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## RESEARCH ARTICLE

### INTERDISCIPLINARY BIBLIOGRAPHY OF URBAN RESILIENCE

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#### ABSTRACT

Concerns about resilience in the urban context cross different fields. Cities and urban spaces are complex systems that comprise social, environmental and economic spheres. The urban resilience is defined as the capacity of a city to survive and achieve the same level of performance after an external or disturbing event. The urban resilience is composed by the governance, management and technological solutions that allows cities to be resilient. For that, the objective of this paper is to explore the scientific corpus about urban resilience using systemic bibliometric method. By mixing two different methodologies, we conducted a three-phases qualitative study. In the first phase we selected and described a papers database provided by Scopus and Web of Science, in the second we deepen the analysis for a systemic overlook and in the final step we propose a research agenda. This method was designed by a systemic perspective of input-processing-output data to align different scientific subjects. Results reveal that the majority of studies is concentrated on environmental and transport areas. The studies that take account other pertinent factors to the complexity of cities like human behavior, individual moving, and central-peripheries location are far from dialoguing with engineering solutions to improve urban resilience. Results show interdisciplinary approaches between engineering and social sciences are needed to deal with urban resilience. The future agenda of this theme tends to optimize social data to produce new products and solutions to shape holistic solutions to address urban resilience complexity. Mapping systems are pointed to be a new way to integrate both literature.

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#### INTRODUCTION

The extent to which the 21st century world will be "sustainable" depends in large part on the sustainability of cities (Ahern, 2011) focusing on the awareness of the need for a worldwide fundamental change in thinking and in practice of environmental management (Folke et al, 2002). Cities are complex and interdependent systems, extremely vulnerable to threats from both natural and social hazards (Godshalk, 2003). One of the most discussed topics on current literature on cities problems is the resilience systems. To reduce the risk for citizens, researchers and policy-makers have focused planning new ways to manage cities (Camagni et al, 2002). The challenge of how to protect urban spaces is a strategic issue that requires a thorough appreciation of diverse problems of the city, especially in emerging countries (SINHA, 2003). The literature has been evolving in this theme and searching for new and effective solutions. However, this information is fragmented in different subject fields like environmental engineering, geography, transport, building, energy, city management and social change.

Also, traditional bibliographic methods (Amui, 2017; Tranfield, 2013) work perfectly in the same field of research but when it comes to cross disciplinary approaches some adjustments are needed. For example, analyzing the activity sector does not contribute to code engineering studies since the same technology can be used in different applications. For that, this paper intends to provide a more concise knowledge and research agenda by using systemic bibliometric review. The contributions are in three different directions: a) identifying technologies that will allow researchers to develop new devices or systems to urban resilience; b) providing educators and researchers new possible methods to bibliometric crossdisciplinarity corpus; c) visioning frameworks to help public policies and managers to improve urban resilience.

#### METHOD DESIGN

Bibliographic measurements are relevant for understanding recent scientific topics (Mariano, Sobreiro and Rebelatto, 2015; Jabbour, 2013). Amui et al. (2016) describes a systematic model for bibliometric studies as shown in figure 1. On the yellow chain of the model, it is possible to observe that authors propose a structured classification system, which can help researcher to identify the main results of past literature providing a summary of those observations.

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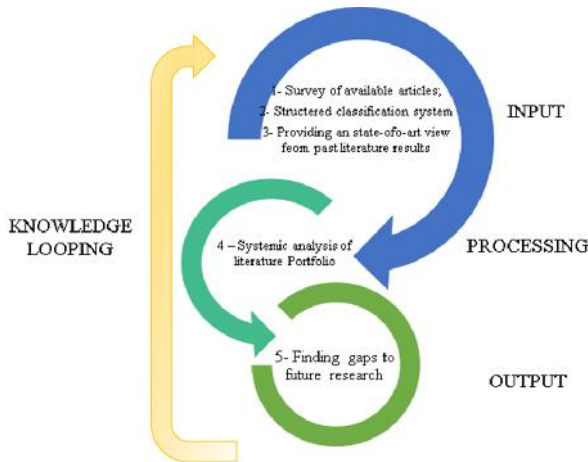
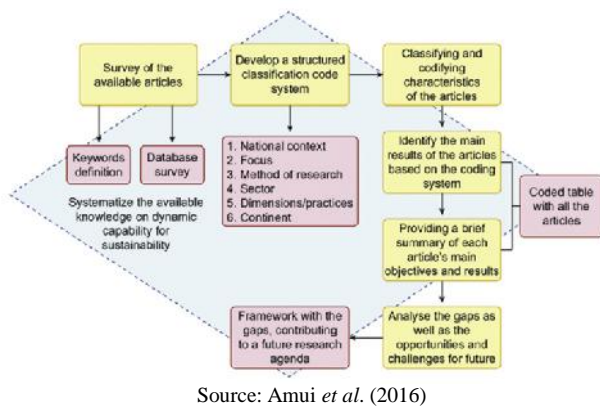


Figure 1. Knowledge loops for method design

In addition, it also suggests that knowledge evolution gaps can be cleared stimulating the rise of a future agenda. The ProKnow-C bibliometric method (Dutra et al., 2015) and its initial orientation on Esslin's works (Tasca et al., 2010; Ensslin et al., 2012; Ensslin et al., 2014) proposes the "systemic analysis". The bibliographic portfolio as an input to six analysis lenses in order to obtain the knowledge gap of each publication and from the whole database (Marafon, 2013, p. 76). Based on a systemic perspective and taking into account that a bibliometric study should also provide the next research steps for advancing on a subject, this study is based in an input-output model to build its specific bibliographic method design.

