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Editorial introduction

Special issue on urbanization in the Gulf

Guest Editors:

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With rapid urbanization and the hunger for new architectural trends, buildings built since the 1960s face the threat of being classified as old and with no value. Lately governments in the Gulf region, such as in Abu Dhabi have paid attention to such buildings and have taken steps to safeguard their modern cultural heritage and building stock ([Chabbi & Mahdy, 2011a](#), [2011b](#); [Yildirim, 2015](#)). The first paper by [Husnéin \(2017\)](#) discusses the importance of this topic and explores the role that the built cultural heritage ([Damlūji, 2006](#)) can play to improve the public realm within a sustainable urbanism.

Current trends in the preservation of our urban heritage and the creation of quality public spaces are shown through case studies, in addition to exploring challenges and exposing some of the weaknesses in the existing approaches to urban development. The author sees in a holistic approach, one solution to giving a sustainable aspect to the conservation of physical public realm heritage.

The United Arab Emirates is not the only gulf region country to experience rapid urbanization after the economic growth of the post-oil era. The Kingdom of Oman is a good example explored in the second paper by [Al-Awadhi \(2017\)](#), in which he discusses the local aspects of globalization through a case study of Sohar city. The paper first discusses the different definitions of “globalization” and its relation to economic and social aspects ([Vongpraseuth & Choi, 2015](#); [Wei & Liefner, 2012](#)), then presents its impact on land use change and urban growth ([Leaf, 2002](#); [Mahgoub, 2004](#)).

The Geographical Information System (GIS), and remote sensing, in addition to socio-economic and demographic data are used to trace the historical development of Sohar city’s growth in three time periods: the years 2003, 2010 and 2015. The study results show an increase in the built-up area and a decrease in open land and vegetation coverage.

This demonstrates the impact of the rapid globalization in Oman during the last three decades, especially the spatial impact in Sohar city, which has received 10 billion US dollars as national and international investments during the last fifteen years. Thus, Sohar moved dramatically from a small isolated city to become a bigger one with a medium size urban center.

Studies have demonstrated the impact of space design, architecture and urban form on people’s behavior and feelings, either positively as happiness,

joy, and satisfaction, or negatively as anger, anxiety and stress. Examples of aggression, crimes and thefts ([Hillier & Shu, 2000](#)) occurred mostly in the low income residential neighborhoods located in the suburbs of European cities. Such anti-social behavior has been associated with multi-story projects built during the post-World War II ([Bullock, 2002](#)) reconstruction period.

Some cities like Liverpool in the UK have learned from past housing mistakes and are making efforts not to repeat them ([Faizi, Hosseini, & Asl, 2008](#); [Godfery, 1977](#); [Wilson, 1977](#)).

However, there is a possible risk that some high-rise building projects, inspired by European Post World War II housing projects, and not located in the downtown areas of some Arabian Gulf cities, may generate social integration issues concerning low-income groups, [Anderson \(2000\)](#) or some health issues ([Wilson, 1977](#)), and criminal activity among youths.

[Mushtaha \(2017\)](#) in his paper investigates the presence of such problems in the Gulf housing projects that followed in the wake of urban forms like those built-in Europe after World War II.

His qualitative study shows that vandalism, and other social problems occur in some projects. Hence, he calls for defining the extent of existing problems and suggests setting some guidelines and rules for new development based on previous experience, studies, etc., ([Faizi, Hosseini, & Asl, 2008](#)). For example, he recommends not to accommodate low income people in high rise buildings, and prefers to locate high rise buildings in the center of a city. These measures, would in his view contribute to partially avoiding social problems in the future and provide a better-quality of life to residents.

The subject of people's satisfaction and comfort while using spaces takes us to the fourth paper by [Meziani and Hussien \(2017\)](#). Entitled: "A Study On the space layouts and configurations of shopping malls in relation to pedestrian movement behavior- Case of UAE".

Much wayfinding research has been carried out for such large buildings as shopping malls ([Dogu & Erkip, 2000](#)), hospitals ([Passini et al., 2000](#); [Rooke, Koskela, & Tzortzopoulos, 2010](#)), airport terminals ([Churchill et al., 2008](#); [Fewings, 2001](#); [Braaksma & Cook, 1980](#)), to decrease the feeling of being lost ([Carlson et al., 2010](#)) and disorientation and frustration ([Bitgood, 1988](#); [Passini et al., 1998](#)) and avoidance of negative financial, psychological and physical effects on people and visitors ([Correia, Wirasinghe, & de Barros, 2008](#)).

Studies have shown that a building's space layout has a big impact on wayfinding and people's satisfaction ([Brösamle & Hölscher, 2007](#); [Hölscher et al., 2006](#); [Hölscher et al., 2009](#); [Peponis, Zimring, & Choi, 1990](#); [Vilar et al., 2012](#)).

The objective of this research is to pay attention to the importance of a building's space layout in wayfinding and people's satisfaction, hence the attractiveness and popularity of a shopping mall, and in the future to contribute to the literature ([Gärling, Bök, & Lindberg, 1986](#)) about developing the space layout of commercial buildings through recommendations and design guidelines.

The paper explores the relationship between a shopping mall's popularity and wayfinding. It focuses on the planned and unplanned visits to some specific destination inside a mall such as 1- Frequently used facilities: prayer rooms, and washrooms; 2- Facilities attractive to families and large numbers of visitors: food courts, cinemas, and play areas, and finally 3- ATM machines.

Based on the assumption that the popularity of a mall is positively related to 1. Visitor satisfaction with wayfinding in the mall; 2. Visitor satisfaction with the location of facilities in the mall; and 3. The location of facilities in a mall is positively related to visitor satisfaction with wayfinding in the mall, surveys were conducted in the city of Abu Dhabi, followed by the application of the Structural Equation Modelling (SEM) technique to verify the above hypotheses.

The paper starts with a strong literature review and covers types of wayfinding, its factors and variables, etc., then presents the methodology, the results analysis and discussion. The results of applying SEM verified the hypotheses about the relationship between the attractiveness and the popularity of a shopping mall and the wayfinding on the one hand and the building space layout on the other. The paper's authors will follow up their research by wider case studies, involving international examples.

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The Evolving Role of Modern Urbanistic Heritage in Shaping Sustainable Public Realm: *The Case of Abu Dhabi*

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Key words: Modern heritage, Gulf urbanism, public realm, public participation

Abstract: Governments are increasingly recognizing the contribution that cultural heritage makes to the social wellbeing of diverse groups living within progressively multicultural towns and cities. This could not be more evident than in the case of Abu Dhabi, the capital of the UAE—a city which has undergone a significant transformation in the last five decades and has been known for its cultural diversity. Several government initiatives and community programs are being launched to promote more sustainable alternatives to urban development. Recognizing the urgent need to safeguard the surviving stock of modern buildings dating back to the late 1960s, the Abu Dhabi government launched the Modern Heritage Preservation Initiative five years ago. This paper explores the role that built cultural heritage can play to improve the public realm within sustainable urbanism. It considers the changing definitions of urbanistic heritage before outlining the broad contribution this cultural resource can make. Insight gained from participating in public workshops and interacting with government agencies and community organizations is presented. This is followed by case studies that highlight some of the trends and challenges to the preservation of urban heritage and the creation of quality public spaces. The paper concludes with a discussion of the shortcomings of existing approaches to urban development and suggests a holistic approach to achieve a greater understanding of how to integrate physical public realm heritage conservation into sustainable urbanism.

1. INTRODUCTION

Following the rapid urbanization process experienced by the Gulf region through its oil wealth, from a confederation of semi-nomadic tribes surviving on a basic subsistence economy into a futuristic post-modern landscape, several of these countries began to pay more attention to their urban cultural heritage ([Husnéin, 2016](#); [Al-Nakib, 2013](#); [Melhuish, Campkin, & Ross, 2014](#)). This recognition was not only manifested in the academic scholarship but also extended to the public sphere ([Chabbi & Mahdy, 2011a, 2011b](#)). In the case of the United Arab Emirates, a clear distinction between the pre-oil and post-oil periods is clearly reflected in the local social and physical characteristics of the urban environment. A continuum of layers of urban growth can be traced in this transition. And while Abu Dhabi, the seat of the federal state formed in 1971, embarked on the most ambitious wave of urban

renewal ([Urban Planning Council \(UPC\), 2011](#)), this enormous undertaking has prompted the need to address major issues and concerns associated with preserving local heritage and culture. Abu Dhabi city makes for an interesting case study as the entire city—with the sole exception of the eighteenth-century Al Hosn (fort)—dates from the mid-twentieth century ([Damlūji, 2006](#)). In addition, Abu Dhabi owes its modern-day achievements to the masses of expatriate workers and professionals taking up residence there, forming a highly multicultural population that has indirectly contributed to the urban culture ([Yildirim & El-Masri, 2010](#)).

While cultural heritage is considered a major element of quality of life and, by extension, of quality public realm, the conventional methods of identifying and safeguarding urban heritage are not designed to deal with less visible features of cityscape, such as street configurations. However it is often exactly these features that offer a city its distinctive character and bestow a sense of belonging that is at the heart of its identity. Prevailing definitions of ‘urban heritage’ are narrow and depend on conventional notions of what constitute architectural and historical value and thus ‘urban heritage’. Likewise, the concept of ‘sustainability’ proves to as nebulous. Its limited ‘three pillared’ model identifying environmental, economic and social dimensions fall short in addressing the cultural aspect of the built environment.

Nevertheless, several government initiatives and community programs have been launched to promote more sustainable alternatives. Recognizing the urgent need to safeguard the surviving stock of modern buildings dating from the late 1960s, the Abu Dhabi Authority for Culture and Heritage (now known as Tourism and Culture Authority or TCA) launched the Modern Heritage Preservation Initiative in 2011. It is aimed at the conservation of the built environment and the promotion of a local sustainable urbanism. Furthermore, the Urban Planning Council’s *Estidama* initiative, launched two years earlier, offers a role for culture to play as a fourth pillar in guiding urban development and, by extension, in preserving built heritage.

Building on previous research centred on what constitutes a modern urban heritage in Abu Dhabi ([Husnéin, 2016](#)), this study examines the role that built cultural heritage can play within the sustainable urban development of quality public realm. A wider debate within the community has ensued in recent years over preserving Abu Dhabi’s ‘late modern’ landmark buildings linked to the early stages of the capital’s boom. Indeed, the urban and architectural legacy of the country’s independence, a modernist statement brought forth in the 1970s and 1980s, is severely endangered.

In order to gain a better understanding of the modern heritage urbanscape, one must consider the underlying cultural dynamics which predicate on value systems, attitudes and behaviours of the stakeholders participating in the public urban realm and discourse. Consequently, a series of questions arise. What is considered to be *urbanistic* heritage in Abu Dhabi? How is this cultural patrimony being managed and who are the stakeholders involved? To which planning framework does an integrated conservation practice and approach belong?

While this paper explores the concept of cultural heritage within the UAE context, it attempts to evoke the need to consider the role of public realm in heritage and renewal in Abu Dhabi: how can we define public space and how to define heritage? What does the public realm look like in a place as new as Abu Dhabi? With local citizens representing almost a fifth of the Emirate’s population per mid 2015 estimates ([Abu Dhabi e-Government Gateway, 2016](#)), whose public space is it? And, in a place with only one

extant vernacular edifice—namely Qasr Al Hosn, what else can be considered heritage? The latter question has been investigated by the author in a recent study that made the case for Abu Dhabi’s late modern heritage ([Husnéin, 2016](#)).

To seek answers to these questions this exploratory study employs a multi-case study research strategy. The methods include narratives and analyses written by experts; interviews of officials at the Urban Planning Council and the Tourism and Culture Authority; participation in public workshops in collaboration with the Salama Bint Hamdan Foundation; mapping exercises; and walks conducted in a semester-long planning design studio. The latter involved an urban inquiry of a project site employing direct observation, photography field notes, unstructured interviews with citizens, and mapping to handle the generated data. The analysis follows cross-case design. My claims are based largely on descriptive data gathered through fieldwork and organized around basic concepts from the social sciences. Given the intent of the research, these concepts offer enough direction to discuss general trends and possibility of alternatives.

The study further draws upon urban spatial theory and sustainability discourses as they pertain to spaces, places and cultural material heritage (both tangible and intangible). This allows for the examination of the capacities of objects, places and practices of heritage to persist. Such scrutiny, in turn, has implications on cultural heritage management in a way that would be mindful of the city’s progress.

The following sections will first introduce the concepts of ‘urbanistic heritage’ and ‘public realm’. An overview of competing views and emergent attitudes will be discussed against the backdrop of the regulatory setting. Three case studies signifying Abu Dhabi’s late modern heritage and the public realm they help shape are further explored to shed light on the neglected yet important episode of the city’s evolution. The paper concludes with a brief discussion of relevant themes that attempts to engage the ongoing debate over the genesis of cultural heritage and the values which underpin conservation decisions and landmark designation process in shaping and maintaining a distinctive, active, and sustainable public realm.

2. THE ROLE OF URBANISTIC HERITAGE

The concept of cultural heritage has constantly evolved in the global context since the birth of this modern notion in the 19th century exemplified in Camillo Sitte’s introduction of the urban approach ([Collins, Sitte, & Collins, 1986](#)). It was not until the advent of Gustavo Giovannoni’s *Vecchie città ed edilizia nuova* (1931) that heritage began to be understood in an *urbanistic* sense and to feature in planning discourse especially by the middle of the twentieth century. In fact, the original term ‘urban heritage’ has been attributed to Giovannoni, who also played a leading role in defining an original strategy for the safeguarding and the enhancement of urban heritage on an urban scale, without overlooking the significance of urban development ([Bandarin & Van Oers, 2012](#)). To him, a historic city is, at once, a monument and a living tissue. Thus, ‘urban heritage’ began to transcend the curatorial notion of single monuments and museums. Giovannoni considered the old city as historic monument. But he also held that the old city and the contemporary city cannot be separated from each other as they both form part of the whole contemporary urban phenomenon.

The implications of this relevant conceptual milestone continue to be addressed nowadays.

However, [Gonçalves \(2007\)](#) argues that the term ‘urban’ is a diffuse concept and its diffuseness eventually lent itself to urban heritage conservation. Instead, he espouses the concept of ‘urbanistic heritage’ since ‘urbanism’ signifies urban space and the processes of change over time, and encompasses social and cultural attributes. Key to his argument is that though urbanism the comprehension of the urban phenomenon is diverted towards a ‘rational domain,’ rather than a diffuse understanding that does not differentiate between what is spontaneous and what is not. He links ‘urbanistic heritage’ to the idea of ‘identity’ based on rational attributes, as in the case of easily identifiable traces of city wall or street or a square that persists through time despite the changes in the urban fabric. In fact, this concept combines the idea of identity with the concept of city as an ‘endless changing process.’ Therefore, ‘urbanistic heritage’ is a concept that is apt to function as a catalyst for promoting a proactive approach to urban renovation “involving both cultural and urban policies; residents and non-residents’ interests; private and public interests” ([Gonçalves, 2007](#)).

As such, heritage management considers not only the listing of buildings or their expressed meaning and value, but also, as Giovannoni emphasizes, the urban ensemble, including the structure and the activities of its inhabitants within and without, to be of cultural importance. According to Giovannoni, ‘heritage management’ should be incorporated into the broad notions of urban planning and development, and as such people are to be considered part of the city. The promotion of the significance of integrating heritage management into broader policies of planning was echoed in cultural policy by UNESCO as early as the 1960s ([Veldpaus, 2015](#)). This paradigm shift becomes quite evident and relevant considering the potentially significant role of the public realm in sustainable urban development.

3. SIGNIFICANCE OF THE PUBLIC REALM

The quality, role, and significance of the public realm have always been limited and disputed ([Harvey, 2001](#); [Lefebvre, 1994](#); [Whyte, 1980](#)). This view is particularly crucial against the growing privatization of public places and the rise of the virtual public realm influenced by new forms of information and technology.

The role of the public realm in the evolution of the urban is at the core of Henri Lefebvre’s writings. To [Lefebvre \(1994\)](#), the city is a place where inhabitants encounter each other, where they realize their differences and may be forced to confront and manage these differences, and where they engage their creative potential in communal *oeuvres*. In the city, he observed, everyday life arranges itself primarily around transactions of all varieties: buying, playing, traveling, and labouring. According to Lefebvre, the purpose of the city manifests itself in the often fleeting day-to-day activities, and in the often unnoticed everyday shared places. This is what he describes as ‘spatial practice’—the cohesive patterns and places of social activities.

The significance of the urban public realm as a place of everyday activities has been underscored by both Lefebvre and Crawford. Everyday life is connected to urban design through everyday experiences of physical space—a space that is configured spontaneously between ill-defined and

contested boundaries of home (private), institutions (public), and workplace (third place) ([Chase, Crawford, & John, 1999](#)). Such a space assumes the vigour of everyday public experiences. This, [De Certeau \(1988\)](#) has termed the ‘practice of everyday life.’ De Certeau criticized the bureaucratic view of public officials and planners for viewing space as a frozen and static entity, neglecting in the process the small dynamics that brings life to the city. In response, he attempted to establish a discourse between the institutional structures in charge of planning and managing urban space and the everyday users of the space. Thus, through the conception of everyday space, research in everyday urbanism attempts to re-establish the neglected linkage between the human sense of everyday urban milieu and the public realm.

As development continues in Abu Dhabi, the public realm is expected to provide the various amenities needed to ensure a high quality of life. The public realm is the physical and symbolic link between people, and achieving these demands would require efficient utilization of public property and right of way as well as productive partnerships on privately owned land. According to Danish architect and author [Gehl \(2011\)](#) “The presence of other people, activities, events, inspiration, and stimulation comprise one of the most important qualities of public spaces altogether.” Thus, the public realm can be recognized as not only a place but also an experience.

Nonetheless, how is the public realm being perceived locally? In the pre-1962 oil era, the public realm constituted a clear organic structure: each tribe clustered in a traditional neighbourhood system known as a ‘fareej’. The fareejs were connected by narrow passages (or ‘sikka’) that led to the ‘baraha’ (or plaza) on which the main mosque or a souq opens ([Urban Planning Council \(UPC\), 2007](#)) These traditional uses of public space—the meeting place, marketplace and traffic space— all coexisted in balance ([Gehl & Gemzøe, 2001](#)).

Today, nothing remains of this vernacular structure. Based on the fact that approximately 81% of the population living in the Abu Dhabi region consists of migrants and foreigners ([Statistics Centre Abu Dhabi \(SCAD\), 2016](#)), urban governance is being increasingly challenged to preserve local traditions and cultural values, while defining a new urban image for an internationally connected hub. The main landmark projects, such as sporting venues, world-class museums, and major real estate developments, do not reflect the various social groups, and are often not accessible to a large part of the population.

In 2011, the Urban Planning Council released its ‘Abu Dhabi public realm design manual’ ([Urban Planning Council \(UPC\), 2011](#)) to provide an international best practice approach and act as a planning tool and benchmark for public areas. Despite its claim that the public realm will serve “the diverse, multicultural population,” it is not clear how the manual will actually take into account the diverse population which has generally been overlooked by local planners and aggressive developers. As urbanist [Elsheshtawy \(2004\)](#) observes, despite the UAE’s celebrated cultural diversity “no real effort is made to resolve social problems, address concerns of [expat] lower class, or try to make the urban environment more ‘liveable’”. Without access or participation in the public spaces of the city, there is little or no sense of belonging. The absence of an all-inclusive urban development vision will pose the biggest challenge to establishing a coalescing society that sees Abu Dhabi its current and future home, which, in turn, would promote the development of a distinct urban identity for the city. In applying a more holistic approach to urban planning, only then

would the planning process be seen as integral to creating, analysing and understanding space. This cannot be overstated when it comes to the public realm, for it is a continuous process of placemaking.

In the early decades of nation building (throughout the 1970s and 80s) everyday practical spaces developed into a zone of possibility and potential transformation of publicness as illustrated in the following case studies. It is for this reason that this study attempts to highlight the importance of the public realm in the existence of Abu Dhabi's late modern heritage since the new sanitized versions of development do not make room for spontaneity and imagination. Before presenting the case studies, it would be beneficial to gain insight into the local regulatory setting in order to appreciate the emergent attitudes towards urban heritage and the competing views of modernization and preservation.

4. REGULATORY CONTEXT AND ATTITUDES

According to [Yildirim and El-Masri \(2010\)](#), the development of stakeholders and activities in Abu Dhabi can be traced back to archaeological excavations in the mid-20th century and the establishment of the Centre of Documentation and Research to record the Emirate's history and resolve territorial issues. Later on, the Department of Antiquities and the Al Ain Economic Development and Tourism Promotion Authority were created, which, in turn, solicited UNESCO's support in preparing the Abu Dhabi Cultural Heritage Management, Strategy. Completed in 2005, the 5-year Strategy promoted an integrated approach to the management of the Emirate's cultural heritage, culminating in the creation of Abu Dhabi Authority for Culture and Heritage (ADACH) ([Abu Dhabi e-Government Gateway, 2015](#)). The founding Law no. 28 of 2005 charged ADACH with a broad mandate towards this end, and situated it among several new and upcoming Abu Dhabi government agencies that have been geared to guide Abu Dhabi's ambitious future development. In that same year, the government of Abu Dhabi enacted a law granting citizens the right to buy and sell real estate property. This law set a landmark change of policies which reflects the drive towards gradual liberalization of its land ownership policies ([Sadek, 2014](#)). Shortly thereafter, the government lifted the development restrictions. However, it soon realized that without a comprehensive plan, the Emirate risked repeating Dubai's speculative excesses and incoherent urban form.

4.1 Dawn of a new era

By 2007, the government was poised to unveil its ambitious vision to transform Abu Dhabi into a major global capital. Underlying it was a desire to diversify Abu Dhabi's economy beyond its virtually exclusive dependence on the hydrocarbon sector. This new outlook ushered in an era of state and developer partnership ([Sadek, 2014](#)). To oversee the city's transformation, the Urban Planning Council (UPC) was established by Law no. 23 of 2007. Its mandate was to direct growth through development policies and plans at all levels of planning; ensure compliance of developers' proposals with those plans and policies; and lastly, enhance coordination among the various government agencies and developers ([Urban Planning Council \(UPC\), 2007](#)). Plan Abu Dhabi 2030 (a.k.a. Vision 2030) called for

“setting an international example of cutting-edge sustainable growth—that which filters all decisions through environmental, social, and economic criteria” ([Urban Planning Council \(UPC\), 2007](#)).

