

E-governance, digital mapping and exploratory scenarios for *livable* metropolitan projects

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Introduction

As architects acting and researching in the field of urban planning and design, we must face digitalization and continually question its place in the design and management of our architectural and urban environments.

At the architectural scale, one of the profession's most powerful digital tools, the BIM (Building Information Modeling) is still being broadly discussed and criticized, causing reserved reactions from a social and professional standpoint¹. One of the most significant criticisms of this tool condemns its production-oriented and efficiency-driven dimensions, and the acceptance of technology for profit rather than social benefit.

More recently, the transition from BIM (Building Information Modeling) to CIM (City Information Modeling) and even TIM (Territory Information Modeling), promoted as vital tools for building the "smart cities" of the future, takes the stakes to a whole different level by introducing, together with the change in scale, very complex urban issues of both private and public interest.

Without negating the problematic issues put forward by the opponents to digitalization, our posture distances itself from technical questions of software (and its ownership) by choosing to look for its possible benefits and its potential to underwrite a different philosophy of working.

As researchers and practitioners within the field of urban architecture, we stand by the idea that a less static view of urban territories needs to be adopted in order to fully understand the city itself and, more broadly, the relationship between its past and its future.

Thus, our work stands by the idea that what makes digitalization interesting is its ability to implicate a very wide range of actors (from public stakeholders – government authorities and technicians, to design professionals – architects, urban planners and designers, to researchers, experts and key actors from both academia and the private sector, up to the citizens) in the knowledge sharing and collaborative decision-making processes. In other words, its interest resides in the potential to reorganize traditional authority and authorship, through knowledge sharing, open innovation and collaborative frameworks made possible by technological developments. Furthermore, even if functional, quantitative and technical aspects are easily put forward through the "smart city" concept, we believe that the digital turn could and should also play a role in developing more qualitative, human-oriented and nature-based solutions to current environmental concerns.

Inspired by the Sustainable Urban Mobility Planning philosophy (SUMP), LivCity project (H2020 program candidate) addresses these issues by creating and experimenting with *an advanced urban e-governance framework* based on systemic interaction between several relevant urban actors and by researching and developing *digitalized mapping and planning tools* (mapping & design software) that aim to provide knowledge on city's structural corridors – natural and mobility ecosystems and infrastructures – their spatial configuration and their level of integration. The ENSA Strasbourg and the ENSA Paris-Belleville and their research centers – AMUP (EA 7309)/Innovative Metropolitan Mobility Chair (ENSA Strasbourg-Tongji University-SYSTR) and UMR AUSser (MC-CNRS 3329) – in collaboration with the Politecnico of Turin, and together with the local municipal governments who are also partners of the project, work on the development of a new digital way to visualize and to create exploratory scenarios for European and Asian metropolitan territories.

¹ Deamer P., Cairns G., "Architecture and capitalism. From production to product", in Graham Cairns (eds.), *Reflections on Architecture, Society and Politics. Social and cultural tectonics in the 21st century*, Routledge, Oxon & NY, 2017.

The project thus promotes a new way of planning which aims to improve urban life quality, sustainability and resilience and draws on the experience of Strasbourg and the Upper Rhine Region as an innovative metropolitan reference (pilot case study). The goal is to capitalize on Strasbourg's experience in order to develop knowledge and know-how (technological and non-technological) on innovative and sustainable mobility and ecosystemic planning, and to upscale and operate the transfer of knowledge, tools and design technologies for qualitative metropolitan infrastructures to Paris and other European or Asian cities.

This paper first introduces the principles and objectives for the collaborative digital platform by discussing the SUMP philosophy as a new posture for European metropolitan governance, and presenting a brief state of the art on Open Innovation² and collaborative urban planning practices. It then shows the existing digital tools that support the collaborative digital platform and discusses the innovative governance mechanisms based on the framework of the Development Council of Eurometropole of Strasbourg.

The second part of the paper, through a brief literature review³, analyses the mapping & design approaches linked to ecological networks and livable mobility projects, examining the specificities of sustainable mobility and natural ecosystem planning in Strasbourg, and discusses the importance of a "qualitative digital mapping" tool as base material for exploratory ecosystemic metropolitan scenarios.