Figure 2 explains the looping process. The knowledge is created by taking the state-of-art of literature (1, 2 and 3) and processing it through a systemic analysis (4) that ends up in an output of research gaps and future agenda. It starts from an accurate survey of selected articles by keywords. Once the database of papers is complete, according to Amui et al. (2016) it should be developed a framework using numbers and letters codes to classify the papers. The chosen codes for classification phase are represented by: (1) Source, (2) Document, (3) Expertise Area, (4) Keywords on title, (5) Origin, (6) National context, (7) Results focus, (8) Research Method and (9) Sector of Analysis. Moreover, processing this information through critical lens as proposed by the Systemic Bibliographic Method is the like tracing knowledge evolution using academic papers as signals. The proposed questions would be: which are the most cited papers? Is there a connection between the authorship? Are they concentrated on science area or it indistinctly appears?

In the output phase, a future agenda of gaps that were found on the literature is exhibit but the focus is different from simple new research ideas, this would provide answers and a systemic diagnosis of the knowledge evolution of such a theme around the world and inter universities. That can be called knowledge looping because it offers an upcoming path of knowledge trajectory when understanding last advances.

## RESULTS

Selected keywords were "resilien\*", "urban", "city". In a defined search of: (resilience or resilient) AND Topic: "city" OR "urban". The topic could appear inside the keywords, abstract or titles statement of the paper. Few documents are shown duplicated in both databases, web of Science and Scopus Crozet, Y. (2012); Kuzyk, L. W. (2012); Xu, Z., & Coors, V. (2012); Jones, P. I. (2014); Ravindran, Adiththan, & Iannelli (2016); Saremi, F., & Abdelzaher, T. (2015). After abstract reading three documents were withdrawn from the dataset even though, they have all keywords. They were Melo, Sargento, & Carapinha (2016); Ravindran, Adiththan, & Iannelli (2016) and Mishra, Upadhyay, Sen, Maurya, Choudhury, & Bhattacharjee (2015). The three are connected to computer science research and resilience of virtual networks, virtual mobility and cloud services. The last paper is inside biotechnology research, did not present any link to this subject. The final corpus presents a 24 documents portfolio (Table 3).

## Data Processing

From the total of 24, 5 were found in both Web of Science and Scopus, 4 only in Web of Science and 15 only in Scopus. In terms of subject areas (Table 4) Environmental Engineer concentrates the majority of works. National context represents a relevant factor since there is a trend of researching local context. In this case, although the authorship is concentrated in developed countries, especially in North America and Europe the studies do not present this difference making the gap between results from developed and developing countries smaller. The case of developing countries attracted more researchers trying to mitigate problems of low income cities. Even the context of developing countries is not restricted to local researchers, there is a larger amount of studies that addresses developed countries context. By considering four types of results to analyzing the focus of the research: A – Technological device or system proposal; B – Transport and Logistics solution; C- Business Solutions and D - Not applicable, the papers could be grouped (Table 5).

To propose some device or technological solution applied on environment or transport studies compose the major objective of the sample. It means that the papers present new knowledge being developed around the world in the same direction, or at least in the same subject. That represents an advance for city management using mapping technology but at the same time also means a lack of comparative or exploratory studies that in some way try to analyse these devices, software or systems and perhaps understand their viability on empirical reports. The research method was divided in A – qualitative (case studies, interviews); B – quantitative (survey, statistics); C – theoretical, D – mapping (GIS, ArcGIS); E – simulation, programming (graph 3).

