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**The role of urban governance in shaping the resilience of urban form**

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## **Executive summary**

Throughout history, some cities, and despite challenges and change in socio-economic cultural factors through ages, they still continue to be viable, productive, and attractive for people. This continuity, flexibility and adaptability is how resilience is applied in the context of urban development studies and implemented in the 'resilient urban form' qualities. Where resilience here is against different management modes and policies over time, which shape our surrounding built environment, which in return affect people's spatial behavioural patterns. This study approaches resilience from the point of view of configuration as socio-spatial interface.

Acknowledging that the resilience of an urban form is a complex process between socio-ecological systems, it is also undeniably a path-dependant process. The institutional specificities of governance at the time that urban places were created can have a crucial bearing on the long-term resilience of urban form. At the same time, changing kinds and styles of governance can also shape resilience over time. Therefore our goal is to observe how the designed, as well as the built-in qualities of each urban form; undergoing unique long-term processes of land management through ownership, planning, investment and development, can aid/ constrain resilience.

This study deals with the interaction between urban governance and urban form, and the impact of change on inhabitancy, cultural identity and socio-spatial networks. Aiming to understand how spatial networks are formed through years, affecting inhabitants' sense of belonging, attachment, usage and perception and to study aspects of society and space relationship from the perspective of resilience.

The research in this paper constitutes a dual line of investigation; first, how the resilience of an urban form is being assessed from the spatial behavioural patterns and modes, second, what type of urban governing and management practices best served resilience in terms of the spatial patterns of people.

Through utilising theories and methodologies of space syntax and spatial justice in understanding people behavioural patterns in those 'designed', yet managed spatial network configurations, we are able to clarify the properties of a syntactical view of resilience by means of quantitative comparison of resilience between case studies. It is claimed that the resilience of an urban form cannot be only studied by comparing physical properties of built environments, but rather develop a broader set of measures that empower the altering social life, economic value, and environmental performance, to be taken into account. Comparing socio-spatial aspects in neighbourhood-scaled case studies' in past to present state, helps us know how our urban form is being shaped by actions, decisions and land management strategic approaches embedded in urban development and management practices over time.

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## Introduction

With a dramatic rise in policy, practices and planning discourses, over the last 3 decades, resilience is recently observed, as a contested concept in academic debates. This popularity is related to how resilience theory explicitly deals with socio-ecological complex systems, adding strategic approaches to being safely ready and responsive to changes and potential threats. In contrast to sustainability discourses, ambiguously offering concepts of continuation and commitment to urban living conservation (Rega & Bonifazi, 2020). Resilience, as a term has been associated to anticipate / respond to major global challenges among the last 5 year, ranging from urbanisation, planning, sustainable development, climate change and hazards management discourses. Major global agendas have applied resilience as a prominent theme to implement global policies, including the

2030 Agenda-Sustainable Development Goals, the Addis Ababa Action Agenda, the World Humanitarian Summit Commitments to Action, the Sendai Framework on Disaster Risk Reduction, the Paris Agreement, and the New Urban Agenda.

The resilient urban form is becoming a fast-growing concept in urban development fields. The capability of a place to maintain its core values and functions, despite everyday minor to major challenges it faces, is reliant upon how the place is being managed and perceived by its inhabitants. The role of long-term processes of land management through relationships of ownership, planning, investment and development in showing how spaces evolve over time and form patterns of provision, adaptation and renewal. This paper explores how resilience can be shaped through the interplay between built as well as the 'designed' qualities of urban governance and urban form.

Through applying spatial network configuration to Resilience measures and studying how peoples' patterns of connectivity, integration and choice are being affected after different land management practices. This study utilizes methodologies of space syntax in studying people's behavioral patterns, concluding the resilience capacity of places from a socio-spatial interplay.

This paper focuses on the resilience in response to slow variables; from the minor, every day and incremental to more major causing urban change. While technological and operational aspects of resilience have been widely studied, few studies linked the resilience to the cognitive dimension with the spatial dimension in response to changes over time. This research aims to explore how the change in urban governance policies impact the socio spatial networks, affecting the resilience of urban form through observing how the resilience of an urban form is reliant on long term process of land management and through developing an analytical and methodological approach in examining the resilience of urban form through spatial networks interrelationship with human behavior and cognitive factors. Through applying the methodology on two neighbourhoods in Alexandria, Egypt, to analyse the outcomes of different urban governance modes and planning policies and their impact on resilience.

## **Methodology**

This research traces the transformations imposed on an urban form, by urban governance practices represented in long-term processes of land use management. Resilience is observed as a process building and dependent on dynamic socio-spatial qualities, resulting upon people interacting and experiencing space.

Urban form change is not only reflected on the physical aspects of the built environment, but also on the social, environmental and economic aspects. In addition to being reflective on the socio-spatial relations impacts, which results in a degree to which this urban form

is resilient. Therefore, built environment, space and people are observed as the main actors and variables in the resilience of urban form, which are affected by urban governance practices and land use management policies.

Acknowledging the interrelationship between space and people, which socio-spatial configurational studies extensively addresses this link, this research utilises methodologies and techniques of space syntax and spatial justice, representative in quantitative and qualitative parameters. Where space syntax is a set of techniques for analyzing spatial layouts and human activity patterns in buildings and urban areas, where people are, how they move, adapt, develop and how they talk about it. While spatial Justice is about people’s control over how urban space is imagined, planned/ designed and lived. It is both a goal and a tool to be used in the process of design.

Upon selection process for the case studies, to be included in comparative analysis, aiming to observe resilience in measurable comparable attributes. Through historical dual comparative approach, of each neighbourhood's past and present, and to one another.

Though observations and tracking changes in each case study, where the data collection phase is including comparing different aspects of built environment, in addition to exploring urban governance practices and processes of land ownership, planning and financing land uses on the long-term and upon developmental plans.

Then the analysis process when is divided into quantitative parameters through space syntax; connectivity, integration and choice, through depthmapX platform. And the qualitative parameters which are introduced the spatial justice theories and utilisation of spatial values to conclude comparable spatial claim, power and link with respect to each case study. Through indicatory measures in terms of estimate values of sufficiency (Table1).

Then the correlation process, upon selecting resilience attributes from past studies and correlating each attribute to the measurable and comparable parameters concluded from the analysis process.

By this, an evaluation of the managerial planning policies and developmental projects outcomes in respect to urban form resilience, through their impact on socio- spatial configurational interfaces, which helps in decision-making processes in planning, developing and managing a city, when resilience is an objective.

| Rating system           |    |    |
|-------------------------|----|----|
| Highly sufficient       | ++ | 2  |
| Moderately sufficient   | +  | 1  |
| Moderately insufficient | -  | -1 |
| Highly insufficient     | -- | -2 |
|                         |    |    |

*Table 1 Rating system in the qualitative analysis*

## Relations between resilience of urban form and its governance

### - Overview on resilience concepts

Due to the evolving nature of the resilience thinking, it has been a major conceptual tool in dealing with disturbances in ecological and environmental studies, from the local to the global level. (Gunderson & Holling, 2002)

When applying resilience theory to cities, which is referred as the urban resilience, different conceptualisations have been studied (Christmann et al., 2012). Resilience can be seen as the ability to bounce back to the original state, enhancing stability and equilibrium (United Nations, 2017). This approach is applied in the Engineering resilience, where stability, resistance to disturbance and the speed of return are the measuring properties. (Gunderson & Holling, 2002)

Contrary to the Engineering resilience, the ecological resilience acknowledged the dynamic properties of ecosystems and the existence of multi-equilibria (Meerow et al., 2016).