This article finally stresses the importance of knowledge assessment and scenario thinking in relation to the "preparing well" phase (SUMP method), and discusses the possibility to organize it in the digital framework of e-governance.

a. SUMP philosophy, Open Innovation and collaborative practices in urban planning

More than a method or a step-by-step defined process, the SUMP acronym – standing for Sustainable Urban Mobility Planning – summarizes a posture where the idea of "democratization from below" (originated in the 80s) meets that of "a search of a common ground on which building a better future" (developed in the North-American context in the 90s)⁴. Adopted and put forward by the European Commission in 2013⁵, SUMP stands for the idea of drawing together data and knowledge, organizing cooperation across different policy areas, fields of knowledge, levels of government and administration, in collaboration with citizens and other stakeholders. Within the LivCity project, an online platform is meant to provide a digital framework to support and develop this collaborative approach. Its main purpose is to store and organize thematic contextualized knowledge, to open spaces of public debate and, finally, to contribute to the "preparing well" phase⁶ and, more specifically, initiate market regulation on the level of "scenario development". In Europe, this important sector of urban policy and strategic metropolitan design is not yet regulated. In each metropolitan city and territory, local actors and technicians tend to work separately, which makes it difficult to strengthen the deep relationship between territorial and local, national and European urban strategies. The digital platform could provide a frame for organizing these planning phases in advance of the operational planning.

² The state of the art on Open Innovation and the brief literature review on mapping ecological systems are part of the research work of architect Pierre-Baptiste Tartas, in preparation for his PhD project at Paris Est University.

³ Ibidem

⁴ Missions Publiques, *Practical Guide on running a Future Search Workshop for polycentric regions*, www.missionspubliques.com

⁵ European Commission EC. (2013), *Guidelines. Developing and implementing a sustainable urban mobility plan*, Rupprecht Consult-Forschung und Beratung GmbH; http://www.eltis.org/sites/eltis/files/guidelines-developing-and-implementing-asump_final_web_jan2014b.pdf.

⁶ European Commission EC. (2014), *The Poly-SUMP Methodology. How to develop a Sustainable Urban Mobility Plan for a polycentric region*. Guidelines, p.8. <http://www.eltis.org/sites/default/files/trainingmaterials/polysump-sump-guidelines-final.pdf>.

Another major guiding principle of the LivCity project that will be implemented and/or supported by the digital platform is that of Open Innovation. According to Chesbrough et al.⁷, Open Innovation is not a new phenomenon and it consists in “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the market for external use of innovation, respectively”⁸. Originating in the fields of business strategy and technology development⁹, it is focused on the importance of creating and encouraging development by motivating users, researchers and companies¹⁰ through co-creation and crowdsourcing methods¹¹. For Seltzer & Mahmoudi¹², this process applied in urban planning can be related to the development of “communicative planning”. Other studies also linked it to “urban commons” and “open-source urbanism” development¹³.

In Strasbourg, the pilot city for the LivCity project, a major step towards an open debate and an open innovation approach to metropolitan planning was taken with the creation of the Development Council of the Eurométropole, in which civil society and the university can take up more space than before. Presented as a tool for dialogue and consultation on the metropolitan level, the Development Council of the Eurométropole organizes prospective work meetings where elected officials, European institutions, representatives of the German neighbors and civil society meet and discuss issues related to future metropolitan development. The resulted contributions feed the development strategy of the territory and participate in the construction of public decision.

Nevertheless, in urban research, open innovation and the processes behind it are mainly associated with the “smart city”, where the latter term is used to describe the “deployment of digital technologies, smart environment and user engagement to optimize urban systems and the economic and social life of the city”¹⁴.

In line with the strategies and targets of DG Climate Action¹⁵, in the LivCity project, the “smart city” is intended as a low-carbon and resource-efficient city which will be achieved through both nature-based solutions and technology-led strategies. One of the latter is precisely the local e-governance digital platform supporting the human platform inspired by Strasbourg’s Development Council of the Eurométropole.

The principles considered for its development are: the utilization of a holistic approach; the development of a collaboration method; the combination of top-down and bottom-up approaches; and the construction of a strategic framework.

