
Paper

FOREVER FRENEMIES: BUILT HERITAGE, MEGACITIES AND NEW TECHNOLOGIES

Planning for culture

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Abstract

Knowledge about how built heritage and megacities interact is still limited. At this stage of development, it is not yet clear what are winning approaches, how to measure performance, which data should be collected and how, and what is optimal way of using potentials of new technologies for that purpose. EU invested substantial resources into defining policy framework for culture and puts further efforts on its thorough understanding, which points out its huge estimated importance for societal well-being. Built heritage is most evident component of it, being usually “hardware” for all other cultural industries, and, at the same time, being the most threatened by growth of cities. In this paper we focused on modelling – with its core in interaction between megacities and built heritage. From one side, there are heritage experts who value their legacy according to success in preserving heritage, and on the other side – there are planners facing new economic and societal challenges due to historic growth of urban population. In addition, there are new technologies which develop faster than the capacity to apply them adequately. We analysed collecting and processing data which are required for clear insight and objective evaluation of an outcome. We discussed methodology – combination of methods and technique which may lead to desired outcome – full understanding and control – within planning and management of existing and emerging megacities. Having in mind that size determines economic performance, quality of life and subsequently future of designated megacity, including if there will be any, understanding this correlation substantially helps good governance.

Keywords

Megacities, Built heritage, ICT, Big data, Spillover

1. Introduction: Heritage as Nucleus of Megacity

Megacity, urban agglomeration, metropolis, city, town, village or any other urbanity consists of small(er) elements which one may call “cells” (with implicit comparison to living organism) or “digits” (as part of matrix in “metromatrix”, i.e. in an associated abstract, numerical model (Ortiz, 2017)(Fig. 1. Left); the essence or the “heart” of such cell, a nucleus, is always a heritage, and usually it is built heritage but not necessarily so ((Luxor-Zivaljevic N., Kurtovic-Folic N., 01-04.02.2015.)). Depending on local characteristics, “cell” may have different shapes, as shown on the right of Figure 1. Once such huge “organism” has been developed, a nucleus may be considered redundant, because it already served its main purpose. However,

a “heartless organism” may hardly survive, and even if it does, common sense says it must be in a way which is “not natural” e.g. with some artificial substitute, or even in some inverted or cancerous way. In this paper we assume that **similar happens to megacities without their built heritage.**



Figure 1. From nucleus to cell of metropolitan (Ortiz, 2017)

The reasons for abjuring built heritage, as genuine nucleus of an urban structure - in particularly after metropolitan area was generated, are numerous and not different than those at other levels: demographic pressure, land use efficiency need, redundancy of buildings without function, attractiveness of locations fully equipped by infrastructure, pressure of stakeholders, necessity of stable economic growth founded on urban developments, instant acceleration of economy, high costs of research, management and maintenance of heritage sites etc. With increase in size it is expected that pressure gets higher and such arguments seem to get stronger. Fortunately, arguments in favour of heritage are also unchanged and numerous: smart development, preserves diversity, strengthens identity and social cohesion, helps prevention of social problems, increases employment, efficiently improves local household incomes, provides better alternative for environment, educational benefit, has potentially catalytic effect on regional economy and positive demographic impact, helps improving quality of services, serves as “hardware” for other cultural industries etc. Most of listed benefits do not come from “existence” of built heritage, but from good heritage management, which requires knowledge, effort, operational skills and more, and that is a game-changing difference, which is undoubtedly present at all levels. **Therefore, our research question is how heritage management changes with size beyond metropolis.**

Knowledge about how built heritage and megacities interact is still limited. At this stage of development, it is not yet clear what are winning approaches, how to measure performance, which data should be collected and how, and what is optimal way of using potentials of new technologies for that purpose. In this paper, our hypothesis is that heritage management will change following overall human perception of space with size of urban agglomeration, and that it will emerge in intersection of three spheres: heritage value preservation, urbanization pressure and ICT development.

2. Importance of Year 2018 for Europe and Beyond

2.1. European Year of Cultural Heritage

Following radical changes of perception of space and comprehension of heritage values, existing urban development and heritage protection theories were substantially not

prepared for surprisingly rapid urbanization, huge number of new heritage sites and numerous new challenges of socio-economic development, or for seemingly unlimited opportunities of digital world. Therefore, impact of international doctrine became bigger than ever, with numerous documents adopted internationally, nationally and sub-nationally. Its latest milestone is European framework for Action on Cultural Heritage) (HEREBITS 2017) adopted less than a year after European Heritage Strategy for the 21st c (Europeana 2019) by EU members and 9 partner countries in May 2018. In those documents, innovations and new digital solutions are pointed out in several cases.

