Cultural heritage, smart cities and digital data analytics

Karima KOURTIT[*]

Abstract

This paper addresses the new opportunities and pitfalls of smart cities, with a particular view to the maintenance and use of historical-cultural resources in a city. The emergence and wide-spread application of digital technology appears to shape a new arena for urban cultural policy analysis, especially in the framework of big data in relation to social media information platforms. The paper argues that in a digital age new forms of data metrics policy are needed for an affective cultural heritage policy in cities.

Keywords: smart cities, intelligent cities, cultural heritage, urban cultural capital, digital technology, big data, social media platforms

1. Introduction

We live in the '*urban century*', according to recent UN studies. More than 50 percent of the world population is registered to live in urban areas. In contrast to 200 years ago, when about 10 to 15 percent of the population on our earth was living in cities, this present urbanisation phenomenon is a demographic-geographic revolution in the world history. But the unprecedented growth in the number of people residing in cities will most likely not yet come to a standstill: recent UN projections show that by the middle of the present century about 70 to 75 percent of the global population will live in urban agglomerations, mainly as a consequence of the rapid urbanisation rate in the developing world and in emerging economies. At present, we have already several dozens of mega-cities (cities with more than 10 mln inhabitants), and this class of cities is also rapidly growing in number. Thus, in the '*New Urban World*' (Kourtit, 2019) cities grow in number and magnitude. And consequently, cities grow also in socio-economic importance.

[*] Karima KOURTIT is Phd and she works at JADS (Jheronimus Academy of Data Science), 's-Hertogenbosch, the Netherlands; Uppsala University, Uppsala, Sweden; Centre for the Future of Places (CFP), KTH Royal Institute of Technology, Stockholm, Sweden; School of Architecture, Planning and Design, Polytechnic University, Ben Guerir, Morocco, and Adam Mickiewicz University, Poznan, Poland; e-mail: k.kourtit@tue.nl.

Many cities on our planet house a great collection of cultural resources, such as architectural heritage, monuments, precious urban landscapes, historical landmarks etc. The rising urbanisation trend may mean a serious threat to the maintenance and quality of urban cultural resources. In addition, the attractiveness of such scarce resources means also a rise in visitors, which may also cause an erosion of the cultural authenticity and typical urban ambiance in historical cities. Thus, cultural resources are becoming increasingly vulnerable in historical cities that aim at gaining a competitive edge in data-driven policy. The question emerges now what kind of contemporaneous cultural policy in cities is needed in the age of information technology.

The present paper aims to sketch the new force field of cultural resources (cultural capital) in cities, by addressing and mapping out the new opportunities of digital technology in smart cities. Particular attention will be paid to the information needs of intelligent urban policy against the background of the emerging data platforms and rapidly rising heterogeneous big data systems in modern cites.

1. Urban cultural capital

As mentioned in Section 1, urban agglomerations are often the home base of a wealth of cultural amenities. They reflect the history, culture, prosperity and architectural features of a city (see for a broad overview Fusco Girard and Nijkamp, 2009; Kourtit and Nijkamp, 2018a; 2018b). Such historical-cultural resources are part of a broader urban historical capital portfolio that shape and characterize the typical and authentic landmarks of a city; examples are cathedrals, castles, archaeological sites, waterfront areas, political-historical urban districts, etc. These cultural resources create a broad collection of spatial externalities, such as a relaxed urban atmosphere, enjoyment of an authentic life style, exposure to historical ambiance of a city. Cultural amenities have unfortunately been studied somewhat sparsely in the history of urban-economic sciences (see for some examples e.g., Bartik and Smith, 1987; Baumol and Bowen, 1966), mainly from a policy and externalities perspective. Cultural-historical externalities are also reflected in the valuation of the valuation of the urban economy, in particular the value of real estate. Several studies have in recent years undertaken to assess the economic and social significance of urban cultural resources or even of an entire ‘urban cultural complex’.

A recent example (in Milano) of a study on the value of culture to housing prices can be found in Borgoni *et al*. (2018), using hedonic price models. Such models have often been used to assess the price of the built environment or of real estate, by addressing the impact of socio-economic or cultural-historical factors on the value of houses or real estate in a market system. Hedonic price studies have in the past decades become rather popular in applied welfare research (see e.g., Smith and Huang 1995), and have laid the foundation for various recent studies at the interface of cultural resources and urban-economic values. Examples can be found

inter alia in: Boualem (2014), Clark (2003), Falck *et al*. (2018), Garretsen and Marlet (2017), Koster and Rouwendal (2017), Lazrak *et al*. (2014), Moro *et al*. (2013), Russo and Van den Berg (2010) and Throsby (2001, 2016).