Where how the system observes instabilities as opportunities, be able to bounce forth and shift into another regime of behaviour (Barnes & Nel, 2017). Where the magnitude of disturbance a system can absorb and still persist, before changing its structure.

Evolutionary resilience, which is also referred as the socio-ecological resilience, where the continuous adaptability and transformation are the distinguishing features of this approach. The focus in this stream is on the dynamic non-equilibrium aspects of systems undergoing continuous change (Meerow et al., 2016).

In addition to the conceptualisations of resilience, which results in different streams and capacities for identifying a resilient system, factors of change or the disturbance to which the system responds, has been varying a lot in resilience literature (Sharifi & Yamagata, 2018a).

Studies particularly dealing with urban resilience, tend to be divided into two types. First, resilience after drastic change, in the form of sudden shocks; as earthquakes, floods, hurricanes or even terrorist attacks (Coaffee, 2016; Savitch, 2008). Where focusing on how cities and urban communities recover from traumatic sudden events, is the major goal of these studies. Resilience of a system is associated with least vulnerability and more preparedness (Gunderson & Holling, 2002).

Second, resilience after the slower processes of transformation, in the socioeconomic, cultural, environmental and governmental aspects of a city and urban communities, over time, (Müller, 2011) or even interventions in the form of urban regeneration projects and developmental plans and policies, which shape slow variables creating urban change. Studies dealing with these more gradual changes (Eraydin, 2013), take into account properties which enable cities and urban communities to maintain value and regain stability over the long term (Müller, 2011). Authors aim to identify how the relationship

between change, stability and transformation is managed as a continuous dynamic process between complex systems and multi-actors (Ernstson et al., 2010).

Acknowledging the complexity and open character of urban and regional socioeconomic, cultural and political systems, cities' resilience are too complex to be referred to single or even multiple equilibrium state (Rega & Bonifazi, 2020). Therefore when it comes to spatial planning and urban studies, the evolutionary perspective represents the pathway which endures socio ecological systems' interactions and how change at one particular scale can extend over number of scales due to complex relationships and interpretations between them (Yamagata & Maruyama, 2016).

As the Engineering and ecological resilience conceptualisations tend to be applied in cities in terms of risk management and projecting future. Resilience objectives are to be efficiently prepared to face certain hazardous event, rather than taking a closer look in the historical contexts and everyday changes (Ernstson et al., 2010). By this, resilience with which this research is concerned, is far from the process-based understandings of adaptation and transformation, which emphasise the place of the physical in broader social process, and in this context, the ability of urban form, through ongoing urban interventions over years, to still be active and acting (Davis & Uffer, 2013).

- Resilience of urban form

Social resilience as well as community resilience aimed to investigate the role of human, society and communities and their adaptive capacities in responding to certain event. Spatial resilience tends to focus more on the "space", where actions and activities take place (Cumming, 2011). Resilience attributes are therefore, correlated to the morphological urban fabric and urban design principles (Fleischmann et al., 2020). While the resilience of urban form seems to be more inclusive framework for "people", "space" and "form"; the urban form actors. Where "people" is responsible for the image of an urban form. "Space" is where people connect, act and live daily events. And "form", not only representing the physical aspects of the built environment, but also the social, environmental and economic (Table2).

|                   |                       |  |   |  |  |
|-------------------|-----------------------|--|---|--|--|
| Built Environment | Physical aspects      | <ul style="list-style-type: none"> <li>- Sufficiently sustain residential population, making adequate use of available infrastructure and spaces.</li> <li>- Support a diversity of other collected usages.</li> <li>- Provide levels of land cover according to different densities.</li> <li>- Create opportunities for a variety of street- based activities, according to how the built form is capable to be converted and adjusted to facilitate and enhance new potential of a space in an economically sustainable way.</li> </ul> | Density levels of population                      | Residential occupancy's intensity.<br>Efficient of urban land usage and management.  |  |
|                   |                       |  | Density of built form                             | Development intensity in comparison to the available open space on the ground level.   |  |
|                   |                       |  | Street layout and building topologies adaptations | Adjustable capacity and changes of the built environment in response to change over time in cultural, economic and social aspects. |  |
|                   | Social aspects        | <ul style="list-style-type: none"> <li>- Incorporate diverse land uses; where social and public amenities are included.</li> <li>- Share resources and facilities across social and economic categories through accommodating diverse tenure types.</li> </ul>   | Land use diversity                                | Mixed-use development potential and its associated social, economic and environmental benefits.                                    |  |
|                   |                       |  | Tenure diversity                                  | Socio-economic heterogeneity.  |  |
|                   | Environmental aspects | <ul style="list-style-type: none"> <li>- Address how permeable and accessible near and far places.</li> <li>- Enhance publicity for open accessible green spaces for biodiversity.</li> </ul>  | Public transport accessibility                    | Public transport and its associated benefits to environment sustainability.  |  |
|                   |                       |  | Green spaces                                      | Preservation of open land, biodiversity<br>Securing the right for public assets and accessibility over the long-term.              |  |
|                   | Economic aspects      | Show relative stability overtime.  | Property values                                   | Change in property values over time and in comparison to the wider city and its role in gentrification or urban decay.             |  |
|                   | Activity              | <ul style="list-style-type: none"> <li>- To which degree is this urban form is spatially connected or segregated.</li> <li>- To which degree the vitality and street life is continued to be profound in this space.</li> </ul>  |   |  |  |
|                   | Image                 | <ul style="list-style-type: none"> <li>- How this urban form is being perceived.</li> <li>- To what degree it still upholds its identity and attraction towards its inhabitants and visitors, and leaving what memory.</li> </ul>  |   |  |  |

Table 2 Urban form actors of change; built environment, activity and form

Acknowledging the effect of people on space and vice versa, where people shape the vitality of a space and space shapes sense of belonging in people (Felicciotti et al., 2016). This interrelated relationship between space and people is intensively studied in socio-spatial studies (Stroink, 2020).

Upon focusing on the human factor, behavioural reactions and citizen-based approach are no longer studied alone, but rather in a spatial context, acknowledging the role of space (Forgaci & Van Timmeren, 2014). On the other hand, a space studied without people's effect is static, functional and theoretical-based approach. Therefore, this paper further the



socio-spatial perspective and utilises it in measuring the resilience of urban form and analyse the change effects on people and space over time, which will be noted in details in the next chapter.

- Urban land governance

Land governance is the interconnection between its fundamental pillars; land policy, land administration and land use management (Ostrom & Janssen, 2004). Land development is generated upon the change in one or more of these pillars and hence the change in land use planning. To efficiently handle the whole system land governance is needed. Which is to guide the land sector through creating and regulating action spaces for actors and promoted activities (Wubie et al., 2020).