In the new European agenda for culture, the European Year of Cultural Heritage has been described as “a pivotal opportunity to increase awareness of the social and economic importance of culture and heritage”. EAFH descends agenda from 2007, in an ambitious way.

2.2. European heritage strategy for 21st c

European Heritage Strategy for the 21st century “is based on three components:

1. The “social” component – harnesses the assets of heritage in order to promote diversity, the empowerment of heritage communities and participatory governance.
2. The “territorial and economic development” component – seeks to strengthen the contribution of heritage to sustainable development, based on local resources, tourism and employment.
3. The “knowledge and education” component focuses, through heritage, on education, research and lifelong training issues, by establishing heritage knowledge centres and centres for training in heritage trades and professions, by means of appropriate teaching, training and research programmes.” (HEREBITS 2017)

The second of those components “focuses on the relations between cultural heritage and spatial development, the economy and local and regional governance with due regard for the principles of sustainable development” whose challenges include:

1. Building a more inclusive and cohesive society
2. Developing Europe’s prosperity by drawing on its heritage resources
3. Ensuring that Europeans enjoy a high quality of life, in harmony with their cultural and natural environment
4. Implementing the principle of integrated conservation
5. Ensuring that heritage is taken into account in sustainable spatial development strategies and programmes
6. Developing the ability of public services to address sustainable spatial development issues by means of better use of heritage
7. Preserving and developing the ability of public services to address heritage issues
8. Increasing the use and reuse of heritage

Among recommendations how to respond to those challenges, there is recommendation to:

“Use (of) innovative techniques to present cultural heritage to the public, while preserving its integrity: Innovative techniques and approaches must be used to the full in showcasing operations but must be used judiciously in order to meet the dual challenge of preserving the integrity of the cultural heritage and making it accessible to as wide a public as possible”,

as relevant for challenges 3, 4 and 5.; courses of action include informing heritage players, in co-operation with specialists, about the new technologies, including their potential and their limits, carrying out pre-restoration work studies using non-invasive technologies (digitization, augmented reality, 3D scanners, modelling, drones, LiDAR, etc.), using non-invasive exploration techniques to study inaccessible or fragile areas, developing representations of heritage by means of the new technologies (modelling, 3D printing)". (HEREBITS 2017)

The European Framework for Action on cultural heritage is based on five pillars:

1. Cultural heritage for an inclusive Europe: participation and access for all;
2. Cultural heritage for a sustainable Europe: smart solutions for a cohesive and sustainable future;
3. Cultural heritage for a resilient Europe: safeguarding endangered heritage;
4. Cultural heritage for an innovative Europe: mobilizing knowledge and research;
5. Cultural heritage for stronger global partnerships: reinforcing international cooperation.

Each pillar corresponds to clusters of actions.

2.3. Smart solutions for a cohesive and sustainable future

Following lead of United Nations 2030 Agenda for Sustainable Development, the second pillar recognizes "culture, including cultural heritage and the creative industries an important role in achieving inclusive and sustainable development"; its three clusters of actions aim at a) regenerating cities and regions through cultural heritage; b) promoting adaptive re-use of heritage buildings; and c) balancing access to cultural heritage with sustainable cultural tourism and natural heritage. It means in practice, there are numerous projects supporting cultural heritage through EU-funded projects for urban and rural regeneration and sustainable development (European Structural and Cohesion Funds, URBACT, Erasmus+ and Horizon 2020)".

In addition to many pragmatic solutions, in 2019, European Spatial Planning Network (ESPON) 2020 Cooperation Programme co-financed by the European Regional Development Fund, has initiated research for **empirical evidence on the impact of material cultural heritage on the most important economic sectors in 10 selected countries and regions**; ESPON initiated targeted Analysis "The Material Cultural Heritage as a Strategic Territorial Development Resource: Mapping Impacts through a Set of Common European Socio-economic Indicators" and study "Cultural Heritage as a Source of Societal Well-being in European Regions". (HEREBITS 2017)