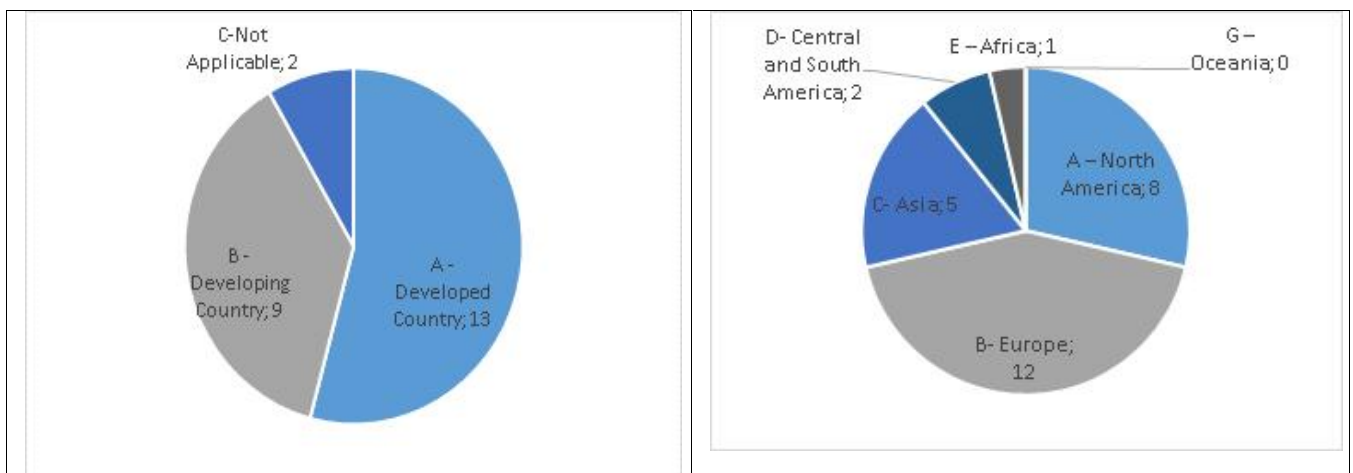
**Table 1 – 6 Systemic Bibliographic Method**

Lenses	Description Questions
1 – Theory Approach	The paper conciliates theory and empirical data.
2 – Singularity	The paper recognizes the problem as unique
3 – Identification Process	It uses any process to identify the motivations and perceptions of subject.
4 - Measurement	It exhibits the scales and respective features properties
5 - Integration	The paper presents the scale or indicators
6 - Management	It presents how knowledge can be expanded and deepen in future works

Source: Adapted from Marafon (2013); Lacerda, Ensslin, and Ensslin. (2011).

**Table 2. Codification of the Bibliographic System adopted**

1- Source	A – ISI Web of Knowledge; B – Scopus
2 - Document	A – Periodical Paper; B – Conference Paper
3 - Expertise Area	A – Environmental Engineering; B – Telecommunications and Computer Sciences C- Sociology, Anthropology; D –Geography E- Management, Economics, Accounting F – Transportation Sciences
4 - Keywords on the Title	R – Resilience/resilient; M- Map/mapping; Mob- mobility; S – Sustainability/sustainable.
5- Origin	A – North America; B- Europe; C- Asia; D- Central and South America; E – Africa; G – Oceania
6 - National Context	A – Developed Countries; B- Developing Countries; C- Not applicable
7 - Results Focus	A – Technological device or system proposal; B – Transport and Logistics solution; C- Business Solutions; D - Not applicable
8 - Research Method	A – qualitative (case studies, interviews); B – quantitative (survey, statistics) ; C – theoretical, D – mapping (GIS, ArcGIS); E – simulation, programming
9- Sector of Analysis	A- Manufacture; B – Services (including transports) ; C- Agriculture; D – Forest, Ecosystems, Nature; Disasters, Hazards; E – Cities; F – Not Applicable



**Graph 1 and 2. Origin of authorship and National Context**

Table 3. Filtered documents portfolio by author, name of the journal, title, citations and country of origin