Vision 2030 and its policy agenda has been followed by sectoral iterations that produced an ensemble of visions, plans, and policies covering every aspect of the Emirate’s transformation—including the Council for Economic Development’s Economic Vision 2030, the Environment Agency’s Environment Vision 2030, and the Department of Transport’s Surface Transport Master Plan, and so forth. Further, the plan claims to be “grounded in the cultural and environmental identity of Abu Dhabi” and focuses on “striking a balance between conservation and development” without “unnecessarily tearing buildings down” ([Urban Planning Council \(UPC\), 2007](#)). UPC has also developed the *Estidama* program, which is Abu Dhabi’s edition of the LEED system calibrated to the particular environment of the region. *Estidama* takes into consideration environmental, economic, social and cultural sustainability at the community, development and villa levels. An essential tool to advance this program is the Pearl Rating System, which measures a project’s compliance with *Estidama*. However, it has not been clearly defined how cultural heritage features within this agenda, i.e. in terms of the social, environmental and economic ‘pillars’ of sustainability. This may be a point that will be addressed among the agencies in future deliberations, as the Environment Agency and ADACH have many procedural and practical relations in effect.

4.2 Modern heritage preservation initiative

ADACH’s Modern Heritage Preservation Initiative, launched in 2011, is wide-ranging and aims first at setting a framework for the future on how to deal with the late modern architectural and urban stock. Its objectives are mainly to safeguard a collective memory of the emirate and preserve its historic evolution for posterity by establishing preservation guidelines and developing effective strategies. The challenge of the project is to raise awareness on the value and importance of this type of heritage, garner public interest and support, and reconcile the constant drive for urban renewal with the aims of preservation ([Chabbi & Mahdy, 2011a](#)).

A year later, in 2012, ADACH was integrated with the Abu Dhabi Tourism Authority (ADTA) to form the Abu Dhabi Tourism and Culture Authority (TCA) ([Thomas, 2012](#)). This restructuring was seen by some as indicative of a shift in the emirate government’s policy toward engaging culture and heritage more actively in economic development. The Abu Dhabi government also demonstrated strong will in adopting the Abu Dhabi 2030 Policy Agenda. Although cultural heritage is given an important role as one of the main subject areas in the agenda at policy level, the level of implementation has revealed challenges. It is often not clear how conflicts arising between the mandates of different agencies will be resolved and how the government’s priorities will be negotiated.

Moreover, recent research (Getty Conservation Institute (2010)) reveals that “conflicts between heritage needs and development needs” have as yet not been fully resolved either in the fields of both conservation and urban management. Heritage is frequently perceived as a hindrance to the city and local community development. In this regard, TCA has endeavoured to act as a ‘resource’ and not just the ‘stick’ by developing the tools to help other agencies and communities do a better job at maintaining the balance between development pressures and conservation needs.

Generally, as shown later in one of the subsequent case studies, TCA's ability to slow down development is doubtful and quite challenging at best. However, when met with opposition, TCA would need to evaluate the controversy and have all the pertinent studies in place while working in tandem with stakeholders on gaining important allies in higher places. Furthermore, these longstanding concepts may still motivate preservation efforts but the real task lies in practice. An assessment of the management policies and practices is paramount. This becomes especially pertinent in view of the projected effects of climate change and population growth as forecasted in a recent summit ([Habitat III, 2016](#)).

Moreover, global doctrines and professional standards of heritage conservation have become ubiquitous around the world, yet their varied interpretation is predicated on cultural milieus and the degrees of practice attained. This lends itself as both a challenge in terms of safeguarding the values that heritage presents, and an opportunity when considering the numerous options for conservation methods offered by virtue of cultural diversity. Hence, approaches can be customized to avoid importing foreign models to milieus far from their original source with no regard to the particular needs of local settings.

4.3 Emergent attitudes

The dominant role of the Abu Dhabi emirate government extends to funding development and conservation projects. But that does not preclude municipalities from exercising their regulatory capacity which leaves its mark on the urban landscape. For example, during the 1980s, Department of Town Planning guidelines demanded that façade treatment of new, especially residential, buildings incorporate 'Arab/Islamic' motifs. The outcome was dismissed by critics as superficial and lacking consideration for the supposed regionalism and underlying principles of Islamic architecture ([Damlūji, 2006](#)).

Likewise, the misappropriation and literal application of features of traditional architecture such as wind towers and desert forts have produced unintended consequences, misrepresenting the identity of the built heritage. Here, the quality and role of design professionals becomes key as they interpret and reproduce the regional cultural identity ([Chabbi & Mahdy, 2014](#)). In fact, there are some examples of architectural modernism in Abu Dhabi from the 1960s-80s, which have provided an appropriate response to local cultural and climatic conditions, such as the Taxi Stand discussed later ([Damlūji, 2006](#); [Husnéin, 2016](#)). It is important to recognize this layer as part of the urban heritage, to complement and provide continuity to the older pre-oil era sites and buildings, which are more readily accepted as national heritage. Unfortunately, it is not as easy to see stakeholders do so for modern buildings. [Damlūji \(2006\)](#) provides some insights into this, such as the conventional architectural education in the region having been oriented towards structural engineering, and the influx into the region of architects from different backgrounds and senses of aesthetics during the post-oil decades resulting in the experimental nature of the architectural profession ([Damlūji, 2006](#)). More recently, many Western-trained professionals have been recruited to the newer public and private sector agencies established in the mid-2000s. These professionals have been advocating context-sensitive design as global best practice, instead of the conventional, narrower focus on operational and 'engineering' aspects of urban projects more typical of the

Middle East region. This is a salient instance of the multi-cultural character of the stakeholder ecosystem in Abu Dhabi at work.

Interestingly, as indicative of this earlier attitude towards the late modern heritage, the previous logo of the Abu Dhabi Culture and Heritage (ADACH) depicted a silhouette of a camel joined by what appears to be traditional costumes with some brandishing swords or sticks. The emblem is remarkably devoid of any references to the modern markers that contributed to Abu Dhabi's national narrative. This observation was discussed with TCA's Amel Chabbi (Building Conservator) and Dr. Husam Mahdi (Building Conservatory Supervisor) before the new logo was unveiled. The replacement logo for the newly established TCA, however, does not have any depiction of animate or inanimate objects (Figure 1). Instead, it displays a simpler form that employs the name of Abu Dhabi in Arabic calligraphy enclosed in a pseudo-ellipse. The same logo is used by other Abu Dhabi government agencies ([Chabbi & Mahdy, 2014](#)).



Figure 1. ADACH old logo (left) and new (Source: TCA)

The local heritage discourse is polarized. There are those who see heritage limited to only what has been around them in the pre-oil era; those who envision it in cordoning off Qasr Al Hosn, organize a festival, bring in the sand dunes, some water and boats, sheep and camels, and elderly Emirati ladies making baskets or traditional sweets; and those who see Formula One (Abu Dhabi Grand Prix) as the quintessential embodiment of heritage. While the tourism industry is selling an image of Abu Dhabi it does so by showing off the ultra-modern, when in fact, the true essence for Abu Dhabi society is embodied not in the 'product' but in the process as the 'journey of transformation'. Alternatively, to be an Emirati is not by only portraying the Arab Bedouin with a falcon on shoulder and camels in the background, to be an Emirati is to embrace the present by celebrating the journey (Formula one in the TCA logo!) ([Chabbi & Mahdy, 2014](#)). This latter discussion brings in clear view the relevance of 'urbanistic heritage' to the public realm since as discussed earlier it fuses the idea of identity into the notion of the city and its historical formative elements of transformation.

5. CASE STUDIES

Three particular case studies, as a research strategy, are highlighted here to illustrate issues related to the role of urbanistic heritage and the associated public realm (Figure 2). On one side of the debate is the need to develop modern and comfortable facilities; on the other, is the protection of key threatened edifices deemed vestiges to the city's recent past. These conflicting goals of modernization and preservation need to be reconciled in

order to reverse what some has described as the “vicious cycles of Abu Dhabi's urban renewal” (Chabbi & Mahdy, 2011b).

Emblematic of this passionate debate are a three-decade-old bus station and taxi stand, the industrial warehouse district at the Mina Zayed Port, and the Cultural Foundation sharing the same city block as the eighteenth-century Fort. All three ‘heritage’ sites and buildings with complex stakeholder relations sit in a prime location ripe for replacement.

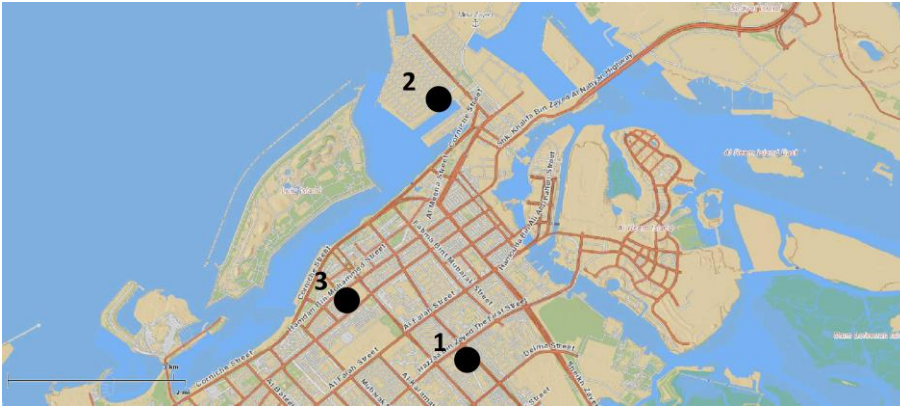


Figure 2. Locations of case studies: (1) bus station and taxi stand, (2) warehouse district and mina zayed port, (3) cultural foundation and block w17 (Source: Abu Dhabi Geoportal)

These case studies explore the notion of publicness in various urban manifestations and scales which includes a city block representing its historic core (cultural foundation), an industrial warehouse (district) that ties the city to its maritime past, and a public transport facility, which plays an important role in connecting the city to its environs and other faraway destinations.

Two main criteria have been considered in the selection of the case studies: (1) they are representative of the late modern urbanistic heritage and (2) that they are relevant to the everyday life in the public sphere. By ‘late modern’, the study refers to urban and architectural vestiges from the nation building era of the 1970s and 1980s. Whereas the public realm, as a place of everyday urbanism, becomes the overarching discourse that ties these case studies together.

Once the case studies were identified, various data collection techniques were employed, ranging from historical narratives to interviews and visual analyses. While the case of the bus station and taxi stand engaged structured text (writings, guides, news articles, conversations with academic Deborah Bentley), and photography, the port and warehouse district involved unstructured texts (individual interviews, conversations with curator Michelle Bambling), and graphics. The types of qualitative data in the case of the cultural foundation and heritage district used structured and unstructured texts, in addition to the walking and mapping activities conducted during a semester-long studio exercise. The latter also involved conversations with building’s architect Hisham Ashkouri, UPC’s former planner Ahmad Sadek, and academic Yasser Elsheshtawi). This method helps bring about an understanding of context, people, and interaction of various actors with the built environment. Lastly, relevant themes were drawn across the cases to draw out patterns from the concepts and insights.

5.1 The bus station and taxi stand

The Abu Dhabi Bus Station (Figure 3) can be seen as an example of conflicts that arise between the mandates of different agencies. A major urban landmark of modern architectural heritage in downtown Abu Dhabi, the Bus Station was designated for protection in 2011 by TCA (then ADACH), but also scheduled for replacement with a new facility as part of the bus transportation development plans of the Department of Transportation (DoT). Several rounds of negotiations between the two contending agencies began in relatively uncompromising tones but later evolved into more subtle discussions seeking acceptable design solutions. Fortunately, the debate favoured the side of preservation, as it was raised to the level of the Abu Dhabi Executive Council. Various briefings on the significance of the station prompted key transportation officials to reconsider the redevelopment scheme. Eventually, TCA's plea to preserve the Terminal, bolstered by its own Emirate-wide Modern Heritage Preservation initiative, brought about a favourable outcome ([Chabbi & Mahdy, 2014](#)).



Figure 3. Bus Terminal (top) and Taxi Stand (bottom)

Known for its mint-green colour, the terminal opened for business in 1989. It was designed by Bulgarian architect Georgi Kolarov for the architecture firm Bulgarconsult A&E. The modernist building has two ramp-like prongs that meet to form the interior that house the ticketing stand and some shops. These wings are held by arches reminiscent of ancient viaducts. The interaction between the interior and the exterior is also part of the building's charm. At any time of the day, there are people sitting out under the structure and inside the terminal. There are deep, but narrow windows on all sides of the interior providing natural light. Devoid of any references of stereotypically Islamic or local architectural motifs, the Terminal stands in

stark contrast with the rest of the landscape—a quite stimulating experience. Yet in a landscape that seems to grow vertically unchallenged, the Bus Terminal along with its appended Taxi Stand, are “refreshingly disjointed” from the city.

A closer look at the Taxi Stand reveals a sense of playfulness that is quite remarkable. The roof’s brise-soleil filters (Figure 2) dampen light into the mint-green covered area below that is quite soothing. While the passive solar design was established using modest means available at the time of its construction in the early 1980s, it is now back in trend following the Urban Planning Council’s *Estidama* (sustainability) initiative ([Urban Planning Council and Economic Council \(UPC-EC\), 2011](#)). From the sight of lounging Subcontinental drivers, it is clear that the space has become homely, at least to these marginalized groups who form a sizable proportion of the population. A close observation of this everyday space highlights inhabitation, action, and appropriation.

If the renovation plans were to go ahead it would almost certainly displace the current informal system and threaten the community that has made that space its own—the result is urban fragmentation. And thus, in the words of Elsheshtawy: “The city is ... being re-created through the gaze of the tourist, the look of multi-national corporations, and the stare of real estate development companies. In such a context it becomes quite natural for developments to become isolated and fragmented islands.” ([Elsheshtawy, 2004](#)). So instead of considering this legacy an impediment, DoT should work with TCA on policies that perceive the urbanistic heritage as a constructive asset generating an essential part of a creative urban dynamic that would guarantee its sustained vigour and the inclusion of its diverse communities.

Cultural sustainability entails reconsidering the interconnected roles of government agencies, experts and when possible residents (linking the set of values and judgements of specialists and the set of common knowledge), and increasing the participation of the population in defining heritage and heritage policies, in order to improve community life and promote a sense of ownership.

5.2 Mina Zayed port and the warehouse district

Inaugurated in 1972, Zayed Port has been Abu Dhabi’s premier commercial port for the past four decades. It is located on the northeastern side of the island and spans over 535 hectares ([Abu Dhabi Ports \(n.d.\)](#) para. 1). Following the transfer of all container traffic to Khalifa Port in 2012, Zayed Port became part of a comprehensive development plan to establish the capital city as a world-class cruise destination. It houses a new cruise terminal building which opened in 2015 (Figure 4).

The 13,000 square meter cruise terminal was designed by the international firm BDP. The designers re-used an existing warehouse structure and overlaid it with modern materials and fittings. The new and expensive building boasts “traditional Arabic ornaments, colors, and shapes, combined with modern architectural elements defin[ing] the building’s distinctive style which celebrates the UAE’s cultural heritage and pays tribute to its long maritime history”. In addition, the distinctive lattice roof structure takes inspiration from the native ‘ghaf’ tree, while “wooden features inside reflect traditional dhow sailing vessels.” ([BDP, 2015](#)).

It must be noted, however, that the scope for adaptive reuse of this type of modern industrial heritage is as yet somewhat limited. This is due to factors

related to the substandard physical construction techniques of some early modern period buildings, as well as the absence of a sufficient culture and industry supporting the idea. However, as more value on the full range of heritage assets is placed by the government, developers and the local community, it will be easier to develop methods of regenerating and integrating them within a culturally sensitive urban development.



Figure 4. Cruise Terminal-Mina Zayed (Source: [BDP, 2015](#))

While future plans for the adjacent Warehouse District has not been officially announced, an initiative funded by the philanthropic Salama bint Hamdan Al Nahyan Foundation is seeking to create a cultural space at the epicenter of Mina Zayed. With the help of the Danish design firm Bjarke Ingels Group (BIG), a couple of industrial warehouses were converted into a multipurpose venue which was completed in 2015 (Figure 5). The project will serve as a grass-roots cultural destination for the capital. As part of a newly created urban plaza, Warehouse421 is becoming a cultural hub that fosters the local art and cultural scene and supports the perceptive processes, in order to reinforce the UAE's creative community. The various cultural programs and artistic projects explore themes of memory and transformation which play a strong part in the evolution of Abu Dhabi. This is a unique opportunity for a public realm to invigorate the local and wider community to experience all aspects of culture in a distinctive and original space. Its location within the port vicinity also invokes ideals of national history and tradition.

With proper attention, such projects may extend to the formation of new ecosystems, including the conversion and adaptive reuse of redundant structures and disparate elements of the industrial past as well as integration of new buildings, infrastructures and landscaping.

It is hoped that an initiative such as this will serve as an impetus to re-envisioning the future development of the historic industrial district. This type of infill development and adaptive reuse would also act as a catalyst for the improvement of the public realm.

The Mina Port Zayed district has been for many decades a popular destination for tourists, locals and expatriates. It is one of few remaining public realms where one would always enjoy a true Arabic hospitality and a good bargain. It is host to a number of attractions including the vegetable and fruits market, carpet souk, plant nurseries, and the Iranian souk. There is also a fish market, which gets its daily supply from the fishermen sailing their traditional dhows back with their catch. The sight of shop owners and

fish sellers haggling customers and the sometimes staunch smells and commotion add an air of spontaneity, ruggedness and an organic feel to this particular public realm and urbanistic heritage, which explains its popularity. Therefore, any future plans for this area should consider the need for participation in developing a sense of social inclusion in order for public realm heritage to continue to thrive in the present and into the future.



Figure 5. Artist rendering of the Warehouse421 and vicinity (Source: visitabudhabi.ae)

Sad memories of the long gone, but not forgotten, Central Souk (1968-2005) still linger. The Souk served as a popular and affordable shopping centre. It is noteworthy for its casual and pleasant social engagement between patrons. Its replacement, the luxurious and sanitized Central Market, was built at the expense of people and uses that make it an interesting place to be. Great cities thrive not just on great public spaces but on interconnected diversity. For Abu Dhabi, in order to realize its Vision 2030, this means addressing not only its demographic heterogeneity (ethnicity, class, profession, and so on) but also its diversity of building types and uses, from all eras of its urban history. This will consequently raise issues of governance related to heritage management. Warehouse421 is in a unique position to facilitate and thus contribute to public discourse, interactivity and innovative community development.

5.3 The Cultural Foundation and heritage district

On the occasion of the annual Qasr Al Hosn Festival held in February 2015, the author and his planning studio were invited by the ‘Lest We Forget’ initiative to host a public workshop at the Cultural Foundation (Figure 6). Students grappled with issues related to understanding modern urbanistic heritage in the local context. They sought ways to ‘stitch’ the historic Qasr Al Hosn monument back into the urban fabric along with its neighbouring Cultural Foundation building. The studio/workshop themed “An Exploration of Abu Dhabi’s Urban DNA One Block at a Time” ([Husnéin, 2015](#)) proved to be a great opportunity for students to interact with the public and get a sense of how others viewed and reacted to the question of preserving late modern heritage. Participants were keen to learn more about the city’s recent attempt to reconsider its urbanistic heritage in the face of rapid development.



Figure 6. Public workshop at the Cultural Foundation

In one studio exercise students were tasked with studying a residential city block in the Al Khalidiya district (designated Block W17 on Municipality maps), which is believed to have been outlined in the 1968 master plan. Initial investigation of the site has shown that it may contain samples of the earliest surviving residential villas in the city. And, in the manner of Charles Baudelaire's *flâneur* or the urban explorer ([Benjamin, 2002](#)) students were asked to walk through the site and experience first-hand the bewildering networks of internal streets which vary from one superblock to another. Students recorded what they encountered in direct observations, identified few denizens and compared notes. As it were, many of the residents work around nearby Electra (Zayed the First) Street. This is a friendly, quiet greener neighbourhood that reflects the low density of Abu Dhabi in the 1970s and 1980s. Here you may find a gaggle of children playing pick-up soccer in one of the relatively safer corners of the block—typically landscaped strips of leftover right-of-way next to the main roads. Walking through the wall of high rises into the superblock's interior, the instant calm was almost bucolic as the villas, tucked away from the hustle and bustle of the city, were hardly noticeable from outside the superblock.

This was also a lesson in how the block functioned in terms of connectivity, permeability and wayfinding. Closer inspection of the neighbourhood revealed possible encroachment on the alleyways by residents making it the more difficult to navigate your way around. The author maintains that “[t]hese subtle, ‘ordinary’ actions were investigated by [De Certeau \(1988\)](#) whose theory of everyday life holds that individuals constantly remake and revalue their lives, cultures, and surroundings within broad socio-economic constraints” ([Husnéin, 2016](#)). According to de Certeau, both ‘ordinary’ facets of life and the individual and societal systems are important to consider.

Students were encouraged to search for themes such as existing building typologies. Students compared aerial photos with data collected about the various building types. One objective was to determine if there was indeed extant courtyard housing which was associated with the early Shaabi (folklore/public/national) housing projects era. At times, students asked occupants if they could take further looks. Indeed one or two examples were

identified in the area. Many houses were transformed to accommodate a new mostly low income clientele. Studio participants were accordingly able to read the urban morphology as a palimpsest “encoding the various layers of the block’s evolution and ultimately Abu Dhabi’s story” (Husnéin, 2015). In fact, the studio exercise revealed that “a palimpsest not only manifests itself in plan but also three dimensionally as one gazes across the cityscape at the layering of successive buildings representing various phases of Abu Dhabi’s development” (Husnéin, 2016). One interesting finding during the studio exercise was the need for “an urban viewscape mapping for building envelope height and location” which would act “as a development criterion in assessing the significance of a possible cultural heritage site” (Husnéin, 2016).



Figure 7. The Cultural Foundation c. 1981

(Source: ARCADD, Inc. / Hisham Ashkouri Architects via www.thenational.ae)

Sitting on one of the oldest blocks in the city is the Cultural Foundation (Figure 7) which dates back to 1977. It was one of the earliest civic-minded projects, strongly linked to the era of nation-building, which attempted to bridge an apparent gap—the public realm—which constitutes our everyday experience of urban places. It housed the first national library and served as a significant community and art centre. It brought people together to exchange practices and ideas. The Cultural Foundation was almost torn down in 2010, but the government of Abu Dhabi, opted against the idea. The contemporary building is considered one of the foremost examples of modern architecture in the UAE situated on the same city block as Abu Dhabi’s most significant historic building—Qasr Al Hosn. It was designed by The Architects Collaborative (TAC) in 1977 which was based in Cambridge, MA, and founded by Walter Gropius.

Modern architecture and urbanism might not appeal to many people, but they are important to the heritage of Abu Dhabi and part of the city’s urban history. A general lack of awareness and appreciation was specifically identified as one of the threats faced by Abu Dhabi’s late modern built heritage (Chabbi & Mahdy, 2011a). It is incumbent upon public agencies, such as TCA and UPC, and academic and research institutions to bring this important matter to the attention of the public. The cultural aim would be to introduce the late modern architectural and urban heritage into people’s lexicon.