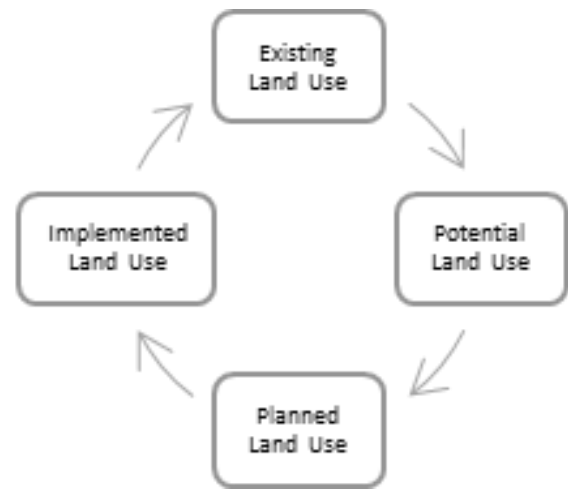


Figure 1 Change process in land use

Urban governance is how government, on the local, regional and national levels, in coordination with stakeholders, are responsible for the decision-making process in planning, financing and managing urban areas (Ostrom & Janssen, 2004). Complex interactions between the dynamic various aspects of land use planning, are responsible for the urban change. Where land use pattern is continuously subject to alternate (Beinat & Nijkamp, 1998) (Figure1).

This process is controlled by city builders and decision making between stakeholders; land owners, planners and planning authorities and financing of development (Davis & Uffer, 2013). Landownership includes private property, whether single or common ownership and state property, where change in ownership patterns is reflected in specific rights and duties, and therefore accessibility of open space (Beinat & Nijkamp, 1998). While planning key functionalities are plan-making; guide spatial organisations and land uses, developmental; land assembly, infrastructure and construction control over, and regulatory; documentation and building regulations. While financing is about how developers and investors are involved in securing finances and decision-making processes related to development time scales (Oliveira, 2017). Across the different types of relationships between land ownership, planning and financing, there had been two main different aspects of governance and management strategies.

I. Long-term perspectives

- Long-term land ownership

Utilising stability in developing strategies to directly invest in urban quality, while being able to derive benefits and returns over years for future society rather than individuals. (Barnes, 2009)

- Long-term planning

Long - term development, lead be planning authorities, where management strategies depend on the capability of sustaining vision and governance principles, while changing leadership strategies to control areas of fragmented ownership. Due to future uncertainties and ongoing challenges of anticipating disturbances and change, long-term visions are difficult to plan and implement (Ortega et al., 2020). Where conceptualising more flexible and open form, allow adaptability over the long-term.

- Long-term investment in infrastructure

Upfront investment in public infrastructure including; streets, pavement and open recreational spaces, squares and parks (Davis & Uffer, 2013). Through developing financial mechanisms, to overcome the associated challenges with urban value creation.

## II. Urban scale planning

Creating balance between private and public, on the short- and long-term interests and profits, while maintaining dynamic stability of diverse land uses and land tenure. (Davis & Uffer, 2013). Piecemeal development planning; parcel by parcel and building by building, tends to result in maximum profit, unless being efficiently regulated (Nagendra et al., 2004). Urban scale development tends to realise value through optimising and creating balance and equities between areas of greater intensity and revenue, through generating opportunities for the provision of resources types for urban form future. (Duit et al., 2010)

## **Merging Socio-spatial configuration approach in resilience measuring**

- Limitations in Current approaches for measuring resilience

Measuring resilience has been the most studied topic in resilience research over the years (Figueiredo et al., 2018). It is thought that there had been a broad agreement that; upon finding the right indicators, exact calculations and framework for resilience assessment, planners and urban researchers would have gone a long path to working out how to best build resilient cities and communities or examine and quantify resilience in urban areas (Holling, 2013). But along extensive research, this process is proven to be much more complicated than it seems to be (Sharifi, 2016).

As resilience definition throughout literature review has been varying to a wide degree, making it a more vague and contested term (Fikfak, 2018). Therefore, metrics found in current resilience measurement approaches are actually based on different understanding and conceptualisations of resilience as a term (Woolf et al., 2016). Moreover, observing resilience in fields like risk management, differs from fields of urban planning, economics and social sciences, etc (Cumming, 2011). Adding to this, aiming to study the resilience of "what", varied a lot, due to different dimensions resilience; physical, social, economic,

environmental and governmental. Multiple approaches are recently found in resilience measurements approaches, and yet not a single approach can be a fit-all approach for measuring such a complex term (Levine, 2014). Where observing resilience not as a constant static property, ability or character of a system, but rather as a dynamic multi-actor process (Brunetta & Caldarice, 2020).

Approaches to quantify resilience based on functionality and performance; example ASPIRE - Atlas of Social Protection Indicators of Resilience and Equity-, MCEER- Multidisciplinary Center for Earthquake Engineering Research- and PEOPLES - Population and Demographics, Environmental/Ecosystem, Organized Governmental Services, Physical Infrastructures, Lifestyle and Community Competence, Economic Development, and Social-Cultural - methodologies, which tend to reduce functionality to few clearly defined variables in coordination to certain events, through mathematical functions and models (Boeing, 2018). Where resilience is measured objectively, resulting in theoretical functionality, apart from actual performance on real life (Cumming, 2011).

Indicators based approaches, aiming for developing indices for a set of characteristics; measurements like poverty, through Human Property Index, development, through Human development index, etc. Livelihood vulnerability index and City resilience Index are examples for this approach (Gonçalves & Marques da Costa, 2013). Using judgemental models rather than empirical evidence, resulting in modular approaches. Which do not take into account the backstage actual actors and resilience building components. (Levine, 2014) Some indices do not cover all relationships, relying only on measuring a certain indicator for a certain character or dimension, through a specific formula or definition. Where the subjective measures are not covered and how they impact those indicators and indices (Jones & Tanner, 2015). Where at sometimes, when applied in practice, they have the capacity of changing the actual outcomes of these applied formulae and definitions.

Approaches based on frameworks and case studies, like Practical Action, USAID - United States Agency for International Development -, TANGO - Technical Assistance to NGOs - and DFID - Department for International Development. Offering a conceptual framework for resilience building upon satisfying certain actions and goals, not taking into account internal and external, sudden and slow, acute and incremental everyday variables, which all together often change the expected outcomes of the plan. (Levine, 2014)

As the resilience measurement approach tends to be one way oriented and exclusively measuring specific parameters, while ignoring others, the resulting outcomes tend to be moving apart from actual resilience measuring, but rather only measuring those selected parameters. (Hoffman & Hancock, 2017; Sharifi & Yamagata, 2018b)

Therefore, a need for a holistic framework, focusing on the analysis of variables and actual actors, rather than standardising attributes, seeking relevant characteristics and measuring them. (D'Ascanio et al., 2016)

- Socio-spatial configuration approach.

When studying urban form, space cannot be observed as a neutral background to human activity, a fundamental aspect and influencer for people daily life activities and opportunities. (Kesteloot, 2005)

Morphological and configuration studies, in general, deal with the effect of space on social life, the way society interacts and opportunities offered by space to integrate and connect people and to what extent degrees of surveillance and control are over each other. (Goldhagen & Gallo, 2017)

Despite space being not deterministic of practice, it has a great role in inviting and stimulating certain actions, enabling a form of power in the social network of interaction (Legeby, 2013). Therefore, space cannot be only characterised by its individual properties, but rather the interactions upon which it inhabits and offer (Siavash, 2016).

