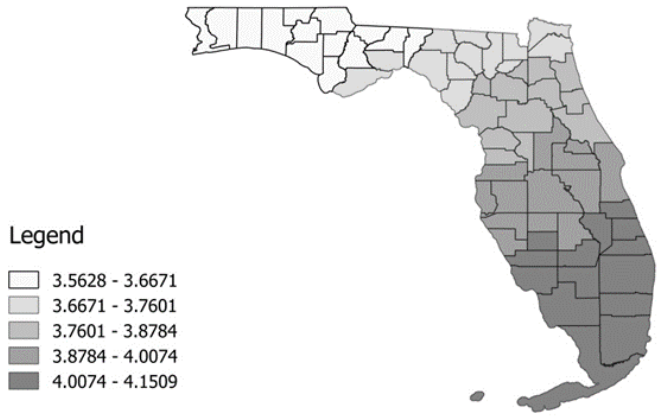

Figure 5 – GWR estimates of the provision of broadband, Retail trade, Florida (Source: Authors' calculations)

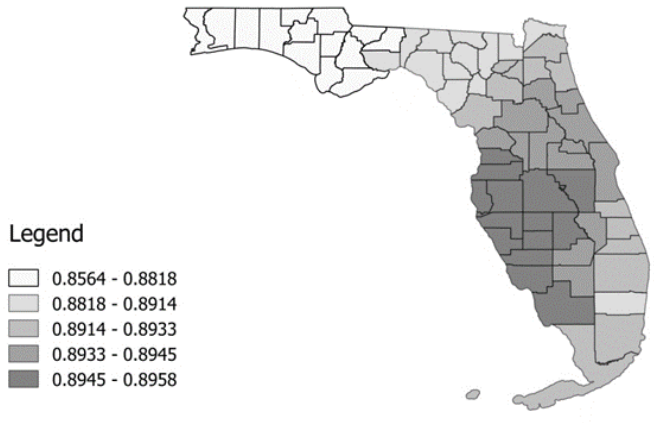

Figure 6 – Local R-squared values, Retail trade, Florida (Source: Authors' calculations)

Table 7 – OLS and GWR models, Construction, Ohio (Source: Authors' calculations)

	OLS	**GWR**				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	0.1988	-0.3334	-0.0197	0.2690	0.9449	1.8580
popgr	0.0359	-0.1976	-0.0659	0.0456	0.1178	0.1637
perincgr	-0.0045	-0.0253	-0.0038	0.0135	0.0277	0.0664
estsize	-0.0485**	-0.0572	-0.0440	-0.0334	-0.0262	-0.0146
unemprt	-0.2260***	-0.3794	-0.2871	-0.1994	-0.1614	-0.1015
fincap	-0.0030	-0.0146	-0.0052	0.0008	0.0069	0.0132
fedspnd	-0.0274	-0.0492	-0.0343	-0.0292	-0.0176	0.0391
white	-0.0780***	-0.0931	-0.0874	-0.0790	-0.0628	-0.0502
metro	0.8290***	0.3957	0.6058	0.7360	0.7850	0.8379
Constant	11.6452***	5.7290	8.5370	11.0600	12.1400	13.0100
Observations	88	88				
Number of nearest neighbors		1				
AIC	191.16	156.04				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

Table 8 – OLS and GWR models, Retail trade, Ohio (Source: Authors' calculations)

	OLS	**GWR**				
		Min.	1st quar.	Median	3rd quar.	Max.
logmxprov	1.0514**	0.6087	0.8139	1.1050	1.4860	2.0620
popgr	0.0691	-0.0866	0.0042	0.0634	0.1048	0.1437
perincgr	0.0551	0.0349	0.0625	0.0837	0.1141	0.1391
estsize	-0.0552**	-0.0687	-0.0551	-0.0491	-0.0412	-0.0247

	OLS	GWR				
unemprt	-0.0368	-0.1334	-0.0937	-0.0352	-0.0024	0.0197
fincap	-0.0232	-0.0534	-0.0258	-0.0217	-0.0177	-0.0106
fedspnd	0.0150	-0.0526	0.0039	0.0162	0.0277	0.0599
white	-0.0844***	-0.0910	-0.0887	-0.0859	-0.0773	-0.0704
metro	0.5830***	0.1798	0.3252	0.4137	0.5164	0.6914
Constant	9.0597***	6.0210	7.7570	8.6996	9.2700	10.1200
Observations	88	88				
Number of nearest neighbors		2				
AIC	203.53	180.72				
Significant at $^{*}p < 0.1$ level, $^{**}p < 0.05$ level, and $^{***}p < 0.01$ level						

Tabs. 7 and 8 show the results of OLS and GWR models of the construction and retail trade sector of Ohio, respectively. These results also suggest that, unlike the global estimates given by the OLS modelling approach, GWR gives locally-varying coefficient estimates. In both the case, GWR models provide a better fit than OLS models.

5 CONCLUSION

This paper examined spatial heterogeneity in relation to broadband Internet and new firm formation using GWR models. The estimates of GWR models were able to capture the spatially-varying effects, which indicated that firm formation and broadband provision are non-stationary. In addition, it was also found that the local models provided better fit compared to the global OLS models at both the aggregate and economic sector levels.

In today's informational economy, while infrastructure such as broadband Internet is important for attracting new firms, which create jobs and contributed to the overall economy, the association between broadband and new firm formation varies spatially. Thus, policy makers need to take into account the local spatial dynamics that are not revealed at the global level while formulating broadband and economic development policies.

In this paper, AIC scores were used for selecting the true model. Based on AIC GWR models were found to be better fits than OLS models, but their differences were not statistically determined. Future research should statistically assess such differences. In addition, new studies should also focus on examining spatial dynamics of broadband Internet and new ventures in other states in the U.S. This would reveal whether or not other states exhibit spatial non-stationary as observed in Florida and Ohio. Spatial regression models, such as spatial lag, spatial error, and spatial Durbin models, can also be calibrated to examine spatial dependence and spillovers.

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Multicriteria Tools for the Implementation of Historic Urban Landscape

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ABSTRACT

Purpose: The aim of this paper is to provide an overview and critical outlook of current evaluation tools for the implementation of the UNESCO Historic Urban Landscape (HUL) approach, focusing on the need of multidimensional / multistakeholder evaluation and impact assessment to turn heritage / landscape into a driver of sustainable development.

Methodology/Approach: We analyse the definition of Historic Urban Landscape comparing the thoretical mandate to current tools / practices. Based on literature review and critical analysis of recent experiences, we identify indicators categories and evaluation methods that can be applied for a reacher cost-benefit analysis.

Findings: Indicators and evaluation methods for multidmensional impact assessment of conservation / regeneration are not applied in HUL recent initiatives and guidelines. Evaluation tools can be developed and tested to inform decision-making processes and to turn the cultural value of heritage / landscape into a resource able to attract investments. A framework for HUL impact assessment can be structured including wellbeing indicators and stakeholders analysis.

Research Limitation/implication: New hybrid tools are proposed, providing a possible toolkit for evaluation. However, it needs further testing and implementation.

Originality/Value of paper: This paper contributes to bridging the gap between the theoretical approach of the Historic Urban Landscape and its operative practice. The HUL approach has been generally acquired in the theoretical research, but its implementation is still sporadic, and unframed into urban regeneration policies. Evaluation tools are not incorporated in the HUL practices.

This paper aims to advance the existing knowledge on evaluation tools to make operational the HUL approach.

Category: Research paper

Keywords: Historic Urban Landscape; evaluation tools; impact assessment; cost-benefit analysis; multidimensional indicators

1 INTRODUCTION

Urban heritage conservation in rapid transformation contexts is a great challenge for today's cities (Bandarin and Van Oers, 2012; Bandarin and Van Oers, 2014). There is an urgent need of adequate services and infrastructure for millions of people expected to migrate to urban areas in the next decades.

Cities can be engines of economic growth of regions and countries, but also places of poverty, social segregation and fragmentation of relationships, diseconomies and pollution (Fusco Girard, 2014a). Recent outcomes of international meetings and working groups on urban sustainable development highlight the role that cultural heritage can play in enhancing living conditions, social cohesion and cultural diversity in cities, thus contributing significantly to wellbeing and prosperity (European Commission, 2014; United Nations, 2015; UNESCO, 2015). Conservation and regeneration of urban heritage could be considered a key investment for sustainable local development (Licciardi and Amirtahmasebi, 2012; Van Balen and Vandesande, 2016), but sound methods and tools for the evaluation of the economic and social / environmental impacts of heritage-led urban regeneration are still lacking (Ginsburgh and Throsby, 2014; Throsby, 2016).

The 2011 UNESCO Recommendation on the Historic Urban Landscape (UNESCO, 2011) recognize the need of supporting the protection of cultural and natural heritage in rapid and uncontrolled urbanization contexts, integrating the notion and value of transformation in heritage integrated conservation strategies.

The definition of Historic Urban Landscape (HUL) considers the "historic layering of cultural and natural values and attributes, extending beyond the notion of 'historic centre' or 'ensemble' to include the broader urban context and its geographical setting" (Art. 8). It includes "perceptions and visual relationships", "social and cultural practices and values, economic processes and the intangible dimensions of heritage as related to diversity and identity" (Art. 9). The intangible social and cultural dimension of urban heritage/landscape, the "atmosphere" and sense of place as perceived and created by local communities (past and present ones) contribute to the productivity of cities in a broad and multidimensional sense.

The HUL approach aims at "preserving the quality of the human environment, enhancing the productive and sustainable use of urban spaces, while recognizing their dynamic character, and promoting social and functional diversity" (Art. 11).

It introduces a paradigm shift from conservation as a "value in itself", to conservation as a "tool" for managing change while preserving cultural values. HUL advocates the development of tools to "manage physical and social transformations and to ensure that contemporary interventions are harmoniously integrated with heritage in a historic setting" (Art. 12): innovative civic engagement, knowledge and planning tools, financial tools and regulatory systems (Art. 24).

The assessment of multidimensional impacts of HUL conservation / regeneration on city productivity is fundamental to demonstrate the effectiveness of proposed tools, to inform policy design and leverage private and public investments.

The objective of this paper is to provide an overview and critical outlook of current evaluation tools for the implementation of the UNESCO Historic Urban Landscape approach, towards a comprehensive framework for impact assessment of HUL conservation / regeneration. Section 2 provides a critical overview of existing tools, briefly analysing recent experiences of HUL implementation. In Section 3 we identify indicators categories and evaluation tools for multidimensional / multistakeholder impact assessment. Section 4 provides a critical discussion and open questions, proposing a possible framework for HUL impact assessment.

2 EVALUATION TOOLS: THE NEED OF SPECIFIC APPROACHES

Cultural heritage can be an effective catalyst for stimulating local and regional economies, producing significant economic impacts (Nypan, 2006; Rypkema, 2008).

The recent HUL Guidebook highlights that "successful management of urban heritage in complex environments demands a robust and continually evolving toolkit" (UNESCO, 2016, p.14). The guidelines identify specific tools based on the 2011 Recommendations: community engagement tools (Planning, GIS, Big data, Morphology, Impact / vulnerability assessment, Policy assessment), knowledge and planning tools (Publicity, Dialogue and consultation, Community empowerment, Cultural mapping), regulatory systems (Laws and regulations, Traditional custom, Policies and Plans), financial tools (Economics, Grants, Public-private cooperation).

Evaluation tools are not included between these tools. Evaluation processes should be considered in this framework as an additional fundamental category of management tools, currently almost unexplored in the field of HUL regeneration. They are necessary to manage the complex balance of conservation and development needs in Historic Urban Landscapes.

Tab. 1 shows six critical steps to facilitate the implementation of the HUL approach, highlighting the need of possible evaluation tools in each stage.

Sectorial tools have been recently developed for heritage assessment, such as the ICOMOS Guidance for Heritage Impact Assessment (HIA) (ICOMOS, 2011), which provides a framework for the assessment of the impacts of urban transformations "on" the cultural value of properties.

The HIA Guidance has been applied in many cases (Pereira Roders and Van Oers, 2012) but it excludes the economic and social dimension of heritage regeneration. The HIA remains a sectorial framework unable to address the complex challenges of integrated impact assessment (Morrison-Saunders, et al., 2014; Pope, et al., 2013; Fusco Girard, et al., 2015).

Fig. 1 shows two possible approaches to impact assessment: impacts "on" the cultural value and the impacts "of" HUL for the enhancement of city productivity.