Refreshingly, Yasser Elsheshtawy, upon his appointment as curator of the UAE pavilion at the 2016 Venice Biennale, chose the theme of the aforementioned Shaabi housing—a seemingly mundane episode yet fascinating aspect of local architectural history to represent the UAE. He stated that “We would like to show the diversity of the architectural and urban landscape of the Emirates and to show people that it isn’t just about iconic buildings and skyscrapers and shopping malls” (Leech, 2015). In delivering ‘heritage’ from the unique and the outstanding, to include the ‘ordinary’ (as suggested by Certeau and Elsheshtawy), the underlying premise is that issues of defining and planning for heritage could play a central role in determining ‘social policies’ for the UAE.

6. RELEVANT THEMES

A major theme that surfaces from the case studies is indeed the way the remains and memories of the past—heritage—not only represent the past, but live—or should live—in the present. They are the backdrop of everyday life, the landscape of people’s lives, and some case studies show how history and heritage need to be viewed as essential components of the daily life of the population. Dealing with the heritage does not mean only focusing on the past. Heritage must be articulated with the needs and aspirations for modern life, most particularly as multicultural and rapidly developing cities as in the Gulf where the influx of temporary populations of tourists, workers and expatriates brings additional complexity.

As a multicultural setting, there is a definite need to underline the idea of cultural sustainability in the Gulf, whether between global and local influences, between and within communities, or between inhabitants and visitors, or inhabitants and experts. There is room in Abu Dhabi’s urban experience and heritage management to enable wider and more diverse groups of people to explore their perspectives, to ensure that dominant narratives are countered by an array of alternative or changing points of view. There is a consensus that the aim is to increase the representation of plural and multiple experiences—in contemporary Emirati society—through increased tolerance for difference and wider appreciation of the ‘palimpsestic identity’ of towns and cities. It is also important to ensure that more people feel that they belong where they live. There is a need to promote social sustainability by cultural and democratic means and not only (as often seems to be the assumption) by economic ones.

The case studies demonstrate The idea that revealing and enhancing ordinary heritage, and at the same time pursuing people-centered rather than object-centered approaches for heritage preservation, can help with community building and contribute to social cohesion and understanding. The case of warehouse421 may, in fact, demonstrate ways in which sharing heritage strengthens relations between communities between neighborhoods and between generations. Enhancing local heritage and making people aware of and concerned about the existing heritage is viewed as a resource for the well-being of the residents/inhabitants. Developing participation processes, educational activities and collaborative work creates place-identity and reinforces sense of place.

In terms of taking ownership of heritage, sustainability means including the living community in the heritage process and taking into account the cultural vitality of the population. It supposes selecting from the past (and perhaps modifying present-day behavior) and finding ways to ensure (not

merely physically but also symbolically) that the past contributes to the quality of life, as shown in the cases of the ‘bus station’, and ‘block W17’. This involves some recognition that heritage can be owned by everyone.

Finally, the paper raises several governance issues related to heritage management. It underlines the need for participation in developing a sense of social inclusion for heritage which can be controversial. As the case studies have demonstrated, cultural sustainability means reconsidering the interconnected roles of government agencies, experts and when possible residents (linking the set of values and judgements of specialists and the set of common knowledge). In this vein, an integrated heritage conservation practice and approach would belong to a top-down urban planning approach tempered by a strategic and communicative model—a bottom-up perspective. Increasing the participation of the population in defining heritage and heritage policies would improve community life and promote values of tolerance and peace.

7. CONCLUSION

Abu Dhabi’s ‘urban history’ or lack thereof, presents a unique situation—a city resurrected in the modern era of nation-building with the aid of a diverse demographic. Decades of aggressive development left most its late modern heritage at the mercy of the bulldozer and ventured into threatening the public realm. Recent activism bolstered by government initiatives may turn the tide in favor of an emerging philosophy that will be able to strike a balance between development and preservation.

Urban or rather *urbanistic* heritage is increasingly regarded as a potential and relevant contributor to the economic and social development of communities. Hence, heritage management would tend to social and spatial refinements while supporting the present qualities of the built environment, which holds cultural, aesthetic and economic values for any community. As such, a structure of broad participation becomes vital for achieving balance between conservation and development endeavors. The public realm is an integral part of that civic experience, as well as the architectural edifices.

As the case studies have shown, the spaces between the buildings are vibrant features that have a distinctive and unique character, whether they are conduits to move through (e.g., streets), or places that gathers people (e.g., plazas). The public realm can actively serve as a ‘canvas’ that serves to unite the old and the new improving the legibility and coherence of the centers of our cities.

However, the realization of a good public realm becomes a question of its contextual design approach and its manageability—a common concern for all case studies. For example, the taxi stand is not just a transitional space to pass through, rather it is a space that entices people to slow down or pause to experience the place. Likewise, the cultural foundation was and hopefully will reclaim its role as a place that will in its own way enrich the lives of people using it—a lesson that can definitely inform the development of the ‘warehouse district’. There already exists Warehouse421 with its potential role to become an urban catalyst that would reinvigorate the area highlighting its historic industrial heritage. One is reminded also not to merely focus on aesthetics, beauty and functionalism at the expense of the liveliness promised on the urban designer’s drawing board ([Gehl & Gemzøe, 2001](#)). Stitching the cultural foundation and the historic fort back into the

city fabric offers an opportunity for city planners to reinvigorate their roles in shaping a sustainable public realm at its cultural heart.

One cannot also overlook the complex issues that shape the heritage experience in this part of the world—issues which include the highly political nature of its cultural heritage activity. The leadership agenda is potentially in conflict with that of local academics, historians and thinkers, which makes presenting a collective, representative and diverse narrative a difficult path to tread. Becoming aware of the historical meanings of urban heritage is the basis for a culturally sustainable development. This would occur when urban communities are able to understand the meanings of all historical components of their townscapes and to develop their urban heritage culturally and economically, realizing in the process an integrated cultural landscape.

The chief argument in this paper is that cultural heritage is not stagnant and has latent dynamic elements that can be fully synergized through an integrated planning process to make the city as a space of cultural diversity, infused with a sense of place, sustainable environment and economic prosperity. The challenge, however, is to reverse the definition of cultural heritage from a set of relics to a set of tools that awakens the innovative dynamic process to consider all possibilities of *urbanism* and so to forge an adequate city environment. Accordingly, the value of heritage buildings and sites needs to be recognized as a true incentive to guide the planning of cities that currently have no reference, to escape urban fragmentation and enhance the quality of public realm.

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Local Spatial Impacts of Globalization in Developing Countries:

The Case of Sohar, Oman

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Abstract: In the last few decades, economic development and urban expansion have become a feature of modern society, especially with fast-growing economies in both developed and developing countries. Economic activities play a major role in most urban activities in all countries, controlling urban growth and its trends, which then could lead to affecting the land use change over time. Globalization in general terms refer to the expansion of global linkages and implies the opening of local and national outlooks to a broader perspective of an interconnected and interdependent world with free transfer of capital, goods, and services. The Sultanate of Oman has undergone rapid globalization in the last three decades, and Sohar city is an example of globalization in action. The city has grown from discrete isolated settlements with fewer than 35,000 inhabitants in the late 1970s to a medium size urban center with a total population of almost 197,000 inhabitants in fewer than 35 years. In the last fifteen years alone, the city has received more than \$10 billion investment value from both government and international investors. This money has been invested mainly in the Sohar port, industrial area and free zone area as the focus of domestic and international investment in the city. This study aims at displaying and measuring the spatial impact of globalization on urban growth of Sohar city. The methodology employed in the study is based on a combination of Geographical Information Systems (GIS) and Remote Sensing (RS) to investigate the spatial changes of land use in addition to other supporting socio-economic and demographic data. The study traced the historical development of the city growth, and the results have revealed the substantial change particularly in the growth and expansion of built-up area into open space and green areas.

1. INTRODUCTION

There is no standard definition of globalization. In the literature, the term globalization is widely used to describe the processes of interaction and integration among the capital, people, information, media, investment, politics, labour, technology,...etc. between different nations ([Leaf, 2002](#)). Other scholars like [Janelle and Beuthe \(1997\)](#) define globalization as the increasing geographical scale of economic, social, and political interactions. Defined thus, globalization is not a new practice. The practice of the exchange of goods between people and countries has existed since antiquity, with goods often crossing thousands of kilometres; for example, goods were

transferred to China and Europe throughout the silk road in the Middle Ages. The term “globalization” began to be used broadly in the early 1960s by social scientists; while economists have used the term since the 1980s ([Guillén, 2001](#); [Yeung, 2002](#))

In the last few decades, there have been huge concerns by scientists about the impact of globalization ([Giddens, 1990](#); [Janelle & Beuthe, 1997](#); [Ezcurra & Rodríguez-Pose, 2013](#); [Liao & Wei, 2015](#); [Leaf, 2002](#); [Lessmann, 2014](#); [Mahgoub, 2004](#); [Mahutga & Smith, 2011](#); [Mazrui, 2001](#); [Held & McGrew, 2007](#); [Pani, 2009](#); [Vongpraseuth & Choi, 2015](#)). According to many scientists ([Leaf, 2002](#); [Held & McGrew, 2007](#); [Vongpraseuth & Choi, 2015](#)), globalization has led not only to the expansion of the boundaries of markets and communications but also to the spread of cultural awareness among consumers all over the world. There are no limitations on capital transfer, goods, people, technology and information between countries, and globalization started crossing international boundaries by finding new opportunities to share goods or investments.

These processes of globalization could have positive or negative effects on the environment, culture, society, and economic and political systems. According to [Held and McGrew \(2007\)](#), globalization activities have consequences in distant regions. The greatest impact of globalization is a foreign direct investment (FDI) ([Vongpraseuth & Choi, 2015](#)), which, in most countries, create opportunities for bettering the lives of the citizens. The priority in most countries around the world, therefore, is to attract direct foreign investment which, in turn, increases the national Gross Domestic Product (GDP) ([Tuan & Ng, 2007](#)). On the other hand, there are some negative effects of globalization, which come in different forms, such as sociocultural changes due to the movement of people from developed areas to developing regions ([Mazrui, 2001](#)). Perhaps the strongest impact of globalization in the city environment is the localization clash ([Mahgoub, 2004](#)) which means some locality characteristics may lose or change with time. The effects of globalization on cities are complex, multifaceted and geographically diverse ([Leaf, 2002](#)). All developed and developing countries have encouraged foreign investors to invest more capital in their economies. Furthermore, some developing countries have looked at foreign direct investment (FDI) as the main solution to most of their development issues. However, these countries need to pay special attention to the following consequences of globalization:

- The impact of globalization on environmental changes, specifically on how environmental degradation may result from intensive industrial development and urban growth. This includes the implications for agricultural land loss and pollution.
- How the capital investment will be directed; the lost control on the foreign direct investment may have also negative consequences on the economy of the country. An example of losing control, investment will be directed to fast return economic fields rather than strategic economic sectors.
- The impact on the structure of planned land use and uncontrolled urban growth.

There are always debates about the benefits and shortcomings of globalization at the global level, creating such dichotomies as north vs. south, integrated centers vs. marginalized peripheries or littoral fringes vs. continental areas. However, the issues of the relationship between globalization and territories are multifaceted and complex. The literature shows that, at different spatial scales, local, regional, national or continental, the territorial dimension has become an essential component of urban

development and spatial organization analysis. Empirical studies have shown that globalization induces major structural changes in national economies and spatial configuration ([Leaf, 2002](#); [Mahgoub, 2004](#); [Mazrui, 2001](#); [Pani, 2009](#); [Vongpraseuth & Choi, 2015](#); [Zhu, Qian, & Gao, 2011](#)). Cities play a major role in the redistribution of populations, the activities and the consequent socio-spatial disparities. The socio-spatial impacts of integration into the global economy appear more clearly in national and regional scales, particularly in the countries of the integrated periphery. Globalization impinges on the national territories, mainly by redirecting national resources, and local and foreign investments alike towards economic gateways. The hasty development of these gateways or globalized metropolises is one of the most obvious effects of globalization. Globalization; hence, transforms the city into an internationalized space whose limits and aspects are rather related to an exogenous network. It is a selective system which inevitably creates differences among the components of the national urban system because globalized cities "are connected to physical and virtual international networks that promote movement of wealth and extend areas of influence" ([Dlala. H, 2002](#)). Thus, the spatial development of globalised cities is reinforced by exogenous factors that hasten the spread of infrastructures, services, and the development of housing, in addition to adequate amenities. This phenomenon affects all dynamic urban centers of developing countries. This trend was already visible before 1980 ([Dlala. H, 2002](#)).

In the last few decades, several scientists have tried to investigate the relationships between globalization, urban growth, and regional development, and how globalization affects land use change in urban areas ([Logan & Molotch, 1987](#); [Feagin & Parker, 1990](#); [Chitrakar, Baker, & Guaralda, 2016](#); [Leaf, 2002](#); [Vongpraseuth & Choi, 2015](#); [Wei & Liefner, 2012](#)). In this context, the present article highlights the issue of how globalisation could change the structure of urban growth in the city of Sohar in the Sultanate of Oman. The main aim of the paper is to quantify the spatial impact of development and the connection of the city to the globalized space and measure the direct impact of such development on the urban dynamic and expansion. In this paper, I investigated how Sohar city has developed and grown from 2003 to 2015, and how some land, with special emphasis on agriculture, has been lost. This change in the urban setting of Sohar is closely related to dense global investments received by the city as the study assumes.

2. CONTEXT

The Sultanate of Oman is part of the integrated periphery, thanks to its strategic location between the Strait of Hormuz and the maritime routes in the Indian Ocean. The proximity of the dynamic metropolis of Dubai and the big consumer markets of the Arab Gulf countries are additional assets that reinforce this trend towards the integration of Oman into regional and global economies. Indicators of globalisation such as the degree of economic openness, the importance of foreign trade in the national economy, and KOF index, which measures the dimensions of globalisation traits, including economic, social, and political aspects all indicate the steady integration of Oman in the global economy. The KOF index of the country in 2013 was 61.38 and ranked 66th out of 207 listed countries, while it was only 51.67 in 2007 and ranked 78th out of 122 countries. In 2015, the KOF index of the country was 61.58 and ranked 67th out of 207 listed in the index ([KOF, 2016](#)). This integration is mainly due to the economic component of KOF

index, which rose to 75.33 with the 38th position in the world ranking. In fact, the foreign trade of the Sultanate has developed, and its growth rate has increased faster than the GDP. This evolution is mainly due to exports that have progressed faster than imports *Figure 1*.

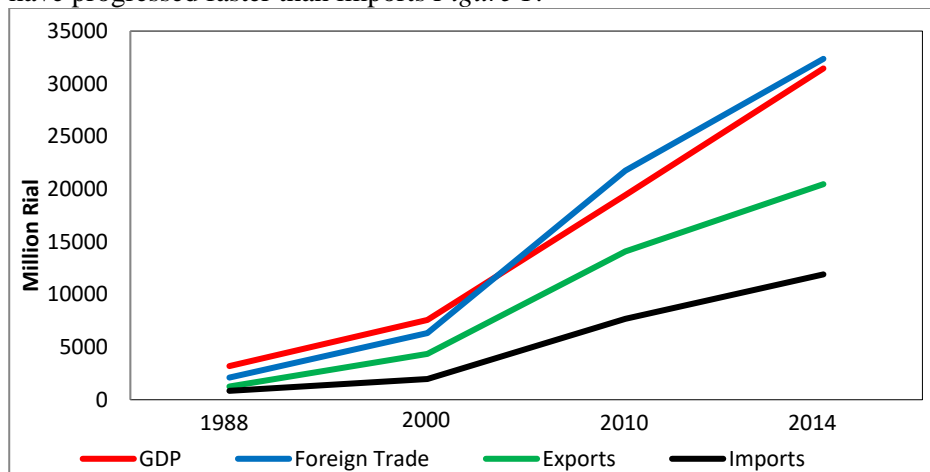


Figure 1. Evolution of foreign trade in Oman. (1 Million Rial = 2.59 US \$ Million)
(Source: (MoNE (Ministry of National Economy), 2001; NCSI (National Center for Statistics and Information), 2015a))

The improvement of Omani foreign trade is due not just to oil exports; the share of non-oil products has also significantly increased from 5% of total export value in 1988 to 17.4 % in 2010 and to 20.2% in 2015. The amount of re-exports had also substantially increased from 235.8 million to 2247.6 million in 2010, while in 2015 it had reached 2944.1 million OMR. (MoNE (Ministry of National Economy), 2001; NCSI (National Center for Statistics and Information), 2015b).

Foreign Direct Investments (FDI), as an important indicator of globalisation, grew at an accelerated pace of 19.36% per year during the period 2005 –2013, but between 2009 – 2013, the growth was only 7.24%. On the other hand, Total Foreign Investment (TFI) developed at a rate of 16.51% per year between 2005 and 2013, but between 2009 – 2013 the growth was only 4.77% as shown in *Table 1*.

Table 1. Development of Foreign Investments in the Sultanate of Oman in R.O. Million
(Source: (NCSI (National Center for Statistics and Information), 2012, 2015b))

Item	2002	2005	2007	2009	2013	Growth rate (% annually)	
						2005 – 2013	2009 - 2013
Total Foreign Investment	-	4007	9913	11295	13610.2	16.51	4.77
Foreign Direct Investment (FDI)	721	1623	3519	5057	6688.4	19.36	7.24

To fulfil the requirements of globalisation, three great maritime hubs have been developed during the last two decades, the Salalah port in the south, the Sohar industrial area in the north, and Al-Doqum industrial area in the middle of Oman. Sohar project is the largest in terms of invested capital, the number of domestic and foreign companies and mobilized space. The Sohar project includes an industrial area (21 Km²), a free zone (45 km²), an industrial port (21 km²) and an airport (under construction, 20 km²). The size of investments for approximately 184 industrial plants amounted to US\$ 10 billion.



Figure 2. GeoEye Images for Sohar Port (January 2012)
(Image Source: MoNE)

3. STUDY AREA

The Sultanate of Oman is administratively divided into 11 governorates that are subdivided into 61 Wilayats. Wilayats is the plural of Wilaya, which means province in Arabic. Sohar is both the center of the Governorate and at the same time the center of the Wilaya. It is the center of the governorate of Al-Batinah North, which includes six Wilayats. The city is also the center of its Wilaya, which is in the north-east of the country, and it directly overlooks the Sea of Oman. Sohar has 40 km of coastline. Its total area is about 2143 km² and its population is approximately 147,000, according to the 2010 census, and it reached almost 197,500 in 2014. ¹ In addition to the city of Sohar, the Province of Sohar includes several rural settlements of different sizes scattered in the area between the gas pipeline in the east and the mountains in the west. The study area extends between latitudes 23^o 47' 16"

and $24^{\circ} 28' 7''$ in the north and longitudes $56^{\circ} 15' 48'' - 56^{\circ} 50' 30''$ in the east, as shown in *Figure 3*. While *Figure 2* shows the Sohar port with the industrial area.

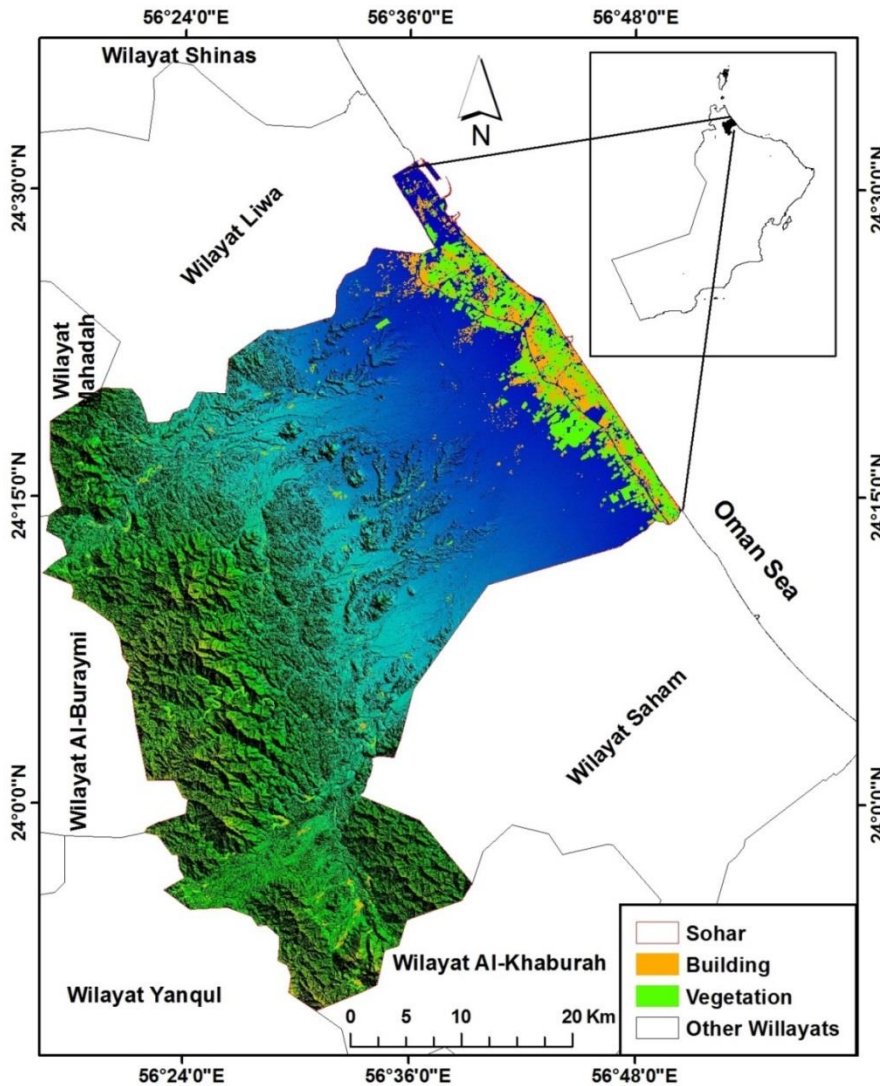


Figure 3. The location of the Wilayat and City of Sohar

4. MATERIAL AND METHODS

The study is based on fieldwork; GIS and RS technologies which were used to measure urban change in the city. To detect and map the demographic and spatial changes, the study used several data sets, including the general censuses of 1993, 2003 and 2010, in addition to statistical surveys, available satellite imageries, and vector data. To measure the extent of the spatial impact of development in the context of globalisation in Sohar, the study traced the evolution of the built up area through a comparison between urban change maps of 2000, 2010 and 2015. Data analysis revealed changes in spatial patterns and key factors of variations. For the study, the researcher attempted to distinguish between the requirements of endogenous urban development (housing, services, infrastructure, etc.) related to the overall development of the Omani society and the specific implications of new globalized urban functions within the city of Sohar.

Remote sensing techniques were used to detect and measure urban change, while GIS were used to manage and understand the urban expansion in the city in the last 15 years. Landsat (ETM) image has the capability to extract urban information in medium scale area like the Sohar area. It also has several bands to complete the analysis smoothly. Three Landsat (ETM) images (for 2003, 2010 and 2015) with 30-meter spatial resolution were used, as summarised in *Table 2*. The three Landsat images were downloaded from the US Geological Department (USGS) (<http://earthexplorer.usgs.gov/>). Landsat image for 2015 was geo-referenced using a WGS84 Zone 40N (UTM) coordinate system by using 10 ground control points with 20 cm accuracy. The image of 2015 was then utilised to geo-reference the other two Landsat images through image-to-image techniques. All images were also enhanced to improve their quality.