Socio-spatial interfaces aim to link the relations between society and space, using methodologies, techniques and theories, while allowing the time factor to be taken into account (Fikfak et al., 2018). Actor-network theory and agent-based stimulation (Figure2).

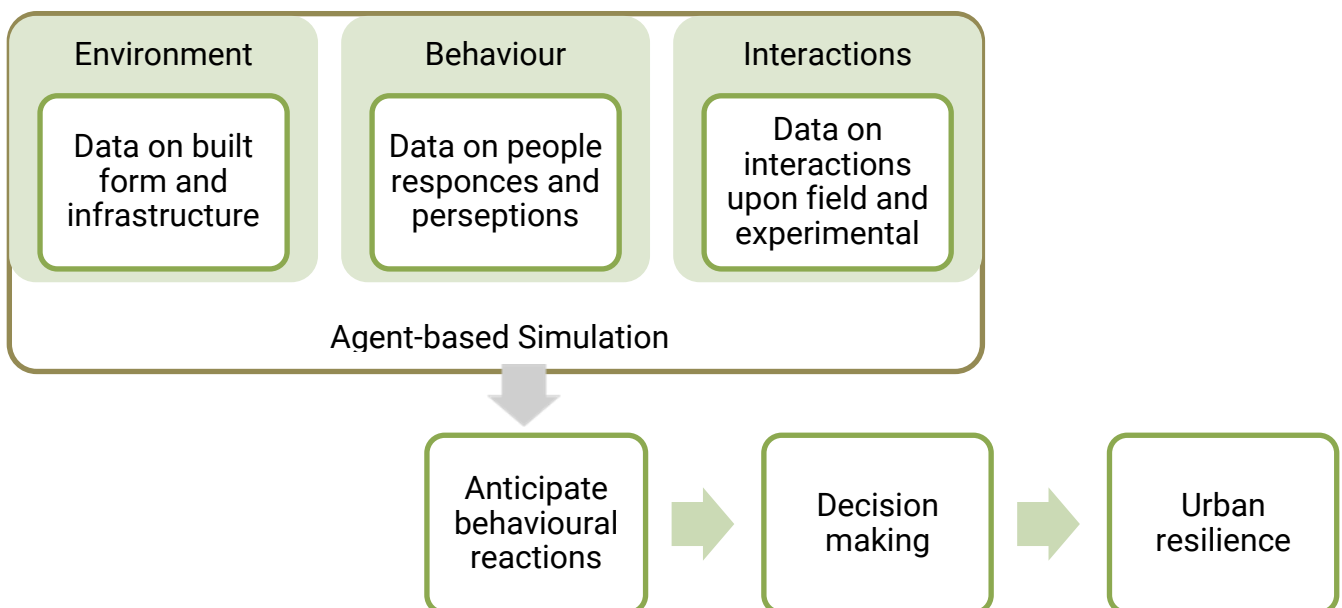


Figure 2 A framework for studying behavioural reactions through agent-based simulation

are crucial in utilising the human factor in morphological and configuration studies (Batty, 2013; Siavash, 2016).

However, urban modelling and simulation seem to be dominated by the analysis of aggregated level of urban systems' dimensions. (Batty, 2008). This is due to the difficulties and challenging approach in gathering fine scaled data, which by turn outlines a realistic approach (Lak et al., 2020). Therefore, there had been an agreement on the need for modelling knowledge or in other words; cognitive level of urban form, which is the level at which people in street interact and experience urban form (Armitage et al., 2012). This level of analysis which is independently acknowledged by urban geographers (Talen, 2003), spatial analysts (Kwan et al., 2003) and urban morphologists (Hillier, 1996) the lack of knowledge in.

Space syntax and spatial justice are two fundamental methodologies in addressing this gap (Fainstein, 2015; Abshirini & Koch, 2017). Both methodologies, offer simplified representation of real life, certain levels of abstraction and apply basic units of space, spatial attributes, links and values (Abshirini & Koch, 2017). While assuming that urban form represents a hierarchical patterns of different spatial configurations and equities; which are able to influence pedestrian movement, land use, densities, sense of belonging and empowerment. (Long & Ye, 2019; Brudermann et al., 2013)

#### - Space syntax

Space syntax offers a set of analytical measures on the cognitive scale of urban form, where the development of "axial map", which is a network representation of space using graph theories, analysis spatial behavioural patterns (Marcus et al., 2016). Expanding space syntax research to wider areas of research in spatial morphology, and therefore heading to "spatial capital" (Marcus et al., 2016). In this framework, distance, density and diversity; the three main features and variables of spaces, with the distinct relations to generic aspects of human level in using space. In this perspective, spatial distance with accessibility to human activity, spatial density with the amount of human activity and spatial diversity with the differentiation of human activity.

- Connectivity measures the number of spaces immediately connecting a space of origin.
- Integration measures the accessibility in a network and closeness centrality
- Choice measures number of shortest paths, betweenness centrality (Freeman, 1977) and a good metric for the study of interactions between morphology and street networks.

#### - Spatial justice


Spatial justice is about social production of a space, addressing impacts on social groups and their opportunities. (Lefebvre & Nicholson-Smith, 1991) Through reconfiguration of

how a space is used and by whom. Where the connection between spatial claim, power and link (Figure3); as compromising factors resulting in understanding how the space is functioning at human scale (Bromberg et al., 2007).

Spatial justice utilises multi-dimensional method; layer approach, where urban form is studied as a set of layers functioning together. Network; tangible and non-tangible, visible and non-visible infrastructure, occupation; spatial patterns due to human use and surface; physical elements of built form.

Where upon the integration across these layers, a set of criteria was developed. Based on usage, experience and future values. (Bassett, 2013) (Table3)

- Usage value: organisation and efficiency.  
Where the criteria for measuring usage value are; Spatial cohesion, Accessibility, Usage and Positive / Negative interference.
- Experience value: value attachment, perception and Identity.  
Where the criteria for measuring experience value are: Past values, Diversity, Recognisability and Identity
- Future value: adaptability and functionality.  
Where the criteria for measuring future value are: Functionality in time, Expansion options, Adaptability and Sustainable structure



|   |  |
|---|--|
| <b>Spatial Claim</b><br>Ability to live, work and experience space          | <ul style="list-style-type: none"> <li>• Who uses the place, who does not, and why?</li> <li>• How is the space used?</li> <li>• What talents and gifts do people have here?</li> <li>• What is unique about the history and culture of the area?</li> </ul>   |
| <b>Spatial Power</b><br>Opportunities to succeed in and contribute to space | <ul style="list-style-type: none"> <li>• What qualities would you use to describe the place?</li> <li>• How are people able to practice, contribute and create here?</li> <li>• What messages and behaviors does the space suggest?</li> <li>• What prevents anyone from full participation in personal or public life?</li> </ul> |
| <b>Spatial Link</b><br>Access and connectivity to and with other spaces     | <ul style="list-style-type: none"> <li>• What barriers exist in the physical environment?</li> <li>• What invisible, historical or social barriers divide people?</li> <li>• What historic memory exists in the place and the people here?</li> <li>• What connects this place to other places?</li> </ul>                         |
|   |  |
|   |  |

Figure 3 Spatial claim, power and link, definitions and detecting questions

- Resilience measurement through socio-spatial perspective  
Resilience of urban form can be treated as a trait or a process. Trait-based approaches investigate characteristics that enable cities; people, spaces and built form to adapt in the face of circumstances. While process-based approaches analyse the processes through which people mobilise in space, interact and experience within built environment (Samuelsson et al., 2019). This approach recognises the dynamic aspects of resilience, as

a varying capacity overtime and across different situations, through focusing on the dynamic influence of people and environment interactions over time.