For a methodology supporting broader participation we refer also to the EURBANITIES¹⁶ Erasmus Plus project finalized in August 2018. In its framework, an educational game was designed to inform people about opportunities to take part in the design and management of their neighborhoods and cities and incite them to get involved. The idea of the game is proficient in co-opting a large category of people not usually participating in the design and management of cities, especially children – who are essential to consider as, on the one hand, cities designed now are going to be inhabited and used by them, and, on the other hand, research proves that places that are good for children (weak users)

⁷ Huizingh, E. (2011). *Open Innovation: State of the art and future perspectives*. *Technovation*, 31, 2-9.

⁸ Chesbrough, H., Vanhaverbeke, W., West, J. (Eds.), 2006. *Open Innovation. Researching a New Paradigm*. Oxford University Press, London, p.1.

⁹ Seltzer, E., & Mahmoudi, D. (2012). Citizen Participation, Open Innovation and Crowdsourcing: Challenges and Opportunities for Planning. *Journal of Planning Literature*, 28(1), 3-18.

¹⁰ West, J., & Gallagher, S. (2006). Challenges of open innovation: the paradox of firm investment in open-source software. *R&D Management*, 36(3), 319-331.

¹¹ Grassman, O., Enkel, E., & Chesbrough, H. (2010). The future of open innovation. *R&D Management*, 40(3), 213-221.

¹² Seltzer, E., & Mahmoudi, D. (2012). *op. cit.*

¹³ Bradley, K. (2015). “Open-Source Urbanism: Creating, Multiplying and Managing Urban Commons”. *Footprint*, 9(16), 91-108; Corsin Jimenez, A. (2014). “The right to infrastructure: a prototype for open-source urbanism”. *Environment and Planning D: Society and Space*, 32, 342-362.

¹⁴ Komninos et al., (2018). “Smart City Planning from an Evolutionary Perspective”. *Journal of Urban Technology*, p. 16.

¹⁵ https://ec.europa.eu/clima/policies/strategies_en

¹⁶ <http://eurbanities.org/>, <https://eurbanities.wordpress.com/>

are good for everybody. The LivCity project considers including data generated by games or other applications engaging the user in an on-site knowledge production process.

From the point of view of software development and the online infrastructural support, the digital governance platform of the LivCity project will be sustained by the Huma-Num infrastructure. Supported by the French National Center for Scientific Research, Aix-Marseille University and the Campus Condorcet, Huma-Num is a Digital Research Infrastructure created for Social Sciences and Humanities.

The aim of Huma-Num is to support research communities through the provision of services, assessment and tools related to digital research data. Its activities are based on innovative organization combining human and technological resources on a national and European scale via groups of researchers and common interests.

Huma-Num coordinates digital data production while providing a variety of platforms and tools for the processing, conservation, dissemination and long-term preservation of digital research data. The promotion of data sharing is a scientific objective so that other researchers, communities or disciplines, can employ research results, including from interdisciplinary perspectives. More broadly, the principles and methods of the Web of data on which Huma-Num's services rely enable dynamic data documentation for diverse uses, while maintaining accessibility.

As such, Huma-Num encourages core principles and approaches such as open science and Web of data technologies to encourage interoperability both for internal communication between services, as well as for external functionality so users can plug their tools into Huma-Num services.

From a technical perspective, the infrastructure itself is hosted in a major data center in Lyon originally designed for and by physicists. Long-term preservation facilities are provided by another data center (CINES) based in Montpellier.

Based on this powerful infrastructure from Huma-Num, the LivCity digital platform is developed as a network of local platforms, each created and tested in different European metropolitan contexts (Strasbourg, Paris, Turin), in partnership with the local public authorities. The goal of the local digital platforms is not to add new layers to a complex regulatory system, but rather to create porosity and give visibility to different types of knowledge and initiatives that different actors conduct in parallel on the same metropolitan territory. The final goal would be to open up the debate on a local level, regarding future metropolitan development strategies and scenarios. Online public arenas, public and micro-forums (cooperative inter-actor forums) on specific projects and strategic orientations would be the base for the online debate. On the European level, multi-platform networking would be a support for wider dialogue, inter-metropolitan cooperation and thematic knowledge assessment and sharing.

b. Digital Mapping of Ecological and Mobility Networks

From a spatial – physical, geographical and ecological – aspect, LivCity addresses the “livability” or the qualitative character of urban space by focusing on the metropolitan infrastructural ecosystems and networks – the “blue” hydrographical one, the “green” natural one and the mobility-public transport system – and their levels of connectivity and integration.