Table 2. The satellite images description used for tracking changes in the study area

Satellite	Date	Row	Path	Bands	Spatial Resolution	Format
Landsat-7 (ETM)	21 st March 2003	159	43	8	30 m	GeoTIFF
Landsat-7 (ETM)	25 th Feb 2010	159	43	8	30 m	GeoTIFF
Landsat-8 (OLI)	14 th May 2015	159	43	11	30 m	GeoTIFF

The three images cover large areas of Sohar; however, the study area covers are restricted to only the center of the Wilayat, defined here as the urban built-up area along the coast of the Sea of Oman from the Sohar industrial port in the north near Majis to Majiuz Al-Sojrah in the south. It also extends from the coastal line in the east to 10 km to the west. All images were subset to the same map extent as shown in *Figures 4 & 5*.

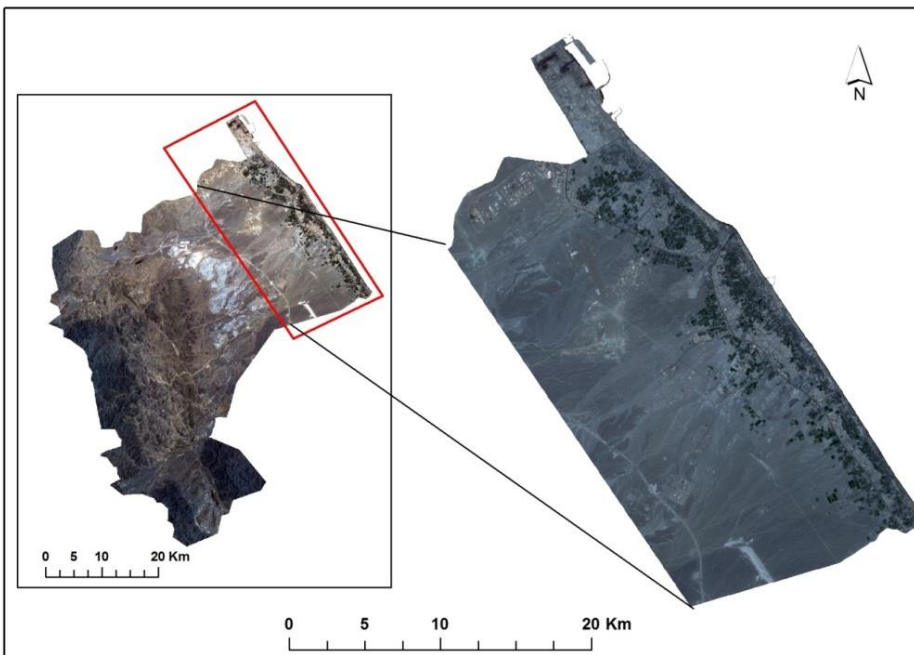


Figure 4. Image subset for Landsat 2010

(source: US Geological Department (USGS) (<http://earthexplorer.usgs.gov/>))

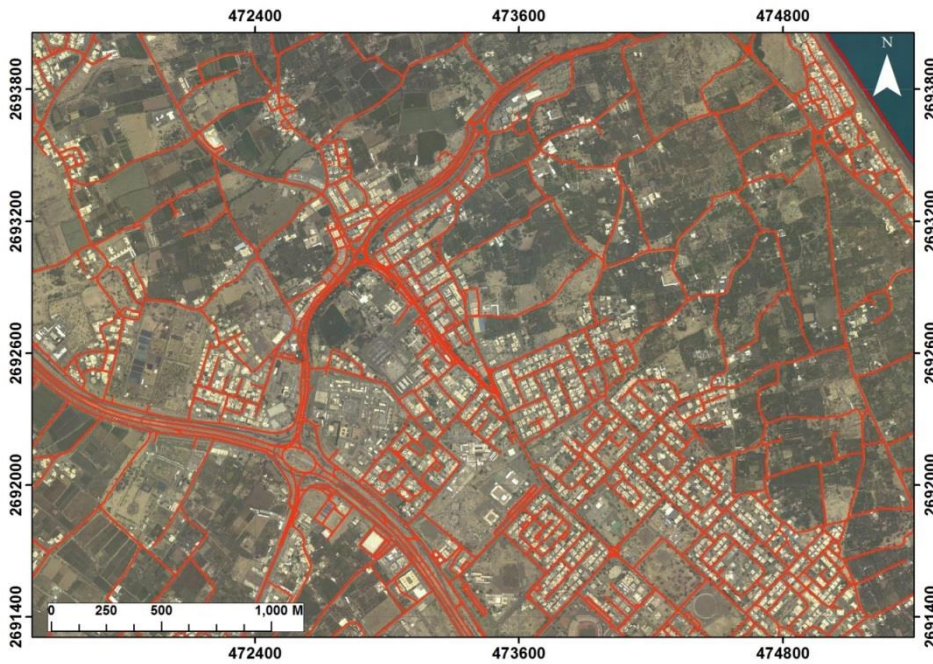


Figure 5. The City of Sohar from GeoEye December 2010 (Source: NCSI)

Supervised classification techniques with a maximum likelihood algorithm were used for all three ETM images. The accuracy of the classification was verified by field checking and by comparing them with high-resolution images (Geo-Eye images for 2012). In order to measure the urban expansion of the city, several classification systems have been reviewed, such as USGS and Anderson classification ([Anderson et al., 1976](#)), Corine Classification ([Bossard, Feranec, & Otahel, 2000](#)) and Land Based Classification Standards (LBCS) ([Sanjay, 2002](#)). However, to simplify the results only three land use classes were used, which includes built up area, vegetation, and unused (open land) area. To keep results consistent for the built-up area between the three images, twenty training samples were used to achieve maximum accuracy with the supervised technique. The same training samples in the same locations were spread into the two images. This method ensured that all classes had the same value for all images. ERDAS 8.7 and ArcGIS 10.3 software were used to process the digital data, while the final outputs were manipulated and managed in ArcGIS software.

5. RESULTS AND DISCUSSIONS

It is clear that Sohar has been transformed from a medium-size urban center for a large regional metropolitan city, according to Omani city sizes; thanks to globalization. The study shows that Sohar has witnessed some indications of globalisation in many aspects. The number of foreign companies and the amount of Foreign Direct Investments (FDI) have increased dramatically within a relatively short time. The manpower employed in the Sohar Industrial Estate, for example, rose to more than 6,200 including 2,750 Omanis and 3,450 expatriates (44.5 %) in 2012. *Figure 1* summarises the evolution of foreign trade in Oman between 2002 and 2013. *Table 1* presents a huge increase in both the Total Foreign Investment (TFI) and Foreign Direct Investment (FDI). The annual growth

rate of TFI is much higher than FDI in both 2005 – 2013 or 2009 – 2013. The annual growth of TFI between 2005 – 2013 was 16.51%, but was only 4.77% between 2009 – 2013. On the other hand, the annual growth rate of FDI was 19.36% and 7.24% for the same periods, respectively. The decrease in growth rates in the subsequent period does not indicate a decline in the investment volume. Instead, it points to the establishment phase with a small amount of investment when compared with the later rate of investment.

In the last 10 years, Oman has received more and more foreign investments. These investments concentrate mainly on oil, gas and related industries. Sohar industrial area, Sohar Port and Sohar free zone are examples of foreign investments directed by the government. These investments played major roles in increasing the population of Sohar which has risen dramatically in the last 10 years as shown in *Table 3*, while *Figure 5* reveals land use change that resulted from the demographic transition.

Table 3. The total population of Sohar and Oman (1993 - 2014)
(Source: (NCSI (National Center for Statistics and Information), 2013b, 2015b))

Year	Sohar Level			Oman Level		
	Omani	Expatriate	Total	Omani	Expatriate	Total
1993	71250	19559	90809	1483226	534427	2017653
2003	83891	20432	104323	1781558	559257	2340815
2010	92590	47416	140006	1957336	816143	2773479
2014	106941	90576	197517	2260705	1732188	3992893

Table 4. The total urban population of Sohar (1993 - 2014)
(Source: (NCSI (National Center for Statistics and Information), 2013a, 2015b))

Year	Number of population
1993	88918
2003	102150
2010	137090
2014	193403

Table 3 and Figure 6 summarises the trends of the population increase in the city between 1993 and 2014. Almost 98% of Sohar population are concentrated in urban areas as shown in *Table 4*. The population increased from 140,006 inhabitants in 2010 to 197,517 inhabitants in 2014, with an annual increase rate of 3.8% of the population, with the national rate of population increase being 3.3%. This shows that Sohar appears to record a faster demographic dynamism at the national scale. Also, between 1993 and 2010, the population of Sohar city increased by an annual growth rate of 2.63% compared with 1.9% at the national level. This is mainly due to the spectacular annual growth rate of expatriates (5.35% annually), who used to represent less than 20% of the total population in 2003, but the percentage increased to almost 34% in 2010, and again increased to more than 45% in 2015. The biggest population increase in Sohar occurred between 2003 and 2010 when the annual growth rate was 4.3%, while it was only 2.5% at the national level. This increase is explained by more expatriates moving to Sohar at an annual rate of 12.8%, while at the national level, the annual rate of expatriates was just 5.5%.

For comparison, there are recognised correlation between the total population growths in the city of Sohar between 2003 – 2014, and the total growth of FDI in Oman between 2005 – 2013. The growth was obvious between the total growth of expatriate (between 2003 – 2014, which was 343.3%) and the growth of FDI (between 2005 – 2013, which was 312%).

This means that more foreign investment has caused greater population growth, especially of expatriates in Sohar city.

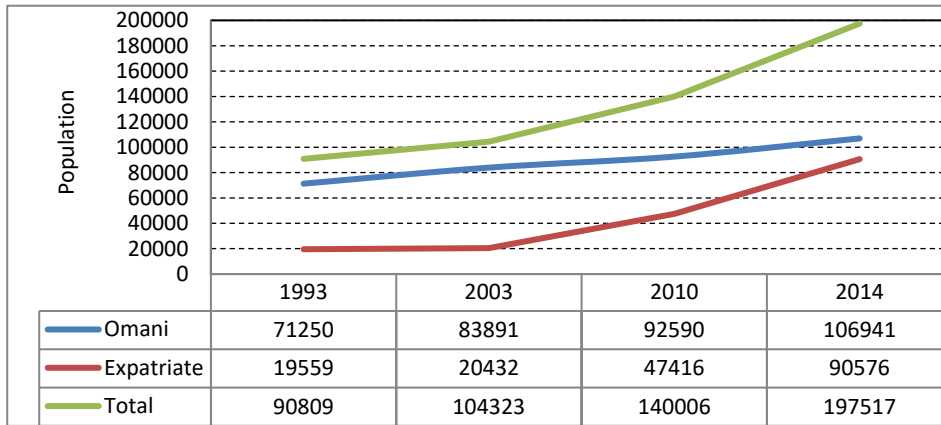


Figure 6. The trend of population growth in the city of Sohar between 1993 – 2014 (Source: former (MoNE (Ministry of National Economy), 2001; NCSI (National Center for Statistics and Information), 2015b)

Table 5 illustrates the total area for each of the three investigated classes: built-up areas, vegetation areas, and open land in the city, which are presented in both meter² and km². The total built-up area increased from around 60 km² in 2003 to more than 90 km². Simultaneously, however, the vegetation decreased from around 90 km² in 2003 to just over 60 km².

Table 6 presents the difference in each class across different periods. The rate of change of the study period 2003 - 2015 is divided into three stages: 2003 – 2010, 2010 – 2015 and 2003 - 2015. Findings are almost consistent with several studies, which use either low resolution image like Landsat or high resolution images like Ikonos (Al-Awadhi, 2007, 2008; Alphan, Doygun, & Unlukaplan, 2009).

Table 5. The total area of each class at three different periods in meter² & km²

Classes	2003		2010		2015	
	M ²	Km ²	M ²	Km ²	M ²	Km ²
Built up area	60249600	60.25	72060300	72.06	91461600	91.46
Vegetation	90483300	90.48	69840900	69.84	61850700	61.85
Open land	236979000	236.98	245810700	245.81	234399600	234.40
Total	387711900	387.71	387711900	387.71	387711900	387.71

Table 6. The difference and rate of change in each class at three different periods

Classes	2003 – 2010		2010 – 2015		2003 – 2015	
	Differences in Km ²	Rate%	Differences in Km ²	Rate%	Differences in Km ²	Rate%
Built up area	11.81	9.6	19.4	26.9	31.21	51.8
Vegetation	-20.64	-22.8	-7.99	-11.4	-28.63	-31.6
Open land	8.83	3.7	-11.41	-4.6	-2.58	-1.1

The annual rate of the increase in population occurred in the planned space where there is more demand for housing and services. Modern activities have also expanded at the expense of traditional activities. During the densification and the expansion of the urbanised area, large agricultural parcels were converted into urban spaces, and about 10 km² of coastline formerly devoted to traditional fisheries was assigned to port activities. The total built-up areas (residential areas, commercial areas, roads, and industrial facilities) increased to 11.81 Km² between 2003 – 2010, which represents an increase of about 10%. The main increase in the built-up area, however, occurred between 2010 – 2015, when it increased to 19.4 km², an increase of

almost 27%. On the other hand, the vegetation areas lost more than 20 km², a reduction of 23% during the period of 2003 – 2010. The vegetation area again lost 7.99 km² between 2010 and 2015, this time, a loss of 11.4%. This shrinkage of vegetation could be a result of weakness in land regulation to protect agricultural land as well as salinization of soil and water. It is obvious that the built up area encroached upon vegetation along the coastal area. This happened due to the natural structure of the city. Also, between 2010 and 2015, the city built-up area also started spreading into vacant spaces and new areas were developed, especially in the north-west of the city.

Urban expansion began, in the first stage, with the intensification of the pre-existing space by integrating previously separate traditional villages (22 villages in 1986) into a continuous and compact urbanized area. In this process, a portion of the arable land had disappeared, while on the second stage, numerous residential, commercial and public plots appeared in the suburbs of the city.

Figure 7 shows that the urban area has expanded tremendously in two areas: (i) the north of the city where the industrial area was built in 2001, and (ii) in the city center of Sohar. These two patterns of growth were completely different. In the center of the city, the growth was based on converting the vegetation into built-up areas, while in the north of the city, the growth was based mainly on utilising vacant space or open land.

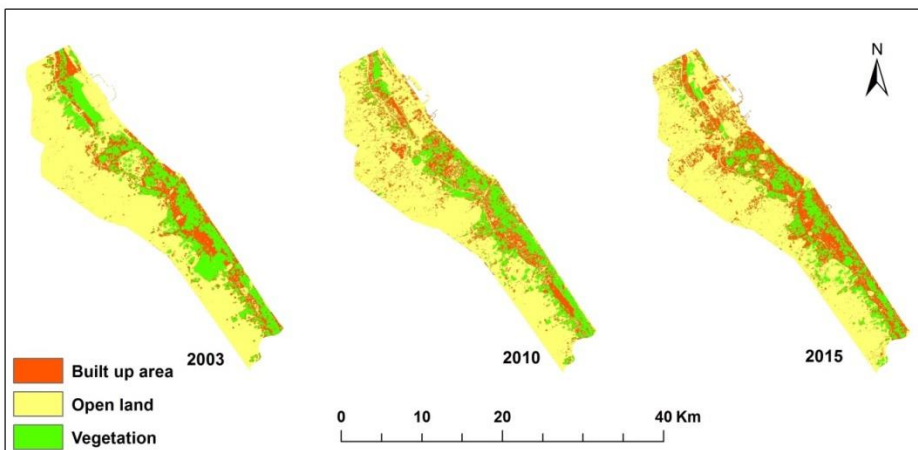


Figure 7. the urban expansion for different period times in Sohar (1988 - 2015)

6. CONCLUSION

It is obvious that international investment has played a major role in improving the economic and social lifestyle of people in many countries, especially in the developing countries such as the Far East in the Asian continent. It has also affected the demographic conditions in these countries which appeared in different types of migration either internationally or locally. This paper has attempted to investigate how the foreign direct investment has affected demographic and land use pattern in the city of Sohar. The study results revealed some harmony in growth rate trends of investment, total urban growth rates and changes in land use in the study area. The increase of population and built-up area has been very obvious in the last 10 years, especially in two areas in Sohar that are namely the north part of the city as well as in the city center.

The spatial transformations induced by a globalised action of development in Sohar have had several implications on people's lifestyle and on the traditional land use patterns, thereby significantly affecting the metropolitan space organization. The trend of population concentration on the coastal zone is one of the larger implications of the globalisation in less developed countries. It often induces a spatial reconfiguration incompatible with the notion of sustainability. It is true that social and economic policies, in a context of globalisation, have improved the standard of life and the employment opportunities in the region; however, both the natural beauty of Sohar and its architectural heritage face serious challenges because of the hasty and unplanned urban development. However, although these changes have increased the pressure on the environment, they have also created a modern, well-equipped and very dynamic metropolis.

The results of this research, including image classification, have shown that the built up areas are mainly located in the city center and north-east of Sohar. Certainly, any more investments in the port and industrial areas in the future will create more pressure on agricultural areas, which is expected to be converted to other uses, especially residential or industrial. The urban sprawl will affect long-term reliance on these spaces as an important producer of local and regional crops. Therefore, this study offers the following recommendations:

- That urban expansion should be targeted through a systematic and well thought plan. The urban pattern should fill the gaps between scattered communities and then continue in the direction of systematic planning in open areas.
- Good urban planning should be extended towards the west, keeping a distance from the city center in order to reduce pressure on the urban heart of the city, while at the same time preventing the expansion of urban sprawl into agricultural areas.
- Regulating of license granted for the conversion of an agricultural property to residential, or commercial or industrial use.
- Further studies should address the issue of scattered urban settlements along the coastline, where most properties lack basic services. Furthermore, studies should consider a detail land use change in the city. More investigation should address the current and future condition of the agricultural area in Sohar.

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Qualitative Study on Urban Morphology and Social Problems in Multi-Story Housing Projects

Ajman City as a Case Study

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Key words: Vandalism, Urban Forms, Social Housing, Arabian Gulf Region

Abstract: Urban development in the Arabian Gulf region has been remarkable within a relatively brief period. The urban expansion of Arabian Gulf cities includes many multi-story housing projects of urban form is influenced by those built in Europe during the post-World War II period of reconstruction. According to the literature, these types of urban forms in Europe are associated with a number of social problems concerning the health of some residents, antisocial behavior by youth and some types of crime. The aim of this research is to investigate the presence of social problems in the Gulf housing projects that embrace urban forms similar to those built in Europe. The study shows that some social problems such as vandalism are present in some projects. Thus, further research is recommended to determine the extent of existing problems and provide guidelines for new development.

1. INTRODUCTION

World War II caused significant destruction throughout Europe and forced the authorities in those countries to provide housing for Europe's many displaced families. The housing units were required within a very short timeframe and at the lowest cost. The German air strikes destroyed approximately 500,000 housing units in Britain alone, in addition to the hundreds of thousands of housing units that fell into disrepair during the economic recession before the war and during the war period. Most of those housing units were home to middle-income groups who were not able to find alternative housing.

Responsible parties came up with modern movement architecture for housing, specifically ideas for high-rise housing designed in new urban styles that did not follow traditional urban architectural styles. This was a quick and economic solution to the housing crisis (*Figure 1*). In addition, the high-rise designs limited the horizontal expansion of cities, which would typically encroach on precious agricultural land. Multi-story housing was ideal at that time as it decreased the plot sizes and maximized the housing units, generating maximum economic benefit because the plot size is directly related to the cost of each unit. This enabled the provision of shelter for

those families that had lost their homes during the war. This phase witnessed the construction of thousands of multi-story housing units in Europe.

High hopes were set for multi-story housing during that period, and the social problems now associated with low- to middle-income groups living in such units did not arise until the late 1960s. Britain had thousands of multi-story housing units ranging between six and thirty stories as well as thousands of other low-rise buildings, which were funded by central or local governments ([Bullock, 2002](#)).



Figure 1. Le Corbusier proposal for building residential towers in Paris city center (1920)

It is clear that most of the new projects in the Gulf region are based on the urban architectural movement of residential high-rise buildings, which are in most cases surrounded by car parking and undesignated green areas. The buildings are disconnected from each other and have similarities to the urban (non-traditional) forms of the mega projects in Britain and other European countries after World War II. To demonstrate the main types of urban (non-traditional) forms and their characteristics, urban traditional forms and their characteristics must be identified to understand the difference between the two.

2. TYPES AND CHARACTERISTICS OF URBAN TRADITIONAL FORMS OF MULTI-STORY RESIDENTIAL BUILDINGS IN BRITAIN

Traditional urban forms have proved their success and flexibility to adapt to meet the changing requirements of urban life. The urban forms discussed here are not those that date back to historic ages but those that spread dramatically throughout European cities and the world. Those urban forms consist of streets surrounding blocks, where each block is divided into plots on which one or more buildings are erected along the side of the road. The plots are usually fenced or have clear distinctive boundary markings. In Britain, for instance, the traditional urban forms built during the British Empire's reign in the 19th century are still in use and have been adapted to suit the needs of the particular period. Furthermore, in response to social problems that are related to non-traditional urban forms (as will be shown later), there are many British and American narratives that are in favor of a return to and the development of traditional urban forms because they have been proven successful and have positive social characteristics ([Bentley,](#)

1985; Calthorpe, 1993). This research classifies the traditional urban multi-story housing forms in Britain and surroundings into three main types (Figure 2).