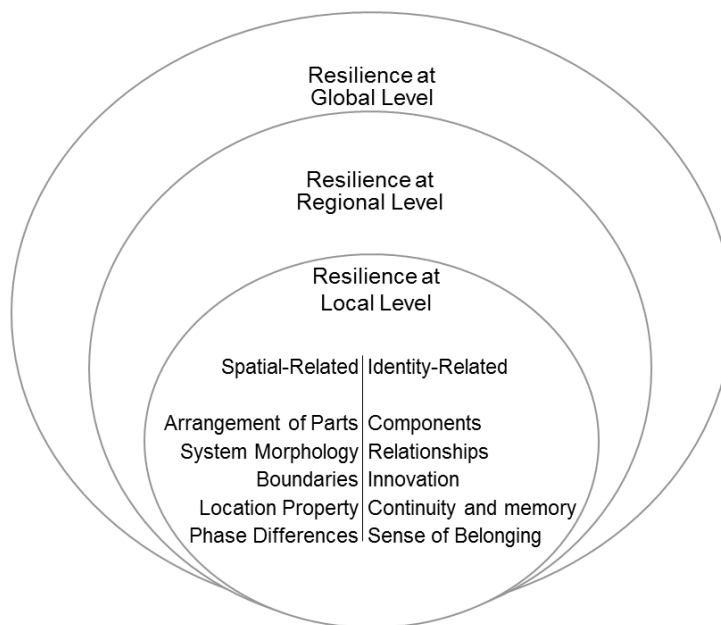
|               | Criteria                         | Values     | Key words   | Measures   |
|---------------|----------------------------------|------------|---|--|
| Spatial Claim | Spatial cohesion                 | Usage      | Urban network<br>Ecological network<br>Public space<br>Private/public interaction | Multi-functionality<br>Ecological integration<br>Safety<br>Social control                                  |
|               | Usage                            | Usage      | Compactness<br>Multiple land use  | Construction density<br>Number of functions per unit   |
|               | Past Values                      | Experience | Relation to all that exists<br>Changes/disappearance                              | Historic structures/elements<br>Cultural-historical expression   |
|               | Recognizability                  | Experience | 'Experience-ability'<br>Continuity  | Form/size with function  |
| Spatial Power | Accessibility                    | Usage      | Journey quality<br>Connectivity   | Travel time (public and private)<br>Reliability<br>Distance and connectivity                               |
|               | Adaptability                     | Future     | Sensitive to changes in function<br>Lasting value                                 | Flexibility in development over time<br>Investment value and depreciation                                  |
|               | Sustainable structure            | Future     | Functional dynamics<br>Simultaneous functions                                     | Integration of land use zoning with factors of environment/social cohesion                                 |
|               | Functionality in time            | Future     | Utilization of existing infrastructure<br>Logical sequencing                      | Initial investments<br>Phasing   |
| Spatial Link  | Positive / Negative interference | Usage      | Stimulate positive interference<br>Counteract negative interference               | Added value connections (green & residential, residential & working; transit & inner city)<br>Displacement |
|               | Diversity                        | Experience | Social cohesion<br>Differentiation  | Multiplicity of social factors   |
|               | Identity                         | Experience | Modern character (upgrading)<br>Articulation of spatial systems                   | Contribution to future history<br>Fits into context  |
|               | Expansion option                 | Future     | Growth factors  | Intensification<br>Dispersion  |

*Table 3 Main criteria, keyword and measures of spatial claim, power and link, with respect to spatial values*

Socio-spatial perspective reveals how process-based approaches are applied, through deeper analysis for how people respond to change while allowing spatial variations and time factor to be taken into account (Jones & Tanner, 2015).

Resilience of urban form through socio-spatial prospective means the degree to which spatial configurations formulates spatial interface, before and after change, measuring the impact of change on inhabitancy and cultural identity (Koch & Miranda, 2013). A resilient urban form is about the attractiveness it holds to people, though maintaining cultural diversity, sense of belonging and socioeconomic benefits overtime. Allowing urban design

principles of place making to take place in this interplay (Marcus & Colding, 2014; Ischak et al., 2017).



*Figure 4 Boundaries as socio ecological landscapes; land uses and tenure, fences and roads. Hierarchical theories at studying resilience at the local, regional and global levels, suggests that resilience at a certain is influenced by event of change at any level. While the local level of resilience is reliant on identity and spatial aspects*

In 2014, Parsons et al., offered a proposal for including cognitive model of resilience, dealing with multiple internal cognitive processes in urban form. Focusing on the human behaviour, experimental and perception aspects, cognitively organises spaces in a topological manner. (Turner & Penn, 2002) And therefore an urban form is perceived as a set of slow variables and a powerful tool in influencing human behavioural patterns, activities and experiences.

## Case studies

Alexandria is located along the western coast of the Mediterranean Sea in Egypt. As Cairo is the capital of Egypt, Alexandria represents the second capital and the second largest city in terms of population and importance; as the main port in Egypt and as a historical, coastal and touristic city. Since the foundation of Alexandria at 331 B.C. By Alexander the Great, the city had passed through various processes of change over time; demographics, social, environmental, economic and governmental changes, which led to its rapid growth, urban extension and urbanisation of the city. Alexandria has witnessed multiple urban expansion plans throughout its history, which resulted in broad positive and negative manifestations, which affects resilience of the city on the regional and local level (Othman et al., 2020). On the local level, extension processes had been in the horizontal axis along



the waterfront, and recently a deeper longitudinal extension along the perpendicular axis and away from the water front main spines.