"At the end of 2018, a Declaration on "Adaptive re-use of the built heritage: Preserving and enhancing the values of our built heritage for future generations" was adopted by stakeholders on 23/11 in **Leeuwarden** as a legacy of the European Year of Cultural Heritage initiative "Heritage in Transition". (HEREBITS 2017)

2.4. Innovative Europe

The forth pillar includes following cluster of actions:

"Digital technologies offer unprecedented opportunities for us to improve public access to cultural heritage assets and allow for their curation and re-use. Innovative technologies, such as virtual or augmented reality, can also enhance people's experiences with cultural

heritage, while digital tools such as 3D scanning play a major role in the preservation and restoration of physical heritage assets. Innovation is not only technological; it also takes place in the social sphere. The role of communities living with cultural heritage assets is changing...To address the challenges above, the Framework entails three clusters of actions aiming at a) capitalising on technological tools for innovation on cultural heritage; b) fostering social innovation; and c) strengthening skills in the field of cultural heritage.” (European Commission 2018)

The correlation of cultural heritage with urban development is considered under also Pillar 2, which refers to applications of new technologies in urban scale.

The overall change towards creating new digital environment calls for new management. Innovative techniques are indirectly mentioned among four principles of the European framework for action on cultural heritage - evidence-based policy making: “Evidence-based decision-making is as necessary in the cultural heritage field as it is in other policies. In that respect, the Framework entails several actions aimed at measuring the impact of actions on cultural heritage. Through its statistical office, Eurostat, the European Commission will also keep improving the methodology and tools to collect data for cultural statistics, in cooperation with the statistical offices of EU Member States.” (European Commission 2018)

2.5. Scientific challenge and significance Beyond Europe

The general intention of numerous European actions, whose small part is described the above, can be summed up as action to increase resilience of European (built) heritage which is considered one of the most important European assets regarding wellbeing of its inhabitants.

European year of cultural heritage hosted 11 700 events with 6 260 000 participants in 37 countries.

Europe declared openness for international cooperation and also set new standards in heritage preservation and urban development worldwide.

Cultural heritage has been classified as tangible, intangible, natural and digital. There are high expectations from ESPON and implementation of **Leeuwarden Declaration**. Huge funds have been assigned to: Creative Europe, a programme of European Commission supporting cultural and creative sectors, between 2014 and 2017, nearly 27 M€ were dedicated to heritage, and in 2018 5 M€ were dedicated to it with 2 objectives: reinforcing a sense of belonging to Europe and Promoting cultural heritage as source of inspiration for artistic contemporary creation and innovation (EUROPA NOSTRA 2018).

In scientific way, we would particularly like to withdraw significance of the programme **European city of culture**, which was established in 1983 (EC, 2019). It is one of the longest living European projects, and it essentially enforces development which comes naturally to some cities, commonly known as “cities of art”. As remarked well long time ago: “...what distinguishes the cities of art from the others it is not so much the presence of artistic and cultural values as the degree of influence that these values exert on the city environment.” (Lazaretto & Cinti, 2001) As an example, “Florence is unanimously considered a city of art and Turin no, despite the artistic richness of Piedmontese villas, both architecturally and on the sculptural or pictorial level.” (IB).

European city of culture generates valuable database (2017 Edition of the Cultural and Creative Cities Monitor is available at: <https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor/> and 2019, the European Commission releases the second edition of the Cultural and Creative Cities Monitor), tool aimed at facilitating peer-learning processes between peer cities based on similar population, income and employment.

In a specific study applied to Venice 3 decades ago, it was noted that the city of art is "a complex cultural asset with its own unitary economic characteristics of which we study the demand and supply function, the cultural and non-cultural investment processes, and mechanisms of formation of collective decisions, phenomena of development and decay for historically differentiated models, the different instruments of public intervention and their effects" (Mossetto, 1992, p. 4) (Lazzartti, et al., 2001). Having many "Venices" as points of reference, many new possibilities opens. In economic terms, phenomenon of "city of art" is related to phenomenon of spillover which is considered generally unplannable and unpredictable. European capital of culture program provides valuable database for further research.

3. Role of new technologies

3.1. Overview

Nowadays, everyday novelties of ICT are extraordinary, inspiring, reinforcing but also overwhelming; therefore, for the purpose of this paper we will point out some key features for rough classification. For some of them, key role has "hardware" – in sense that they are based on inventions, or new provisions of it, regardless if it is satellite, petabyte storage or else, and those with key challenge in "software" – which essentially means collecting and processing data; for scale of "metropolis and beyond", in both case particularly interesting are those which are sensitive to size.