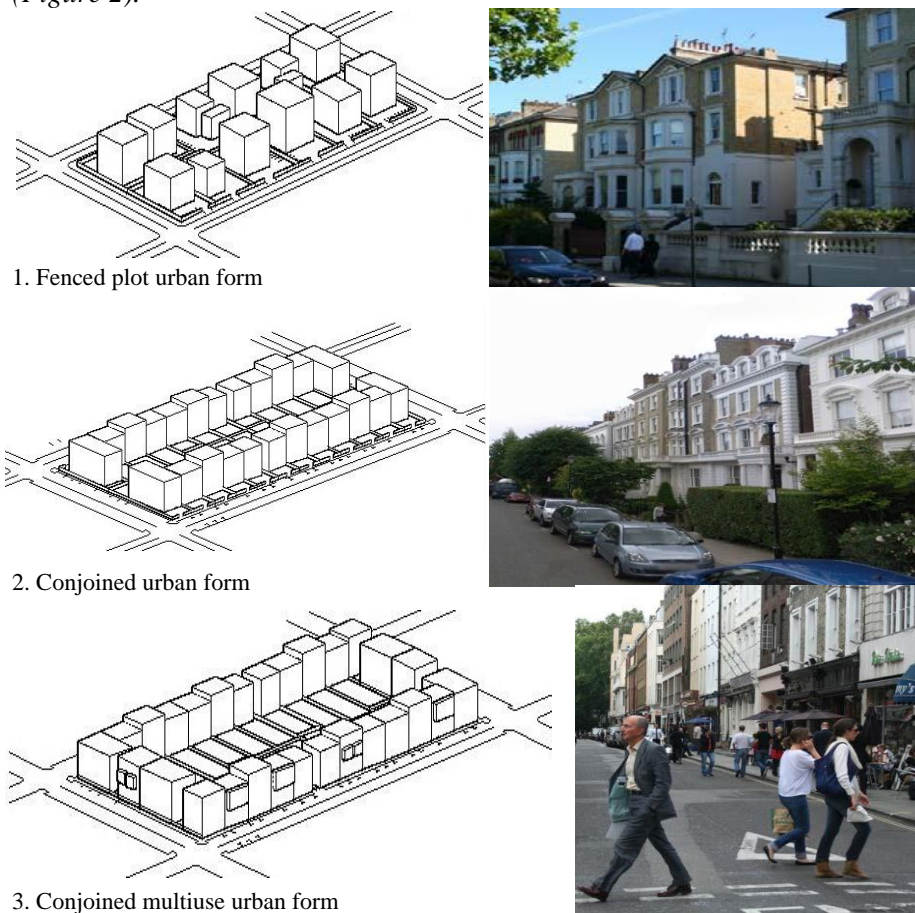


Figure 2. Models and examples of urban traditional forms of multi-story residential buildings in Britain

2.1 Fenced Plots Urban Form

Streets surround the blocks in the district and each block is divided into plots that are positioned along the length of the street. Each plot has a new building or an existing building that has been expanded or renovated as a multi-story residential building. Each building is surrounded by a green area or a paved sidewalk, and each plot is usually fenced or has clear defined boundaries.

2.2 Conjoined or Semi-Conjoined Urban Form

This form is similar to the fenced plots urban form but there are some differences in the houses and multi-story buildings: they are connected from one or two sides along the street and usually have a front and back yard. Those yards are usually clearly marked with fences or distinctive features. Buildings are typically close to the streets or have no front yard so that the building entrance is positioned directly on the street. The semi-conjoined buildings are two or three buildings connected together and separated from the next block of two or three buildings.

2.3 Conjoined Multi-Use Urban Form

Similar to the above mentioned urban form but here the multi-story buildings are positioned along the street edges or the sidewalk, and each building will only have a backyard. The ground floor for each building will often be used as a commercial area, and the rest of the upper floors are residential.

Traditional city plots are mostly a mix of the urban forms mentioned above. Figure 2 shows examples of those traditional urban forms. From the above discussion, three commonly shared characteristics of the three traditional urban forms are identified:

1. Clear boundaries of private and public spaces and clear block boundaries where the streets surround the plots and buildings are positioned along the street length.
2. Human scale reference for building heights.
3. Variable and multi uses of buildings.

3. TYPES AND CHARACTERISTICS OF URBAN NON-TRADITIONAL FORMS OF MULTI-STORY RESIDENTIAL BUILDINGS AFTER WORLD WAR II IN BRITAIN

This research categorizes the main types of post-World War II urban non-traditional forms of British mega projects of multi-story residential buildings into two main categories. Figure 3 shows images of these two categories, which are as follows:

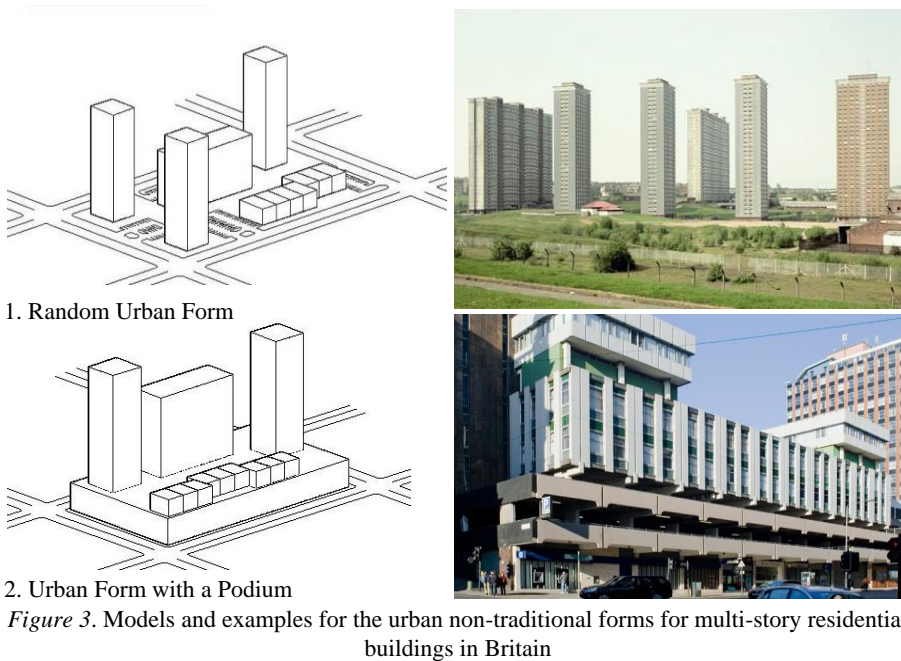
3.1 Random Urban Form

Residential areas are home to apartment buildings in the form of towers or mid-rise buildings (occasionally mixed with housing communities that are randomly spaced) and are surrounded by semi-public green or paved areas. Those areas include car parking and amenities such as garbage and electrical rooms. The apartment buildings might be placed along a road network, which appear at first glance to be similar to traditional urban forms but are in fact characterized by randomness.

3.2 Urban Form with a Podium

This urban form consists of a building that covers the whole project area in the form of a podium of one or more floors. The residential buildings are erected above the podium and can include towers or mid-rise buildings, and occasionally houses. The roof of the podium is used as an open space or a green area for residents in addition to amenities for the services provided on the roof. The podium can house car parking or housing units, and in some cases entertainment or commercial uses can be implemented either in the podium or on the roof in line with the buildings.

Some urban forms with a podium include several podiums under the residential buildings and connected to each other with bridges at different levels. This urban form is also characterized by several entrances and exits to the residential compounds.



Some projects consist of a mix of both of the forms mentioned above: conjoined housing compounds and distributed randomly between multi-story residential buildings. Figure 3 shows examples of the two types in British cities. Based on the outline above, three common characteristics distinguishing those two urban forms are as follows:

1. A Street and block network and undefined public spaces, where (in many cases) the buildings are surrounded by car parking and have undefined open public and private spaces around the buildings.
2. Increased building height and size and a lack of human scale found in traditional urban forms, with increased numbers of entrances and exits especially in large residential buildings connected with bridges or podiums.
3. Single use, where most of the buildings are specifically designed for residential purposes with a few limited services such as food stores, in contrast with traditional urban forms that are distinguished by the variety and proximity of residential, cultural, commercial and other uses.

4. SOCIAL PROBLEMS RELATED TO PROJECTS AFTER WORLD WAR II IN BRITAIN AND ITS RELATION TO URBAN FORM

This section specifically studies the narratives regarding the British experiment, and the social issues related to high-rise apartment housing. In Britain, once the buildings were inhabited, a large number of research and reports were published regarding the social and family problems in some social groups of the low- to middle-income inhabitants, including various health issues of children, mothers and older adults, as well as antisocial and violent behavior of teenagers. The multi-story buildings were also associated with a breakdown of social relations and an increase in crime among those social groups.

In the late 1970s and throughout the 1980s and 1990s, such residential projects in Europe and other Western countries posed a problem rather than

a solution to the housing problem. In the 1980s and 1990s in Britain, those mid- and high-rise residential buildings built in between 1950 and the 1970s were demolished or rehabilitated. Rehabilitation is the process of changing the use of a building from its originally designed purpose. Each building is carefully studied to be transformed according to location and surrounding social issues.

Many high-rise buildings aged between 20 and 30 years have been demolished (*Figure 4*) and replaced with residential buildings derived from traditional urban forms.



Figure 4. Example of British buildings demolished after 3–4 Decades (Right) and example of buildings that replaced them of traditional urban form design (Left)

Furthermore, residential towers in unique locations have been transformed to other uses such as office buildings or residential buildings for single people and students. Other buildings have been transformed to suit high-income earners willing to inhabit multi-story buildings near the city center or as a second home for those who also live outside the city. [Duncan \(1988\)](#) highlighted a number of rehabilitation projects for high-rise residential buildings to improve the public spaces around the buildings for the use of residents. Similarly, the higher floors of the buildings were demolished resulting in mid-rise residential buildings or houses. Previous studies show that three factors aggravated social problems related to residential projects after World War II in Britain:

1. Urban form.
2. Residents' social characteristics
3. Residential building management systems (*Figure 5*).

Although this research is concerned with the effect of the urban form on social life, other relevant factors also exist. Below is a revision of the key social problems related to residential projects constructed in Britain after World War II.

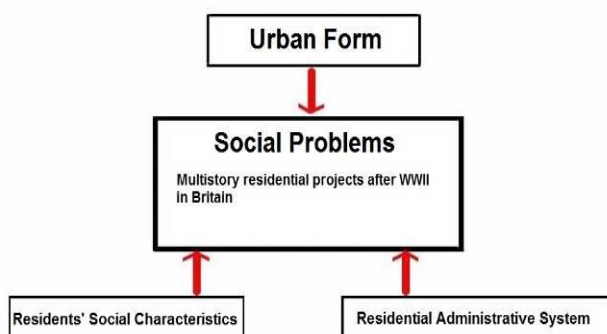


Figure 5. Factors influencing social problems in projects constructed after World War II in Europe and their relation to urban form

4.1 Antisocial Behavior of Children and Teenagers and Related Crime

One of the most serious social problems related to high-rise residential buildings is antisocial behavior from teens and children (*Figure 6*) and crime. Since the expansion such buildings in Western countries after World War II, many official reports, journals and newspaper articles have been published regarding such issues and many theories for the causes have been proposed. Despite the many theories, they all point (either directly or indirectly) to the relation between social problems and the non-traditional urban form of residential building compounds. Such problems recur in open spaces that have no clear ownership and are away from the eyes of tenants such as open spaces surrounding the buildings, the rooftops of podiums, and car parking ([Attenburrow, Murphy, & Simon, 1978](#); [Burbidge, 1981](#); [Anderson, 2000](#); [Faizi, Hosseini, & Asl, 2008](#); [Hillier & Shu, 2000](#)). [Coleman \(1985\)](#) produced a seminal work on the causes of such problems, *Utopia on Trial*, where she identified the relation between social problems and the size and height of residential high-rise buildings. Thus, these urban forms might create an anonymous environment when compared to traditional urban forms.

The theory claims that traditional urban forms consisting of streets surrounding the buildings and houses give the tenants a sense of belonging because of the clear boundaries of the plot and the surroundings they live in. In contrast, non-traditional high-rise buildings reduce the residents' sense of identity. For example, a tenant on a higher floor cannot relate to the surroundings of the building. In addition, this leads to children and teenagers engaging in antisocial behavior, expressing their dissatisfaction of their residential surroundings. Coleman was influenced by the writing of [Newman \(1973\)](#) in his American narrative of this theory, especially in his research presented in his book *Defensible Space*, where he discusses particular crimes in New York City residential components.

Coleman supported Newman's conclusions and included detailed statistics showing the increase in different social problems suffered by residents living in non-traditional urban form projects, particularly those characterized with height, large open areas around the buildings, podiums, connecting bridges, several entrances, and isolated car parking. These characteristics are considered as supporting factors for antisocial behavior and crime as they reduce the tenants' views of their surroundings and aid concealing strangers' access and movement.



Figure 6. Images of antisocial behavior by teenagers on random urban form buildings in Oxford (left) and Rome (right)

Although those two studies present statistics confirming the increase in antisocial behavior and crime in the surroundings of high-rise apartment buildings and those designed using non-traditional urban forms, the theories do not explain the reason for the occurrence of similar antisocial behavior in traditional urban forms. Thus, there must exist a more holistic reason for the existence for such problems in both traditional and non-traditional urban forms but with different percentages. This concludes that there is the need for more in-depth and extensive research on that subject, to specifically identify those factors and present a more holistic theory.

4.2 Increase of Diseases among the Population

Studies on the relation between residential apartments and the increase in the incidence of disease among residents have identified the main reason for this problem: social isolation resulting from the nature of the project design and its effects on certain social groups such as housewives, children, older adults and especially low- to middle-income earners.

Research into this problem started after the spread of high-rise residential buildings in the 1960s ([Bone, 1977](#); [Mahdjoubi, 2007](#); [Williams, 1991](#)). A seminal study was that by a British professor [Fanning \(1967\)](#) who discovered an increase in respiratory system diseases, particularly in children living in residential apartments when compared with those living in houses. It has also been shown that tenants on higher levels suffer more psychological illness than tenants on lower floors ([Fanning, 1967](#)). To explain the rationale behind these findings, Fanning and other researchers have presented a theory that isolation resulting from height is the reason for such diseases. The theory suggests that high-level residence does not encourage housewives and older adults to communicate; instead, they use internal passages to enter and exit the building with no use of open public spaces, which are mostly filled with car parking.

[Fanning \(1967\)](#) results have been confirmed in other studies, with one of the most remarkable being that by [Bone \(1977\)](#), where it was found out that children living in houses spend much more time playing outside than those living in residential apartments. Further research has demonstrated other problems related to family life such as the decrease of social relations for mothers and resident children and their friends. The above studies are exclusive to low- and middle-income groups living in residential compounds. Other research shows that those problems are not applicable to high-income groups living in high-rise residential apartments when compared with houses. The reports indicate a positive effect of raised income level as their apartments are usually more spacious, in addition to the possibility of hiring home help and the use of other high-end facilities such as social clubs, and they can afford holidays. These benefits eliminate the loneliness felt by low- to middle-income groups (children, mothers and older adults).

Research by [Mahdjoubi \(2007\)](#) relates health problems to high-rise inhabitants, stating that apartment housing is related to diseases whose incidence has recently increased in Britain (e.g., diabetes in children). This is directly related to the apartment lifestyle where children spend less or no time outside the apartment and parents refrain from letting their children

play in the areas surrounding the buildings because of the bad design of the open areas and unavailability of play areas.

4.3 Vicious Circle (VC)

The occurrence of any of social problems mentioned above is usually an indication of a more complicated problem, commonly referred to by scholars in urban studies as The Vicious Circle. In Britain, since the 1970s, a number of scholars have studied discussions of this problem in different media including daily newspapers and occupational magazines ([Bullock, 2002](#); [Godfery, 1977](#); [Medway, 1973](#)), confirming that this problem multiplies the social problems resulting in the extreme deterioration of the residential compound or the apartment building.

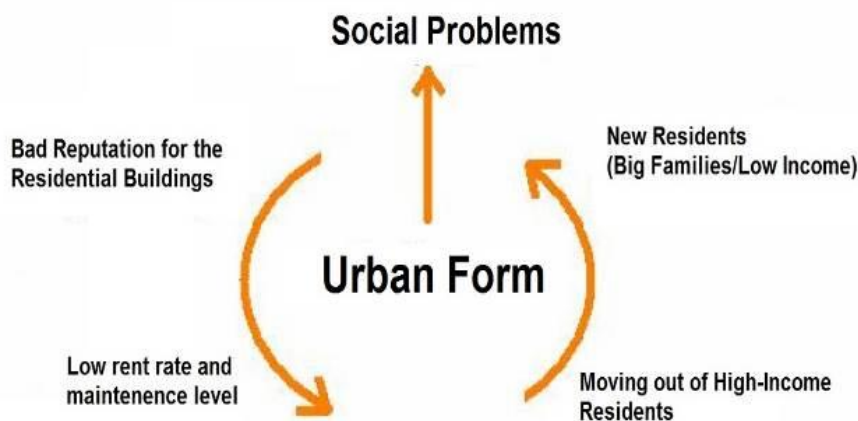


Figure 7. Evolution of the Vicious Circle problem

Figure 7 shows the evolution of the vicious circle problem. When problems start to arise in an apartment building or a residential compound, for any of the reasons mentioned beforehand, then this building or compound will gain bad reputation. In the British context, this building or compound will feature in local newspapers and media in relation to negative behavior or crime. This will worsen the reputation, which might also be accompanied with a deterioration of the image of the building due to vandalism or destruction to the façade.

As a result, people who have the chance to change their residence do so; these people are usually wealthier tenants. Other residents, who accept the condition as it is, are those who do not care about the reputation or the deterioration because of their need for a home. Therefore, the compound becomes a home for new immigrants, multi-family residents, large groups of single men or large families with limited income. This increases the problems and adds fuel to the fire. As a result, the rents are lowered, which forces the landlord to ignore building maintenance. This vicious circle continues until the building or compound becomes home for society's least fortunate and is turned into a hub of crime and poverty.

It is normal for such social groups to exist as part of society, but their concentration in a building or compound that suffers from improper design and social issues makes the problem grow. Thus, those parts of the city are transformed into isolated communities or "ghettos," affecting the areas and communities surrounding it.

The vicious circle problem emerged many years after the buildings were first tenanted, with the constant change of tenants. This problem was encountered in the apartment buildings and residential compounds built in Europe after World War II. In Britain, many such compounds were demolished in the 1980s and 1990s. There are also such communities in Paris, inhabited by those at the bottom of the French social pyramid (e.g., new immigrants and the unemployed) and they pose a social security problem.

Researchers and authors have suggested many solutions to the vicious circle problem. [Wilson \(1977\)](#) studied the problem and identified the relation between improper design practices and the careless management of buildings and compounds, showing that poor maintenance and low rent acted to increase the issues and problems. Wilson suggests that the solution is proper management and consulting residents about managerial and rent issues. In addition, [Ward \(1983\)](#), among others, believes the optimum solution for the social problems leading to the vicious circle problem is to train residents to manage their own communities and buildings through social cooperative unions. The assumption presented is that residents will feel a sense of responsibility and this will force them to care for their neighborhood and surroundings, reducing destruction and strengthening social relations. The above studies indicate that most social problems in relation to high-rise housing are directly related to the design; this could change if the designer understood how his decisions and plans might affect the life of the residents. This confirms the importance of the design as a cause and solution to social problems. Although other factors can affect the situation, the design remains the main reason in these issues and problems.

5. AN EXPLORATIVE STUDY ON THE SOCIAL PROBLEMS OF SIMILAR URBAN FORMS OF ARABIAN GULF AND BRITISH PROJECTS

Cultural differences can have a significant impact on social problems. There is currently no research on the effect of high-rise housing and non-traditional urban forms in Gulf countries or the Middle East on issues related to the health of children, mothers and older adults or the antisocial behavior and crime of children and teenagers. However, there are some measures that can be easily recorded, providing evidence of various issues such as graffiti and the vandalism of public spaces by children and teenagers. Those problems seem to be recurrent in residential areas or residential projects constructed in Europe after World War II. This explorative study is a preliminary study that will concentrate on those two problems. The aim of this study is to form a basis for future studies on that subject.

There is little difficulty in concluding that most new projects in the Gulf area are designed according to the modern movement in architecture in the form of high-rise apartment buildings, in most cases surrounded by car parking areas, open green spaces and unspecified open green areas. These are similar to the non-traditional urban forms of projects in European cities, specifically random urban forms and urban forms with podiums.

The present study required on-site visits to many residential projects to document the previously discussed issues, photographing some of the features and interviewing the management of residential buildings.

5.1 Observation on Vandalism in Public Areas

This problem was found to be common around a number of high-rise residential buildings and seems to be related to the urban form. In some random urban form projects a phenomenon was observed that residents seem not to notice many vandalized walls in public spaces and around uninhabited apartments on the ground floor (*Figure 8*). After interviewing some of the upper management, it is apparent that the increase in the percentage of children and teenage residents has resulted in the increase of this problem ([Hamid, Arar, & Mushtaha, 2011](#)). Although projects designed in a podium urban form are new to the Gulf area, this study has observed examples of vandalism. In some projects with podiums, vandalism to the walls above the podium and in car parking areas were recorded, despite the relatively newness of the buildings (*Figure 9*).

5.2 Observations of the Extent of the (VC)

The research shows that some older high-rise residential apartments are caught in the vicious circle problem. Higher management confirmed that those areas have enjoyed a lower rent for some time and thus have undergone little maintenance (*Figure 10*). The research also shows that there are other reasons related to the urban form that might have negative effects, such as a scarcity of car parking, public spaces and children's playgrounds. This results in the empty spaces around the buildings being used as car parking areas. Often public spaces around the buildings are centralized with electrical generators and garbage collection rooms, which make them unsuitable for social communication and dangerous as playgrounds. The above reasons might force good tenants to leave the area looking for suburbs with higher standards of living. They are then replaced with new immigrants and poorer, large families causing the area to become a hub for social problems.

5.3 Further Observation of Vandalism

One housing area, Al Nuamiya district, in Ajman city was selected to investigate many factors related to problems of vandalism. The residential area was built and completed in 2006. The area consists of 15 residential blocks of flats in 17 floors. The housing district covers an area of 27,810 square meters, with 15,060 square meters of open public spaces (*Figure 8*).

The effect of the perceptions of visibility was assessed in terms of their impact on graffiti. After collecting the data from different locations in the site, 17 vandalized locations were observed. The graffiti size was measured directly from the site using a digital camera. Then, the measurements of the area covered by graffiti were grouped within six classes of visibility (*Figure.11*). As a result, the graffiti area decreased with an increase in the perception of visibility as in ([Mushtaha & Hamid, 2017](#)). Therefore, this study shows the importance of having high degree of the perception of visibility through windows, which in turn reduces vandalism seen from dwellings.