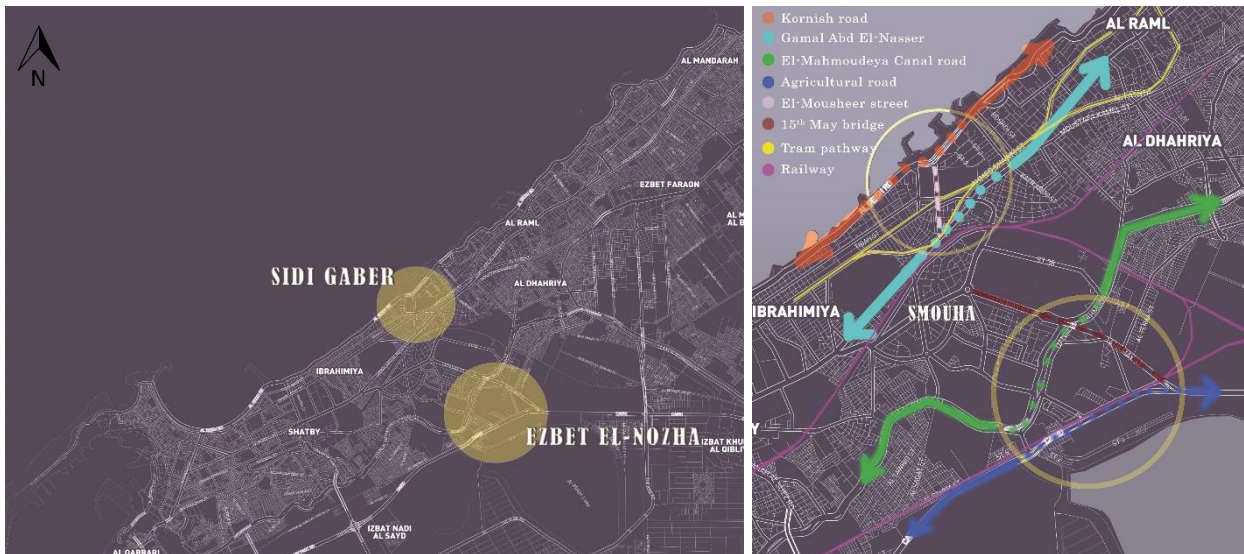


Figure 5 Location of the two neighbourhoods in relation to the whole city (right) in relation to main horizontal and longitudinal streets and railway and tram pathways (left)

The city's urban fabric is planned upon main horizontal streets, along the waterfront line and parallel to it. This horizontal plan had detached - in the past- many areas and districts, which are located far away from the coastal line.

As population increases in the city, congestion and mobility challenges were found in the city's main streets, nodes and connecting spines. Therefore, the government lead several projects for bridges' construction to overcome these challenges, facilitate movement and connect segregated areas to the city.

The government long vision planning for the city introduces touristic developmental plans along the coastal line of the city, including projects like; sidi gaber development, el-montaza renewal, bahary and el-khaledeen reusing and renovation plans.

On the other hand, the southern side on the city, since the most predominant route, Abu-Qir railway, divides the city to northern and southern the route (Othman et al., 2020). El-Mahmoudeya canal which once represented the secondary waterfront line in the southern edge of the city. El-Mahmoudeya canal road replanning and developmental project has been one of the recent great projects in Alexandria, upon canal backfill and constructing new street networks, with water features, gathering nodes, retail and recreational spots. Aiming to turn this new axis as a connection and attraction feature away from the city centre and waterfront main axis to shift densification.

- Selection criteria

- Location and proximity to developmental projects

Along those major projects stated above, two neighbourhoods experienced a lot of change in urban fabric, land uses, planning and management policies.

Sidi gaber, located on the northern side of the city witnessing the waterfront touristic plans (Figure5). As well as its location, within the railway main station in the downtown of the city. Sidi gaber station which also passed through several renovation projects, street

layout adaptations and nearby retail and service buildings. While preserving the historical features of the station, which was once an edge to the city urbanisation and population residence. And now, a central hub of the city and representing a main node along Gamal Abdelnasser street and a tram station connecting almost all of the northern areas of the city.

New land uses and projects in Sidi gaber (Figure6); touristic project, water front expansion, sidi gaber bridge, under bridge parking, restaurants, recreational hub, ball rooms, multi-purpose tower, new residential buildings, hotel, train station renovation, service buildings and multi-story garage

While Ezbet elnozha is located on the southern side of the city and experiencing el mahmouheya canal redevelopment project and new urban expansion projects (Figure5). Ezbet elnozha proximity to a set of important unique features of the city:

- Elnozha airport, which was set to closure few years ago, and now futuristic projects are proposed for reusing its land, which will revive the agricultural road and create a new city extension towards this edge. Therefore, land values are increasing and gentrification indicators are found along this neighbourhood.
- Green areas, two of the historical and few green areas in Alexandria; Antoniados garden, on the eastern side and the entertainment forests on the western side of the neighbourhood, which unfortunately is now coming to an end and decay, to inhabit multiple projects.
- The new Alexandria Governorate building.

New land uses and projects in Ezbat elnozha (Figure7); el mahmoudeya canal road re-planning, new university campus, hotel, airport closure and reusing land into futuristic projects, international schools, shopping mall, bridges, residential compounds, mosques and ballrooms complex, new Alexandria government building and reusing "entertainment forest" into new recreational projects

- Different urban governance strategies



Figure 6 Sidi gaber maps 2001 (top) and 2021 (bottom), while highlighted spots of land use changes, bridges and developments plans bridges locations



Figure 7 Ezbet elnozha maps 2001 (top) and 2021 (bottom), while highlighted spots of land use changes, bridges and developments plans bridges locations

Sidi gaber had followed long-term visions in planning, land ownership and infrastructure, while projects had been lead and financed through authorities and governmental investments.

|                     |                                       |                                      |
|---------------------|---------------------------------------|--------------------------------------|
| Land use management | Ezbet El-Nozha                        | Sidi gaber                           |
| Land ownership      | Fragmented ownership<br>Privatisation | Long-term ownership                  |
| Planning            | Urban scaled projects<br>profit based | Long-term perspectives               |
| Financing           | Investors                             | Authorities<br>Government investment |

*Table 4 Urban governance compared in two case studies*

On the other hand, Ezbet elnozha was initially planned to be an industrial area, and an extension to the industrial zones in the city. But this vision and plans are completely changed now, due to urban extension plans into this area. Which, due to its proximity to the fast-growing area; smouha, the new attraction spot for development and investment, Ezbet el-nozha is observed as an extension it.

Land ownership had changed a lot through years, from public to private, where privatisation changed land uses and initiated profit-based projects. Though fragmented ownership and urban scaled project, this neighbourhood experienced revival, densification and a mixed-use development potential. Private investors observe Ezbet elnozha as an investment spot and finance projects led by them or by governmental and authorities plans (Table 4).

- Built environment aspects

Levels of population density is observed on a wider range in Sidi gaber, despite the fast urbanisation and densification projects in Ezbet el nozha. Large plot areas and open spaces in comparison to floor levels are observed in Ezbet el nozha, while Sidi gaber is featured by high density of built form and residential buildings are built on total plot area. Upon comparing physical adaptations in buildings and street layouts, Ezbet elnozha had a greater potential of adaptation to changes, from industrial to mixed use neighbourhood, which aided the diversity in land use and tenure in Ezbet elnozha compared to Sidi gaber. In terms of environmental aspects public transportation in Sidi gaber, as an old central

district and main transportation hub of the city, exceeded Ezbet elnozha in terms of accessibility for public and private transportation. Ezbet elnozha, on the other hand, new bridges facilitated private accessibility to and from the neighbourhood, to all other areas in

| Built Environment |   |                      | Ezbet El-Nozha | Sidi gaber |
|-------------------|---|----------------------|----------------|------------|
| Physical          | Density   | Levels of population | +              | + +        |
|                   |   | Built form           | -              | + +        |
|                   | Street layout and building topologies adaptations |                      | + +            | -          |
| Social            | Diversity   | Land use             | + +            | +          |
|                   |   | Tenure               | + +            | +          |
| Environmental     | Public transport accessibility                    |                      | -              | + +        |
|                   | Green spaces                                      |                      | +              | -          |
| Economic          | Property values                                   |                      | + +            | -          |

*Table 5 Built environment aspects compared in two case studies*

the city. Where it is no longer a segregated area at the boundaries of the city. Unfortunately, preservation of green areas in Ezbet elnozha did not take the expected importance in the development, despite being a potential for a spot for parks and open green areas. On the economic side, Ezbet elnozha, due to being an investment spot, property values had risen dramatically in the last few years, where informal low-income settlements, as the residential feature in the past of Ezbet elnozha, is now a home to high income residents and gated communities (Table 5).