Table 1 – Six steps for making operational the Historic Urban Landscape approach - adapted from the HUL Guidebook (Source: UNESCO (2016))

Phases	**Activities**	**Possible proposed evaluation tools**
1. Identify Resources	Mapping and survey of cultural and natural resources	Spatial evaluation tools, surveys, community involvement tools
2. Identify Attributes and Values	Involve stakeholders and experts in the identification of attributes and values of cultural and natural heritage	Multistakeholder and multidimensional tools / approaches (through Living Lab processes)
3. Understand vulnerability	Assess vulnerability of heritage to socio-economic stresses and climate change	Multicriteria evaluation tools
4. Planning and design for conservation / regeneration	Identify heritage sensitivity areas and develop regeneration projects	Spatial evaluation tools Evaluation approaches for the assessment of attractiveness
5. Prioritize	Identify and prioritize actions for conservation and development	Multidimensional, multicriteria and multistakeholder evaluation tools, cost-effectiveness and benefit analysis
6. Realize	Establish partnerships and local management frameworks for each project	Monitoring tools Financial tools Cost-benefit analysis New management / economic / business models

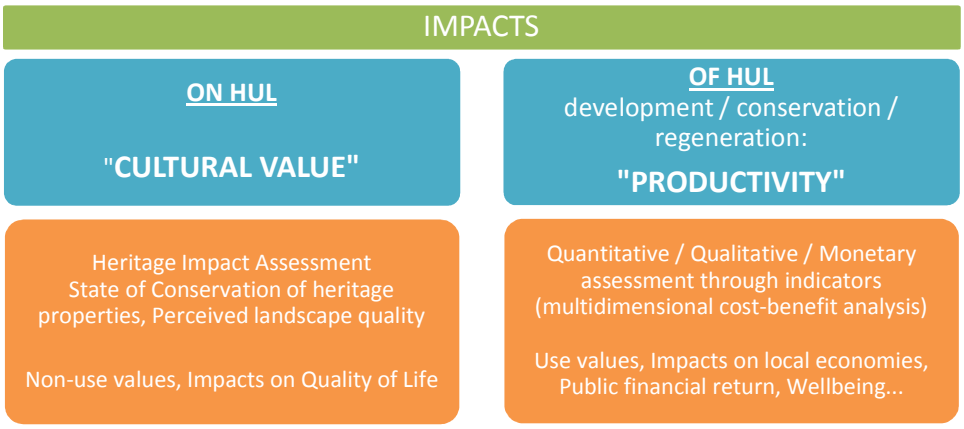

Figure 1 – Impacts of HUL conservation / regeneration on cultural value and overall city productivity

A similar approach has been adopted by UNESCO State of Conservation reports, which identify major threats to World Heritage properties (UNESCO, 2014). Buildings and development, social/cultural uses of heritage (such as tourism pressure) and transportation infrastructures represent threats to World Heritage properties. However, housing and public space enhancement, compatible heritage use and infrastructure can represent also key factors of sustainable development: it is only through the "project" that potential threats can be turned into social, cultural, environmental and economic benefits for communities, exploiting the full potential of HUL as a driver for sustainable growth, taking into account stakeholder and end-users needs/preferences. Adaptive re-use projects, new management and business models can enhance city productivity through HUL regeneration.

2.1 Historic Urban Landscape evaluation: recent experiences

The HUL Guidebook includes 8 case studies and best practice of HUL implementation: Ballarat, Australia; Shanghai, China; Suzhou, China; Cuenca, Ecuador; Rawalpindi, Pakistan; Zanzibar, Tanzania; Naples, Italy; Amsterdam, Netherlands. Only in few cases (Cuenca, Rawalpindi, Amsterdam) assessment methods has been proposed and experimented.

In the case of Cuenca, urban landscape units have been identified based on participative landscape quality assessment. Cultural values, heritage resources, recommendations and necessities of each unit has been the main output of the methodology.

In Rawalpindi, a vulnerability assessment has been carried out based on the outcomes of participative meetings and seminars and street level consultation. The result has been an understanding of the values of the historic city and the attributes which need to be safeguarded. Assessment of the vulnerability of these

attributes to socio-economic pressures has been carried out focusing on built heritage, traditional occupations and bazaar resilience, cultural diversity and the religious landscape.

In Amsterdam, a more sophisticated taxonomy-based (classification) policy analysis tool has been applied to understand how urban policies in Amsterdam are being applied and used in relation to HUL. The tool has four taxonomy dimensions: attributes (what), values (why), actors (who), process (how). A matrix of "cross-relating taxonomy" has been used to analyse the different approaches of workshops' participants, mainly heritage and urban officers, to heritage regeneration.

These experiences have been focused on the assessment of characters and values of historic urban landscape, involving local communities and specific groups of stakeholder for vulnerability assessment and proposal of strategic action. In all these cases, the impacts of conservation / regeneration have not been addressed.

3 TOWARDS A FRAMEWORK FOR MULTIDIMENSIONAL IMPACT ASSESSMENT OF HISTORIC URBAN LANDSCAPE

Multicriteria, multidimensional and multistakeholder evaluation methods and sophisticated quantitative-qualitative indicators are needed to hybridize in a creative way tradition and modernity, memory and current action, conservation and transformation, turning the cultural value into a resource of city productivity.

Cost-benefit analysis can provide critical evidence base of the benefits of conservations vs. development, but multidimensional categories of costs and benefits should be introduced. Economic matrix is necessary, but not sufficient to assess the impacts of projects and investments in multiple dimensions. New tools for integrated cost-benefit analysis should be implemented to make operational the HUL approach (Ost, 2013; Fusco Girard, 2014b; De Rosa and Nocca, 2015; Garcia Vélez, et al., 2016).

Fusco Girard, et al. (2015) identify six categories of impact to assess the "productivity" of HUL conservation / regeneration, and thus the multidimensional benefits produced: Tourism and recreation, Creative and innovative activities, Typical local productions, Environment and Natural Capital, Community and social cohesion, Real estate. The cultural value of properties / landscape is introduced as a complex indicator based on the Heritage Impact Assessment matrix.

These comprehensive impact categories can be further integrated considering two key aspects of HUL regeneration: (1) the enhancement of wellbeing / welfare of communities and (2) financial returns of public investments.

A set of synthetic, measurable indicators is necessary to structure a comprehensive framework for a robust and richer cost-benefit / effectiveness analysis. The aim is to produce practical evidence of the cultural, economic,

social and environmental benefits of HUL conservation / regeneration, assessing the economic, environmental and social return on investments based on quanti-qualitative and economic analysis.

Evaluation tools for cultural heritage have undergone vast improvement in recent years (Rypkema, 2008; Ginsburgh and Throsby, 2014; Throsby, 2016). However, multidimensional cost-benefit analysis still have to be developed and tested. Sound methodology and good data are needed to assess the impacts generated by heritage conservation, considering market and non-market values (Vernieres, et al., 2012). To achieve this and promote evidence base for informed policies and investments in Historic Urban Landscape regeneration, existing barriers between disciplines must be overcome and integrated approaches developed.

Tab. 2 shows a proposal of indicator categories related to the multidimensional impacts identified.

Table 2 – Categories of impact of HUL conservation / regeneration and categories of indicators (Source: Adapted from Fusco Girard, et al. (2015))

CATEGORY of IMPACTS	CATEGORIES of INDICATORS
Tourism and Recreation (cultural events and resident's use of heritage)	Tourism demand / supply (direct use of heritage)
	Residents demand (direct use of heritage)
	Cultural facilities, services and events demand / supply
	Tourism facitilities, retail and services demand / supply
	Employment in tourism sector
Creative and cultural / innovative activities	Growth of Creative Industries
	Employment in the Creative Economy
Typical food&beverage local productions	Market value of typical food&beverage products
	Growth of food&beverage companies
	Employment in the typical food&beverage industry
Environment and Natural Capital (natural heritage, cultural landscapes)	Green areas and facitilies use / supply
	Economic value of Ecosystem / Landscape Services (direct use values: provisioning services)
	Energy savings
	Ecosystem preservation - Economic value of Ecosystem / Landscape Services (indirect use values: support services, regulating and maintenance services)
Community and Social Cohesion	Sharing / Collaborative economy
	Donations for heritage conservation
	Social care
	Social cohesion
Real estate	Real estate values
	Urban growth (infrastructure, land use change, public space enhancement)
	Urban renewal (restoration, adaptation of historic buildings, reduction of vacancy rates)
	Employment in real estate sector

CATEGORY of IMPACTS	CATEGORIES of INDICATORS
Welfare / wellbeing	Poverty alleviation
	Sanitation
	Crime reduction
	Improved public safety (perceived)
	Improved wellbeing (perceived)
	Improved cultural benefit (perceived)
	Landscape quality (perceived)
Public financial return	Fiscal revenues
	Attraction of private investments
Cultural value of properties / landscape	State of conservation
	HIA synthetic indicator (1 to 5 value)
	Intrinsic value
	Economic value of Ecosystem / Landscape Services (cultural services – non use values)

Indicators for the assessment of tourism and real estate impacts have been implemented in many experiences, while indicators of environment and natural capital, community and social cohesion, public financial return, welfare/wellbeing still need further research and case study testing. We focus here on wellbeing indicators recently developed and tested in Italy.

Stakeholders' analysis should be integrated in the framework. We analyse the method of Community Impact Evaluation towards a comprehensive framework that takes into account costs and benefits for all stakeholder groups in the perspective of effective HUL management.

3.1 BES indicators of Sustainable and Equitable Wellbeing

The indicators of "Sustainable and Equitable Wellbeing" (BES) have been developed by the Italian National Institute for Statistics providing annual reports at the national and city level (ISTAT, 2015a; ISTAT, 2015b). The BES framework identifies 12 domains of wellbeing and 134 indicators, monitored on an annual base using nationally aggregated data as well as local data. The BES project links with the international debate on "GDP and beyond" (Stiglitz, Sen and Fitoussi, 2009; Costanza, et al., 2009; European Commission, 2009; Bartelmus, 2014), the central idea is that economic parameters alone are inadequate to evaluate the progress of societies and should be complemented by social and environmental information and by measures of inequality and sustainability. The 12 domains of wellbeing are showed in Tab. 3.

Table 3 – BES Wellbeing domains (Source: Adapted from ISTAT (2015a))

The individual sphere	
1. Environment	5. Work - life balance
2. Health	6. Social relationships
3. Economic well-being	7. Safety
4. Education and training	8. Subjective well-being
The context	
9. Landscape and cultural heritage	11. Quality of services
10. Research and innovation	12. Policies and institutions

The BES framework explicitly includes the domain of "Landscape and cultural heritage" in the contextual indicators of wellbeing, an innovative approach compared to other well-established indexes developed worldwide such as: the Canadian Index of Wellbeing, Capability Index, the EU Set of Sustainable Development Indicators, European Benchmark Indicators, Genuine Progress Indicator, Happy Planet Index, Human Development Index, Index of Living Conditions, JFS Sustainability Vision and Indicators, MDG Dashboard of Sustainability, Millennium Development Goals Index, Sustainable National Income, World Happiness index, National Accounts of Well-Being (European Commission, 2016).

Tab. 4 reports the indicators used in the BES for the measurement of landscape and cultural heritage component of wellbeing. These include subjective and objective indicators, which data are collected through annual national surveys.

Table 4 – BES Landscape and cultural heritage indicators (Source: Adapted from ISTAT (2015a))

BES Domain 9. Landscape and cultural heritage indicators	
Objective indicators	Endowment of cultural heritage items
	Current expenditure of municipalities for the management of cultural heritage
	Illegal building rate
	Urbanization rate of areas subject to building restrictions by virtue of the Italian laws on landscape protection
	Erosion of farmland from urban sprawl
	Erosion of farmland from abandonment
	Presence of historic rural landscapes
	Presence of Historic Parks/Gardens and other Urban Parks recognized of significant public interest
	Conservation of historic urban fabric

BES Domain 9. Landscape and cultural heritage indicators	
Expert assessment	Quality assessment of regional programmes for rural development (PSRs), with regard to the landscape protection
Subjective indicators	People who are not satisfied with the quality of landscape of the place where they live
	Concern about landscape deterioration

The BES (national level), UrBES (city level) and Provincial BES experiences demonstrate how local-national data and subjective-objective indicators can be used in a comprehensive framework for the monitoring of multiple benefits of HUL regeneration.

3.2 Towards a Community Impact Evaluation (CIE) revised approach

The Community Impact Evaluation (CIE) has been proposed by Lichfield to allow for quantitative-qualitative impact evaluation of projects/programmes, considering costs and benefits to directly and indirectly involved stakeholder groups (Fusco Girard and Nijkamp, 1997; Lichfield, 2005). A revised CIE approach (Fusco Girard, et al., 2016) can be applied for the assessment of HUL regeneration projects, using matrices that include stakeholders categories and objectives / criteria / indicators related to project scenarios, integrating quantitative monetary and non-monetary data (hard data) with qualitative / perceptual data (soft data). Stakeholder analysis should include the categories of promoters and producers/operators (policy-makers, local authorities, private companies, workers, associations, project related businesses), as well as consumers/users (residents, visitors, local businesses). Ost (2012) identifies four main categories of stakeholders involved in heritage regeneration: residents; visitors; population at large; business, shops and services. Tab. 5 proposes a classification of stakeholders involved in HUL regeneration projects

Table 5 - Stakeholders categories involved in HUL regeneration projects (Source: Adapted from Ost (2012) and Lichfield (2005))

Category	Group
Promoters, Producers/Operators	Local authorities
	Developers/Financiers
	Conservation employees
	Construction industry employees
	Cultural associations
	Foundations
	Craftmen/farmers
	Tourism-related businesses
Consumers/Users	Local businesses / shops / street vendors
	Local owners

Category	Group
	Local residents / occupiers
	New residents
	Users of heritage
	Visitors / tourists
	Passers-by
	Heritage community
	Local community
	Community at large

The costs and benefits for each stakeholders group (other groups can be added based on the specific project/programme) should be assessed to process a comprehensive evaluation of development versus conservation/regeneration projects, in order to find possible balances between conflicting interests.

4 DISCUSSION AND CONCLUSIONS

Though some evaluation tools have been applied in institutional and academic contexts, more research has to be carried out to test effective evaluation tools to manage historic urban landscapes.

Community involvement, vulnerability assessment and mapping tools are necessary, but not sufficient to promote more informed decision making and investments in HUL conservation / regeneration. The experiences analysed show how cultural value can be assessed, but this value should be turned into a resource for economic, social and environmental local development.