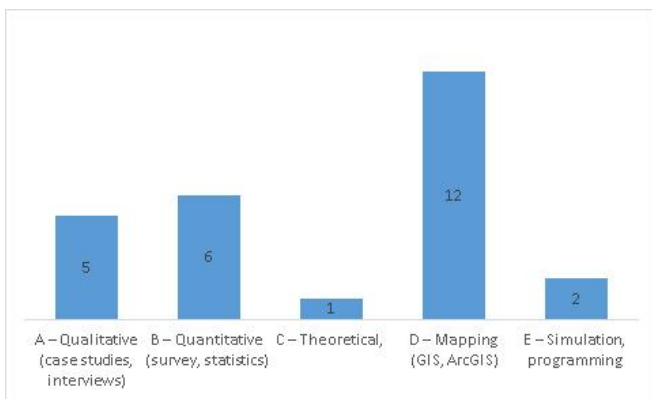
	Year	Authors	Journal	Title	Citations	Country of origin
1	2005	M. R. Rahnema& A. Lyth	Environmental Health Risk	Accessibility and urban environment sustainability in Sydney (1991–2001)	10	Australia - Iran
2	2011	Jarvis, A, Lau, C, Cook, S, Wollenberg, E, Hansen, J, Bonilla, O and Challinor, AJ	Experimental Agriculture	An integrated adaptation and mitigation framework for developing agricultural research: synergies and trade-offs	51	Colombia – United States – United Kingdom
3	2011	Kuzyk	Local Environment	Ecological and carbon footprint by consumption and income in GIS: down to a census village scale	4	Canada
4	2011	M Dijk, C Montalvo	Journal of Transport Geography	Policy frames of Park-and-Ride in Europe	24	Netherlands
5	2012	Xu & Coors	Building and Environment	Combining system dynamics model, GIS and 3D visualization in sustainability assessment of urban residential development	59	Italy - Germany
6	2012	Kuzyk	Ecological Indicators	The ecological footprint housing component: A geographic information system Analysis	16	Canada
7	2012	Georgiadou, Hacking & Guthrie	Energy Policy	A conceptual framework for future-proofing the energy performance of buildings	26	United Kingdom
8	2012	Widlok, Aufgebauer, Bradtmöller, Dikau, Hoffmann, Kretschmer, Panagiotopoulos, Pastoors, Perters, Schäbitz, Schlummer, Solich, Wagner, Weniger& Zimmermann	Quaternary International	Towards a theoretical framework for analyzing integrated socio-environmental systems	27	Germany
9	2012	Tabibian, M, Rezaie, N, Nouraie,	Journal of Environmental Studies	Impact of Migration on the Sustainability of Residential Environments (Case Study: Neighborhood of "Kan" in Zone 5 of Tehran)	3	Iran
10	2013	Ning, Liu, Chen, Dong, Li &Liang	Frontiers of Environmental Science & Engineering	Sustainability of urban drainage management: a perspective on infrastructure resilience and thresholds	2	China
11	2013	E. Paffumi, M. De Gennaro, H. Scholz, & G. Martini	WIT Transactions on The Built Environment	Electric vehicles and charging strategies to meet urban mobility requirements	3	Italy
12	2013	Shiau& Liu	Ecological Indicators	Developing an indicator system for local governments to evaluate transport sustainability strategies	18	Taiwan
13	2014	A Rienow, D Stenger, G Menz	Erdkunde	Sprawling cities and shrinking regions – forecasting urban Growth in the Ruhr for 2025 by coupling cells and agents	4	Germany
14	2014	Jones	Cultural Geographies	Performing sustainable transport: an artistic RIDE across the city	3	United Kingdom
15	2014	Li, Shi, Qureshi, Bruns& Zhu	Ecological Indicators	Applying the concept of spatial resilience to socio-ecological systems in the urban wetland interface	12	China-Germany-United Kingdom
16	2014	Marletto	Technological Forecasting & Social Change	Car and the city: Socio-technical transition pathways to 2030	23	Italy
17	2014	Arena, M., Azzone, G., Colomi, A., Conte, A., Luè, A., & Nocerino, R.	IET IntelligentTransport Systems	Service design in electric vehicle sharing: evidence from Italy.	4	Italy
18	2015	Onur, A. C., &Tezer, A.	Habitat International	Ecosystem services based spatial planning decision making for adaptation to climate changes	5	Turkey
19	2015	Garza-Reyes, J. A.	Journal of Cleaner Production	Lean and green—a systematic review of the state of the art literature.	15	United Kingdom
20	2015	Grieco, M	Research in Transportation Economics	Poverty mapping and sustainable transport: A neglected dimension.	2	United Kingdom
21	2015	Miller, W	Sustainable Cities and Society	What does built environment research have to do with risk mitigation, resilience and disaster recovery?	5	Australia
22	2016	Lombardini, G., &Scorza, F	International Conference on Computational Science and Its Applications	Resilience and Smartness of Coastal Regions. A Tool for Spatial Evaluation.	0	Italy
23	2016	Fernández, I. C., Manuel-Navarrete, D., & Torres-Salinas, R.	Sustainability	Breaking Resilient Patterns of Inequality in Santiago de Chile: Challenges to Navigate towards a More Sustainable City	0	Chile
24	2016	Turner, M. D., McPeak, J. G., Gillin, K., Kitchell, E., &Kimambo, N.	Human Ecology	Reconciling Flexibility and Tenure Security for Pastoral Resources: the Geography of Transhumance Networks in Eastern Senegal	0	United States

**Table 4. Expertise Area Derivation**

Environmental Engineering	10
Telecommunications and Computer Sciences	4
Sociology, Anthropology	1
Geography	2
Management, Economics, Accounting	1
Transportation Sciences	6

**Table 5. Paper classification about Results Focus**

Results Focus	
A – Technological device or system proposal;	10
B – Transport and Logistics solution;	9
C- Business Solutions;	3
D - Not applicable	2
Total	24

**Graph 3. Research Method**

Graph 3 emphasizes the tendency to technical method using GIS software, programming definitions and quantitative studies more than “soft” works based on behavioral of citizens and social factors. Finally, transports and its respective technologies were the most frequent topic, focusing on environment hazard. People and social consequences as emotions, habits, culture are the less studied, what can mean a lack of interdisciplinary when it comes to sector of activity, concentrating studies on the expertise area of the authorship, without risking other applications. From 24 papers, 12 were about transport system, 10 about rebuilding programs and only two about linking resilience to social aspects of cities.