For example, interesting applications recently come from analysing night light, from urban to metropolitan scale (data were always "there" and collectable since the begging of satellites, but nowadays they are easy accessible to public and can be applied on entire regions beyond legal jurisdiction). This application is size sensitive, based on hardware invention and software which is freely accessible for scientific purpose.

Another example refers to (numerous) econometric methods for heritage, which were developed in last 2-3 decades, and developed successfully as spatial on urban scale, now need to be adopted to metropolitan scale which requires demanding new software solutions regarding processing huge amount of data.

Another classification that may be useful refers to inductive or deductive approach. There are numerous global phenomena – like Blockchain, which "also" can be applied on megacities and heritage, and others scientifically developed for the purpose from scratch. Same data can not be reached from outside but only within certain channels and they may provide urban reality of its own.

3.2. Collecting data

The Laconic answer to the question which data we should collect to follow impact of culture on society would be: "All". More specifically: Web, (seems to be infinite source of data);

Social networks (e.g. very valuable for discovering preferences related to cultural tourism), Satellites, Digitalised communal infrastructure, Econometric data and much more. In other words, data sources include: Sensor Networks, Social Networks, Digital Libraries, Multimedia Collections, Web Data Service (Amati et al. 2017)

3.3. Processing data

Even small urban entities generate huge amount of data. Having too many data is as useful as having none: it means being at the beginning. Empirical analyses of huge urban entities are impossible without data processing. In overwhelming amount of data, data mining is name for “the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems... an interdisciplinary subfield of computer science and statistics with an overall goal to extract information (with intelligent methods) from a data set and transform the information into a comprehensible structure for further use.” Big data is misnomer, because they are not big, but may appear “too big” for designated capacity at the time. At this time, synonym for Big data is petabyte, but soon it will be exabyte or zettabyte.

It proves that megacities can not be managed without proper processing of Big data.

Similar to our tendency to rely recently more on heritage doctrine and not on theories (because we do not have them), we tend to rely on empiric data of urban reality instead on theoretical models; using empiric data could be thwarted without methods for **collecting and processing** Big data.

4. Scenarios of extremes

4.1. Between urbanization, heritage and new technologies

Following our initial hypotheses, in ideal megacity, urbanization, heritage and new technology are perfectly balanced, generating successful and progressive society. Let`s see what happens in cases of extreme dominance of one of those components.

“Zero built heritage in heartless megacity” is scenario in which urbanisation dominates; we assume that pressure of urbanization reaches such level that pressure from stakeholders wins in favour of new development. It can be done in early stage – as soon as demographic pressure becomes high or at later stage, once all the spatial relations are defined, in an urban entity that reached its demographic maximum. Difference in outcome may be relevant. In first case, reconstruction would bring along fully new spatial relations and, in time, memory of the heritage would be fully lost. In second case, all functions would remain the same, according to original spatial hierarchy, but may start to deteriorate in time without symbol of community`s cohesion, similar to a hive without queen bee.

“Beyond psychical structure: virtual built heritage as substitute in overcrowded megacities” is a scenario in which advanced technologies technics and come to “rescue” of heritage values although not of heritage itself. There could be many variations of this scenario. As in many other examples of virtual reality, in this case focus would be on sensations, “experience” of built heritage, instead of genuine structure. One version of it includes that built heritage becomes fully privatized and commercialized trough a blockchain of its digital version (which in time may become its only version). Then, the focus would be on the appearance and it is highly questionable if dematerialized built heritage (eventually

reduced to ordinary artefact) may keep performing its social and economic role and how. Virtual built heritage would mark “techno-heritage” singularity of urban agglomeration.

“Smooth but slow sliding into future behind appearance of an open air museum” is a scenario in which built heritage fully wins although that social-economic development of society is severely diminished. If it means slow development, it is not certain if it can realistically survive in the world with very fast pace.

4.2. Concept of substitutes

All those differences would supposedly happen at level of “cities”, so the question is how those cities would interact within a megacity. If different scenarios happen in one megacity, it may mean new “zoning”, according to which cities take over function which quarters have in a city (and we are fully aware of good and bad sides of it).