Cost-benefit analysis has been processed in the case of World Bank heritage regeneration projects (Licciardi and Amirtahmasebi, 2012; Ginsburgh and Throsby, 2014; Throsby, 2016), UNESCO properties and other cases of investment in historic centres and cultural landscapes regeneration (Rypkema, 2008; De Rosa and Nocca, 2015; Ost, 2012; Gravagnuolo, 2015; Fusco Girard, et al., 2015). These experiences demonstrate the potential of HUL as a driver of sustainable development. However, a structured process for integrated impact assessment, community impact assessment and multidimensional cost-benefit analysis and has still to be implemented.

Fig. 2 shows how a comprehensive framework for impact assessment can be developed, considering the cultural value of HUL, the multidimensional categories of impact, BES indicators and the CIE methodology. The aim is to provide a knowledge base and empirical evidence for informed, effective and wise management of historic urban landscapes.

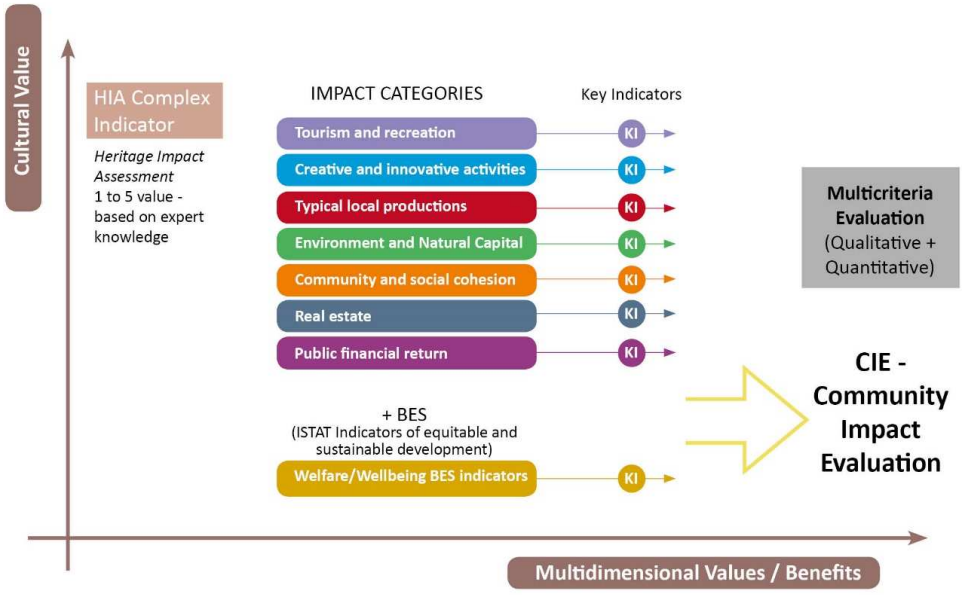

Figure 2 – Towards a comprehensive framework for impact evaluation of HUL conservation / regeneration (Source: Adapted from Fusco Girard, et al. (2015))

Effective, measurable and comparable indicators for HUL assessment should be developed, considering many open research questions:

1) the assessment of costs and benefits and assessment methods for each category of impact;
2) the need of objective, but also subjective indicators, which should be comparable throughout different countries and cultures;
3) the integration of quantitative and qualitative indicators, to assess the sustainability of the benefits produced;
4) the possibility to assess monetary values of non-economic indicators;
5) measurability and reliable / dynamic data sources at the national and regional / city level, and how to aggregate data;
6) stakeholders analysis and involvement in the evaluation process.

Evidence based, wise management of change should be supported by appropriate evaluation methods to promote urban planning and local development strategies that are cultural heritage-led, which enrich the ancient city in a way consistent with the vision of "good city" for all: that is a prosperous city, a “beauty” city, a city of fairness. This is a key dimension of sustainability, and is the way to achieve inclusion, safety, resilience.

The impact categories and methods proposed can represent a starting point for an integrated assessment framework to make operational the Historic Urban

Landscape approach producing evidence base on the contribution of cultural heritage to sustainable development and wellbeing.

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Evaluation of Urban Processes on Health in Historic Urban Landscape Approach: Experimentation in the Metropolitan Area of Naples (Italy)

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ABSTRACT

Purpose: Experimentally apply the Health Impact Assessment (HIA) to the Historic Urban Landscape (HUL) approach according to the socio-ecological model of the World Health Organisation (WHO), where health is defined as "a state of complete physical, mental and social wellbeing and not simply the absence of disease and illness" (1986).

Methodology/Approach: The methodology considers the application of HIA, a multi-criteria evaluation approach capable of organising knowledge concerning the effects that projects, plans and programmes impose upon the wellbeing/health of an urban community. The case study is the metropolitan area of Naples and it considers a system of evaluation to support the drafting of the new instrument for the territorial governance: the Territorial Metropolitan Plan.

Findings: The research has developed through the identification of the "social determinants of health" and in the construction of a set of indicators implemented in a Geographic Information System (GIS), able to identify and to cartographically represent homogeneous landscape units of health.

Research Limitation/implication: The virtuous connection between health and conservation, proposed in the method applied to the case study, is completely experimental because there are no other similar experiences in literature.

Originality/Value of paper: The paper opens a prospect of research for the better understanding of spatial phenomena, creating new tools based on new technologies.

Category: Research paper

Keywords: Health Impact Assessment; Historic Urban Landscape; regeneration; wellbeing; metropolitan planning

1 INTRODUCTION

The issues that affect individual and collective wellbeing/health, adopting a landscape approach to the historical context of the urban landscape (UNESCO, 2011, p.9), are transversal. Therefore, they invite the investigation of the impact on a multidimensional level. A state of complete physical, mental and social wellbeing means the combination of social, environmental and economic factors, affecting the subjective and objective perception of a "safe" life. In this way, it is able to produce conditions (Hancock, Labonte and Edwards, 2000) of liveability in the built and natural landscape; social conviviality (contentment with oneself and others); economic prosperity; sustainability of material resources; habitability of places and vitality of socio-economic relations and equality of rights.

These factors are identified in the literature as "social determinants" of health and they include "experiences of the first years of life, education, economic status, employment and decent work, housing and environment and effective systems for the prevention and treatment of diseases" (WHO, 2011, p.6). The typological interpretation of determinants is extensive and extremely complex, due to the nature of health, according to the subjective perception and objective experience of a population that lives and interacts in a historical urban area of "cultural and natural values and traits" (UNESCO, 2011, p.8).

Following this logic, the UNESCO approach regarding Historic Urban Landscape (HUL) represents an effective strategy to activate a process of urban regeneration, based on participatory governance of cultural heritage and able to convey the impact of urban multidimensional processes on human development (D'Auria, 2009).

"The Historic Urban Landscape approach aims at preserving the quality of the human environment and enhancing the productivity of urban spaces. It integrates the goals of urban heritage conservation with the goals of social and economic development. It is rooted in a balanced and sustainable relationship between the built and natural environment" (UNESCO, 2011, p.3, art.12).

Considering HUL from the perspective of the promotion of wellbeing/health means recognising not only use values but, as stated by Sen (1999), "that the income level is not an adequate indicator of important issues, such as the freedom to live a long time, the ability to escape from preventable diseases, the possibility of finding a decent job or to live in a peaceful community, free from crime". Therefore it must also consider a number of intrinsic values that contribute to the quality of life and motivate people's actions, opening the field of assessing the needs of social groups below the minimum income threshold, the needs of future generations, the natural environment and animal species, in line

with the conceptualisation of the Complex Social Value (Fusco Girard and Nijkamp, 1997).

The strategies to maintain or improve wellbeing/health represent an exceptional trigger point of regenerative community-based urban processes on which the HUL approach should rely, even before the targeted strategies for income, as the economic performance and the attraction of a landscape are closely linked and dependent on the quality of life and relations perceived therein (D'Auria and Monti, 2013).

2 THEORETICAL OVERVIEW

2.1 The multidimensional approach to wellbeing in the historical landscape: the "social determinants"

It is important, considering that the HUL approach impacts on wellbeing, to focus on all the factors (social, economic, cultural, physical, etc.) that can generate an outcome on (Hancock, Labonte and Edwards, 2000):

- satisfying basic needs for all,
- achieving adequate levels of economic and social development,
- the ability to weave social relations based on mutual respect and support,
- the liveability and sustainability of the landscape of life (built and natural).

These factors are identified in the literature as "social determinants" of wellbeing/health and they include "experiences of the first years of life, education, economic status, employment and decent work, housing and environment and effective systems for the prevention and treatment of diseases (WHO, 2011, p.6). Barton and Grant (2006) systematise the general categories of social determinants at the neighbourhood level, the urban landscape and ecosystem level, highlighting the complexity of the factors that can materialise synergistically. At the centre of the discussion is the human being, with biological characteristics.

The model reveals a hierarchy of values between the different determinants in which more external factors, those representing the context of life, affect health. Therefore, the conditions of the natural and built landscape, impacting on business and social processes, have a strong influence on the local economy, the lifestyle of a community, quality of life and ultimately, on the wellbeing of people.

Scott-Samuel's, Birley's and Arden's (1998) studies on the categories of determinants on an urban scale are an example of possible indicators. They can also be a starting point to adapt the approach to the HUL (Tab. 1).

The typological interpretation of these determinants is extensive and extremely complex due to the values of wellbeing, according to the subjective perception and objective experience of the population living and interacting in an historical urban area of "cultural and natural values and traits" (UNESCO, 2011, p.8).

Table 1 – Categories of determinants and indicators (Source: Scott-Samuel, Birley and Arden (1998))

Determinants on health	Examples of indicators
Biological factors	Age, sex and nutritional factors
Family and personal background / lifestyle	Family structure and its operation, primary, secondary and adult education, employment, unemployment, risk behaviours, diet, smoking, alcohol, abuse of substance, physical activity, recreation and transportation
Social environment	Culture, conflicts between different interests, discrimination, social support (neighbourliness, social networks, isolation) the sense of community, participation in cultural and spiritual life
Physical environment	Air, water, conditions of housing and the workplace, noise, odours, visual environment, public safety, design of urban space, shops (location, range and quality), transport (road and rail), land use, waste disposal, energy and characteristics of the local environment
Public services	The access to and quality of primary, secondary and community healthcare, childcare, social services, housing, leisure, social services and employment, public transportation, security services, other public health agencies relevant to the third sector and legal services
Public policy	Trends of economic, social and environmental health, priorities of policies, programmes and projects at the local and national level

Therefore, one of the aims of the "tools of civic engagement", promoted by UNESCO Recommendations (UNESCO, 2011, p.24a), is to stimulate stakeholders to identify not only the complex values of the urban area but also to decipher all those multidimensional factors that, individually or synergistically, may affect the conditions of the community's wellbeing.

2.2 Operational tools to implement HUL approach

In UNESCO Recommendations on HUL, there is an explicit reference to "the need to provide for the monitoring and management of change to improve the quality of life" (UNESCO, 2011, p.24b). However, the question is still open and it considers some specific evaluation tools that should, undoubtedly, be multi-criteria, based on meta-economic (quantitative and qualitative) indicators, chosen on the basis of the recognition of complex values and "social determinants" of health in the urban landscape. In a more analytical way, this evaluation tool should be able to:

- *address* integrated and multidimensional issues at different scales in HUL;

- *define* the meaning and values of urban processes, according to the practical experience of a community in a specific area and related to "social determinants" that can affect people;
- *identify* the indicators and their interpretation from the perspective of promoting human health;
- *evaluate* in a multi-criteria way to study the intensity of urban processes on health determinants;
- *monitor* the impacts of the alternative "action" to take on the "determinants of health", with some medium to long-term effect, and define a list of priorities or rework new "actions" to maximise the benefits for all social groups.

To assess the possible impacts of a regenerative process of HUL on health, it is important to develop an appropriate matrix of indicators able to monitor those multidimensional factors involved in the "social, cultural and economic aspects of conservation of urban values" (UNESCO, 2011, p.4a). It must, firstly, recognise the key factors (tangible and intangible, economic, social, physical, cultural, etc.), or the "social determinants", through which to trace the complex values of the wellbeing of a population, characterised by a community-based approach to the investigation. From a collection of academic research and applications of case studies, a number of these typological "social determinants" could be defined in the following list and considered the basis of different evaluation experiences for urban transformation:

1. safety;
2. education;
3. social services and health;
4. power and local products;
5. social cohesion and local democracy;
6. social peace;
7. employment and income;
8. transportation;
9. quality housing;
10. public spaces;
11. culture and leisure;
12. quality of the built and natural landscape.

While the list of psychophysical determinants and their approach to wellbeing is based on value judgments inevitably linked to personal lifestyle, there is a consensus in affirming that the "holistic" quality of the welfare of the community

in a landscape mainly depends on its perceived safety. This concerns the offer of services in support of basic needs for the performance of daily activities (social services, health, nutrition proximity); the formation of human capital; the cohesion of the share capital in the participation of decision-making in order to reduce conflict and give everyone an equal opportunity to a safe and healthy life; the right to work; to decent housing and living standard materials of households (income, consumption); accessibility to public spaces and cultural heritage/landscape; the vitality of culture and leisure and the quality of the built and natural landscape in which they develop social relationships around these issues. The analysis of the "status quo" of each determinant and reporting of related changes, due to a transformative process, requires the use of appropriate quantitative and qualitative indicators suitable for the scale of the HUL, to detect objective data from surveys and subjective data interpretation of the stakeholders' perceptions through appropriate methodologies.