Figure 8. Random urban form project in the Arabian Gulf showing antisocial behavior from teenagers



Figure 9. New Gulf project with podium showing vandalism by teenagers in areas obscured from view and car parking



Figure 10. Relatively old high-rise residential apartment buildings where antisocial activity has led to the vicious circle problem

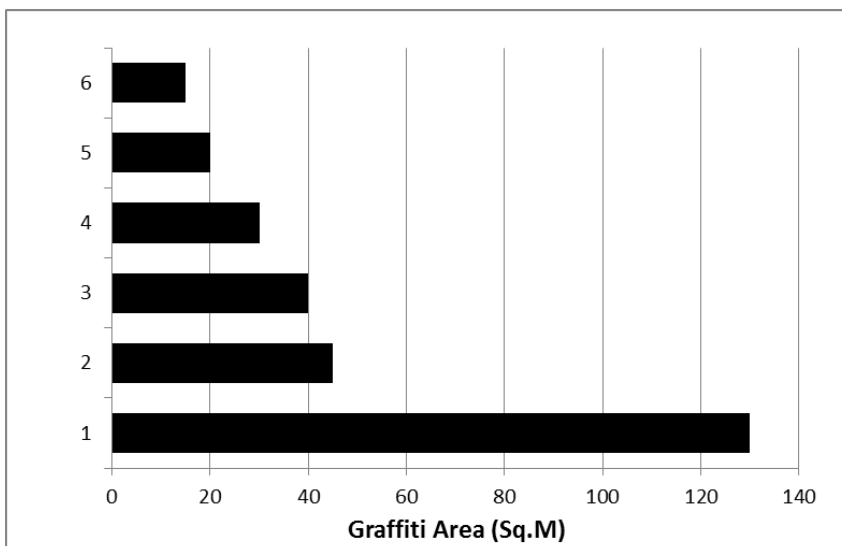


Figure 11. Perception of visibility and graffiti

6. CONCLUSIONS

The present research identifies a number of social problems in high-rise building in the Gulf regions, specifically vandalism to walls and public spaces by teenagers and children. The vicious circle problem is recurrent in Gulf residential projects, similar to that in European projects. Other problems, including the increase of diseases among children, mothers and older adults, and increased crime rates were not touched on in this preliminary study and require more resources to undergo an in-depth analysis. This study represents the first part of extensive research exploring the problem of vandalism and graffiti in the public spaces of high-rise residential areas in the Gulf region. The following study should investigate relevant methods and measurements to reduce vandalism in public spaces. However, based on the present study, it is necessary to perform further investigations into all aspects of these social problems to determine the causes and how pervasive are they in Gulf projects. These findings would be the basis for designing and planning residential projects. Lessons learned, which can be deduced from this research, show that high-rise buildings might be unsuitable for a high percentage of low- to middle-income families. Therefore, this housing option should only be available for high-income groups. High-rise residential buildings might be an option in city centers to provide high-income families and single people with this type of housing, should they prefer such housing. Furthermore, to avoid those problems typically resulting from the urban form of the projects, and based on the findings of this study, it is clear that such projects need to be redesigned and replanned to ensure that they are safe and controlled. This specifically requires defined public and private spaces around the buildings and to encourage residents to monitor any activities in these areas. It is also recommended that open spaces be assigned designated uses; that is, transformed into green areas to be enjoyed by lower-floor families and older adults.

The above lessons can be implemented in new projects where it seems that it is preferable to avoid non-traditional urban forms and return to the study of the traditional urban form. The latter has evolved throughout the ages and has the possibility to serve new needs without destroying its positive characteristics.

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A Study on the Space Layout and Configuration of Shopping Malls in Relation to Pedestrian Movement Behavior - Case of UAE

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Key words: pedestrian movement, behavior, wayfinding, Structural Equation Modelling.

Abstract: The research aims to understand the relationship between the popularity and attractiveness of commercial buildings, shopping malls and any relationship with visitor satisfaction. This would assist in designing new malls or commercial buildings, predict their degree of popularity, and help achieve both higher revenue resulting from increasing the number of visitors and their satisfaction, comfort and enjoyment of the space.

This study will focus on the relationship between shopping mall popularity and wayfinding. Planned and unplanned visits to some specific areas inside the malls will be considered. These areas are: 1- Facilities: prayer rooms, and washrooms, etc.; 2- The largest areas in size and often with the highest number of visitors: food courts, cinemas, play areas; and 3- ATM machines.

The objective of this paper is to verify three hypotheses: 1. The popularity of a mall is positively related to visitor satisfaction with wayfinding in the mall; 2. The popularity of a mall is positively related to visitor satisfaction with the location of facilities in the mall; 3. The location of facilities in a mall is positively related to visitor satisfaction with wayfinding in the mall.

Surveys were conducted in the city of Abu Dhabi and the Structural Equation Modelling (SEM) technique was used to verify these hypotheses.

1. INTRODUCTION

Disorientation and the feeling of being lost in a mall is usually accompanied by some degree of fear and frustration ([Brösamle & Hölscher, 2007](#); [Vilar et al., 2012](#)) which would not usually encourage a repeat visit. Being lost can also have financial implications such as lost business, missed or delayed appointments, etc. ([Arthur & Passini, 1992](#); [Carpman & Grant, 2002](#); [Rooke, Koskela, & Tzortzopoulos, 2010](#); [Vilar et al., 2012](#)). Being lost can also have far more serious consequences, and in addition, if wrong directions are communicated in an emergency, could lead to possible loss of life or delay in medical treatment ([Raubal, 2001](#)).

Lately, more researchers are interested in the problem of “being lost” and developing solutions by studying indoor wayfinding to make it easier for visitors to successfully navigate in such facilities as malls, airport, hospitals, etc.

Experts such as AIS interior designers, and architects, and management teams believe that efficient communication of directional information will increase visitor confidence and satisfaction ([Carpman & Grant, 2002](#); [Vilar et al., 2012](#))

In the case of airports, the literature review based on surveys and studies ([Churchill et al., 2008](#); [Correia, Wirasinghe, & de Barros, 2008](#); [Farr et al., 2012](#)) indicates that wayfinding is placed in 3rd position among service variables.

It is first necessary to explore the “Wayfinding” types, factors and categories in the literature review and any relationship to building layout to understand the relationship between the attractiveness of any shopping mall and the ease of visitor wayfinding.

We believe that the attractiveness of any commercial building is influenced by a person’s satisfaction with their visitor experience, and this will be particularly related to the success of their wayfinding during any type of planned or unplanned trip. Studies have also demonstrated that the complexity of building layout makes wayfinding more difficult and increases the feeling of “being lost”. In this next section, we will explore the literature review and the background of wayfinding and studies conducted on commercial buildings.

We also believe that wayfinding is not the only factor contributing to the attractiveness of a shopping mall. Hence, in this paper the authors first verify the literature review and different definitions, then verify the above theories by survey and Statistical Equation models.

2. LITERATURE REVIEW

Trips fall into two categories, first planned trips with a known origin and destination, for example from the office to the bank and such trips have been classified by ([Allen, 1999](#)) as travel with the goal of reaching a familiar destination ([Vilar et al., 2012](#)). The second type, unplanned trips have an unknown destination and can be exploratory travel with the goal of returning to the start point, or of reaching a new destination as defined by ([Allen, 1999](#); [Vilar et al., 2012](#)).

Several studies have shown the ability to navigate in an unfamiliar environment is affected by the complexity of the layout ([Slone et al., 2015](#)).

Wayfinding is a type of spatial problem solving in which within the environment both the problem and the possible solutions are found ([Passini, 1984](#)). The design of any environment, such as an office block, mall or town is an important part of wayfinding and good design helps in the understanding of any environment and is an aid for users to find a route, keep a sense of direction and stay oriented ([Cornell et al., 1997](#); [Farr et al., 2012](#)).

[Slone et al. \(2015\)](#) indicates that: 1) degree of visibility ([Braaksma & Cook, 1980](#); [Peponis, Zimring, & Choi, 1990](#)); 2) differentiation ([Gärling, Böök, & Lindberg, 1986](#); [Passini et al., 2000](#)); 3) proper signage and maps ([Arthur & Passini, 1992](#); [Conroy, 2001](#); [O'Neill, 1991](#)), and 4) spatial layout complexity ([Moeser, 1988](#)) are variables, which contribute to a better understanding of any environment ([Cubukcu & Nasar, 2005a](#); [Weisman, 1981](#); [Nasar, 1983](#)).

In any unfamiliar environment or overly complex environment the need for signs will increase ([Smitshuijzen, 2007](#); [Vilar et al., 2012](#)).

Three types of wayfinding recreational, resolute and emergency have been identified by ([Fewings, 2001](#)). Recreational wayfinding with no time constraints offers problem solving opportunities which can be enjoyable and fulfilling. In contrast, the primary purpose of resolute wayfinding is to find one route in the most efficient manner, and the environment complexity directly affects the time taken. In emergency wayfinding, speed and efficiency are the only important factors ([Farr et al., 2012](#)).

According to [Allen \(1999\)](#) people use the following means while looking for a new destination in an unfamiliar environment: directional signs on walls or panels (classified under oriented research), colored-coded trails, footprints (classified under continuous marked trails), verbal directional instructions (while piloting between landmarks), or referring to cognitive maps ([Vilar et al., 2012](#)).

Our study survey examines the popularity of use of the available means in Abu Dhabi. The questions surveyed visitors about help/information desks, times when verbal directions are given, and the use of signs, maps and touch screens.

[Fewings \(2001\)](#) considered signs placed beyond decision points would better encourage user confidence in their direction of travel ([Farr et al., 2012](#)).

Furthermore, results of a study by O'Neil (1991) show that in all settings graphic signs gave the fastest rate of travel, and textual signs were the best for reducing mistakes, e.g. wrong turns and back tracking ([Vilar, Rebelo, & Noriega, 2014](#)).

[Slone et al. \(2015\)](#) produced compelling evidence in his study on "Floor plan connectivity influences wayfinding performance in virtual environments" that the complexity of the layout affects the ability of people to navigate in unfamiliar surroundings.

Along with the signage systems defined by [Smitshuijzen \(2007\)](#), such as "You are here maps" and any directly linked to a continuous marked trail ([Vilar, Rebelo, & Noriega, 2014](#)), researchers such as [Cubukcu and Nasar \(2005a\)](#); [Nasar \(1983\)](#); [Weisman \(1981\)](#) take into consideration other environmental factors such as layout complexity, differentiation and landmarks as important for successful wayfinding.

Other factors affecting wayfinding collated by ([Vilar, Rebelo, & Noriega, 2014](#)) are: psychological, for example the feeling of familiarity with a building ([Cliburn & Rilea, 2008](#); [Gärling, Lindberg, & Mäntylä, 1983](#)), cultural factors, age ([Cubukcu & Nasar, 2005b](#); [Kirasic, 2000](#); [Moffat, Zonderman, & Resnick, 2001](#)), and people's physical or mental disabilities for example visual or auditory impairment, etc. ([Blackman, Van Schaik, & Martyr, 2007](#); [Blackman et al., 2003](#); [Passini et al., 1998](#); [Sohlberg et al., 2007](#)).

Successful wayfinding is based on a good decision-making process that relies on information represented by different means and interpreted in people's minds under the influence of several factors: environmental, spatial, cultural, biological, etc. ([Casakin et al., 2000](#)).

Further research is still required to study wayfinding to those destinations described as "secondary" by [Vilar et al. \(2012\)](#) for example, airport and convention center restrooms, offices and storage rooms. ([Dogu & Erkip, 2000](#)) studied a shopping mall in Ankara, Turkey and considered the spatial factors affecting wayfinding, orientation and shopping behavior. The study showed an inadequate signage system and the need to help visitors locate

such specific destinations as telephones, restrooms, or stores located in parts of the building that were not easily noticeable.

Hence our interest is to study wayfinding to similar destinations and any relationships between wayfinding and the attractiveness and popularity of shopping malls in general and in Abu Dhabi in particular. The following sections of the paper will explain the methodology used and discuss the findings.

It is important to note that in this research we are not interested to study wayfinding in virtual reality ([Raubal, 2001](#); [Slone et al., 2015](#); [Vilar et al., 2012](#)) or to apply space syntax and GIS ([Jiang & Claramunt, 2002](#)). Our research is based on surveys, statistical equation models, and graphic representation of plans.

3. METHODOLOGY

The Structural Equation Modelling (SEM) technique is used in this study to test the following hypotheses:

1. A mall's popularity is positively related to visitor satisfaction with wayfinding in the mall.
2. A mall's popularity is positively related to visitor satisfaction with the location of facilities in the mall.
3. The location of facilities in a mall is positively related to visitor satisfaction with wayfinding in the mall.

A reflective model theory was developed to relate 12 indicators to the construct (latent variable) malls popularity (SM). The indicators are:

- 1- Good location (MallLocation, Q1)
- 2- Easy access and availability of public transportation and taxis (EasyAccessPublicTrans, Q2)
- 3- Availability of parking areas (Parking, Q3)
- 4- The interior beauty of the building (IntBeauty, Q4)
- 5- The exterior beauty of the building (ExtBeauty, Q5)
- 6- Natural light from a skylight (NaturalLight, Q6)
- 7- Existence of outdoor dining areas and coffee shops (OutdoorDining, Q7)
- 8- Variety of brands (Brands, Q8)
- 9- Organization of activities for families and children including the existence of play areas (FamilyActivities, Q9)
- 10- Existence of cinemas (Cinemas, Q10)
- 11- Easy-to-find toilets and prayer rooms (PrayerRoomsToilets, Q11)
- 12- Good ambiance and sense of joy (GoodAmbiance, Q12)

Another reflective model theory was developed to relate three indicators to wayfinding in the mall (PFM). The indicators are:

- 1- Help desk (Help-Desk, Q13)
- 2- Signage (signs) (Signage, Q14)
- 3- Maps and touch screens (MapsScreens, Q15)

Question 16, 17 and 18 ask about the preference of the mall visitors to locate the facilities in the center, end or corner of the building in relation to the building space layout, geometry, etc., and represent another indication of wayfinding.

A third reflective model theory was developed to relate three indicators to the location of facilities in the mall (LFM). The indicators are the location and placing of facilities in the mall:

1. Near the stairs (Stairs, Q19)

2. Near the escalator (Escalator, Q20)
3. Near the elevator (Elevator, Q21)

A survey was conducted to measure the above indicators and included the following criteria: the survey was conducted in Arabic and English, the two predominant spoken languages in the UAE; and both male and female visitors of different nationalities, backgrounds and ages were surveyed. The survey was distributed in malls, universities, hospitals, offices, etc. A total of 260 samples were attempted with 180 successfully completed.

The software AMOS (From SPSS) was used to build the reflective SEM model to assess the relationships between the indicators and their corresponding constructs and relationships among the constructs themselves (Fig.1).

The results allowed us to build three models: model 1 (SM) based on the 12 indicators related to a mall’s popularity; model 2 (PFM) based on the 3 indicators related to wayfinding in the mall: and model 3 (LFM) based on the 3 indicators related to the location of facilities in the mall.

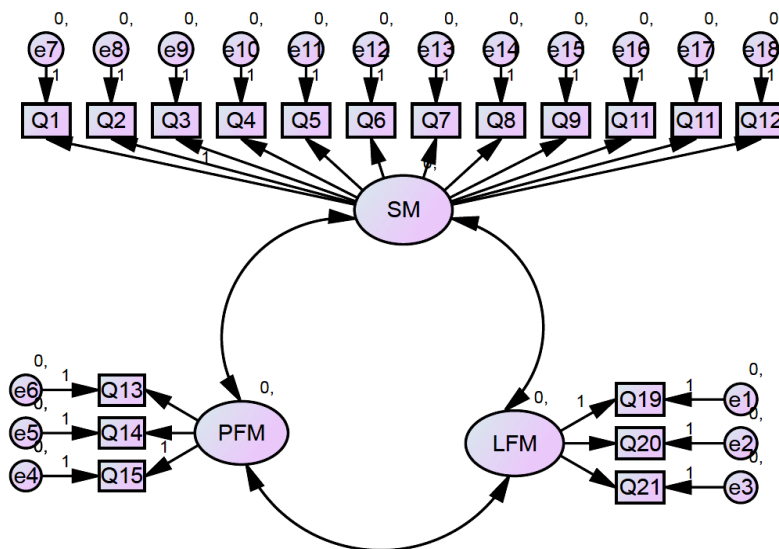


Figure 1. Diagram showing the relationship between the indicators and the three models

3.1 Structural Equation Modelling (SEM)

3.1.1 Description

Some constructs, such as intelligence, ability, trust, self-esteem, motivation, success, ambition, prejudice, alienation, and conservatism, cannot be directly observed or measured. Unobservable latent variables (constructs or factors) are estimated from observed indicator variables, and the focus is on estimation of the relations among the latent variables free of the effect of measurement errors. SEM provides a mechanism for considering any measurement errors in a model’s observed variables. It also provides a flexible and powerful means of simultaneously assessing the quality of measurement and examining causal relationships among

constructs. It can model multiple dependent variables simultaneously and test the overall model fit. ([Jöreskog, 1973](#); [Keesling, 1972](#); [Wiley, 1973](#)).

3.1.2 SEM Steps

1. Model formulation to correctly specify the SEM model that the researcher wants to test.
2. Model identification to determine whether a unique solution for all the free parameters in the specified model exists.
3. Model estimation to estimate model parameters and generate fitting functions.
4. Model evaluation when the researcher assesses whether the model fits the data after meaningful model parameter estimates are obtained.
5. Model modification is carried out if the model does not fit the data.

3.1.3 Type of Construct

Reflective Measurement Theory: (most common) assumes the latent constructs cause the measured indicator variables and that any error is a result of the inability of the latent constructs to fully explain the indicators. Therefore, the arrows are drawn from the latent constructs to the measured indicators. Example: the service quality provided by a business is believed to cause measured perceptions of specific indicators, such as the speed of service or knowledge of the employees.

Formative Measurement Theory: assumes the measured indicator variables cause the construct and that the error is a result of the inability of the measured indicators to fully explain the construct. Therefore, the arrows are drawn from the measured indicators to the constructs. A very important point is that “formative” constructs are not considered latent, and are typically viewed as indices.

As an example, a social class index typically is viewed as a composite of educational level, occupational prestige and income (or wealth). Social class does not cause these indicators. Rather, the formative indicators cause the index.

Note: The choice between specifications of a formative versus a reflective measurement model should be based primarily on theoretical considerations regarding the causal priority (direction) between the observed indicators and the (latent) variable involved. ([Diamantopoulos & Winklhofer, 2001](#)).

4. FINDINGS AND RESULTS ANALYSIS

4.1 Structural Equation Modelling

4.1.1 Results of the Model Fit and Goodness

The model fit summary from AMOS showed a CMIN/DF value of 1.994 which is the minimum discrepancy divided by its degrees of freedom. Some researchers have recommended using ratios as low as 2 or as high as 5 to indicate a reasonable fit. ([Marsh & Hocevar, 1985](#)). It seems clear per Byrne that a ratio > 2.00 represents an inadequate fit. ([Byrne, 1989](#)). We can say our model fit is within the acceptable range for CMIN/DF. Also, the model

fit summary showed a RMSEA (Root Mean Squared Error of Approximation) value of 0.075 which is the square root of the resulting ratio, which gives the population "root mean square error of approximation", called RMS by [Steiger and Lind \(1980\)](#), and RMSEA by [Browne and Cudeck \(1993\)](#). From practical experience a RMSEA value of 0.10 or less is considered acceptable and less than 0.08 is considered good. We can also say our model fit is within the acceptable range for RMSEA.

4.1.2 Parameters Estimates

Table 1 below lists the standardized regression weights (Loadings) for the estimated indicators ranked per their degree of most affect from the corresponding construct.

Table 1. Standardized Regression Weights (Loadings)

Location of facilities in the mall (LFM)	SRW*	Way Finding in the Mall (PFM)	SRW*	Popularity of Malls (SM)	SRW*
Escalator	0.83	HelpDesk	0.64	GoodAmbiance	0.78
Elevator	0.83	MapsScreens	0.59	MallLocation	0.74
Stairs	0.76	Signage	0.59	EasyAccessPublicTrans	0.70
				Brands	0.68
				FamilyActivities	0.67
				Parking	0.66
				PrayerRoomsToilets	0.65
				IntBeauty	0.60
				OutdoorDining	0.58
				ExtBeauty	0.55
				Cinemas	0.54
				NaturalLight	0.53

* Standardized Regression Weights.

4.1.3 Construct Validity

This is the extent to which a set of measured items reflect the theoretical latent construct they are designed to measure. It consists of four components.

4.1.3.1 Convergent Validity

The extent to which indicators of a specific construct "converge" or share a high proportion of variance in common. To assess we examined construct standardized loadings which should be 0.5 or higher, the variance extracted should be 0.5 or greater to suggest adequate convergent validity and the reliability should be 0.7 or higher to indicate adequate convergence or internal consistency.

The model results showed that all factors concerning standardized loading are above 0.5 and the variance extracted for the constructs mall popularity (SM) and the location of facilities in the mall (LFM) are greater than 0.5, while for the constructs way finding in the mall (PFM) it is 0.36.

4.1.3.2 Discriminant validity

The extent to which a construct is truly distinct from other constructs. The Rule of Thumb is that all construct variance extracted (VE) estimates should be larger than the corresponding squared inter-construct correlation estimates (SIC). If they are, this means the indicators variables have more in common with the construct they are associated with than they do with the other constructs.

The model results for the (SM) and (PFM) constructs are less which indicates that these two constructs are not distinct from each other, while for the (LFM) construct it is greater which indicates that it is distinct from the other constructs (Table 2).

Table 2. Correlations

Correlations: (Group number 1 - Default model)			
			Estimate
SM	<-->	LFM	0.239
LFM	<-->	PFM	0.222
SM	<-->	PFM	0.827

4.1.3.3 Nomological Validity

Examines whether the correlations between the constructs in the measurement theory make sense. The covariance matrix Phi (Φ) of construct correlations is useful in this assessment. In our model (Table 3) positive correlations between all constructs have been accepted. We find they are all positive and significant.

Table 3. Covariances

Covariances: (Group number 1 - Default model)							
			Estimate	S.E.	C.R.	P	Label
SM	<-->	LFM	0.133	0.051	2.634	0.008	par_16
LFM	<-->	PFM	0.102	0.049	2.065	0.039	par_17
SM	<-->	PFM	0.351	0.066	5.318	***	par_18

4.1.3.4 Face Validity

The extent to which the content of the items is consistent with the construct definition, based solely on the researcher’s judgment.

4.2 Results of the questionnaire

4.2.1 Model 1

Regarding the malls popularity model (SM), the results of the survey show that among the 12 indicators taken into consideration to build the model, 6 questions were considered as top indicators, which are highlighted in yellow in the table below (Table 4). The top ranked indicators are:

- Good location (Q1),
- Availability of parking areas (Q3),
- Variety of brands (Q8),
- Organization of activities for families and children including kids play areas (Q9),
- Easy-to-find toilets and prayer rooms (Q11),
- Good ambiance and sense of joy (Q12).

Table 4. Summary of the survey results (Q1 to Q12)

Q#	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
% of answers (agree and strongly agree)	83	79	86	77	74	65	74	80	80	70	88	88

4.2.2 Model 2

Regarding the three indicators of the wayfinding in the mall model (PFM), which are: 1) Help desk (Q13), and 2) Signage/signs (Q14), and 3) Maps and touch screens (Q15), the survey results indicate that 81% of respondents found the help and information desk (Q13) useful compared to 78% who found signs (Q14) useful, and 75% who found following maps and touch screens (Q15) to get directions as useful.

Fig.2 below shows the percentage distribution of responses to Q13, 14 and 15 through a scale of 5: strongly disagree with value (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The answers represent how useful the respective means were found: help/information desk Q13, maps and touch screens Q14, and signs/signage Q15.