It should be noticed that the assessment of economic price effects of cultural-historical capital in cities is an important avenue, but calls also for a follow-up research activity focussing on evaluation and planning of urban resources. According to De Torro and Iodice (2016), evaluation is "a set of activities oriented to the appropriate organisation of the information necessary to make a choice, so that each actor involved in the decision-making process is able to take a balanced decision" (p.93). In this context, a wide range of planning and policy analysis tools has been developed, ranging from traditional (social) cost-benefit – and related cost-effectiveness – analysis to multicriteria and multi-objective decision support tools (see e.g., Nijkamp *et al*., 1990). In more recent years also new extensions have been made, for instance, by linking evaluation analysis to GIS (Geographic Information Systems) and BIM (Building Information Models) research. Examples can be found inter alia in Malczewski (1999), Ferretti and Pomarico (2017), Sharifi *et al*. (2009) and Tammi and Kalliola (2014).

It is evident that most studies on planning evaluation in cities are directly or indirectly related to urban land use planning and to a lesser extent to urban amenities (see e.g., Cerreta and De Toro, 2012; Fusco Girard *et al*., 2012). But irrespective of the scope of a study, most urban planning research is nowadays oriented towards the achievement of sustainable development, in the vein of the UN SDGs (Sustainable Development Goals) in the framework of the New Urban Agenda. Against this background, sustainable city policy includes regularly – and correctly – the importance of historical-cultural heritage, with a particular view to the significance of cultural capital in shaping inclusive, safe, resilient and sustainable cities.

In the New Urban Agenda 2030 (NUA) (UN 2016) the key functions of culture, cultural-historical resources and urban landscapes are explicitly recognized. It is noteworthy that both material historical-cultural resources and intangible cultural assets (e.g., urban ambiance, social atmosphere) are included in the NUA, for instance, in Item 20 (cultural diversity), Item 38 (urban revitalisation), Item 45 (vibrant urban economies), Item 119 (cultural service provision), and Item 124 (planning for culture in cities). An interesting contribution in this field can amongst others be found in Gravagnuolo and Fusco Girard (2017). To summarize the above sketched significance of historical-cultural resources in the city, we refer to a UNESCO (2011) recommendation on the material and intangible components of urban culture and landscapes: "This wider context includes notably the site's topography, geomorphology, hydrology 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, perceptions and visual relationships, as well as all other elements of the urban structures. It also

includes social and cultural practices and values, economic processes and the intangible dimensions of heritage as related to diversity and identity" (article 9).

Finally, it ought to be added that cultural capital in a city acts also as a magnet for tourism, a trend that is intensified through the use of digital technology, e.g., e-booking systems (see e.g., Kourtit *et al*., 2019). In the same vein, the relationship between visitors to the city and the creative ambiance in cities has shown a booming interest (see e.g., Cohendet *et al*., 2011; Florida, 2005; Richards, 2011). Thus, the combination of cultural and creative tourism will most likely exhibit a rising popularity in many historical cities.

2. Creativity and cultural resources in the city: the wider spectrum

The contours of cultural policy in a city have dramatically changed over the past years, as a consequence of the wide-spread adoption of digital technology and the current trend towards smart city policy. In both cases advanced data analytics has become a critical issue. These new developments tie in with the modern views on cities as creative cultural magnets (see e.g., Caves, 2000; Florida, 2002; Hartley, 2005; Landry, 2000; Scott, 2006; Storper and Scott, 2009; Andersson *et al*., 2011). Creativity research has consequently led to a wealth of conceptual, applied and planning studies on the new roles of cities in the digital era, against the background of the '*New Urban World*'. Most urban creativity studies address the conditions of vibrant local economies (such as cultural amenities), the expected impacts of place-marketing and the economic significance of a creative cultural complex in a city.

In general, creativity refers to out-of-the-box, innovative thinking and acting. In the extant literature, creativity is often a poly-interpretable concept. First, it may be regarded as an urban productivity-enhancing factor inducing cognitive abilities, innovative behaviour, business competitiveness, and – in the long run – urban economic prosperity. Secondly, creativity may be seen as an output factor (or outcome) that is induced by the prevailing social and cultural context, e.g., economic openness, societal tolerance, entrepreneurial 'genes' or cultural suprastructure. And finally, creativity may also arise as a broader societal externality in a city as a result of learning processes or adaptation mechanisms in specific urban communities, e.g., artists or hippies districts etc. The latter perspective runs parallel to the notion of cities as 'creative buzz areas', with a strong orientation towards a heterodox or 'flamboyant' life style.