3 METHODOLOGY

3.1 Health Impact Assessment, experimental approach to integrate heritage conservation with human wellbeing

The Health Impact Assessment (HIA) is a multi-criteria evaluation approach capable of organising knowledge regarding the effects that projects, plans and programmes can have on the wellbeing/health of an urban community. Its mission, in fact, is supporting policy makers in the analysis of potential impacts of the physical transformations on "social determinants" and to identify the most effective solutions for an equitable distribution of benefits to all social groups. As such, the potential of HIA is to facilitate the activation of integrated planning strategies, bringing together all urban sectors, to pursue local objectives of sustainable development, broad and inclusive (as supported by the United Nations summit in Rio de Janeiro, 1992) placing human beings at the centre (Breeze and Lock, 2001). The main reference for the definition of HIA is the document drawn up in 1999, in Gothenburg, by the European Centre for Health Policy. It reads: "The Health Impact Assessment is a combination of procedures, methods and tools with which one can estimate the potential effects on the wellbeing/health of a population caused by policy, plan or project and the distribution of those effects within the population" (WHO, 1999). The development of this tool originated at the end of the 1980s. The Ottawa Charter, in 1986, recalled the urgent need for "a systematic assessment of the health effects of a rapidly changing environment of life - particularly in the areas of technology, work, energy production and urbanisation". The HIA focuses on urban factors that can undergo a series of changes (social, economic, environmental, cultural) upon which the community's state of wellbeing/health is highly dependent.

In urban areas, recognising the wellbeing/health of the community as a complexity of values, it is necessary to adopt the holistic conceptual model of "Merseyside" (Scott-Samuel, Birley and Arden, 1998; Quigley and Taylor, 2003), which monitors the impacts of physical and spatial transformations of the landscape, analysing the social determinants of wellbeing/health. There are three operational models to the evaluation, distinguished by methods, phases and characteristics:

- *Model 1.* Proposed by Scott-Samuel, Birley and Arden (1998) and accepted in foreign countries, the "Merseyside model" is based on the health of a socio-economic development, focusing on the analysis of the determinants of health that influence the welfare of the community. The HIA, developed through "bottom-up" processes, includes the participation of all possible stakeholders to promote a democratic process (Cole and Fielding, 2007) in the definition of the categories of determinants and the set of indicators around the project to be undertaken. This ensures greater consensus in the decision-making phase of the project.
- *Model 2.* The evaluation methodology developed in Germany, recognised as the "Bielefeld model", is closely associated with biomedical health, using the collection of scientific evidence of a quantitative nature. In this approach, the evaluation follows a similar process and Environmental Impact Assessment techniques are used for risk assessment with extensive use of mathematical models. Monitoring is, in this case, an integral part of the assessment of the project in order to compare the risk estimates with the results of the actions taken.
- *Model 3.* The methodology came out of an investigation into health inequalities, disclosed as the "Acheson model" and is widespread in the United Kingdom for the evaluation of policies (Acheson, 1998). It is directed especially at the health sector, with particular emphasis on equity and distributive effects of health services. As for the Anglo-Saxon model, this approach is based on bottom-up participation, recognising the community decision-making ability and leadership throughout the course of the evaluation.

Beyond these models, commonly used and promoted in the literature of case studies, central passages of the evaluation are often incomplete (Wright, Parryand Mathers, 2005; Mohan, et al., 2006). There are reasonable grounds for believing that the best approach is to be developed ad hoc, based on the conditions and needs of the case and the local community. In fact, applying HIA is uniquely determined by local factors, such as:

a) the state and the complexity of the policy, programme or project;
b) whether HIA is to be taken before, during or after adopting decisions on policy, the programme or project;
c) the likelihood of impacts on health;

d) the establishment of values that define the "category" health for the local community;

e) the definition of the determinants that affect the local community's wellbeing;

f) the construction of meta-economic indicators that investigate the determinants of health;

g) the extent and severity of the impacts;

h) the human resources available to conduct the evaluation process;

i) the quality of basic data and data availability;

j) priorities and health targets that local politics will pursue.

Whatever the approach, it should definitely be rigorous, systematic, participatory and transparent. The procedure commonly adopted is based on a methodological process marked by five stages, where the action is preceded by evaluation consultative activities/knowledge, followed by communication of the activities results and finally, the monitoring of the impacts of the alternative action choice by appropriate decision makers. The five stages are, in particular:

1. *Screening:* represents the first phase of problem finding, based on mostly dialogic activities. It determines the programme, plan or project under consideration and may have an impact on welfare/health and define whether it is appropriate to initiate an evaluation procedure.

2. *Scoping:* constitutes the steering group (composed of representatives of the public sector, by stakeholders, the third sector and the private sector) through which complex values of wellbeing/health on the urban landscape identify its categories of "social determinants". Also, some operating procedures must be adopted to assess the impacts through a multi-criteria approach, taking into account participatory activities to the community perception of the quality of the transformations, and quantitative measuring methods, objectively communicating the impacts.

3. *Assessment:* is the central and operating body of HIA, making use of the integration of qualitative and quantitative assessments based on the indicators defined in the meta-economic phase scoping. The following procedures are discussed to:

    a. identify the profile of the community;

    b. apply the most suitable methodology for participatory learning from perceptions, knowledge, opinions of the community involved, the possible qualitative impacts (through focus groups, workshops, interviews, surveys);

    c. support the previous assessment to quantitatively estimate and communicate the relationship between the variation of the physical-

spatial conformation of the urban landscape and the increase/decrease of welfare (socio-economic surveys of the change in the local real estate market, the profit of the small-medium enterprises, income, etc.);

d. determine a preference for alternative actions, useful to support policy- makers through a final report, or develop a new proposal which can better integrate the issues raised and the equitable distribution of the benefits.

4. *Declaration of influence:* filed in a statement to demonstrate how the HIA has influenced the process decision-making based on empirical evidence (ensuring its validity and reliability). This document will demonstrate the effectiveness or otherwise of the evaluation process performed in the following monitoring phase, checking the consistency of the impact produced by the project.
5. *Monitoring and evaluation:* ongoing, the goals and expectations set by previous impact multi-criteria evaluation are achieved in the medium to long-term, or if the expected positive effects, wellbeing/health and fair distribution of the benefits have been strengthened and negative effects were minimised.

The potentiality detected in HIA methodology is to start multi-criteria evaluations to compare the social determinants of health related to the landscape heritage (natural and built), urban activities, the local economy, the community and its lifestyle. In a hierarchical process, codes of relatedness between landscape, society and people are affected. The operational activities have allowed the development of new information and evaluation system to support the Metropolitan City of Naples' sustainable planning.

3.2 An operational experiment applied to the metropolitan area of Naples

HIA is tested through the case study of the Metropolitan Area of Naples (Italy). The objective is to support political decisions in drafting the new Metropolitan Territorial Plan Law (as considered by the Italian Law No. 56/2014), interpreting the environment through UNESCO approach from the perspective of health promotion, highlighting landscape units and homogeneous areas in need of the special intervention of sustainable scenarios (D'Auria and Pugliese, 2013).

The HIA methodological process starts with the phases of "screening" and "scoping"; considering the territorial characteristics to recognise the HUL according to the attributes defined by UNESCO (2011, art.10): "the wider context includes the site's topography, geomorphology and natural features; its built environment, both historic and contemporary; its infrastructures above and below ground; its open spaces and gardens; its land use patterns and spatial organization; its visual relationships; and all other elements of the urban

structure. It also includes social and cultural practices and values, economic processes, and the intangible dimensions of heritage as related to diversity and identity". This interpretation considers the urban context as the result of a historical layering of cultural and natural values resulting from the complex social, economic, environmental processes and expressed by the tangible and intangible heritage according to two criteria:

- *diversity:* the unique and irreproducible characters;
- *identity:* the people, the municipal and the metropolitan community recognise themselves; they build their lifestyle by adapting to daily challenges to lead a healthy and productive life.

The conservation of the heritage might suggest the development of regenerative strategies, able to convey the principal objective of the Statute of the Metropolitan City of Naples (art. 1(2)): "making cities and settlements inclusive, human, safe, durable and sustainable", in line with the eleventh Goal of the 2030 Agenda for Sustainable Development. The first step of the experimental method proposed in this paper then, is to understand the different features of the physical-spatial and intangible attributes (topography, geomorphology, hydrology, natural features, the built environment historical and contemporary, infrastructure above and below ground, the open spaces and gardens, the land use and spatial organisation, perceptions and visual relationships, practices and social and cultural values, economic processes, the intangible dimensions) which allow to recognise, according to UNESCO approach, the Historic Urban Landscape of the Metropolitan Area of Naples.

The land area occupies 1,171 km^2: 8 % of the Campania region. It has all 53.4 % of the population of the Region and is the most densely populated province of Italy (3,118,149 inhabitants surveyed by the Italian Institute of Statistic in 2014). It is bordered in the north by the provinces of Caserta and Benevento, in the east by the province of Avellino and the south-east by Salerno. It overlooks the Tyrrhenian Sea to the west and south and is also characterised by the presence of three anthropised islands: Ischia, Capri and Procida. The territory is administratively divided into 92 municipalities, with variable geographical areas:

- 60 % of the municipalities are small (inferior or equal to 10 km^2);
- 36 % are medium-sized (> 10 km^2 and ≤ 25 km^2);
- the remaining 11 % are over 25 km^2 and, of this, only Acerra and Giugliano are between 50 and 100 km^2 while Naples exceeds 100 km^2.

The components of cultural interest, landscape and economics, as well as its strategic location in the Mediterranean, make the area very attractive for tourism and entrepreneurship, but at the same time it is characterised by a strong propensity to hydrogeology and a high volcanic risk in the most densely populated areas. In addition, the management policy of urban areas has caused a

number of negative impacts at the expense of the physical-spatial quality and the health of the inhabitants.

All the research carried out was by the judgement of experts concerning the characteristics and quantitative parameters of the landscape (Daniel and Vining, 1983; Dakin, 2003) and of particular interest were the reports and dossiers that have tried to bring out a wealth of knowledge on the perception and the needs of people (Censis, 2014). After the operating framework of the HUL in the metropolitan area, all the influential factors on the "state of complete physical, mental and social wellbeing" (WHO, 1986) of the population, e.g., the "social determinants of health", were identified. It was decided to take 11 of the 12 social determinants of health found in the literature and presented in paragraph2.2, to integrate the crucial issues unearthed by expert analysis in the analysed reports. The determinant "built and natural landscape" has been treated according to two spatial depth levels:

1. built and natural landscape at the municipal level, referring to the physical and spatial attributes of the urban environment within the administrative borders;
2. built and natural landscape at the metropolitan level, covering the structural attributes of the Historic Urban Landscape which, with their characteristics, directly and/or indirectly affect human activities and the socio-economic characteristics of the whole area.

The social determinants of health were then grouped and classified hierarchically by territorial aspects, also called "themes", and the collective and individual health is the result of complex interactions of special physical-spatial qualities and of activities and socio-economic processes. Therefore, as pointed out by the WHO (2012), it may be investigated not only for its clinical aspects but it requires a multidimensional approach to the social aspects of proposed determinants of health. To do this it was necessary to prepare, for each social determinant of health, a matrix of indicators comparing three levels of investigation of HUL (Tab. 2):

- Provincial level, analysing the physical-spatial structural characteristics, the equipment and importance of provincial infrastructure;
- Municipal level, focusing on each of the 92 municipalities;
- Census areas, detailing the scale information of the neighbourhood or neighbourhood's aggregates.

Based on the statistical and administrative sources, two databases were processed; the quantitative information of each indicator has been tabulated in them. The first database covers municipal indicators; the second details the indicators of the scale of Census Areas.

To facilitate the management and subsequent analysis of heterogeneous data (around 6,500), a Geographic Information System (GIS) has been employed

(Burrough, 1986; Murgante, 2008). The map projection is UTM (Universal Transverse of Mercator) and datum is WGS (World Geodetic System) 1984, 33North. A rasterisation process was proposed by which the data is mapped, with respect to the administrative borders, and classified into a range of five quantitative measurements at regular intervals (equal interval) and ascending, on the basis of the significance of emerging phenomena. Each pixel cell expresses information relating to spatial surfaces, with dimensions of 100 meters by 100 meters. This process - synthesized in Fig. 1 - was used to generate 77 thematic maps through which the actual values reported by each indicator of the determinants of health can be seen and to start a first comparative reading of the information in the large metropolitan area (Fig. 2).