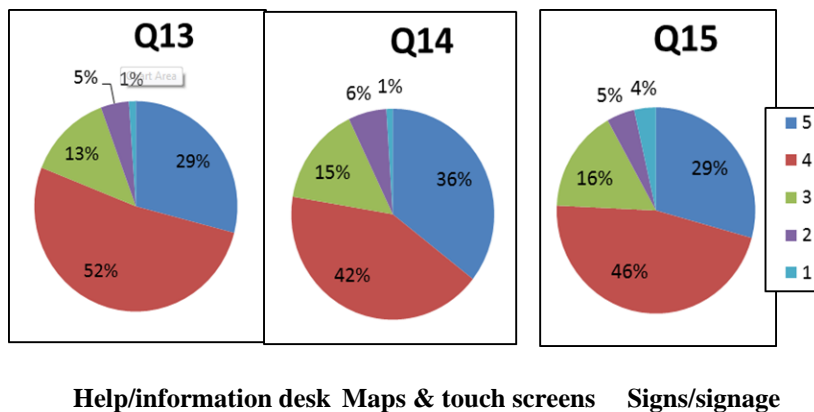


Figure 2. Survey results of question 13, 14 and 15 used as indicators in the model 2: Wayfinding in the mall

4.2.3 Model 3

Regarding the indicators related to model 3: the location of facilities in the mall (LFM): 1) near the stairs (Q19), and 2) near the escalator (Q20), and near the elevator (Q21),

People prefer (agree and strongly agree) the facilities (Cinema, food court, kids play area, prayer room, washrooms, ATM machines) to be located near by the elevator (66% of the answers) or the escalator (65%) for fast and easy access, but also for visual access since most of the visitors nowadays use elevators and escalators to move between the floors (vertical circulation), rather than locating such facilities near a staircase (58%).

Fig.3 below shows the percentage distribution of responses to Q19, 20 and 21 through a scale of 5: strongly disagree with value (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The answers represent the preference for near the stairs (Q19), near the escalator (Q20), and near the elevator (Q21).

Furthermore, responses to the questions about the preference of people concerning the location of the facilities (Cinema, food court, kids play area, prayer room, washrooms, ATM machines) in the center, corner, or at the end of the shopping mall building, 61% prefer (agree and strongly agree) the location of the above facilities to be in the center of the building, probably midway between the main entrance and the secondary entrance of the shopping mall, but also more visually accessible, while 32% preferred the location to be at the end or the corner of the building. However, 38% of the

answers were in the favor of locating the above facilities in the corner/angle of the building.

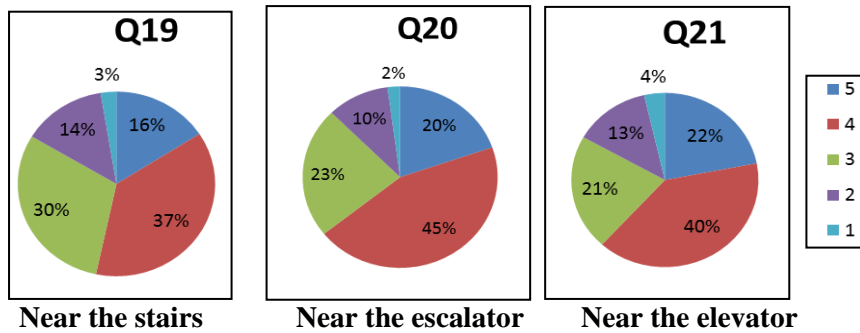


Figure 3. Survey results of question 19, 20 and 21 used as indicators in model 3: the location of facilities in the mall

Fig.4 below shows the percentages distribution of responses to Q16, 17 and 18 through a scale of 5: strongly disagree with value (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The answers represent the preference to locate facilities in the center of the building, corner of the building, and end of the building.

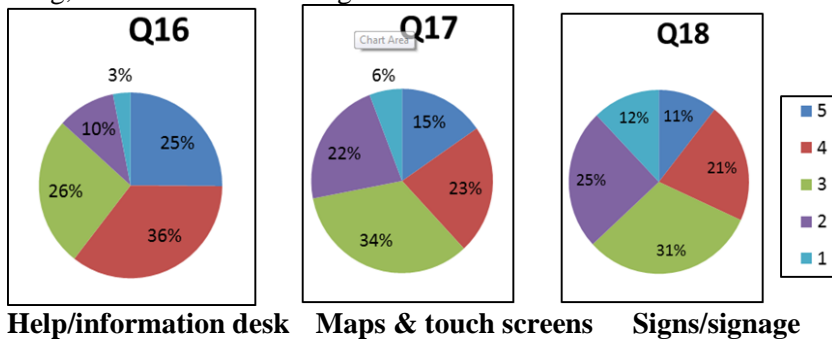


Figure 4. Survey results of question 16, 17 and 18 related to the location of facilities in the mall

This means that the location of the facilities is not only related to the location of the means of vertical circulation inside a building such as stairs, elevators and escalators, but also their positions in the center, the corner or the end of the building, which is directly linked to their visibility and the length of the route.

5. CONCLUSION

The purpose of this study is to identify those factors that create or generate the popularity and attractiveness of a shopping mall, to check the relationship between visitor satisfaction with a shopping mall, the degree to which they would recommend it to others and the ease of finding directions inside the building. The wayfinding study of the “secondary destination”, as called by some researchers, to the facilities (toilets, prayer rooms, ATM machines), and big surface areas for example: cinemas, food courts and kids areas) was done via Structural Equation Modelling based on a survey.

The results indicate that the three hypotheses below are validated:

- The popularity of malls is positively related to visitor satisfaction with wayfinding in the mall.
- The popularity of malls is positively related to visitor satisfaction with the location of facilities in the mall.
- The location of facilities in the mall is positively related to visitor satisfaction with wayfinding in the mall.

The results also strongly indicated that wayfinding factors are highly correlated to the popularity of malls. The top indicators affecting a mall's popularity are a good ambiance and sense of joy, good location, easy access and availability of public transportation and taxis, and then the variety of brands. While for the wayfinding the top indicator is the help desk. As for the location of facilities in the mall the top indicators are a location near escalators or elevators, and preferably in the center of the building or midway between the entrances. As opposed to a location in the corners. So, this could be an indication for future designs of malls.

Although this is not always possible, it would be prudent for architects and mall developers to consider three factors: the importance of these facilities in the wayfinding; how a well-thought out location helps in increasing customer and visitor satisfaction; and the role that these spaces indirectly play in the popularity of shopping malls. This importance has to be interpreted spatially in building plans and also in the space layout by studying their visibility, which can be strengthened by signs and indications or perhaps colors, and attractive use of logos, characters, etc., by considering the distance from the entrance, their location near the elevators, stairs and escalators, or near landmarks. For example, fountains, halls, etc., and their position in the center, corner or the end of the building plan. The geometry of the building and the complexity of the space layout and whether the building is symmetrical or not, may also affect the ease of way finding, in addition to the number of turns or deviations from a perceived route that must be made to reach them.

In a natural landscape people carry out wayfinding by a combination of noting the position of the sun, prevailing weather such as wind directions and using several types of landmark: topographical such as hills, rocks and water features, natural such as trees, fields and vegetation, and manmade impressions such as paths, walls and buildings. They also ask the way from fellow humans. In the enclosed and artificial environment of modern shopping malls which are increasingly growing in size, none of the above exist naturally, but by incorporating wherever possible some of the above examples in a scaled down format such as the help desk, different color pathways, clear visual signs and well-located facilities in relation to routes, the visitor experience of the shopping mall can be significantly improved.

This paper represents the first part of a research project, which will be carried on by studying more examples throughout the world to build a bigger database for a wider and more complete comparison. In addition, we are interested in examining international building codes and regulations regarding the location of facilities in commercial buildings and compare them with the practice (current plans and space layout of existing shopping malls) and the survey results. The purpose of the future research will be to study the relationship between the building layout, its spatial organization, and the wayfinding within the frame of the design principles and building codes.

We believe that the outcomes of this research (current and future) would contribute to increase the popularity of malls by improving their space planning, space layouts and design, and help to not only just rely on their size or other factors to attract visitors. Good wayfinding in shopping malls would satisfy both sides of the retail equation: visitors and shoppers on one side, and mall owners and management teams on the other.

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Interaction and Integration of Cultural Inheritance, Ecotourism, and Industrial Development.

Strategies, Mechanisms and Spatial Practice of The Amis Dietary Culture Transformed into Creativity Living Industry.

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Key words: Creativity Living Industry, Ecotourism, Dietary Culture, Amis, Social Network Analysis (SNA).

Abstract: Diet is the important foundation in constructing traditional culture in aboriginal tribes. Because food is usually regarded as the fundamental element of cultural and social interaction, diet carries symbolic information of cultural tradition in the society. In the face of severe challenge in the globalization era, how to conserve aboriginal culture as well as build aboriginal competitiveness in the free market becomes an important issue in enriching plural ethnic culture. Existing research indicates that the traditional economic structure and cultural context of aboriginal tribes may develop a new cultural pattern after tourism development is drawn into aboriginal living territory. Especially the introduction of ecotourism and tourist experience activities can positively support the conservation of local characteristics and contribute to ecological conservation. Moreover, ecotourism also benefits the promotion of local employment and brings natural resources into aboriginal daily life to preserve local characteristics. On the other hand, Creativity Living Industry is the unique type of Cultural and Creative Industries in Taiwan, and it is full of experimental vitality. However, how to develop Amis tribe's dietary culture into promising Creativity Living Industry is still rare in the field of academic research. This research is intended to fill in these academic blanks. Therefore, this project will conduct a field survey and interview with local persons and professionals in Hualien to collect basic data and information. Social network analysis (SNA) is applied to analyze the mechanism which can effectively transform Amis dietary culture into Creativity Living Industry. Finally, some suggestions regarding spatial planning and improvement are also proposed.

1. INTRODUCTION

In recent years, the impact of globalization on local culture has raised public awareness on the importance of localization. Exploring and maintaining local characteristics and creating regional differentiation are the core strategies employed in manifesting the subjectivity of local regions. The government of Taiwan has actively utilized local resources to develop local cultural industries, implying that developing local characteristics has become a key trend for local economic development. Cultural and creative industries are emerging industries that the government of Taiwan has endeavored to develop in recent years. In particular, the creativity living industry is a unique

industry in Taiwan. In 2003, a promotion panel organized by the Ministry of Economic Affairs in Taiwan described the categories of cultural and creative industries, defining the creativity living industry as creative or culture-based industry, in which commodities or services for daily life (e.g., food, clothing, accommodation, travel, education, and entertainment) are innovatively managed through composite, creative, regenerative business models, thus offering learning activities to customers. When the creativity living industry was an emerging industry, case studies and academic research have shown that companies operating in the creativity living industry feature the following three elements: core knowledge, quality aesthetics, and in-depth experience; therefore, the creativity living industry was redefined as an industry “providing economy of in-depth experience and quality aesthetics based on the core knowledge of integration of creativity and living aesthetics (e.g., in dietary culture, daily living education, natural ecosystems, fashion, artifacts, and crafts).” ([Chang, W. H., 2010](#)).

Since the 1980s, with the deterritorialization and time-space compression that comes with advanced modernization, the social, political and aesthetic properties potentially associated with cuisine have come to be immensely significant in modern societies. Against this backdrop, food has gradually become a central focus of socio-cultural forces and gained a key position that reflects socio-cultural power relations ([Lai, 2006](#)). In the context of modern development, diet carries the connotation of a cultural code. Food is the clue to memory, a specific food is associated with the memory and the growth experience of an individual which is capable to awake the collective memory of a group. Food sources and cooking methods imply social and cultural identity (including diet heritage and cultural mosaic) ([Lin, H. C., 2009](#)). [Mak, Lumbers, and Eves \(2012\)](#) contend that globalization poses a threat to local gastronomic identity and image, there is preliminary evidence suggesting that it can provide an impetus for reinventing local gastronomic products and identity. Beside, a diet of over-refined foods can cause numerous diseases. Because people currently exhibit strong intentions of living a natural primitive lifestyle, natural foods for lifestyles of health and sustainability (LOHAS) have become a popular trend. Incorporating traditional cooking methods and fresh seasonal and local ingredients into dietary habits is generally conducive to good physical health.

Because of globalization, minor traditions have gradually received increasingly more attention and have thus been recreated, reused, redefined, and redeveloped. Herbs and medicinal foods are also used in the creation of a diverse range of delicacies ([Liao, 2004](#)). Given the numerous cultures in Taiwan, diets of indigenous peoples have a profound relationship with the natural ecosystem. Indigenous diets not only interact with nature, but also reflect the wisdom of indigenous tribes and the abundance of culture in the mountainous areas of Taiwan ([Ju, H. L., 1997](#)). Traditionally, indigenous peoples pick edible wild vegetables, which have been a crucial food source for them since ancient times. The Amis people live in the eastern area of Taiwan where natural resources are abundant, and they thus have access to abundant food sources in the rivers, forests, mountains, and the sea (including vegetables, fruits, peat moss, laver, and kelp) ([Tian, 2001](#); [Chang, Y. S. & Yang, 2004](#); [Wu, S. Y., 2006](#)). In the current society where localization is embraced and people advocate natural health, indigenous dietary culture in which local and natural foods with simple seasoning are served and simple cooking methods are used have started to receive increasingly more attention.

In the present study, the tribe in the Matai'an Wetland (hereafter, Matai'an tribe in Guangfu township, Hualien County, Taiwan served as a research base.

Social network analysis (SNA) was adopted to holistically investigate and comprehensively analyze Amis dietary culture of the Matai'an tribe. This study has two main purposes: (1) to explore the development of Amis dietary culture in the Matai'an tribe and the relationship between Amis dietary culture and the Matai'an tribe; and (2) to construct and analyze the interactive network in which the Matai'an Tribe transformed Amis dietary culture into the creativity living industry.

2. LITERATURE REVIEW

2.1 Creativity Living Industry

In 2002, the Taiwanese government proposed the "Challenge 2008 - National Development Plan," and admitted the creativity living industry into the "Cultural and Creative Industries Development Plan" as one of the categories for the cultural and creative industries. The creativity living industry is a category uniquely created based on the economic situation in Taiwan and practices used in other countries. Unlike other industries that target artists, designers, and cultural workers, the creativity living industry primarily targets traditional industries and is a part of the creative industries ([Lin, F. J. & Lin, 2012](#)).

Business operations in the creativity living industry are focused on developing effective business strategies and interactive commodities along the dimensions of product, promotion, space, and service. These four major items must be interconnected to form a niche for and key characteristics of business management ([Chang, W. H., 2010](#)). Currently, which types of businesses are entailed in the creativity living industry is not clearly defined; all businesses related to daily life activities and in possession of unique core knowledge, experiences, and aesthetic designs can be included in the creativity living industry ([Lin, F. J. & Lin, 2012](#)).

Food is a type of product that depicts local and cultural characteristics and local identification. It provides a special dietary experience for tourists. ([Sánchez-Cañizares & López-Guzmán, 2012](#)) argue that typical local cuisine, as perceived in the restaurant sector, is an important tourist product that revalorizes the culture of a given location. This study explored the concept of diet and investigated how dietary culture can be transformed into the creativity living industry.

2.2 Dietary Culture

Dietary culture represents a lifestyle of a group of people, and it includes previous and current cultural heritage and integrates physical and spiritual concepts ([Teng, 2009](#)). Some dietary customs are deemed fundamental, and are incorporated into the cultural practice of an ethnic group; they are endowed with distinctive ethnic cultural connotations, and become symbolic marks that are transmitted and passed down and consolidate group membership internally and serve to fix boundaries externally ([Wang, 2007](#)). A food system integrates and connects various social groups based on characteristics commonly perceived and demonstrated in a region. Such system can be used to differentiate the explicit or implicit differences between societies ([Lai, 2006](#)). Although eating is a natural human behavior, there are specific reasons for eating certain foods, and some foods have specific cultural meanings. Dietary

culture is integral to a culture on an overall level. Diet can reflect the local characteristics of an area and help people understand certain social and cultural implications. During the modernization of society, food has become an element of social and cultural functioning, reflecting specific social and cultural meanings. The dietary cultures of various countries effectively characterize the national cultures of countries ([Lin, H. C., 2009](#)).

Local dietary resources are used to satisfy the dietary needs of local people and to develop local dietary cultures. Additionally, local dietary resources have other values and functions such as serving as a carrier of local dietary cultural heritage to embody local traditional culture, and as an option to develop local tourism resources and the local economy ([Ju, M. K., 2010](#)). A growing demand for distinctive, local produce has encouraged the renewal of traditional festivals, inspired the emergence of educational visitor attractions, reconnected consumers with the countryside, inspired the retention and development of culinary and agricultural skills, and offered dying traditional industries and small businesses a lifeline ([Everett & Aitchison, 2008](#)). Thus, tourism destinations can create a strong tourism image by exploiting unique culinary features and cultural assets.

Food is one of the essential elements of the tourist. Food tourism is an emerging theme in the international tourism and hospitality business; a significantly growing number of tourists travel to destinations to taste unique and authentic culinary products ([Smith & Costello, 2009](#)). Food tourism is clearly able to contribute to the “triple bottom line” of environmental, economic and social sustainability ([Everett & Aitchison, 2008](#)). While ecotourism is to promote sustainable development of local communities in the best way, so that community residents with ecological knowledge and awareness of the ecological environment, promoting community consensus through the autonomous communities in the ability to improve the community natural ecological environment, the economy and the preservation of community culture ([Sirakaya, Sasidharan, & Sönmez, 1999](#); [Vincent & Thompson, 2002](#)). The present study focused on exploring the feasibility of using dietary culture to develop tribal ecotourism by examining the relationship between dietary culture and ecotourism.

2.3 Ecotourism

Hetzer was one of the first scholars to propose the term ecological tourism. He proposed four criteria for ecological tourism: (a) minimizing the impact of the local culture and environment, (b) using local resources or cultures to produce the greatest economic benefit, (c) minimizing the effect of local tourist destinations on the ecosystem, and (d) achieving complete satisfaction of visitors ([Hung, Tsaour, & Lu, 2008](#); [Lu, 2006](#); [Wu, T. C., 2007](#); [Yang, 2014](#)). In 1991, the International Ecotourism Society (TIES) defined ecotourism as “responsible travel to natural areas that conserves the environment and improves the well-being of local people” ([Wu, T. C., 2007](#)).

Regarding the development of ecotourism of Taiwan, to promote ecological education, the United Nations declared 2002 to be the International Year of Ecotourism. The tourism policy-promotion panel at the Executive Yuan requested the Tourism Bureau to publish an ecotourism white paper, develop related promotion policies in recognition of 2002 being designated as the International Year of Ecotourism, thus establishing the Taiwan Ecotourism Association (TEA). In 2005, the Tourism Bureau published the Ecotourism White Paper, defining ecotourism as tourism in natural areas where ecological conservation and sustainable development are valued.

Additionally, the Tourism Bureau proposed specific assessment criteria that tourism activities must meet to be classified as a form of ecotourism. For ecotourism, only camping and leisure activities that have a low impact on the environment can be allowed, the number of tourists must be limited (including group size or the number of tourist groups), conservation of local natural resources and cultures must be advocated, services and carriers provided by local people must be used, tourism must focus on a “natural experience,” tour guides must possess an understanding of local natural culture, wild animals and plants must not be disturbed, the environment must not be damaged, and traditional culture and the privacy of local people must be respected.

The meaning of ecotourism can be expressed as a form of tourism in natural areas, emphasizing the concept of ecological conservation and sustainable development as the ultimate goal (Yang, 2014). Thus, ecotourism is based on the sustained conservation of resources in a non-consumptive manner involving nonintrusive exploitation of natural resources through the controlled use and management of cultural and environmental resources for the future (Sirakaya, Sasidharan, & Sönmez, 1999). To fulfill the spirit of ecotourism, the following five dimensions must be integrated:

(1) *Natural experience*: Travel plans and services are developed according to natural resources, ecological characteristics, and features exhibiting educational values (e.g., local fauna, nature, and culture) to provide tourists with an in-depth experience.

(2) *Environmental education and interpretation*: Tourists are guided to experience, understand, appreciate, and enjoy nature. Professional and in-depth explanations and accurate information about natural areas and cultural assets are provided to tourists as they interact with the environment. Tour guides are employed to guide and provide tourists with correct information before and during the tour. In addition, educational environmental activities are held so that tourists could learn various levels of knowledge, and perceive, appreciate, and experience nature.

(3) *Sustainable development*: Regarding the development and implementation of business operation methods in ecotourism areas, the sustainability of natural resources and conservation of local fauna, diverse resources, and natural habitats must be fulfilled. The impact of human activity on the environment must be reduced as much as possible. Revenues generated through tourism activities must be channeled into protecting and conserving local natural environments and cultural assets.

(4) *Environmental awareness*: A sense of mission toward the natural environment should be integrated with a sense of responsibility toward social morality. These ideas should be promulgated among tourists to gain their recognition. Through interpretive services and environmental education, tourists can be enlightened and encouraged to respect local traditional cultures and lifestyles, establish environmental ethics, and raise awareness on environmental issues.

(5) *Benefits and feedback*: An ecotourism strategy involves using earnings obtained from tourism activities as conservation funds for local areas. In other words, community residents are encouraged to participate in raising environmental conservation, research, and education funds through various mechanisms to help protect and conserve local ecological and cultural resources while developing tourism.

Ecotourism is considered to be a responsible approach of tourist development. It aims to keep the balance between the economic growth and environmental concerns and furthermore, to enhance the cultural integrity of

the local residents in order to achieve sustainable living ([Huang, C. T. & Lo, 2013](#); [Lu, 2006](#)). The sustainable development of ecology emphasizes the balance between the use of the natural environment and development to maintain the integrity of the ecosystem and the ability to regenerate ([Yang, 2014](#)). In summary, ecotourism is a small-scale tourism model that integrates leisure activities, in-depth experience, and intellectual education. The objectives of ecotourism are to protect and conserve ecosystems and to enhance the well-being of local people through tourism activities.

3. METHODOLOGY

3.1 Research Methods

(1) Literature Review: On the basis of related studies and information, historical data were collected from relevant books, research reports, statistical data, and newspapers to explore the origins of Amis dietary culture (including natural and geographic conditions, production and living conditions, and social and cultural factors).

(2) Field Study and In-depth Interviews: Field study and in-depth interviews with tribal elders, restaurant owners, and people who have hosted dietary cultural activities were conducted to elucidate the development of Amis dietary culture, thereby bridging the research gaps in previous studies.

(3) Observational: Naturalistic observation was undertaken, in which research targets were observed in natural conditions without disturbing their behavior and observations were recorded in writing. Amis dietary culture was observed in dimensions of ecology, culture, and industry.