Strasbourg metropolis appears again as a reference in the matter as the Ecocités project of 2009 (built together with the neighboring German city of Kehl) that poses the three systems as the base for addressing the then-new metropolitan ambition of Strasbourg and building the future common vision for the cross-border metropolis. Drawing from the historical development of the Strasbourg city center, where the three systems are very well articulated, the Ecocités project anticipates the importance of working not on one, but on all three of the structuring networks at the same time.

If traditional mapping and recent projects developed in Strasbourg already started to give a better understanding of the state of these systems and their relations, a *digitalized mapping and planning tool* would allow Strasbourg and other cities to take this work even further.

As reported by Ignatieva et al. (Ignatieva, Stewart, & Meurk, 2011), the definition of ecological networks depends on the different disciplines that study them. In urban planning and landscape ecology they relate to spatial context, with a focus on visual, physical and, more recently, ecological connections. In other words, beyond their physical configurations, these corridors could (and should) be considered as green and blue “highways” where organisms live and move. For Voghera & La Riccia (2019), the blue and green networks are “landscape-biodiversity” and “natural-rural-urban” corridors that should act against the fragmentation of habitats and natural areas – the main cause of biodiversity loss in Europe (Torta, Ardissono, La Riccia, Savoca, & Voghera, 2017; Voghera & La Riccia, 2019).

Several studies (Ignatieva, Stewart, & Meurk, 2011; Voghera & La Riccia, 2019; He, Shen, & Zhang, 2018; Burkhard, Santo-Martin, Nedkov, & Maes, 2018; Torta, Ardissono, La Riccia, Savoca, & Voghera, 2017) pinpoint that these ecological networks are key to preserving local biodiversity as well as to providing various ecological services, and thus sustainable planning needs to integrate them in relation to anthropogenic elements. And yet, according to Ignatieva, Stewart, & Meurk, green spaces in urban areas are still primarily planned nowadays for aesthetic and socio-economic functions (Ignatieva, Stewart, & Meurk, 2011). Voghera & La Riccia (2019) also criticize the logic of “simple ‘territorial schemes’” where new ecological corridors are planned for “aesthetic” reasons and do not take into account biodiversity aspects.

Facing these challenges, ecological networks and systems are at the core of the European Union Biodiversity Strategy 2020 (EUBS-2020)¹⁷. A key action of this strategy is the “Mapping and Assessment of Ecosystems and their Services” (MAES) which correspond to action n° 5 of the EUBS-2020’s second target “Maintain and restore ecosystems”¹⁸. One interesting outcome, the MAES digital atlas (with an interactive version online)¹⁹, identifies and locates 10 different Ecosystem types across the European territory, by using only information that has been published at European, national or subnational scales.

Furthermore, the MAES working group of the European Commission produced four guidelines for future research: (1) the mapping of ecosystems, (2) defining the condition of ecosystems, (3) quantification of the services provided by ecosystems and (4) the compilation of these previous steps in an integrated assessment. These guidelines are based on the hypothesis that ecosystems’ spatial accessibility and condition is strongly influencing socio-economic development and long-term human well-being (Burkhard, Santo-Martin, Nedkov, & Maes, 2018). Interestingly, when comparing this hypothesis to the research made by He et al. (2018) on ecological vulnerability assessment, it appears that the socio-economic development cumulated with environmental pollution strongly affect ecological vulnerability and human health. Therefore, it seems that a balance between ecosystem and socio-economic and especially urban development is beneficial for these intertwined systems.

However, instruments developed so far in the field of urban planning (e.g. ArcGis, UrbanAPI, CivilCad, Cybercity3D, CityPlanner...) have focused on the specific skills of each actor, disregarding the cooperative work between them. Imposing cultures of collaboration (collaboration as a natural way of doing) at the urban and territorial levels, the model proposed by LivCity will improve cooperative mapping, designing, assessing and evaluating impacts of sustainable metropolitan planning.