Table 2 – Themes, determinants, indicators and spatial scales

Urban Sector	Social determinant of health	Number of indicators	Spatial reference scales
Built and natural landscape	Built and natural landscape at metropolitan level	7	Provincial
	Built and natural landscape at municipal level	13	Municipal, Census Area
Activities	Culture and leisure	5	Municipal
	Food and local products	4	Municipal
	Transport	6	Municipal, Census Area
Local economy	Employment and incomes	6	Municipal, Census Area
Local community	Social cohesion and local democracy	4	Municipal, Census Area
	Social services and health	3	Municipal
Lifestyle	Safety	11	Municipal
	Public spaces	4	Municipal, Census Area
	Housing quality	9	Municipal, Census Area
	Instruction	5	Municipal, Census Area
Total	**12**	**77**	

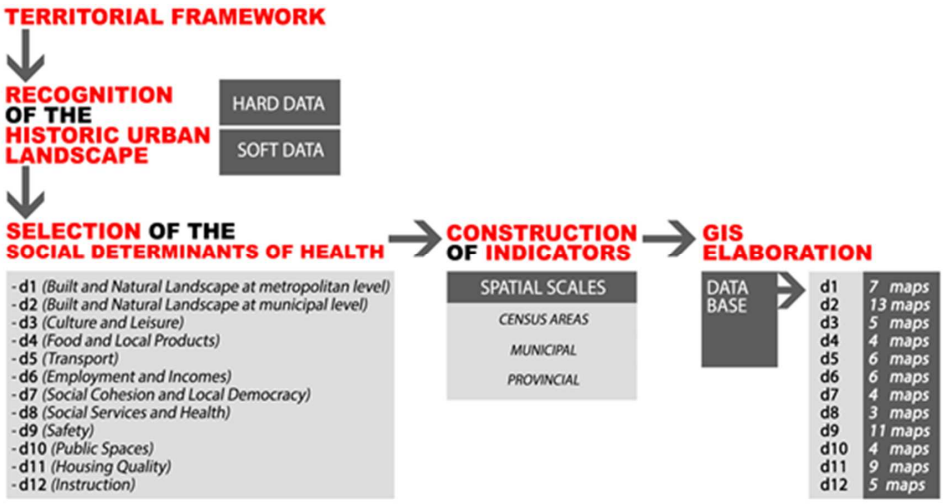

Figure 1 – Methodological framework

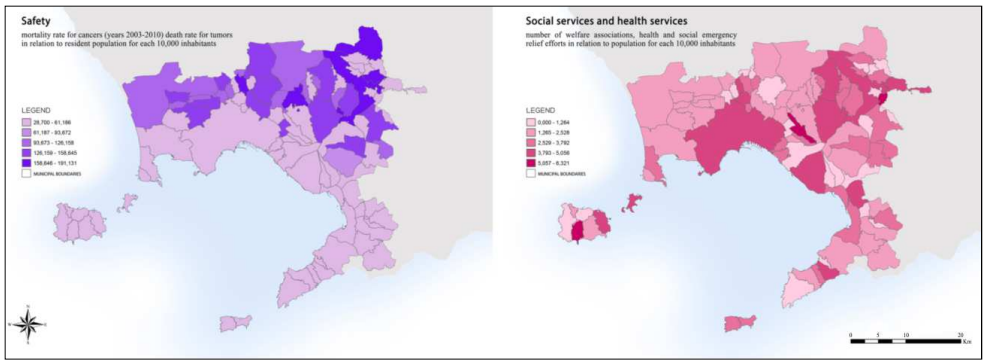

Figure 2 – Maps of Safety and Social Services for health

3.3 The interpretation of the Historic Urban Landscape in the perspective of health promotion

Thematic maps have disclosed complex information in databases in synthetic and readable cartographic representations. It was necessary, however, to codify this information in order to make them comparable with each other through a normalisation process, transforming the measures of the indicators along a common ordinal scale with 0-1 range, on the basis of the particular key of reading of the promotion of human health.

This activity has produced two more geo-referenced databases of normalised values scale and municipal scale of census areas. Multivariate analysis for major components has allowed the analysis of the correlation matrix, the eigenvalues and the matrix of the eigenvectors of each set of indicators relating to the social determinants of health (Lillesand, Kiefer and Chipman, 2015). The main

components have been selected with a cumulative percentage of variance that stood between 75 % and 85 % and were subsequently semantically interpreted, investigating the "weight" of the numeric variables.

Employing this statistical method, it was possible to reduce the set of 77 initial indicators in a selection of 34 major components of the 12 determinants of health. The main components are the new "synthetic indicators" that reduce the initial complexity and enable the comparison of these determinants in the Historic Urban Landscape, without resorting to possible problems of data redundancy that would compromise the final results of the evaluation process (Tab. 3). The support of their respective GIS maps has favoured a clear and controlled understanding of their physical-spatial distribution.

The identification of 34 major components has allowed recognition of those phenomena, in the HUL of the metropolitan area of Naples, which have particular significance to people with respect to each social determinant of health. However, it is important to recognise the degree of impact on people. The Barton and Grant scheme (2006), reworked specifically for this study, orders the pertinent urban factors into a hierarchical procedural structure that suggests at least three "degrees" of influences on health:

- urban themes, in an important scale from the outer circle to the inner;
- determinants groups that characterise every urban theme;
- the main components of the social determinants of health.

This complexity needs Multi-Criteria Decision Aid (MCDA) (Keene and Raiffa, 1976; Munda, 1993; Fusco Girard, Cerreta and De Toro, 2014; Figueira, Greco and Ehrgott, 2005) to face multi-dimensional and integrated assessments.

Table 3– Interpretation of the main significant components

Social determinants of health	Main components	Interpretation of main components	% variance explained
Built and natural landscape at metropolitan level	1 2	Rural landscape Incidence of urban functions on the rural landscape	52.5 26.2
Built and natural landscape at municipal level	1 2 3 4 5	Settlement efficiency Anthropic concentration in vulnerable areas Urban area to consolidate and regenerate Historic/natural fabric Buildings with thermo-hygrometric under requirements	27.4 17.5 14.0 9.0 8.3
Culture and Leisure	1 2 3	Associations for the exploitation of local resources Surface of historical, cultural and landscape interest Attractiveness of minor heritage	60.7 13.3 12.5
Food and local products	1 2	Solidarity groups of purchase Cultural and food awareness	56.7 27.5
Transport	1 2 3	Availability of private and public transport Commuter out of municipality of residence Extra-communal travel by private vehicles	63.9 11.4 10.5
Employment and incomes	1 2	Economic sustainability of families Occupation	38.4 24.0

Social determinants of health	Main components	Interpretation of main components	% variance explained
	3	Development of human resources	15.4
Social cohesion and local democracy	1 2	Social vivacity Social inclusion	49.6 38.5
Social services and health	1 2	Differentiated collection of urban waste Associations for social welfare	51.3 38.4
Safety	1 2 3	Environmental health Security to the anthropic risks Survival from environmental / social / accidental causes	50.8 19.9 11.6
Public spaces	1 2 3	Municipal area to urban uses Functional mixitè Public permeable surfaces on the impermeable	37.1 28.4 19.3
Housing quality	1 2 3	The long term affordability Sanitary conditions of leaseholders' families The short-term affordability	38.8 24.9 20.0
Instruction	1 2 3	People with skills and competences to work Cultural disparities Low level of education	54.7 20.6 9.8
Social cohesion and local democracy	1 2	Social vivacity Social inclusion	49.6 38.5

The result of the valuation model of Analytical Hierarchy Process (AHP), formulated by Thomas Lorie Saaty (1980), is particularly interesting as it combines multi-dimensional scales measuring, revealing a single hierarchical scale of priorities (Fusco Girard and De Toro, 2007; Cerreta and De Toro, 2012), giving weights between quantitative and qualitative elements that are not directly comparable. Through the Expert Choice software (Forman, et al., 1983), it structured the hierarchical tree AHP and dealt with value judgements on greater importance. The hierarchical tree consists of four hierarchical levels, considering:

1. overall objective: the promotion of human health in the Historic Urban Landscape;
2. under objectives (in the Expert Choice are called the "goals" to be reached): urban themes;
3. criteria: the social determinants of health themes;
4. sub-criteria: the main components of any social determinant of health.

The comparison of activity took place from the micro to the macro level, defining the relative importance between pairs criteria on the basis of Saaty 1-9 scale. It was decided to give equal importance to all the sub-criteria, as they express different but closely interdependent aspects of the same phenomenon. The relative importance of the criteria under each objective has been decided on the basis of issues raised in dossiers and reports studied in Screening HIA phase. In this way, it was possible to perform an overlay geographic features of the variables, giving everyone the specific weight emerging from AHP.

The elaboration of maps of the five urban themes returned a sector inquiry of HUL, highlighting areas that express different intensities of health phenomena, based on the social determinants group considered. Finally, the overlay of five thematic maps, each associated with AHP weight, reported the synthesis of intensity mapping of current urban processes that significantly affect the health of the metropolitan population (Fig. 3).

The most intense phenomena in humans are observed in the hinterland metropolitan area, which is undergoing a strong vocational change from agricultural to urban/productive. There are areas to be monitored as incubators of new economic, social and environmental change, and from which the Metropolitan Territorial Plan will be drawn up through sustainable development strategies coordinated among municipalities around the capital specificity. The less intense phenomena, however, are observed in the historic urban settlements located along the coast and in areas with a strong naturalistic prevalence, mostly governed by the physical heritage protection plans. None of these cartographic products express qualitative information about the state of health, other than the investigated phenomena. The store of knowledge comes from the study of 77 indicators and 34 previously analysed main components. However, these maps identify spatially urban areas, currently connoted by a greater or lesser intensity of multidimensional processes that particularly affect the population.

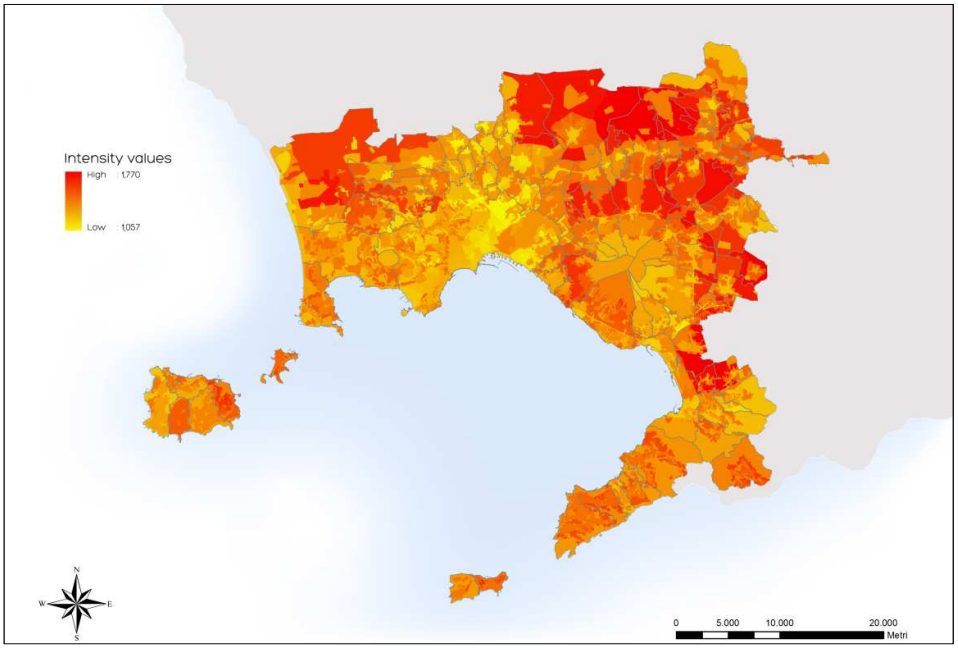

Figure 3 – Intensity of urban processes on human health in the Historic Urban Landscape of the metropolitan area of Naples

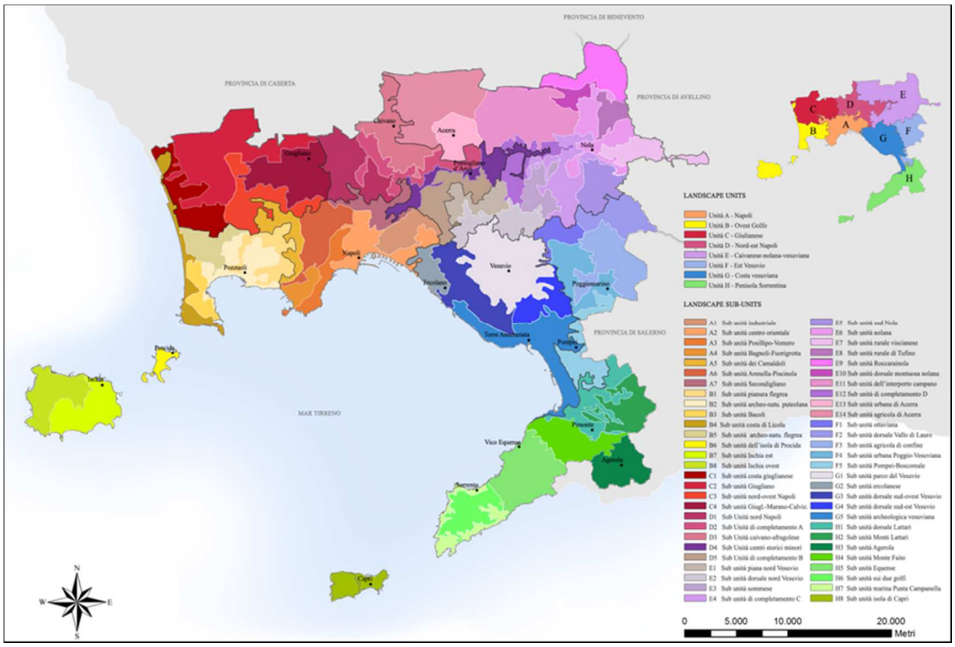

Figure 4 – Proposal for dynamic landscape units

Starting from the mapping of processes in the Historic Urban Metropolitan landscape, some units of homogeneous intensity levels are geographically analysed. This activity has redrawn the map, identifying the health landscape units. The definition of territorial perimeter portions has brought about a considerable variance of processes involving the determinants of health. We have traced eight units with the respective 56 sub-units or aggregations of heterogeneous municipal portions in which it is possible to observe the processes on the promotion of health of homogenous intensity. They may vary over time because the spatial boundaries are closely related to changed determinants of health (Fig. 4).