### Systemic analysis of literature portfolio

Theory approach is the first issue to investigate. The sample presents papers in different ways, some of them like Rahnema and Lyth (2005), Kuzyk (2011, 2012), Jones (2012), Xu and Coors (2012) and Widlok *et al* (2011) have a concern on developing solutions, technological devices or system. Also, Arena *et al.* (2014) approaches theory softly because of papers objective, which is to design a phase of an electric vehicle sharing service for the city of Milano, the same case occurs to the spatial resilience model proposed in Li *et al.* (2014). A last way inside this same approach theory is describing data, focusing in technical details that will validate technological model proposed on the empiric section, that is the case of Paffumi *et al.* (2013). Others mix different theories like sustainability conferences and climate change as a reference to ecosystem consequences (ONUR; TEZEL, 2015) or to risk mitigation (JARVIS ET AL., 2011). Grieco (2015) uses the context of poverty and the search for socially sustainable

transport to support its work and goes to a different approach from studies that deal with city management and transportation. A different paper is Garza-Reyes (2015) which explores past literature systemically through a concept map, but concentrated on greener infrastructure. Singularity is something that cannot be seen on this sample. Papers recognize the resilience as different approaches not always involving stakeholders and with diverse perspective of investigation. An exception is found in Marletto (2014) which is a problem-solution paper but it takes into account social and technical perspectives to construct a map of actors’ members of the city system. Another example can be described in Widlok *et al.* (2012) through archaeology, the geosciences and socio-cultural anthropology provide information relating to a diversity of specific time series and spatial distribution in order to answer questions relating to the impact of environmental and anthropogenic factors in population growth and migration processes. Identification process, instead, is concentrated on the need of improving resilience in cities. Some of them presents comparative cases. Shiao and Liu (2013) provides indicators of city mobility from Taipei to New Taipei and mix statistical methodologies for that. However, the model is a proposal not a case reporting its weakness or strengths. Ning *et al.* (2013) also present a case study but to comprise resilience to natural disaster on a touristic Chinese city and Rahnema and Lyth (2005) a case about Sidney mapped geographical areas. A step ahead is Kuzyk (2012) with information about a case study applying its method using GIS. A more complete approach is found on Dijk and Montalvo (2011) when the authors compare the model of ride and park in 45 European cities also providing correlation between management attribute data.

Measurement gets more evident on works of Shiao & Liu (2013) and Li, Shi, Qureshi, Bruns & Zhu (2014), Onur and Tezer, A. (2015) and Garza-Reyes (2015). All of them provide scales and quantitative indicators that prepare future works using their research framework. Integration is the less present attribute. That is because in all sample different authors are cited. It means that the papers of the sample are constructed by different line ideas that not converge to the same continuous development. A change of integrating Smart Programs and GIS for providing a systemic and resilient solution for natural disasters is exhibited on Lombardini and Scorza (2016) GIS and environmental problems of cities can be viewed at Onur and Tezer (2015) and Xu and Coors (2012). When it comes to management, the focus of analysis goes to what the sample proposal as future ideas. The model generated by Lombardini and Scorza (2016) assures the interdisciplinary of environmental problems but in other way around does not provide any future applications for the model itself. Garza-Reyes (2015) has identified and classified six streams of research in the area of lean and green, to explore: (1) their compatibility, (2) their amalgamation, (3) their integration with other paradigms, (4) methods/indicators to measure their contribution and effect, and their dependencies, on the performance of organizations, (5) their impact on organizational performance, and (6) their application in various organizational functions and industries. Even Onur and Tezer (2015) discuss the limitations of their work on the lack of interdisciplinary with public politics and city management. To Arena *et al.* (2014) actually, firms—while competing in the market—build and develop two kinds of coalitions: a first one, in order to innovate their products and services; and a second one in order to lobby.