- Space syntax

Upon analysing connectivity, integration and choice to a specific radius, the results are reflective to people movement patterns in real life. Analysis in this research is based on pedestrian level and walkability with radius of 800 metres, representing the local level of examination, while on the global level, a radius of 25,000 metres, the relative automotive distances (Figures 8 & 9).

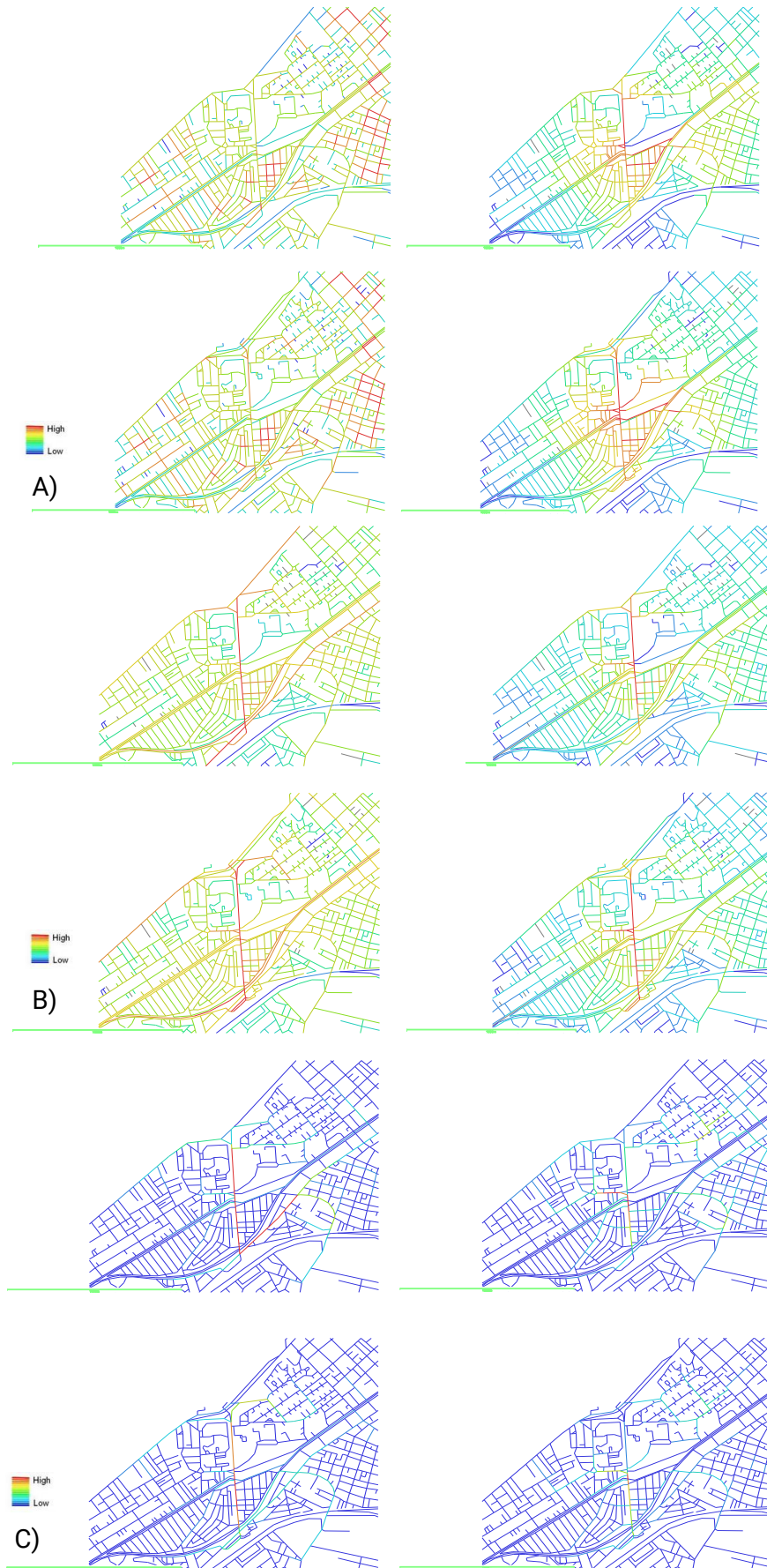


Figure 8 Sidi gaber, A) connectivity B) integration C) Choice. 2001 maps (above) and 2021 maps (below). Global scale of analysis at radius 25,000m (left), local scale of analysis at radius 800m (right)