4 CONCLUSION

The Historic Urban Landscape (HUL) in the UNESCO approach addresses territory in a multidimensional context and it expresses the interdependence between heterogeneous attributes that produce new values under pressure from socio-economic and environmental changes, with outcome effects on people. The adoption of the socio-ecological model of health, attentive to the relationship between man and the urban context, creates a benchmark of the analysed category to measure the sustainability of HUL and to observe the urban processes' view of the fundamental right to life. Even though there are no case studies in the literature concerning the virtuous connection between health and conservation, we think that urban strategies, focused on the promotion of wellbeing and human development, could promote economic productivity. This

could determine the attractiveness and the competitive character of the landscape and, therefore, move towards actions that can also enhance the urban space, with the creation of a positive outlook (win-win) which can fuel a virtuous and sustainable process.

The significance in the methodology at Health Impact Assessment (HIA) is the potential to start integrated assessments to systematically compare all the factors, or the social determinants, of health that affect relationships between landscape and people, in a hierarchical process. It is an interesting perspective in support of the effective sustainability policies of the landscape regeneration strategies. Therefore, it is considered that this evaluation experiment deserves special consideration and implementation by UNESCO (2011), as it offers a solution to point 24b of the Recommendations to the HUL, concerning the need for monitoring urban processes to allow the preservation of assets and the quality of people's lives.

The decision to conduct the entire process via an "expert" approach has proved necessary for the size of the territory analysed. Replicability and scalability of the methodology to smaller, more manageable geographical areas, such as landscape units or homogeneous territorial areas, can give way to a "bottom-up" approach and even the use of perceptive indicators. It could also support the municipal policy-makers to:

- "provide for the monitoring and management of change to improve the quality of life and of urban space" (UNESCO, 2011, art. 24/b);
- develop alternative scenarios of sustainable urban regeneration;
- assess the impacts, focusing on the effects on the holistic health of residents;
- make operational development strategies, involving local actors.

The identification and the division of the territory into smaller areas could support the MTP (Metropolitan Territorial Plan) in territorial government, systematically regulating programmes and strategies for macro areas, in which municipalities are aggregated to similar phenomena prevailing on human health. Instead, the recognition of units and sub-landscape dynamics of health units, which provide insight into phenomena beyond the administrative borders to encourage micro-scale participatory governance of local communities, make the concept of self-sustainability operational through alternative forms of organisation, management and financing of the urban regeneration process.

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Towards a Local Comprehensive Productive Development Strategy: A Methodological Proposal for the Metropolitan City of Naples

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ABSTRACT

Purpose: Identify homogeneous areas for metropolitan cities in order to activate a new governance based on territorial synergistic and symbiotic conditions, thus increasing multidimensional territorial productive processes through spatial planning.

Methodology/Approach: The adopted methodology aimed at structuring a Spatial Decision Support System (SDSS) through three main phases: 1) Selection of criteria and indicators; 2) Statistical implementation procedures; 3) Multi-criteria evaluation.

Findings: Experimentation of a useful procedure for supporting the elaboration of strategic metropolitan plans oriented to development strategies for achieving a comprehensive territorial productivity. The obtained results can support the selection of territorial opportunities able to integrate complementary local resources and to activate synergies and symbiosis among them, combining tangible and intangible components.

Research Limitation/implication: The research is the first step of a more general study that will be improved with the availability of more data, especially with reference to the industrial and economic processes.

Originality/Value of paper: Proposal of an approach based on a complete integration between Geographic Information System, Multivariate Analysis and Multi-Criteria Evaluation in order to improve the governance of metropolitan cities.

Category: Research paper

Keywords: metropolitan cities; synergy; symbiosis; multi-criteria evaluation; TOPSIS

1 INTRODUCTION

Improving the planning activity of cities towards a higher productivity and giving, at the same time, a human shape to local development, requires a multiplication of the density of relationships between activities, areas, institutions and inhabitants. The capacity to regenerate relationships among productive activities, built environment and rural environment, among people and the physical assets, areas and sites, big cities and towns, people and ecosystems is stressed because the "new paradigm", often evoked today, is based on relationships/bonds that can trigger new synergies and symbioses to activate new chains of value creation. The general model of sustainable regeneration is linked not only to the perspective for extracting the resources and energies needed for new dynamic trajectories through circular processes from the local level, but also to the re-generation of relationships.

Metropolitan cities are characterised by a greater complexity than other cities: every facet is interdependent. A metropolitan city can be considered as a system comprised of many other systems and subsystems: natural/ environmental/ecological; residential; productive/industrial; energy; cultural; economic and social. Many critical issues diffused in metropolitan cities are related to the privatisation and reduction of public spaces, the increasing of informal peripheries, the waste of energy, water, natural resources, the speculative real estate market, the loss of local identity, the lack of accountability and transparency in local governance. Taking into account the above considerations, do we consider metropolitan cities as a problem or as an opportunity? Are metropolitan cities facing dynamic virtuous evolution or are they in a chaotic involutive state? We need effective approaches and tools for a positive answer. The future of metropolitan cities lies in our creative choices and in our creative capacity to identify cooperative win-win solutions, characterised by synergies and symbioses, able to increase metropolitan productivity (Fusco Girard and Di Palma, 2016) through scale economies, agglomeration economies, the territorial value added on time and the synergies economies. Which principles, criteria and tools can be identified for improving the planning activity of metropolitan cities towards a higher productivity and for giving, at the same time, a human shape to local development, multiplying the density of relationships among activities, institutions and local communities?

The model of sustainable regeneration is useful to identify innovative approaches for implementing circular processes. The circular processes are an essential element of metropolitan productivity and, in turn, metropolitan productivity is a key outcome of design and planning. This means considering the economic productivity, but also the social and ecological productivity, including economic and non-economic components. The "comprehensive productivity" is economic,

ecological and social and also includes non-economic and intangible components for the metropolitan cities' development, playing a key role for a more desirable urban future: a more resilient, inclusive, safe and sustainable future. The key elements of urban attractiveness are human and social capitals from which cooperative capacity, synergies and symbioses arise; the real engine for local development, wellbeing, health and quality of life.

The New 2030 Agenda, approved in New York in September 2015, in the United Nations' Plenary Assembly, identifies 16+1 strategic goals, among whose goal No. 11 concernsmaking cities and human settlements inclusive, safe, resilient and sustainable. Goal No. 12 is about sustainable production and consumption and thus introduces the circular economy approach. All these 2030 Agenda goals (or the majority of them) can be achieved (or not) in the space/cities and, in particular, in metropolitan cities. Urban landscapes reflect local culture and all the challenges of our time. Culture is the key element that can reshape every development perspective.

UN-Habitat is going to reshape the New Urban Agenda as the general agenda for operationalizing principles in a coordinated, integrated and coherent way at different local, metropolitan, regional, and national level. Managing urbanisation is seen more as an opportunity than a problem, to contribute to local economy growth and to increase the urban productivity, creating new employment, in a co-evolutive perspective with ecosystems stimulating the perception of the inhabitants' wellbeing.

Circular processes are the characteristic of the natural systems. Circular processes allow the increase in "comprehensive metropolitan productivity" (i.e. economic, social and environmental productivity) (Varlet, 2012), reducing waste and activating three kinds of symbiosis: that between productive and industrial systems, between the city and industrial systems and between the city and the rural territory (Fujita, et al., 2013). The circular urban economy is referred to the comprehensive city economic organisation, through different kinds of symbioses, demonstrating that the circular organisation is able to produce economic convenience, ecological benefits and social benefits, thus enhancing the attractiveness of the city/territory.

In this perspective, urban planning should be able to manage the circular/virtuous processes between the metropolitan city and the rural territory through a systemic approach, evoking the approaches and tools of industrial ecology; the attention to the flow analysis between the city and the territory, to the urban metabolism, to synergistic exchanges between resources flows, due to the spatial/geographic proximity.

The paper moves in an ongoing research context, with a double aim: to develop an operational approach through the case-study and, at the same time, to produce a theoretical-methodological approach for an eventual replicability in analogous problems of homogeneous territorial areas classification. It proposes a comprehensive metropolitan productivity framework for the Metropolitan City of

Naples. Some relevant and specific indicators are selected to identify local resources and the "homogeneous zones" for activating synergies and symbiosis among the 92 municipalities that form the metropolitan area. Section 2 introduces the concept of comprehensive productivity. Section 3 illustrates the methodology. Sections 4 and 5 present the case study of the Metropolitan City of Naples and first outcomes of the proposed approach and Section 6 offers conclusions.

2 A COMPREHENSIVE PRODUCTIVITY STRATEGY FOR METROPOLITAN CITIES

In the typical development processes of metropolitan cities, the commitment that the city must implement to make its organisational structure more efficient becomes crucial to increase wealth production in the direction of sustainable development (Fusco Girard and Di Palma, 2016). Several cities are utilising new tools to face the main challenges emanating from change: environmental decay and ecosystems alteration; intensification of economic competition and growing unemployment. The metropolitan city is the context wherein different economic, social, cultural and environmental factors relate and manage the complexity according to a systemic approach able to balance land resources in order to build a sustainable vision for the future (D'Auria, 2009; D'Auria and Pugliese, 2013). The city – to address the economic, social and environmental change – needs a new model for managing its organisational structure, based on cooperative processes, and thus on synergies and symbioses. In particular, symbiosis becomes the means to rebuild and multiply the bonds at different levels and therefore – thanks to the density of the relationships it generates – makes the system more resilient and less dissipative, while improving its regenerative capacity. The concept of symbiosis has been used in the field of industrial ecology to indicate an organisational system in which different companies, characterised by geographical proximity through an associative approach based on the shared resource management, obtain benefits and competitive advantages from an economic (and also environmental and social) point of view. This is achieved by means of the physical exchange of materials, energy and sub-products (Chertow, Ashton and Espinosa, 2008; Boons and Howard-Grenville, 2011), as well as achieving broader strategies of sustainable industrial development (Chertow, 2007; 2009; Ashton, 2008; 2009; Jensen, et al., 2012).

Recently the concept of symbiosis has been applied to the urban context, by transferring the interactive phenomenon and interdependences, typical of natural ecosystems, to anthropic systems (Fusco Girard, 2014). Some cities have implemented interesting symbiotic processes, considering practices of industrial, urban and territorial symbioses (Fujita, et al., 2013). The focus on different scales of symbiotic processes allows an understanding of how to implement a systemic and integrated approach involving different levels of relationships at the same time, taking into account the various forms of capital. The city is identified as a

complex system, which requires dynamic and adaptive integrated actions for the construction of synergies between urban, rural and natural areas, and for the circularisation of processes, occurring in natural ecosystems in a similar way. By means of best practices (ex-post evaluation) – as implemented in many port cities such as Rotterdam, Stockholm, Lisbon, Kwinana, Kawasaki, Akita, Aichi, Kitakyushu, etc. (Fusco Girard, 2016) – it is possible to produce empirical evidence about economic, social and environmental advantages of symbiosis, in order to formulate strategies of eco-innovation for future sustainable policies. The evaluation process highlights the benefits derived from the circular economy in terms of wealth production and local employment and the existing links between the promotion of green economy and opportunities to create new jobs. Indeed, symbiotic processes generate a density of links and activities that produce, in their turn, new jobs, providing a significant contribution in terms of social impact and the humanisation of development (Wijkman and Skånberg, 2015; Jacob, Quitzow and Bär, 2015).

Starting from the empirical evidence provided by the evaluation of a selection of cities worldwide, it is possible to highlight that investing in symbiosis – activating a process of circularisation, reciprocity and mutuality – determines an increase in the comprehensive territorial productivity from different viewpoints: a) economic, because it allows income production; b) environmental, since it promotes the preservation and protection of cultural and natural heritage; c) social, in terms of employment growth and strengthening the sense of belonging to a place.

In the Italian context, in the last twenty years, metropolitan cities have been losing productivity and attractive capacity in comparison with other European cities, although the potential of the Italian territory is very high, considering that Italy is a large logistic platform in the Mediterranean Sea and is the expression of one of the best cultural landscapes in the world. Many metropolitan cities are port cities and many of them are UNESCO sites.

Italian metropolitan cities are spaces with a high demand concentration for goods and services, where the pressure on natural and environmental capital is very strong, with many consequent risks. In many cases, agglomeration economies are diverted into diseconomies with the overuse of resources, pollution, congestion, discomfort and illness perception. The recent Italian Law No. 56 of April 7, 2014, “Provisions on metropolitan cities, provinces, unions and mergers of municipalities”, is a positive initiative to face the multiple difficulties of metropolitan cities and identifies an institutional framework for the activation of strategies for the development of a comprehensive territorial productivity, starting from the awareness of the proximity opportunities for synergies and symbiosis among the different municipalities.

3 METHODOLOGY

The Italian Law No. 56 of April 7, 2014, identifies the metropolitan cities of Rome, Turin, Milan, Venice, Genoa, Florence, Bari, Bologna, Naples and Reggio Calabria, and provides guidelines for the formation of "homogeneous zones" characterised by specific functions and taking into account specific local requirements. It is necessary to identify the characters of the metropolitan cities, considered as territorial institutions that deal with the care of the metropolitan area's strategic development, and the promotion and integrated management of services, infrastructure and communication networks. Unions of municipalities, part of the metropolitan cities, facilitate the implementation of associated functions or local services.