**Table 6 Summary, keywords and some results of the researched portfolio**

	Authorship	Brief Summary	Results
1	M. R. Rahnama& A. Lyth (2005).	The authors calculated the accessibility indicator by a zonal opportunity gravity model (employed person) for 38 local government areas (zones) in Sidney with mapping, and, in addition, the changes in accessibility measured during 1991– 2001. In addition, the relationship between the indicator and six sub socio-eco-physical factors was calculated by multiple regressing.	The results achieved show that here is not direct relation between car usage and family income on mobility system.
2	Jarvis, Lau, Cook, Wollenberg, Hansen, Bonilla & Challinor (2011)	Outlines a framework for research on climate change and food systems from a pro-poor perspective. The inherent complexities between the climate system and food security means that science must make a great effort to take a holistic view to adaptation and mitigation research to understand the trade-offs and synergies involved in interventions aimed at addressing the climate crisis.	Food security research must go beyond its focus on production to also examine food access and utilization issues of sustainability.
3	Kuzyk (2011)	Presents a method that can be used to estimate the ecological footprint and its sub-categories in global hectares at a fine level of geography.	The method allows the pattern of variation of resource consumption to be shown across Canada, and with the, insight into which areas are more sustainable than others for targeting further consumption data collection or possibly intervention policy.
4	Dijk & Montalvo (2011)	The authors conducted a survey amongst 45 major cities in Europe on how deployment of P + R (Park and Ride) is framed by policy makers within their broader transport policy. A quarter of the responding cities are extensively engaged on implementing P + R, whereas another quarter has little or no engagement.	Linear regression analysis suggests that economic implications, perceived demand, and organisational learning capabilities are the most important drivers for engagement in P + R development.
5	Xu&Coors (2012)	System Dynamics was applied to construct a sustainability model for urban residential development and then integrated with GIS technology to generate a spatial simulation and 3D views. It examined interactions among five categories (“Driving forces”, “Pressures”, “State”, “Impact” and “Responses”) during the simulation and a validation was undertaken to verify the SD simulation in comparison with the historic data.	The case study in the Stuttgart Region of Germany showed that the application. Allows the decision makers to predict the single unstable factor or follow up the entire sustainability situation in the process of residential development with a quantitative criterion.
6	Kuzyk (2012)	Analyses the ecological footprint (EF) measurement at a household geography for the City of Calgary, allowing mapping presentation material to raise awareness and assist in communication for policy planners as well as making available direct decision-making support based on the EF.A sample analysis was carried out involving comparison between the sustainability of inner city single family, infill housing and older existing single family housing..	The results make up an example of what may assist planners in formulating sustainability policy
7	Georgiadou, Hacking& Guthrie (2012)	Presents a review undertaken to understand the concept of ‘future-proofing’ the energy performance of buildings, a concept related to design processes that accommodate explicitly full lifecycle perspectives and energy trends and drivers by at least 2050, when selecting energy efficient measures and low carbon technologies	A knowledge map is introduced, which explores the key attributes for achieving a ‘future-proofed’ energy design: coverage of sustainability issues, lifecycle thinking, and accommodating risks and uncertainties that affect the energy consumption. Reveals the need to integrate futures thinking into the energy design of buildings.
8	Widlok, Aufgebauer, Bradtmöller, Dikau, Hoffmann, Kretschmer, Panagiotopoulos, Pastoors, Perters, Schäbitz, Schlummer, Solich, Wagner, Weniger& Zimmermann (2012)	A model based on the key idea of adaptive cycles was employed to answer questions relating to the impact of environmental and anthropogenic factors in population growth and migration processes. It outlines first steps towards recognizing similar patterns across a wide spectrum of empirical observations.	The model helps to infer internal dynamics in the diverse environmental and social domains without reducing one domain to another while still connecting evidence from a host of different sources

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9	Tabibian, Rezaie&Nourai (2012)	Based on social-spatial dialectic, it explores the causes and social-spatial impacts of inter-urban migration in the sustainability of “Kan” residential environment, in Tehran Municipality, with the aim of understanding the mechanisms governing this type of mobility to provide proper solutions for Tehran planning.	The results show that the principles of sustainable development are not being considered in planning the development of Kan.
10	Ning, Liu, Chen, Dong, Li &Liang (2013)	Investigates infrastructure resilience against the risks of long-term changes rather than natural disasters. A land use-based accounting method, combined with a grid-based database, is developed to map domestic discharge and urban runoff to service areas of wastewater treatment plants.	The results of a case study on downtown Sanya, in China, show that the average resilient values of three sub-catchment areas will strengthen significantly. Also suggests that infrastructure resilience needs to be considered for urban planning and the related realm of urban governance to foster more robust wastewater management under various risks.
11	Paffumi, Gennaro, Scholz & Martini (2013)	Develops a methodology to determine the potential of electric vehicles to meet the urban drive needs of a mid-size province. The method relies on real driving data collected by GPS black boxes installed in approximately 16,000 vehicles in the province of Modena. It examines the relevance of different recharging scenarios against real-life mobility data.	The results provide a new insight into the potential electrification of urban transport and development of recharging infrastructure
12	Shiau& Liu (2013)	The study proposed an indicator system for measuring and monitoring transport sustainability at the county or city level. Twenty-one indicators were grouped into economy, environment, society, and energy aspects, of which ten were selected to measure the sustainable transport strategies for the Taipei metropolitan area. Fuzzy Cognitive Maps and Analytic Hierarchy Process were used to construct the cause-effect relationships between the indicators and to evaluate the strategies.	The results showed that expanding mass rapid transit lines was predicted to produce the most significant improvements; integrating bus exclusive lanes would provide the least improvement; and promoting cleaner vehicles and integrating Fu-Kang bus resources would perform similarly to each other in improving transport sustainability.
13	Rienow, Stenger &Menz (2014)	Presents an integrated CA-MAS modelling approach to simulate the spatial pattern of urban growth in the declining polycentric Ruhr metropolitan area. Beside a “business as usual”-scenario, two further scenarios of changing housing preferences are simulated for 2025 and reflect the dissemination of sustainable thinking among stakeholders and the steady dream of owning a house in sub- and exurban areas.	The sprawled pattern of the cities of the Ruhr is just prevented in the scenario “sustainable thinking”.
14	Jones (2014)	The paper explores the value of artistic practice as a means for undertaking research. The performance was a piece of GPS drawing, using the movement of a body in space to write the word ‘RIDE’ across the city, subsequently represented in the form of a map	Through the experiment the author was able to create a new understanding of cycling practices that would not be captured through conventional social science techniques.
15	Li, Shi, Qureshi, Bruns& Zhu (2014)	The authors developed a spatial resilience assessment and zoning system with a mapping method of the urban wetland interface in the Taihu Lake watershed in China. The assessment was integrated with indicators of ecological sensitivity, the assessment of water quality monitoring and vegetation cover, to complete the practical application of spatial resilience.	The zoning maps and plans generated on the basis of spatial resilience assessment, social indicators, and the existing administrative region can help the government protect and restore ecological services in the wetlands. The proposed ecosystem-based approach aimed to redistribute regional growth in a way that minimizes negative environmental and social effects.
16	Marletto (2014)	Through a socio-technical approach to innovation, it analyses three transition pathways to 2030 for urban mobility. Also, introduces a new graphical tool which provides a synthetic representation of the variables that are relevant to understand the cumulative processes between the transformation of supporting coalition and their access to higher level of competence and power.	The resulting policy prescriptions are clear-cut: if not destabilized by policy pressure, the ‘AUTO-city’ pathway will prevail; to support the ‘ECO-city’ and the ‘ELECTRI-city’ pathways, a multilevel policy for urban and transport planning and a national innovation and industrial policy are needed, respectively.
17	Arena, M., Azzone, G., Colomi, A., Conte, A., Luè, A., & Nocerino, R. (2014).	“Vehicle road sharing has attracted growing attention from both researchers and operators, as a potential instrument to improve the sustainability of urban mobility or transport systems”. One of research phases was mapping of mobility profiles and service performances.	This process lead to the formulation of three vehicle-sharing configurations that are based on targeted classes of users, in the attempt to offer them a ‘personalized service’. One of them is the variation of accessibility to urban mobility system.
18	Onur, A. C., &Tezer, A. (2015).	It integrates by mapping ecosystems and their services into spatial planning using Istanbul case in order to combat climate change, and/or take precautions to increase their resilience. Sustainability is considered under triple bottom line approach and should be prioritized to promote the adaptation of key ecosystems to climate change.	Mapping space scenarios planning provided different ecosystem indicators and their respective sustainable impacts.