¹⁷ European Union, *The EU biodiversity strategy to 2020*, 2011.

<http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf>

http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

¹⁸ http://ec.europa.eu/environment/nature/biodiversity/strategy/target2/index_en.htm

¹⁹ <https://biodiversity.europa.eu/maes/maes-digital-atlas>

To realize ecosystem mapping, an extensive use of GIS, remote sensing, GPS (the 3S) as well as thematic data and qualitative data (when Participative GIS is used) is necessary. In this field, we refer especially to the ESMERALDA project²⁰. Current developments also consider knowledge integration, data harmonization and sharing, crowdsourcing as well as data mining and software able to learn pattern recognition. Among these current approaches, Torta *et al*²¹ have developed an OWL ontology²² for the representation of Ecological Networks and able to test scenarios and engage in planning. This was made possible through the creation of a new language: GeCoLan. This project, developed in Turin, was used in two cities (Ivrea and Chieri) to test their ecological network proposals. The contribution of this project will be further advanced in the framework of LivCity through the integration of Participatory GIS, thus enabling the collection of feedback and project proposals, as well as allowing for checks on feasibility.

Burkhard & Maes²³ present various types of models used in different conditions: models for ecosystems assessment (p. 125-126) and models to help decision-making (p. 131-132). Five models applicable for the former are presented: (1) Conceptual models, (2) Statistical models, (3) Deterministic models, (4) Probabilistic models, and (5) Rule-based modelling. In the latter category, three models are presented:

- (1) Bayesian Belief Networks (BBNs) which is flexible in data integration allowing the utilization of quantitative and qualitative data. Moreover, they can integrate additional complex models. They use automated machine learning or statistical approaches if conditional probabilities are unknown and take uncertainty into consideration. They can also be incorporated in GIS or web-based platforms. Thus, they allow for interactive scenario exploration with stakeholders, with the quick visualization of a changing input during discussion.
- (2) Multi-Criteria Decision Analysis (MCDA) which allow for the examination of preferences for different decisions outcomes. This method seems to be the most commonly used²⁴.
- (3) Participatory modelling with stakeholders, which increases the legitimacy of the modelling while integrating the local knowledge of the stakeholders, thus improving the model's quality. However, such an approach is time-consuming.

To be effective, the information integrated in decision-support systems and mappings have to be understandable by the decision-makers. Klein *et al.* identified five recommendations for the communication of the results:

- (1) 3D landscape visualizations are preferred for analyzing and exploring Ecosystem Service-related information.
- (2) Texts and abstracts are preferred for communication and discussion support.
- (3) Thematic 2D map representations are preferred to support scenario development in public applications.
- (4) Abstract 3D landscape visualizations facilitate estimations in group applications.
- (5) Charts and tables combined with thematic 2D map representations, support analyses.²⁵

²⁰ <http://esmeralda-project.eu/showpage.php?storyid=11754>

²¹ Torta, G. *et al.* (2017). Representing Ecological Network Specifications with Semantic Web Techniques. *Proceedings of the 9th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management - Volume 2: KEOD*, ISBN 978-989-758-272-1, (pp. 86-97).

²² According to WW3C Semantic Web (<https://www.w3.org/OWL/>) Web Ontology Language (OWL) is a Semantic Web language designed to represent rich and complex knowledge about things, groups of things, and relations between things. OWL is a computational logic-based language such that knowledge expressed in OWL can be exploited by computer programs, e.g., to verify the consistency of that knowledge or to make implicit knowledge explicit. OWL documents are named ontology and can be published on the World Wide Web.

²³ Burkhard, B., Maes, J. (2017). *Mapping Ecosystem Services*. Sofia: Pensoft Publishers, 374p.

²⁴ La Rosa, D., Barbarossa, L., Privitera, R., Martinico, F. (2014). Agriculture and the city: A method for sustainable planning of new forms of agriculture in urban contexts. *Land Use Policy*, 41, 290-303.

²⁵ Klein, T., Celio, E., & Grêt-Regamey, A. (2015). Ecosystem services visualization and communication: A demand analysis approach for designing information and conceptualizing decision support systems. *Ecosystem Services*, 13, 173-183.