Homogeneous zones, defined as part of the metropolitan strategic plan, reflect the need to improve the effectiveness and efficiency (the productivity) in the definition of policies and projects, and in the delivery of services to citizens, prompting municipalities to operate more increasingly in cooperative form. The establishment of homogeneous zones is an important opportunity to configure shared territorial interests and projects, putting in direct relation metropolitan cities and their municipalities, reorganising and rationalising the existing forms of inter-municipal cooperation and managing associated forms of different services.

A decision-making framework is proposed where Geographic Information Systems (GIS), statistical analysis and Multi-Criteria Evaluation (MCE) techniques are integrated to identify a comprehensive metropolitan productivity framework for the city of Naples and to support the governance change management.

According to the above issues, the proposed Spatial Decision Support System (SDSS) aims to identify the homogeneous zones of the Metropolitan City of Naples, identifying the system of relationships, synergies and symbiosis that can foster cooperation between municipalities, considering the correlation of spatial variables during spatial decision-making. This process uses Principal Components Analysis (PCA) and MCE in order to remove data redundancy among a large set of spatial variables and determine "ideal points" for homogenous zones configuration (Batty and Xie, 1994; Malczewski, 1999; Yeh and Li, 2002). In the present case-study, PCA is integrated with GIS for the simulation of Dynamic Spatial Units (DSUs), useful for planning purposes and able to describe the synergies and symbiosis among the existing local resources.

4 THE METROPOLITAN CITY OF NAPLES: A PROPOSAL OF DYNAMIC SPATIAL UNITS

The Metropolitan City of Naples, in Campania Region, Italy (Fig. 1), was established on January 1, 2015, after the reform of Italian local authorities with

the Law No. 142/1990, and then established by the Law No. 56/2014. Its capital city is Naples and it includes 92 municipalities.

Naples, with 3,118,149 inhabitants, is the third Italian most anthropic metropolitan area after Milan (3,707,210) and Rome (3,700,424). Moreover, it is in the second class of the European metropolitan areas for population density. It is formed by 92 municipalities, 12 of which count more than 50,000 inhabitants, showing also relevant phenomena of anthropic pressure in limited territorial areas.

Its ageing index outlines a "stable" social structure in which the number of young people is equal to the number of the old one and the mean age is 40. In the last years, its birth and death trends record a constant mortality growth (28,482 deaths in 2014) often due to tumour pathologies. In addition, the murder rate is above the Italian average, and its road unsafety is proved by its road accident mortality rate of 6.90 % (while the national average is 4.65 %).

Figure 1 – The study area: the Metropolitan City of Naples (Source: Authors)

Concerning the family affluence, the average disposable gross income (34,230 euros) is above the regional one (32,114 euros) but under the Italian one (40,191 euros). The mean wage is 19.8% lower than the Italian average that is 16,924 euros.

Notwithstanding that many important cultural and landscape assets are present in its territory, the metropolitan area of Naples devotes only 3.5% to public urban parks, in comparison with the national 5.1%; on average, there are 12.4 m^2 of urban green spaces for each inhabitant (vs. the national 32.2 m^2) and 0.3 m^2 of museums every 10,000 inhabitants (vs. 0.8 in Italy).

The Statute of the Metropolitan City of Naples was adopted by the Metropolitan Conference Resolution No. 2, June 11, 2015. Article No. 4 defines the so-called "homogeneous zones" and identifies their features. It highlights that the Metropolitan City of Naples is divided into homogeneous zones for a more harmonious, balanced and functional arrangement of its territory. These areas must be identified through the following factors justifying their common membership: local characters and historical reasons; geo-morphological, naturalistic and landscape contexts; functional relationships and socio-economic frameworks.

Homogeneous zones must be formally established by a specific Resolution of the Metropolitan Council, upon agreement with the Campania Region Government. Each homogeneous zone is formed by the aggregation of contiguous municipalities, in order to include a population of not less than 150,000 inhabitants. A possible derogation, in the perimeter and in the number of inhabitants, must be specifically justified and approved with the agreement of the municipalities involved. Homogeneous zones constitute the optimal environment for both the management and the supply of associated local, municipal and metropolitan services, also through the delegation of functions by the Metropolitan City. In addition, the Metropolitan City economically promotes the joint exercise of functions by the municipalities within the homogenous zones. Their identification is part of a significant decision-making problem: it is essential to propose an aggregation, between municipalities, that may constitute a homogeneous environment with respect to some significant features. At the same time, it is able to activate appropriate synergies and territorial symbiosis oriented to the increase in comprehensive territorial productivity. This will reduce territorial differences/disequilibria.

The adopted methodology (Fig. 2) has allowed the structure of a Spatial Decision Support System (SDSS) and it has be divided into three main phases: 1) Selection of criteria and indicators; 2) Statistical implementation procedures; 3) Multi-Criteria evaluation. In the first phase, we selected a set of criteria and indicators compatible with available data, able to explain constituent components and features characterising the territory of the Metropolitan City of Naples. These have been analysed considering some important criteria: environment, built heritage, quality of life, economy and production, transport, culture and society. These criteria were, in turn, declined by 45 indicators (Tab. 1).

The knowledge of the territory has been structured considering two geographical scales of information selection, in order to analyse existing phenomena through a process of gradual deepening of the constituent components: a) the municipal

level, considering the specificities of the 92 municipalities forming the Metropolitan City; b) the Census Areas level that identifies the scale of the neighbourhood or information related to aggregates of districts.

The selection of indicators made it possible to describe the main characteristics of the territory, making its specificities explicit. The opportunity to use both municipalities and Census Areas indicators permitted to obtain more detailed information for a certain number of indicators. This is particularly meaningful for the bigger municipalities, as Naples, for which a sub municipal classification was obtained.

The variables information refers to 2011, when the last national Census was taken. Each indicator has been identified with an appropriate synthetic code (Tab. 1), explaining the data coverage (Municipality or Census area) and the positive direction (max/min). Based on available sources, we created a database collecting information concerning the performance of the 92 municipalities, with respect to each indicator related to the municipal level or the Census Areas. The nature of the database allowed us to structure a spatial information system through the support of a GIS software.

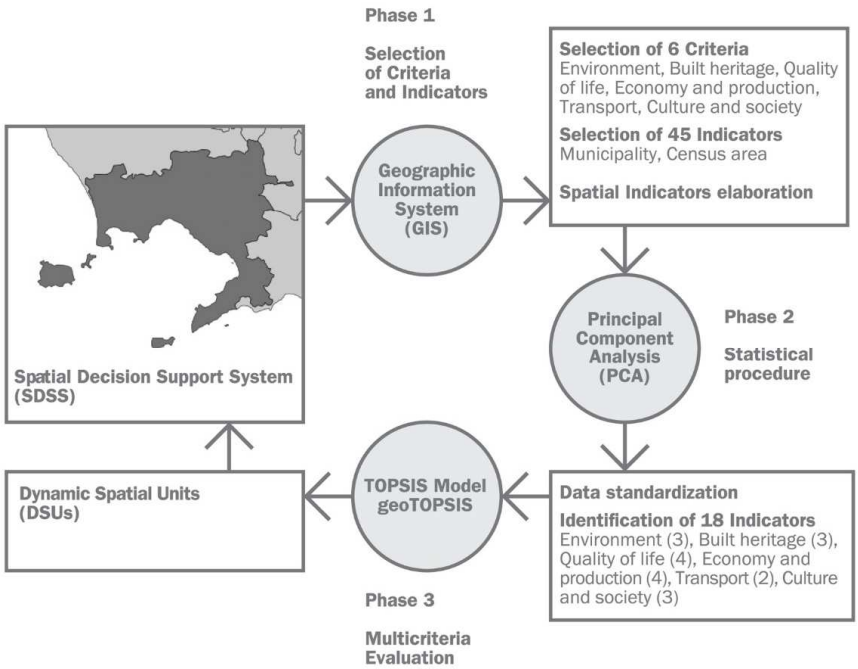

Figure 2 – The methodological framework (Source: Authors)

The available information was made homogeneous with respect to the geographical location, also by means of a spatial representation through 45 thematic maps, corresponding to each indicator. We then transformed each map

in a raster dataset, where 100×100m is the adopted geometric resolution; the map projection is UTM and datum is WGS 1984 33N. The information was mapped with respect to administrative borders and classified into five intervals according to an ascending chromatic scale, based on the emerging significance for each of the analysed phenomena.

Table 1 – Criteria and indicators (Source: Authors' processing)

Criteria	Indicators	Code	Data coverage	Positive direction
Environment	Percentage of areas of natural interest compared to the total surface	A1	Municipality	max
	Percentage of areas subject to urban and environmental rehabilitation compared to the total surface	A2	Municipality	max
	Percentage of neglected areas subject to landscape rehabilitation compared to the total surface	A3	Municipality	max
	Percentage of urban areas compared to the total surface	A4	Municipality	min
	Percentage of agricultural areas compared to the total surface	A5	Municipality	max
	Exposure to volcanic risk (high, medium or low risk)	A6	Municipality	min
Built heritage	Percentage of used buildings compared to the total number of buildings	P1	Census areas	max
	Percentage of residential buildings with medium or low conservation status compared to the total number of residential buildings	P2	Census areas	min
	Percentage of residential buildings compared to the total number of buildings	P3	Census areas	max
	Population density	P4	Municipality	min
	Percentage of areas of historic, cultural and landscape interest compared to the total surface	P5	Municipality	max
	Percentage of areas for public (or public interest) services and facilities compared to the total surface	P6	Municipality	max
Quality of life	Number of usable parks and historic gardens per 10,000 inhabitants	Q1	Municipality	max
	Percentage of community spaces compared to the residential surface	Q2	Municipality	max
	Percentage of waste sorting compared to the solid urban waste	Q3	Municipality	max
	Number of organized crime groups per 10,000 inhabitants	Q4	Municipality	min
	Number of cancer deaths per 10,000 inhabitants	Q5	Municipality	min
	Exposure to air pollution (reclamation, observation or conservation zones)	Q6	Municipality	min
	Number of contaminate sites	Q7	Municipality	min
	Elderly index	Q8	Census areas	min
	Average unitary market price of dwellings	Q9	Census areas	min
	Average unitary rent price of dwellings	Q10	Census areas	min
Economy and production	Percentage of production areas and industries compared to the total surface	E1	Municipality	max
	Number of local working units per 10,000 inhabitants (age 15-64)	E2	Municipality	max
	Number of employees in local working units per 10,000 inhabitants (age 15-64)	E3	Municipality	max
	Average income per capita	E4	Municipality	max
	Employment rate	E5	Census areas	max
	Unemployment rate	E6	Census areas	min
	Number of agricultural firms compared to the used agricultural surface	E7		max
	Number of biological agricultural firms and/or with typical products compared to the total number of firms	E8	Municipality	max
	Percentage of certified firms (EMAS and/or UNI-EN-ISO 14001) compared to the total number of firms	E9	Municipality	max
	Number of beds in hotels or other types of accommodation	E10	Municipality	max

Criteria	Indicators	Code	Data coverage	Positive direction
	Average monthly income by visits in museums, monuments and archaeological areas	E11	Municipality	max
Transport	Percentage inhabitants moving daily outside of their resident municipality compared to the total number of inhabitants	T1	Census areas	min
	Number of buses per 10,000 inhabitants	T2	Municipality	max
	Number of railway stations per 100 km^2 of surface	T3	Municipality	max
	Number of stops of underground lines, funiculars, cableways and ferries per 100 km^2 of surface	T4	Municipality	max
Culture and society	Percentage of graduate inhabitants compared to total number of inhabitants	C1	Census areas	max
	Average monthly number of visits in museums, monuments and archaeological areas	C2	Municipality	max
	Number of associations for social, cultural and leisure promotion per 10,000 inhabitants	C3	Municipality	max
	Number of ethical purchasing groups and networks per 10,000 inhabitants	C4	Municipality	max
	Number of no-profit organizations per 10,000 inhabitants	C5	Municipality	max
	Percentage of volunteers in no-profit organization compared to the total number of inhabitants	C6	Municipality	max
	Number of associations for social assistance and health aid per 10,000 inhabitants	C7	Municipality	max
	Number of foreign-born people per 100 inhabitants	C8	Census areas	max

In the second phase, a statistical procedure was carried out in order to make comparable indicators expressed in heterogeneous units; a process of normalisation of all indicators was performed, using a 0-1 interval scale (Fig. 3).

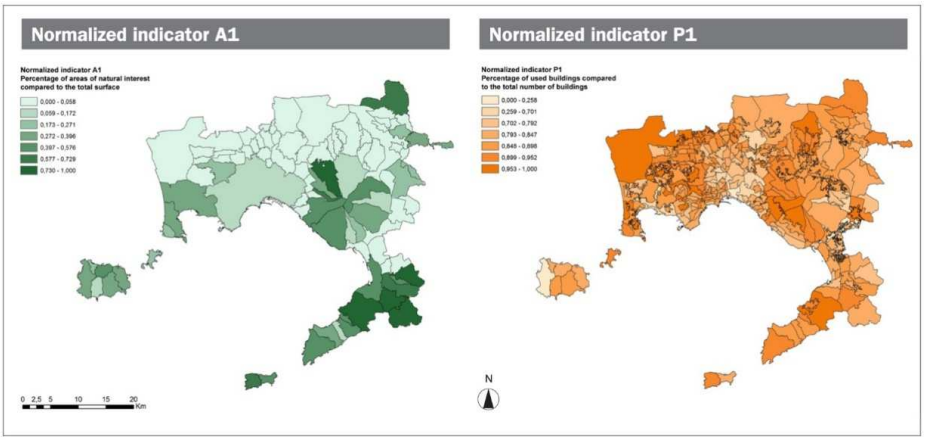

Figure 3 – Example of two different data coverage indicators (Source: Authors' processing)

Afterwards, six Principal Component Analyses (PCA) were carried out (i.e. a PCA for each criterion), using normalised indicators. In particular, Principal Component Analysis (Dewan, 2013; Mago and Dabbaghian, 2014) represents a multivariate analysis that convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables, called "principal components". The number of principal components is less than or equal to the

number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible) and each succeeding component, in turn, has the highest variance possible under the constraint that it is orthogonal to the preceding components.