5. Discussion: Looking for empirical proofs

5.1. Efficiency as precondition for size

The comparison with living organism (by Pedro B. Ortiz, (Ortiz, 2017)) explains why bigger means more efficient in case of urban entities. Existence of metropolises or megacities can be justified only if they would be more efficient then before. That should mean practically that if there is synergy between compounds i.e. that there is beneficial correlation. Sinergy in economic terms means a spillover, which can not be planed or predicted but it could be measured. Econometric methods for measuring spillover exist, although they are not considered fully sufficiently developed yet ((Yang & Wong, A spatial Econometric Approach to Model Spillover Effects iin Tourism Flows, 2012), (van Duijn & Rouwendal, 2013)). Spillover may be based on heritage (e.g. provided by cultural routes; it may be measured by following economic performance before and after cultural routes have been established/branded or other spillover effects i tourism flows (Yang & Wong)). In that sense, proving existence of metropolis to megacities means looking for signs of spillover. Another proof may come from researching cultural tourist preferences (e.g. if they visit sites in other part of assumed megacity within the same tourist visit).

5.2. Data and methods

Big data draws a lot of attention (agedly, in particularly after CCC- **Computing Community Consortium** established in 2006 – leading organization voice of USA computing research community, pointed it out in 2008.), and it is thoroughly researched as being considered by some scholars “the next big thing”; processing large amount of data usually means remote sensing database, generated from images (Wang et al. 2016) (Merino et al. 2016). Lot of data are generated from Google Earth Engine in cooperation with different map sources (Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community) (Amato et al. 2017) (Agapiou 2017); also by The Defense Meteorological Satellite Program/Operational Line-scan System (**DMSP/OLS**) which “collects visible and near-infrared **light** from the Earth's surface at **night** without moonlight. It generated “effective **time series** data for mapping the dynamics of urban expansion” since 1992. (Agapiou 2017) Data can be further processed based on aspects as the saturation of luminosity, the blooming effect, the intercalibration of time series, and their temporal pattern adjustment (IB). Processed data can further be used

e.g. for analysing urbanization around heritage sites or still earthed archaeological finds, i.e. data can be further processed through Spatial interaction model is popular method for analyzing areas with size of megacities. This method belongs to Structural equation modelling (SEM), developed for social sciences “as a form of causal modelling that includes a diverse set of mathematical models, computer algorithms, and statistical methods that fit networks of constructs to data **The structural equation method** belongs to a high level statistical category of multi-variety statistics, reallocates the factorial analysis and path analysis, tests the relationship of dominant variate, latent variable, interfere or errors included in the model at the same time (Shi 2016). SEM may include confirmatory factor analysis, confirmatory composite analysis, path analysis, partial least squares path modelling, and latent growth modelling. Semantic web is applied the “intrinsic relationship for questionnaire design, which improves the reasonability of analysed results” (IB).

The aim of such research is to find patterns in empirical data which would serve for modelling of future megacities. (Marrocu & Paci, 2013).

Other researches are based predominantly on econometric data, i.e. irregularities which are expected to be caused by cultural heritage interventions, e.g. proofs of spillover as mentioned previously.

5.3. Principle of Substitutes

At this time, we could not scientifically tell how to intentionally create city of art, but it would be useful to know it in case cities within megacity start getting “roles” and if at least one of them would have role of “city of art”.

Empirical analyses on urban scale showed that heritage is required, but that built heritage may have substitutes. Substitutes may get bizarre appearance reduced to symbol (e.g. in famous historical case of Las Vegas in middle of 20th century, which later became role model for many cities, and e.g. because of which nowadays exist 50 copies of Eiffel Tower in the world) or that role may play tangible heritage of different kind or natural heritage (e.g. ship wrecks and natural heritage, in case of Sharm el-Sheikh, small but globally positioned town on far western fringe of Asia. We did not find examples of intangible heritage playing such role but it does not mean such examples do not exist. If they do, it would make easier to accept that such role could be played by digital heritage in the future, as well.

6. Conclusion

In well balanced urban agglomerations, which we want and act to have in Europe, built heritage is expected to keep the role it has nowadays. However, in many cases built heritage may be in danger of being dematerialised and replaced with its digital copy.

Those are only some of examples indicating that European policy makers are aware that the applications of new innovative methods require new approach in collecting data from the field, and different management of overall process.

It is expected that heritage management becomes more “digital” as well as heritage itself. As direct consequence, and it is expected to be more scientific: subject of Big (remotely-obtained) data processing and high-end statistics.

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