Continue .....

19	Garza-Reyes, J. A. (2015).	Paper maps a systematic review of lead and green supply chain literature. Resilient arise as a kind of supply chain and sustainability as a stress to move supply chain to green formats and process.	“It has identified and classified six: (1) compatibility, (2) amalgamation, (3) integration, (4) methods/indicators to measure their contributions, and dependencies, on the performance of organizations, (5) impact on organizational performance, and (6) application in various organizational functions and industries
20	Grieco, M. (2015).	Sustainability is approached in a social dimension where urban mobility relates to poverty in Latin America, this paper identifies the utility of poverty mapping in developing sustainable transport systems.	Mobility needs to be closely integrated with e-services and local accessibility planning as opposed to being focused on great metropolitan transport systems. “mobility is one of the means to achieve social sustainability”.
21	Miller, W. (2015).	It explores resilience as resistance on disasters by describing three Australian building projects: heat waves, net zero energy homes and house spacing information stock. A core sustainability indicator would be technical, social and economic approach to adapt and reduce its risks for buildings among climate change.	“Disaster management, insurance and finance sectors may work collaboratively with the housing sector to reduce risk, enhance occupant health and safety, and protect the immense capital investment that Australia’s housing represents”
22	Lombardini, G., &Scorza, F. (2016)	Evaluates the level of resilience of a territory space as its resists against risk and disasters by using Italian coast area cases. Sustainability is analyzed under Sustainable Development Goals (SDGs) of UN (2015). Geographic Information System (GIS) provided space mapping.	A resilient behavior is the ability of a system to maintain identity. “The latter in turn can be articulated in two models: the first concerns the representation of the territorial status conditions (status indicators) and the second the representation within a logical assessment model of the elements-processes which define vulnerability and resilience of the territorial system and in particular of the landscape system (pressure indicators and response)”.
23	Fernández, I. C., Manuel-Navarrete, D., & Torres-Salinas, R. (2016).	Resilience as a descriptor of complex systems dynamics of inequality spatial segregation of Santiago do Chile. Sustainable development is the objective of politics, actions and change against segregation resilience. “It was mapped Santiago’s spatio-temporal inequality trends and explored if patterns support an inequality-resilience stability landscape”	Santiago’s urban sustainability may require breaking resilience with bottom-up process like social movements
24	Turner, M. D., McPeak, J. G., Gillin, K., Kitchell, E., &Kimambo, N. (2016).	Mobility is about livestock in Africa. Sustainability is about making eastern Senegal a balanced territory for pastoral land use and livestock mobility, still increasing for travel, water, and forage as herds move along a north-south trajectory. “It contributes to the existing literature by assessing the institutional requirements of mobility in terms of access to important resources (e.g.,water and forage) through a network of livestock corridors that connect encampment sites and water points across eastern Senegal. By mapping the pastoral geography of corridors, encampments, and water points within the study area, our research describes the network of pastoral resources that serve as the foundation for transhumance in eastern Senegal.” Resilience comes on the persistence of agro pastoral economies.	“The study demonstrates that extant transhumance networks accommodate the competing needs of pastoral tenure security by facilitating herd movements in response to changing resource availabilities through a series of spatially fixed components (encampment sites, water points, and corridors) that can be recognized and protected through legislation. Thus, the demands for tenure security and flexible patterns of resource use can both be potentially accommodated.”