In general, cities with an attractive profile of varied cultural resources offer the seedbed conditions for the rise of creative professions in an open and historical city ambiance. Clearly, the creative class is heterogeneous in nature. For example, Florida (2002) distinguishes this class into a super-creative core (e.g., science, research, design, media), creative professionals (e.g., knowledge workers) and 'bohemians' (e.g., writers, artists, photographers, entertainment). It is noteworthy that – in case of broad interpretation of the creative class – the creative sector may

account for almost one half of the urban labour force. However, in a more recent study, Asheim (2012) argues that reality is more differentiated and that the creative class may be found in all urban economic sectors and are not a *sui genesis*. The urban geography of creative-cultural talents in a city is indeed complicated, as the locational force field of this class is co-determined by quality of life (e.g., urban green), cultural diversity (e.g., pluriform neighbourhoods), proximity and accessibility (e.g., density or transportation access), authentic 'ambiance' (e.g., cultural amenities), social capital (e.g., community bonds), and economic wealth conditions (e.g., affordability of expensive housing in inner cities).

3. Towards data-driven urban cultural policy

As mentioned above, the context of urban cultural policy has shown significant changes in the recent past. The introduction of digital technology and the rising popularity of creative class ideas have both contributed to the popularity of smart city policies. A critical factor in any smart city strategy is the availability and exploitation of digital data. Cities and urban agglomerations are the contemporaneous cognitive and socio-economic magnets of our world. Clearly, they are faced with a great diversity of challenges (e.g., maintenance of culture, sustainable transportation, climate-neutral energy use, care for public spaces, social deprivation, protection of historical ambiance etc.), which call for effective and informed policy responses. Modern cities accommodate a great variety of stakeholders and interest groups, with a broad diversity of goals and information needs on many relevant domains of the city.

Urban data and information systems are multidimensional and multilayer in nature, and may range form micro to aggregate information, with different degrees of precision (nominal, ordinal, cardinal etc.) There is unfortunately hardly any systematic architecture for transforming large volumes of heterogeneous and often unstructured urban data into a coherent, tailor-made and measurable data system that is suitable for policy making and operational decision support in the city. The emerging avalanche of 'big' data (originating e.g., from personal mobile devices, social media platforms, sensorization of public space, digital information sources, etc.) does not only prompt difficult data management choices, but creates also innovative and unprecedented chances for a balanced and pro-active urban management and city governance. Consequently, intelligent city policy needs to design and apply advanced expertise on the multiple and interdependent facets of city life and its dynamics, on appropriate urban informatics and analytics, on smart urbanity and public policy, and on digital civil participation.

As mentioned, there is an enormous variety in data and information needs for a smart city. Such data may range from aggregate scales (e.g., number of inhabitants, street length, surface of urban green) to detailed micro indicators (e.g., air quality on a city square, density of museums, use of cultural amenities by specific target groups

etc.) Also, some data may be collected on a structural and regular basis, while other data are only available on an ad-hoc or unstructured basis. The use of social media makes the city an urban data machine (Betty, 2013). A smart or intelligent city aiming at strategic urban performance management needs up-to-date information on both critical urban domains (e.g., environmental quality, educational facilities, mobility profiles or the stock of cultural capital) and on ad-hoc relevant issues (e.g., safety during demonstrations, crowd management in case of cultural manifestations or festivities). And of course, information is needed on land use changes and city morphology (including use of public spaces). The modern data avalanche provides an enormous reservoir of data and information on monocentric vs. polycentric urban evolution, locational patterns of households and firms, geographic dispersion of cultural amenities, the use and crowdedness of public spaces in the city, demand profile of cultural visitors, etc.

In recent years, the term 'big data' has become *en vogue*. This term does not only refer to the volumes of data generated through digital technology use, but also on the interdependent, volatile and non-linear nature of such data. They originate from and cover different sources, different geographical scales, different domains, different degrees of accuracy, different profiles and different measurement scales. In an urban – or more generally, a spatial – context the new data metrics has also led to novel geo-science methods (such as BIM – Building Information Models), spatial data mining techniques and computational neural network (CNN) methods. The 'big data' revolution offers many new perspectives for sophisticated architectural design, unorthodox heritage maintenance policy, and new forms of cultural and economic integration in the city.

The new digital technology is not only a matter of quantity of data; it also has prompted new forms of market organisation in the digital era, as is witnessed by the use of so-called platforms in social media (e.g., Facebook, Uber, Airbnb). This has led to vanishing borders between the producer and the consumer in a modern society, a phenomenon coined '*prosumer*' by Marsden (2018). Electronic booking systems for cultural events are a good illustration of this modern development. More recently, this has culminated in so-called blockchain technology which forms a collection of interdependent data machines which may make several established production and service constellations redundant (e.g., bitcoins).

5. Retrospect and prospect

Our modern society – certainly in developed economies like in Western Europe – is increasingly characterized by a rising demand for cultural amenities. At the same time, smart cities invest more and more in a broad variety of cultural amenities as part of an attractive city profile. The demand management of cultural facilities is increasingly influenced by the widening set of new digital opportunities.

It goes without saying that the modern big data revolution will have unprecedented impacts on the outcomes of smart city policy. The field of intelligent cultural policy will become more knowledge-oriented and data-intensive and will require new smart data management skills in cities.

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