Drawing on these recommendations and experiences, the LivCity digital mapping tool focuses on *urban ecosystems* and their relation to the third major urban infrastructural network, the mobility system. The overall goal is to cooperatively build a solidly documented and visible foundation for enabling the restoration and the connectivity of green and blue metropolitan ecosystems through sustainable mobility for people and goods. The aim of the digital mapping software is to bring together qualitative and quantitative data and to link, in accordance with the scale of representation chosen by the users, 2D maps with 3D visualizations.

Conclusion. Eco-systemic metropolitan exploratory scenarios for Strasbourg and Paris

The knowledge gathered and displayed through the digital mapping software represents the base material for exploratory eco-systemic metropolitan scenarios. In other words, the LivCity concept will be tested on a local level through two exploratory scenarios – for Strasbourg and for Paris – seeking to base future metropolitan development on structural networks with enhanced connectivity between blue and green ecosystems and to reduce ecosystem risks.

The “exploratory scenario” is a tool for thinking about the future while coping with the multiplicity of challenges and uncertainties of the current context dominated by climate change and environmental concerns.

As all the other tools and principles described in this paper, the “exploratory scenario” addresses the necessity for a more open interpretation of urban space and its governance, where shapes and numbers are not sufficient to explain the complex nature and interaction of processes and systems. This approach favors an inductive mode of thinking, in search of “possible futures”, as opposed to probable or desirable ones. Thus, “exploratory scenarios” support the idea that it is impossible to predict what will really happen as well as to try to define and then reach an ideal configuration²⁶. This scenario approach aims at the exploration of “what could happen?” by formulating hypotheses and unfolding a range of possible consequences (risks, strengths, gaps, etc.). For city planning, its openness represents a clear advantage when it comes to difficult and/or conflicting questions and decisions, for it allows for the testing of new concepts, strategies, priorities and innovations while stimulating reactions and widening the debate by generating images outside the routine (Viganò, 2012).²⁷

Related to the SUMP approach (the scenarios appear as the last step of the “preparing well” phase), the “exploratory scenario” will be a way to articulate quantitative and qualitative thinking in the progression from the Smart City to the Livable City. This should not be confused with utopian or romantic approaches, since the exploratory scenarios’ baselines are attached to territorial realities, as in geographical and landscape features, local landmarks, cultural representations, and ways of living and sharing the metropolitan space. Thus, “exploratory scenario” developments rely on quantitative data and qualitative information in order to cover and explore not only explicit features, such as physical layouts and ways in which the territory functions, but also implicit ones, such as mental constructions related to the former. This implies both a spatial and a conceptual exploration of possible futures during scenario development.

The scenarios to be developed (for Strasbourg and Paris) in the framework of the LivCity project will specifically focus on hypotheses regarding ecosystems as metropolitan infrastructures and their evolution possibilities. In a wider sense, and after our research ends, exploratory scenarios could become a regular practice in urban prospective, of direct and indirect use during latter planning and decision-making phases. Promoted through the local digital platforms, “exploratory scenario”

²⁶ Börjeson et al. (2006), “Scenario types and techniques: Towards a user’s guide”, *Futures*, No. 38, pp. 723-739.

²⁷ Viganò P. (2012), *Les territoires de l’urbanisme. Le projet comme producteur de connaissance*, MetisPresses, Genève.

consultations could be opened by the local authorities on different themes, territories and questions that need further debate. Consortiums formed by research structures together with planning and design professionals could be expected to submit their scenarios online. The results could then be publically discussed online, and both the proposals and the public debate could be used to inform and nourish the decision making process.

If the LivCity concept relies on an exploratory attitude, it does so in combination with Open innovation approaches, in order to question the status quo in prospective planning processes. Similarly, LivCity embraces a posture that argues for the necessity to switch from the “smart city” model to the “livable city” idea, moving from data-driven and technology-based urban development toward a middle ground situated between technological, nature-based, and human-oriented solutions that use both quantitative and qualitative data and approaches. Digitalization provides a broad set of tools that go hand in hand with changes in posture and functioning, but the direction taken by these changes is not prescribed by necessity. By combining digital tools, such as e-governance platforms and digital mapping systems, with innovative, open, and exploratory positions, the LivCity concept aims to create more livable urban spaces through a democratization of planning processes.

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