Thus, the dynamics of a societal system should be represented in a more appropriate way as a Darwinian multilevel process that simultaneously takes place in three different environments: the market, the technology and the policy. Table 6 shows a summary of the portfolio content.

**Future Agenda:** The sample is somehow divided in technological papers (including computing, software programming) and sustainable solutions (based on case studies and surveys). These two different worlds exhibit a gap on the state of art of literature which is using technology solutions to city management towards resilience. Grieco (2015) resume the first state “In the end, access is the final product; mobility is just one of the means to achieve it. The existing body of evidence on the social sustainability, accessibility and transport indicates that this is a framework which has considerable utility in the contemporary planning environment and there is much progress yet to be made in respect of its full utilization. New information and communication technologies have a very important part to play in improving access to urban services and can be of great assistance in moving the fully participative framework, most particularly in a period of global austerity”. And technological papers in other way around states “future research could focus on the seasonal variation in EV use, addressing more specifically the aspect of the human behavior, together with an extension of the analysis to other cities or European countries” (PAFFUMI, ET.AL, 2013). In addition, only one paper tries to make this connection like Garza-Reyes (2015) but it was considered an “outlier” since it is the only one that uses systemically bibliographic review. The study has identified and classified six streams of research in the area of lean and green, these being directed to explore: (1) their compatibility, (2) their amalgamation, (3) their integration with other paradigms, (4) methods/indicators to measure their contribution and effect, and their dependencies, on the performance of organizations, (5) their impact on organizational performance, and (6) their application in various organizational functions and industries. The paper could reach with a different way some similar conclusions that are being learned on this present study, the lack of integration between technical devices papers and sustainability approaches. Pointed by Kuzyk (2011, 2012) and Jarvis *et al.* (2011) complexities and inter-relations between the climate system means that science must make a great effort to take a holistic view to adaptation and mitigation of synchronized actions and also develop significant effort to understand the trade-offs and synergies green mobility in both perspectives. How these technical device and system are viable on a large-scale basis? How these theoretical models towards resilience will deal with information technology, cleaner energies and social impacts? What can be addressed is that mapping is an integrative tool for this conflict. It evolves new researchers composing interdisciplinary in diverse ways: mixing software engineers and environmental managers, mixing city cases that has been already studied with the same mapping method, mixing politics pressures as public city management to solutions arisen from universities, and, finally, mixing researchers from developed with developing countries in a tentative of reaching a systemic view of resilience; not just something based on the build structure of a specific city.

#### All three-suggestion point to a future research agenda

- ) Comparing case studies of failed and successful models;

- ) Searching for the social and politics pressures of trying to make technical systems and devices viable to city management, and;
- ) Providing a study that can compare, using mapping process, resilience on city mobility in different contexts, specially evolving develop and developing cities and researcher’s cooperation worldwide.

## DISCUSSION

Concerns about resilience in urban context essentially cross the state of art of different fields research and subjects. A sample of 24 papers was selected from ISI Web of Knowledge and Scopus databases. Data shows that most of the papers are indexed in both databases but this not necessarily increase their citation power. The more relevant expertise area was Environmental Engineering followed by Telecommunications, Computer Sciences and Transports. The studies are produced more frequently in developed countries but the object of study (cities) can vary making this difference between develop and developing countries reduced. As expected, mapping process, using GIS and other related software was the most regularly research method of the sample. About the sector of activity there is a clear division between services (information technology, commonly) and environmental issues as nature, disasters, build structured and other city ecological issues. Results from the systemic analysis reveal that some papers are “practical” like Rahnama and Lyth (2005), Kuzyk (2011, 2012), Jones (2012), Xu and Coors (2012) and Widlok *et al* (2011) Arena *et al.* (2014) Li *et al.* (2014) and Paffumi *et al.* (2013) when developing literature in order to support technical systems or models. Other can be called as “green” like Onur and Tezel (2015) Jarvis *et. el.* (2011) and Grieco (2015) that describe resilience contexts in a global scale exploring its causes and consequences. A last type would be “theory” paper represented by Garza-Reyes (2015) which foos ahead into literature process for this research question but focused on greener manufacture. Therefore, a lack of studies that integrates both literatures to refer to technical devices taking into account other perspectives of resilience in urban space is revealed. The studies that take account other factors like human behavior, individual moving, and central-peripheries location changes are far from using mapping or any other technology resource on their solutions. It is clear that on the limitations of their texts both “practical” and “green” papers expose others aspects that were not included on their model like politics issues, social pressures and flux movements. Then, although past literature of resilience in urban spaces has evidenced a growing movement on research that produces good and innovative papers, different lens between technology and social sciences avoid a holistic advancement. Looking at the problem by a holistic perception can be only found in few papers that explore mapping systems from social data of cities. More complete approaches that value social and human aspects into the mapping systems results is critical for the evolution of resilience literature.

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