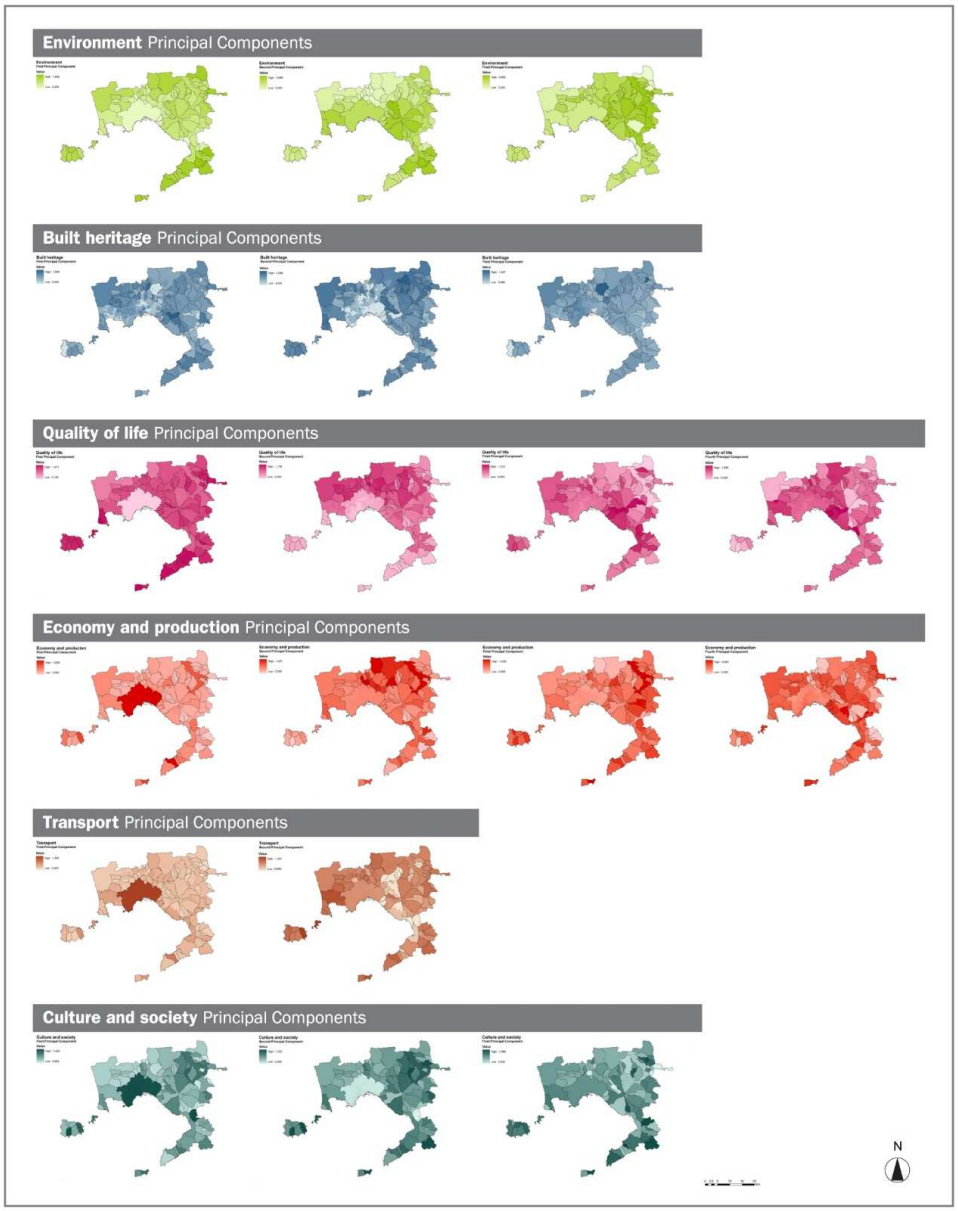

Figure 4 – Principal Components (PC) related to criteria (Source: Authors' processing)

The resulting vectors are an uncorrelated orthogonal basis-set. PCA is sensitive to the relative scaling of the original variables. A spatial PCA (i.e. using raster layers in GIS) has allowed to identify a set of 18 principal components, explaining about 80% of cumulative variance: 3 for Environment; 3 for Built heritage; 4 for Quality of life; 4 for Economy and production; 2 for Transport; 3 for Culture and Society (Fig. 4).

The used indicators, synthesized by the Principal Components obtained, explicate the major characteristics of the Metropolitan Area of Naples. The followed can be underlined:

- the most significant areas from environmental quality viewpoint are the Sorrento Peninsula and the islands of Capri and Ischia, as well as the Vesuvio National Park;
- the built heritage, particularly the cultural one, strongly connotes the historic centre of Naples and minor interest towns, e.g. Pozzuoli;
- the quality of life too is better in the Sorrento Peninsula, in the islands and in some minor towns, and anywhere the criminal organizations and the cancer mortality is low;
- economic dynamics are more significant in the city of Naples (that has the higher number of enterprises and workers) or in the Nord-East area of Naples where are the support infrastructures to commercial traffic, e.g. the Nola logistic centre. Whereas Pompei, Sorrento, Naples and the islands are connoted by touristic attractiveness at international level;
- transportation infrastructures are concentrated in the city of Naples, where are various urban underground lines and along the coast, where are railways at metropolitan level;
- the best performances of "culture and society" indicators are found in the city of Naples, full of museums and monuments, and referring to archaeological cultural heritage especially in Pompei and Pozzuoli.

In the third phase, a Multi-Criteria Evaluation was carried out, using the geoTOPSIS algorithm, available in the current VectorMCDA version in QGIS (Rocchi, et al., 2015) that implements the TOPSIS model (Hwang and Yoon, 1981), based on the ideal point approach. Through geoTOPSIS, it was possible to identify some Dynamic Spatial Units (DSUs) for the Metropolitan City of Naples. They represent progressive aggregation of homogeneous areas with respect to which are highlighted territorial synergistic and symbiotic conditions, able to activate multidimensional territorial productive processes (Fig. 5).

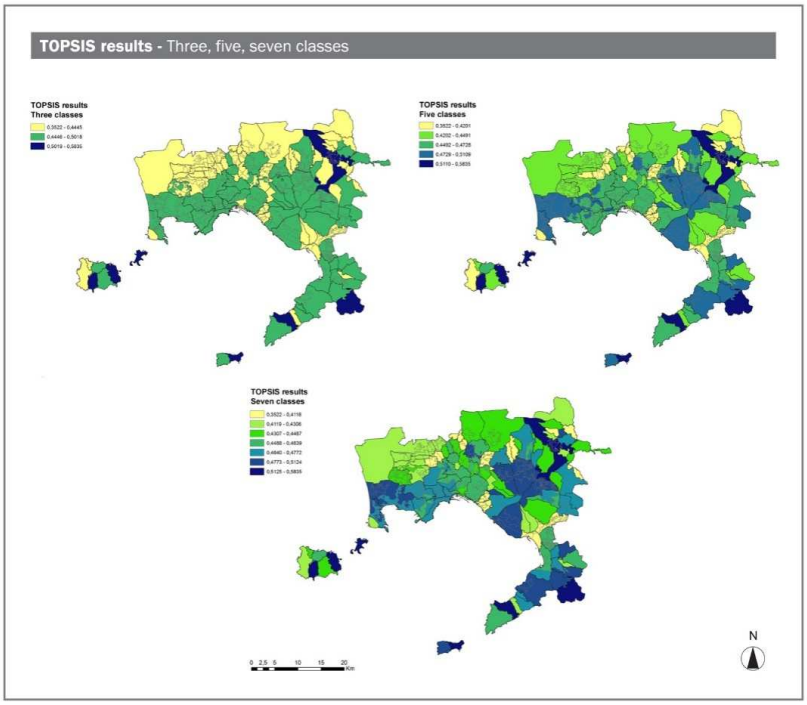

Figure 5 – Dynamic Spatial Units (DSUs)
(Source: Authors' processing)

5 FIRST OUTCOMES OF THE PROPOSED APPROACH

Starting from the DSUs it is possible to outline a new geography of the metropolitan area of Naples, identifying the combinations between municipalities in order to establish Homogeneous Zones, reflecting the criteria required by the Statute of the Metropolitan City. Taking into account the fact that each homogeneous zone is to be formed by the aggregation of contiguous municipalities territorially, including a population of not less than 150,000 inhabitants, we propose a possible combination (Fig. 6).

A collection and waste management service (from paper packaging to electrical equipment, plastics, etc.) becomes a necessity within homogeneous zones, representing a continuous challenge for the city of Naples. Furthermore, in these areas, the coordination of the different sectorial policies becomes easier, reducing production/management costs. Starting from the local characteristics, we must build and enhance a common culture between inhabitants and local actors,improving governance as a bottom-up approach, and then improve the quality of life/wellbeing, itself.

In the homogeneous zones, it is easier to proceed to the regeneration of relationships/bonds between social actors and the territory, thus promoting interactive collaborative processes (stimulating a multi-helix approach).

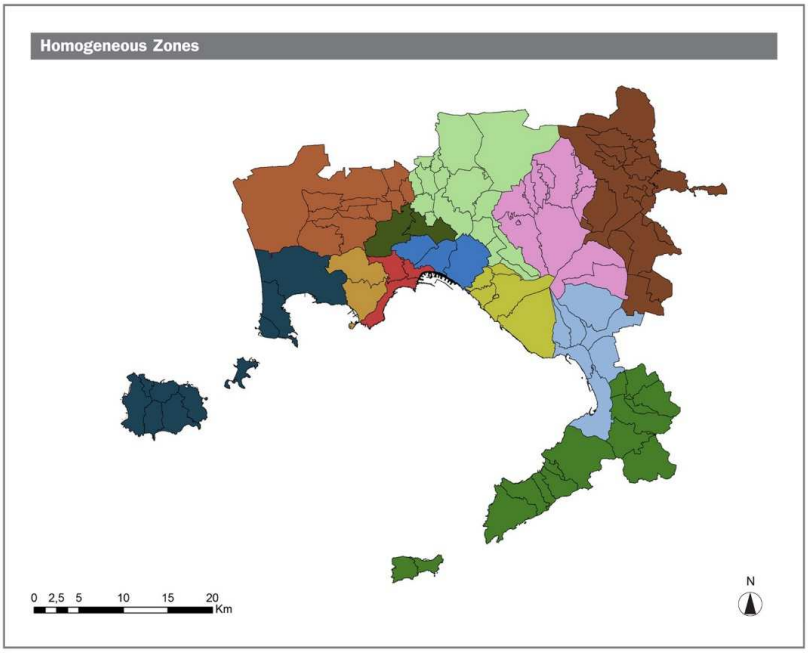

Figure 6 – Proposal of Homogeneous Zones for the Metropolitan City of Naples (Source: Authors' processing)

The current lack of useful data did not allow us to elaborate flows/exchanges analysis between the urban zones and the port areas (such as Pozzuoli, Torre del Greco, Torre Annunziata, Naples, etc.), necessary to promote a productive regeneration of processes between territories/cities and ports, and thus activate processes of circular economy (starting from agro-food sector, logistics, shipbuilding, etc.), reducing environmental impacts together with production costs.

The city of Naples has been divided into homogeneous districts that present characteristics strongly knowledgeable for their economic dynamics, historical and landscape values, environmental qualities, human health, etc.

Moreover, we think that results are sufficiently sound over time and therefore there is no need of new data working out in the short term. This is true because in spite of referring mostly to the 2011 Census data, the last ones express and confirm trends already in progress in the previous census of 2001. The resulting classification explicates the characteristics that strongly connote the territorial elements of the metropolitan area of Naples, as already explicated in the previous paragraph.

6 CONCLUSIONS

The Metropolitan City of Naples is an interesting example wherein to implement a methodological approach, able to support the elaboration of the strategic plan oriented to development strategies for improving the comprehensive territorial productivity. The identification of DSUs supports the selection of territorial opportunities able to integrate complementary local resources and to activate synergies and symbiosis among them, combining tangible and intangible components (Cerreta and De Toro, 2012; D'Auria and Monti, 2013).

Starting from the DSUs, it is possible to facilitate the aggregation of municipalities and the awareness of homogenous units, making suitable land available and analysing its development possibilities; implementing a sustainable economic development; protecting and enhancing the natural, historic and cultural environment; ensuring high quality development and efficient use of resources; promoting inclusive and liveable communities. Homogenous zones will outline the background information and characterisation, from a territorial, economic and social point of view; a possible territorial vocation, considering both the history and the future perspectives and actions, policies and projects that can be charged by municipalities in a cooperative/partnership form.

Within each homogeneous zone, it is possible to activate circular processes of mutual cooperation between different actors, as generators of new value creation chains, reducing costs. New productive relationships can be implemented between the different homogeneous zones, valorising differences in a complementary/holistic vision and based on cooperation, thus opening new opportunities for investments in the metropolitan area.

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