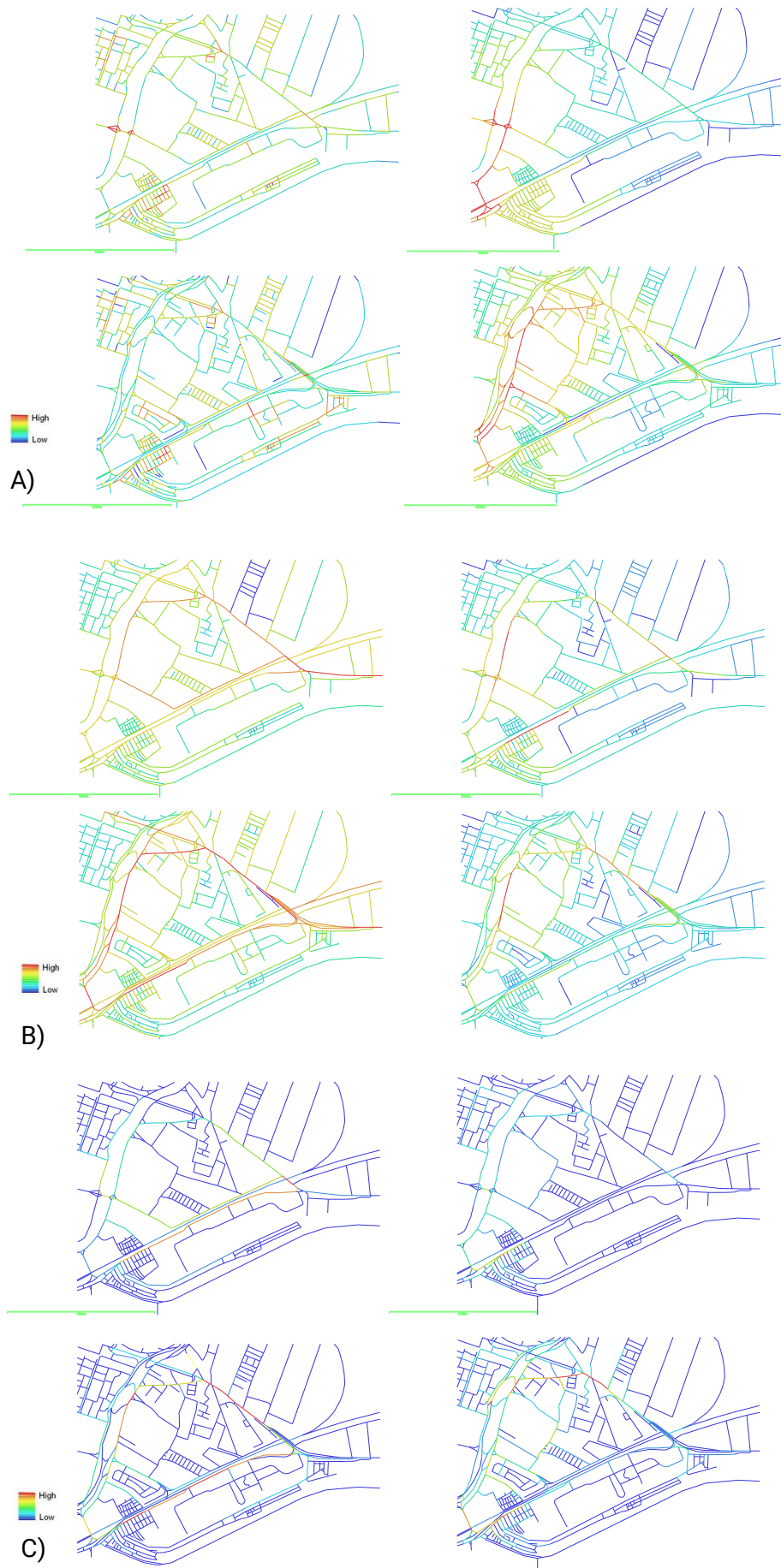


Figure 9 Ezbet elnozha, A) connectivity B) integration C) Choice. 2001 maps (above) and 2021 maps (below). Global scale of analysis at radius 25,000m (left), local scale of analysis at radius 800m (right)

|                     |                                  | <b>Ezbet<br/>El-Nozha</b> | <b>Sidi<br/>Gaber</b> |
|---------------------|----------------------------------|---------------------------|-----------------------|
|                     |                                  | % of change               |                       |
| <b>Connectivity</b> | T64 Connectivity                 | -0.15                     | -0.6                  |
|                     | T64 Total Connectivity           | 42.97                     | 10.16                 |
|                     | T64 Connectivity<br>R800 Metric  | 45.85                     | 0.58                  |
| <b>Integration</b>  | T64 Integration<br>R25000 Metric | 35.28                     | 4.04                  |
|                     | T64 Integration<br>R800 Metric   | 22.17                     | 3.95                  |
| <b>Choice</b>       | T64 Choice<br>R25000 Metric      | 49.02                     | 19.95                 |
|                     | T64 Choice<br>R800 Metric        | 81.95                     | 5.25                  |

*Table 6 Percentage of change through years from 2001 and 2021, in each case study*

Percentages of change in terms of connectivity, integration and choice, after development and land use changes, are obviously high in Ezbet elnozha compared to Sidi gaber, which showed relatively small differences in the numerical values, when compared to pre-development (Table 6).. This is due to changes in street networks, land uses and densification in Ezbet elnozha, while static long-term vision in Sidi gaber development. Negative percentages in both neighbourhoods in terms of connectivity, after development, are reflections to the effect of bridges on connectivity. On the contrary, upon comparing the two neighbourhoods measures in the meanwhile, Sidi gaber shows relatively higher values in connectivity, integration and choice measures. (Table 7).

| Sidi Gaber |                                 | Ezbet      |
|------------|---------------------------------|------------|
| Ezbet      | Criteria                        | E-Nozha    |
| E-Nozha    | Connectivity                    | Sidi gaber |
| -          | Spatial cohesion                | 3.14       |
| 4030.65    | Total Connectivity              | 2924.33    |
| +          | Usage                           | ++         |
| 997.68     | Local Connectivity              | 580.52     |
| --         | Past Values                     | -          |
| 215.28     | Global Integration              | 177.12     |
| +          | Recognisability                 | +          |
| 83.35      | Local Integration               | 53.92      |
| -          | Spatial claim                   | +++ +      |
| 27052.70   | Global Choice                   | 21790.30   |
|            |                                 |            |
| +2839.53   | Accessibility                   | 1551.33    |
| ++         | Local choice                    | +          |
|            | Adaptability                    | -          |
|            | Sustainable structure           |            |
| -          | Functionality in time           | +          |
| +++        | Spatial power                   | +          |
|            |                                 |            |
| ++         | Positive /Negative interference | -          |
| +          | Diversity                       | ++         |
| -          | Identity                        | ++         |
| ++         | Expansion option                | -          |
| ++++       | Spatial link                    | ++         |
|            |                                 |            |

Table 7 Values of Connectivity, Integration and Choice upon analysing the present maps of the two case studies

Table 8 Estimated values for comparing the two case studies spatial claim, power and link through a set of criteria

- Spatial justice

Sidi gaber showed higher estimated values in comparison to Ezbet elnozha in its spatial claim, as usage values; spatial cohesion and usage increased in Sidi gaber. Spatial link, is higher is ezbet elnozha, due to its increase in future values; positive and negative interfaces and expansion option. While experience values and social aspects; diversity and identity which increased in Sidi Gaber. Spatial power, is also stronger in Ezbet elnozha due to higher future values of adaptability (Table 8). Therefore, Sidi gaber experienced higher values in usage and experience values, while lower future values when compared to Ezbet elnozha (Table 9).



Upon correlation with resilience attributes found in literature, with the estimated values and findings from space syntax and spatial justice parameters, based upon comparative analysis (Cruz et al., 2013; Eraydin, 2013)

| Sidi Gaber | values           | Ezbet El-Nozha |
|------------|------------------|----------------|
| 5          | Usage value      | 3              |
| 4          | Experience value | -1             |
| -2         | Future value     | 4              |

*Table 9 Spatial values of the two case studies compared*

- Flexibility: modification and adaptation capacities and is correlated to; connectivity, choice, experience and future parameters
- Efficiency: effective response and functionality and is correlated to; integration and usage parameters
- Capital building: shaping social cohesion and foresting future capacities and is correlated to; choice, experience and future parameters
- Physical/ social connectivity: degree of social and physical linkages and is correlated to; connectivity, usage and experience parameters (Eraydin, 2013)

#### - Discussion

Flexibility and efficiency attributes are higher in Ezabt elnozha, while capital building and physical/ social connectivity attributes are higher in Sidi gaber. Long term perspectives and planning regulations enhanced capital building and physical/ social connectivity, which aids resilience. Urban scale projects and investments led to higher efficiency and flexibility, due to diversity in land uses, and higher land values, while gated communities, building-by-building development and fragmented ownership led to loss in capital building and physical/social connectivity

## Conclusion

Development projects are management processes of land use on the long term shapes the society and space interrelationship, which shapes the resilience and adaptability capacities of a city to continue through years and overcome challenges. Throughout this methodology and comparative analysis, in terms of quantitative parameters as connectivity, integration and choice, and qualitative values as the usage, experience and future, the two cases studied are studied across all levels; the social, spatial, built environment level of its different aspects level. While urban governance and planning policies are observed as the agent of change, and a main motivator to aid or constrain resilience of urban form. Resilience is not a fit to all process upon satisfying certain attributes and criteria, rather a unique process in each urban form

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