(4) Social Network Analysis (SNA): Social network refers to a specific tie and relationship established among individual nodes of a group in a certain manner. Function and authority is distributed across the nodes and linkages, such that decision-making and implementation are conducted through informal and temporary coalitions of actors and resources ([Gilchrist, 2004](#)). SNA is a tool for examining network relationships. After identifying which actors are nodes, network data are collected through questionnaires, interviews, and observations and then input into an analysis software package to calculate various network indicators and depict network graphs representing various types of relationship. Actors are connected to one another through a line, and a social network graph is presented by using dots and lines. The structure of the social network graph is identified, and graph theory, theoretical modeling, and cognitive analysis are employed to understand the social network and interpersonal relationships of the actors in that social network; to examine their influence on people or organizations; and to explain the social behavior of group members ([Chen, M. H. & Lee, 2008](#); [Huang, C. Y. et al., 2011](#)). [Chen, C. S. and Tai \(2007\)](#) indicated that social networks possess the following six crucial features:

Size: The size of a network refers to the number of network members. Larger networks produce a greater amount of useful information, and network members are more likely to obtain information.

Density: Density refers to the level of intimacy or connection strength between network members, and it can be assessed on the basis of interaction frequency and the amount of time spent on building a network.

Content: Content refers to the relationship between network members.

Diversity: The diversity of network members refers to the various background and experiences of network members.

Purpose: The purposes of building networks may vary. If building a network is to satisfy a certain purpose, the network will not last long and will provide limited information and interests. If network members have been acquainted with one another for long, they will build a profound affective connection with one another, gain support from one another, and share information with one another.

Social norms: Considering how network members govern, maintain, and use networks for an extended period, trust and interaction between network members and written and unwritten norms are crucial for governing networks.

The connection framework and interaction model among network members can be verified through SNA. Therefore, group phenomena can be explained using the concept of social networking (Huang, C. Y. et al., 2011). Before performing an SNA, a relation matrix must be established. The main networks are interlinked if the themes are related to one another. According to the relation between actors, an $n \times n$ actor-by-actor matrix is formulated. Table 1 shows an example of such a matrix; under a theme in one dimension, four main networks exist, and the links between the networks represent the interaction between nodes. A value of “1” indicates that a response relationship exists between nodes, whereas a value of “0” indicates that no response relationship exists. The response relationship is represented by a social-network-relationship matrix.

Actor	1	2	3	4
1	-			
2	1	-		
3	0	1	-	
4	1	0	0	-

Figure 1. A social-network-relationship matrix

A social network graph can be constructed as a relationship matrix according to the response relationship between actors. A node represents an actor and a link represents a response of an actor to another actor. Using Node 1 as an example, Node 1 has a response relationship with Nodes 2 and 4, but not with Node 3.

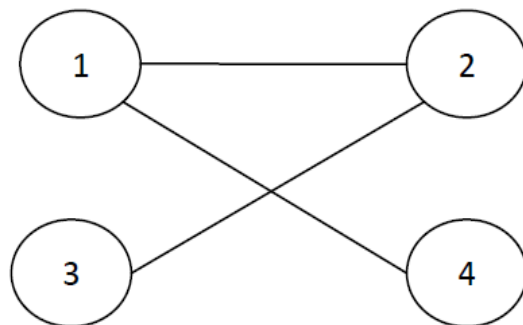


Figure 2. A social network graph

A primary function of networks is to facilitate boundary-spanning cooperation, co-ordination and communication. In a network-type organization, members are generally loosely connected through a variety of formal and informal linkages that enable them to share information or to trade with one another (Gilchrist, 2004). In this study, University of California of Irvine Network (UCINET) 6.0 was used to explore individual actions within an overall structure. According to social network theory and an analysis of network centrality, critical actions in the network were identified to understand the role of various action factors in building an interactive network of transforming the Amis dietary culture into the creativity living industry.

3.2 Research Design

The actions of interviewees who transformed Amis dietary culture into the creativity living industry served as nodes; in addition, the social network formed by various actions during the development of the creativity living industry was illustrated. Four main elements that formed the creativity living industry were denoted as A, B, C, and D, and the reasons for the interaction between cooperating bodies were denoted as Reasons x, y, and z. Actions were related to one another on the basis of the aforementioned elements and reasons. Using Node 1 as an example, Node 1 is connected to Node 2 because of Elements A and D and Reasons x, y, and z.

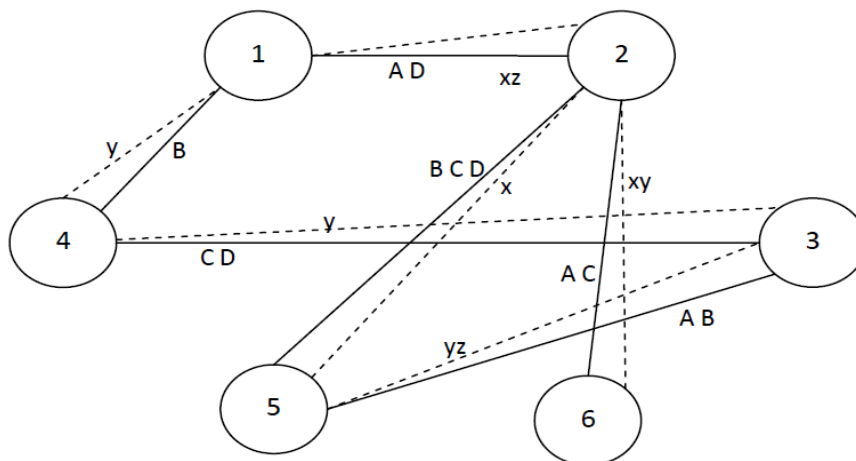


Figure 3. The schematic diagram of a social network graph

4. RESULTS

On the basis of the four constituent parts of the creativity living industry, this study adopted interactions between partners involved in ecological conservation, cultural heritage, and industry development as research dimensions, interviewed local tourism businesses, and treated the interviewees' actions as the foundation of a network for analysis. Degree centrality was used to measure the importance of each action in the interactions

4.1 Coding and Analysis of the Interview Data

The actions collected through interviews were divided into five categories:

(1) Industrial operations:

A (providing traditional meals): The primitive cooking methods of the Amis people were adopted for tourists to experience tasting traditional cuisine (e.g., salted and grilled fish and stone hotpot).

B (developing creative dishes): Creative cooking methods were employed to prepare and promote exotic local foods that tourists would not normally accept (e.g., solanum coagulans, kakorot, okra, pigeon peas, and snails).

C (researching and developing special agricultural products): Through cooperation with the Industrial Development Bureau of the Ministry of Economic Affairs, local crops (e.g., purple rice, pigeon pea, kakorot, roselle, and rice) were incorporated into the design of souvenirs.

(2) Promotion and education:

D (providing introductions and tours): Through ecological tours and bicycle tours, tourists can learn about the natural ecology and cultural history of the Matai'an Wetland.

E (engaging visitors in actual operations): The traditional fishing method (Palakau) and cutlery-making method (e.g., betel leaf tableware, stone-hotpot cooking method, and mochi pounding) of the Amis people were demonstrated.

F (offering performances and demonstrations by local residents): Local residents demonstrated the traditional fishing (fish and shrimps) and cooking methods of the Amis people.

(3) Raising animals and cultivating plants:

G (contract farming and purchasing and cultivating plants and raising animals for personal consumption): Business operators purchased foods from or entered contracts with specific farmers to ensure the origin of food ingredients (organic).

H (purchasing): Business operators purchased foods from markets or farms, and occasionally obtained free food from relatives or friends.

I (cultivating plants and raising animals for personal consumption): The ingredients for preparing indigenous dishes (Amis dishes) were cultivated in fields or yards. Accordingly, the freshness of foods can be ensured, and rare wild vegetables could be reproduced to ensure abundance of local specialty foods (water sprite).

(4) Social interactions:

J (providing mutual support among local residents): Local residents were employed to work part-time or full-time in restaurants and parks or to work as tour guides or performers.

K (attracting tourists from outside the community): Travel agents, government departments, and schools were consulted about itineraries to attract more tourists, generate additional income sources, and promote cultural and ecological education.

(5) Spatial development:

L (preserving the original features of Matai'an): The appearance of the local ecological environment was preserved as much as possible. For example, fences, boardwalks, and signs were used to minimize anthropogenic influences on the environment.

M (promoting indigenous Amis cultural styles): Culture and history workshops decorated with tools, clothing, totems, and craft works were established to recreate the atmosphere of the Amis tribe

4.2 Social Network Analysis

With Social Network Analysis (SNA), it analyzes the centrality intensity of all actions in dimensions like Ecological conservation, Cultural inheritance, Industry development when dietary culture is transferred into product,

promotion, service and space. The higher intensity shows higher importance. The analytical results, as shown in the table (i.e., data analysis of action relations) and figure (i.e., social network based on action relations), illustrate the social network formed by actions performed in developing a creative living industry.

4.2.1 Ecological conservation:

Element L (preserving the original features of Matai'an) was the most crucial, followed by Elements E (engaging visitors in actual operations) and I (cultivating plants and raising animals for personal consumption). These elements interacted independently with seven other actions.

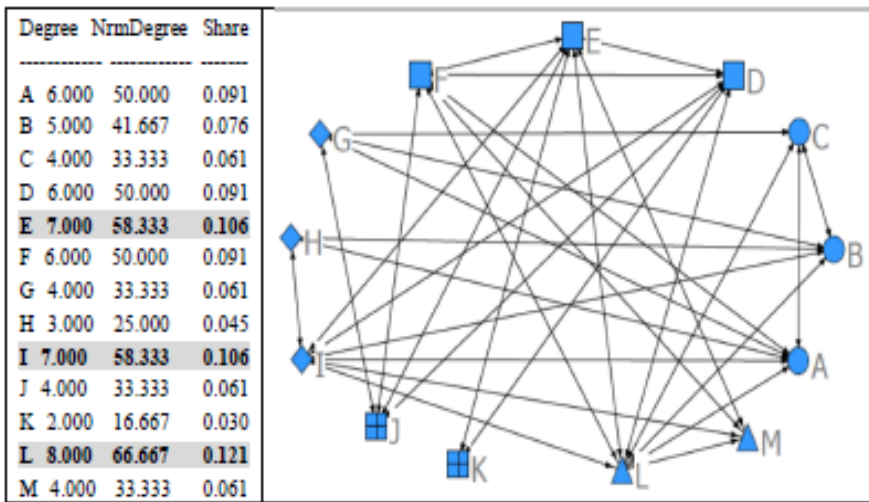


Figure 4. The social network graph of ecological conservation dimensions

4.2.2 Cultural inheritance:

Elements D (providing introductions and tours), E (engaging visitors in actual operations), L (preserving the original features of Matai'an), and M (promoting indigenous Amis cultural styles) were independently related to eight other actions. The link degree was approximately 67%. Elements D, E, L, and M were equally crucial for cultural inheritance.

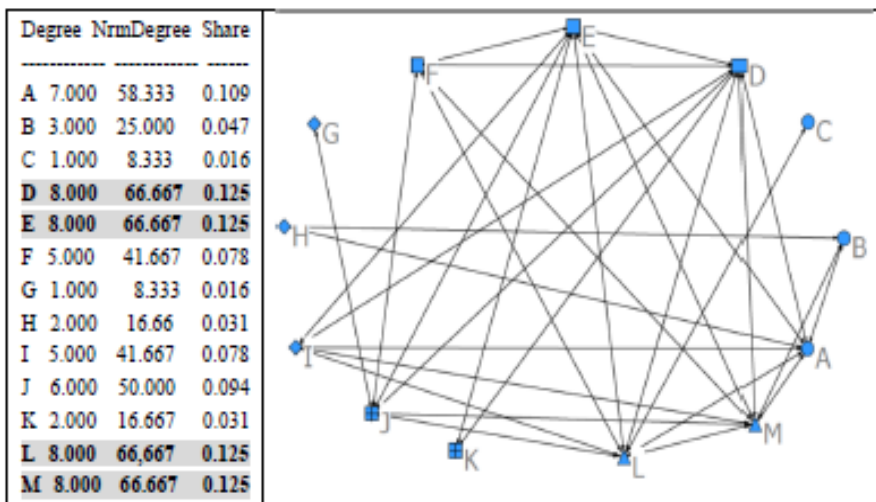


Figure 5. The social network graph of cultural inheritance dimensions

4.2.3 Industry development:

Element J (providing mutual support among local residents) was connected with the most number of actions (12 nodes); the link degree reached 100%. Elements A (providing traditional meals), L (preserving the original features of Matai'an), and M (promoting indigenous Amis cultural styles), which were equally crucial, were connected with the second-most number of actions (11 nodes); the link degree reached approximately 92%.

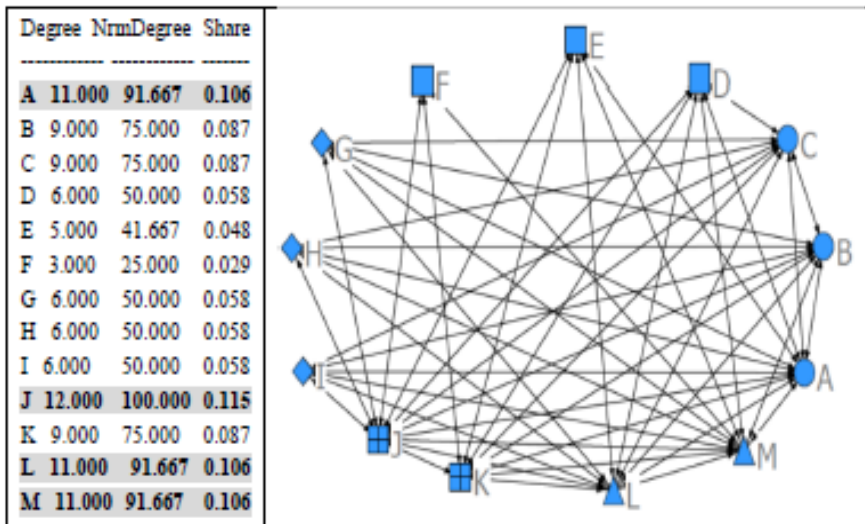


Figure 6. The social network graph of Industry development dimensions

5. CONCLUSION

This research found that local dietary resources are used to satisfy the dietary needs of local people and to develop local dietary cultures. Local dietary culture offers an alternative means of local and regional development, with the potential to strengthen identity, enhance appreciation of the environment, encourage the regeneration of local heritage and the economy. According to the social network analysis, the Matai'an tribe presented Amis dietary culture in various forms and practiced it in various ways. In the product dimension, local or innovative dietary experiences were provided. The space dimension involving the creation of a dining environment, comprised more links compared to other actions; in other words, creating a dining environment was crucial because it was connected with numerous nodes. Therefore, the Matai'an tribe used space as a medium for promoting traditional culture, which then became the basis for the creativity living industry, as well as for marketing local delicacies, craft works, agricultural products, cultural landscape, and in-depth tourism. Tourist consumption of local foods creates a market opportunity that can encourage the development of sustainable agriculture, help conserve traditional farming landscapes and assist the local economy.

Production and consumption processes in the creativity living industry increased job opportunities and local incomes. In particular, when local indigenous peoples are employed and trained as tour guides, they gain insight into the precious experiences of tribal elders and the values of traditional culture and ecological wisdom, and subsequently identify with and exhibit a sense of belonging to their culture. Consequently, cultural education and heritages are promoted, thus facilitating the preservation of Amis culture and

ecological conservation of the Matai'an Wetland. Moreover, Amis dietary culture attracts tourists and stimulates local economic growth. The local economy and industries can be diversified to achieve the prosperity of an ecological environment, social and cultural lifestyles, and a production-based economy. Through managing traditional Amis cuisines, providing ingredients required for creative Amis delicacies, and constructing a catering environment, the geographical landscape of Matai'an Wetland and biological habitats are preserved and unique edible plants are reproduced to protect the ecology and ensure biological diversity.

With the increased life quality of Taiwanese, the recreational industry leads to green tourism. To promote indigenous cultural industry, the characteristics of indigenous culture must be considered, rather than merely pursue mass production and economic benefits. The creativity must be fulfilled in the life and each industrial level. Exotic tribal characteristics of buildings and human resources should be highlighted in the planning of an indigenous the creativity living industry involving gourmet feasts, ecotourism, cultural-workshop visits, and daily living experiences to develop the creativity living industry that embodies the characteristics of tribal people, landscapes, and production activities. Ecological knowledge about means for coexisting with nature is the result of the long-term interaction between the aborigines of Taiwan and the natural environment, and it is an ecological value that should be promoted. Overall, the sustainable development of an indigenous tribal industry can be achieved by focusing on nature-based ecotourism, the creativity living industry based concepts, unique tribal cultural resources and natural landscapes, leisure activities aimed at conserving nature and achieving sustainable development, conventional industrial technologies, the creation of a knowledge economy, and integration of tradition and innovation.

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Exploring the Politico-Cultural Dimensions for Development of Smart Cities in India

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Keywords: Cultural theory, Environmental challenge, Socio-economic challenges, Smart city, Urban governance

Abstract: Indian cities seem to be in transition regardless of the various sustainability challenges they have experienced in recent years. Globalization, market economy, and technological developments have brought economic, social and infrastructural advantages. However, population growth, proliferation of urban functions, insurmountable increase in size of cities, and environmental crises because of climate change have caused the cities to experience severe spatial, infrastructural and environmental ailments. Besides, the significant rise of Information Communication Technology (ICT) industries in the cities and their socio-economic and spatial influence have brought about inequitable development. At this juncture emancipation of a political will to build smart cities in India provides a new impetus for changing the planning perspectives and warrants a politico-cultural discourse to examine the prerequisites and paradigms, which could aid in development of smart cities in India. Drawing upon the stimulating mix of past experiences and prospective approaches across the world and discussions with experts in the political science, local governance and urban development, this explorative paper provides a discourse on the concept of smart cities, opportunities, challenges and the way forward to realize the goals of smart city development in a heterogeneous but democratically unified country like India. Based on the discourse, it is argued that the current urban governance system is not congruent for development of smart cities in India. Therefore, it is advocated that a cultural theory inspired politico-cultural mechanism be explored and crafted to assemble the requisite elements of an urban governance system that should enable the dynamics and cohesion needed for developing smart cities in India.

1. INTRODUCTION

The majority of Indian cities seem to be in transition because of the changes in global economic and technological scenarios. Certain phenomena like globalization, adoption of market economy, and technological developments – particularly in the Information Communication Technology (ICT) sector and the consequent shifting in the industrial economic scenarios (like ICT and service industry that have become more predominant than conventional industries) – have brought some economic, social and infrastructural advantages to the cities. Concurrently however, severe sustainability challenges have been experienced. For example, huge population, proliferation of urban functions, insurmountable increase in size

of cities, and environmental crises have made the cities experience severe spatial, infrastructural and environmental ailments. There is a growing concern among the common men and professionals alike whether the cities of India will remain functional and contribute effectively to the socio-economic development of the country or degenerate and bring misery to people¹. At this juncture, emancipation of a strong political will to build smart cities in India offers new challenges to planners and as such provides impetus to change the planning perspectives.

Urban development is considered by many as mostly a physical and spatial challenge, although some also combine it to a certain extent with wider socio-economic challenges ([Stone, Clarence N, 1993](#); [Todes, 2011](#)). Although, it is equally a political ([Peterson, 1981](#); [Mollenkopf, 1983](#); [Ward, 1996](#)) and a cultural issue ([García, 2004](#)), such aspects are undermined in a large and diverse country such as India. The urban planning process in the country largely focuses on the technical and spatial challenges conducted by the professionals under the tutelage of decision makers, despite the provision of stakeholders' engagement and participation, which remains mostly marginal². Moreover, the democratic setup of governance has offered a political platform, which is perhaps the single most dominating factor that decides the fates of cities in India. The mammoth diversity that exists in the country in the form of race, religion, caste, class and socio-economic inequality, varied culture, etc., adds another dimension to the challenges. Thus, it is argued that the political and cultural issues cannot be ignored while deciding new paradigms and evolving policy interventions for the development of urban areas – particularly smart cities in the country. Thus, this scenario warrants a politico-cultural discourse to examine the prerequisites and paradigms, which could aid in development of smart cities in India. Therefore, the objective of this explorative paper is to examine the challenges of smart city development in India; and to proffer a politico-cultural discourse for engagement and participation of different social solidarities to realize the goals of smart city development in a heterogeneous but democratically unified country like India. In other words, it focuses on mapping the politico-cultural participative approach as the basis of planning smart cities in India. The article follows an explorative discourse, drawing upon a mix of past experiences and prospective approaches across the world available in the literature as well as discussion with experts and stakeholders engaged in the field of urban development, political science and local governance. Based on the discourse, it is argued that the rationale behind developing smart cities in India is not explicitly defined – and the current social and morphological characteristics of the cities as well as the governance system for development of cities are not congruent for development of smart cities in India. However, a cultural theory inspired programme may be explored and crafted to assemble the requisite elements of an urban governance system that should enable the dynamics and cohesion needed for developing smart cities in India, which could also help in achieving long term sustainability of such cities.

¹ View of urban development professionals and people who participated in the survey

² View of urban development professionals and political experts

2. THEORETICAL PERSPECTIVE OF SMART CITIES

‘Smart cities’ is a relatively recent concept which appeared small but gradually loomed larger - as affirmed by [Townsend \(2013\)](#) in the epilogue of his book ‘Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia’. Moreover, it has found more rhetoric in the academic literature on urban sustainability in recent years ([De Jong et al., 2015](#)). It has become one of the most popular formulations for the future city, and is becoming a globally recognized term, displacing ‘sustainable cities’ or ‘digital cities’ as the word of choice ([Moir, Moonen, & Clark, 2014](#)). However, scholars argue that it has been around for a long time – since the 1980s – although known in different ways such as ‘wired cities’ ([Batty, 2015](#); [Martin, 1978](#)). The smart city has no unequivocal definitions; different schools of thought and different approaches to build such cities have emerged. For example, in South Korea a smart city – Songdo – is developed to foster sustainable design practices through incorporation of the latest technologies that reduce energy consumption and increase energy efficiency, utilize recycled and natural materials and generate clean or renewable electricity ([www.songdo.com](#)). Another city, PlanIT valley in Portugal, is developed to combine intelligent buildings, transport, built environment information and energy systems with enhanced mobility, parking and emergency services ([Cavada, Hunt, & Rogers, 2014](#)); Living-PlanIT-SA, 2013). Similarly, Dholera in India was planned or being developed with a perception of seamless integration of urban planning with digital technologies being the most sustainable solution to rapid urbanization in India, which promises to be a new city without the annoyance of everyday urban life ([Datta, 2015](#)).

On the other hand, some scholars perceive a smart city in a more systemic way. To them, for example, it is a concept that is derived from the combination of concepts of the Connected city (smart logistics and sustainable mobility), the Entrepreneurial city (economic vitality), the Pioneer city (social participation and social capital), and the Liveable city (ecological sustainability) ([Nijkamp & Kourtik, 2011](#)). A smart city is not considered in a holistic manner, rather with reference to various aspects which range from ICT (Digital) districts to smart populace in terms of educational level ([Giffinger et al., 2007](#); [Komninos, 2002](#); [Lombardi, 2011](#); [Shapiro, 2005](#)). It has certain characteristics such as smart economy, smart people, smart mobility, smart governance, smart environment and smart living, which are measured by a set of indicators ([Das & Emuze, 2014](#); [Giffinger et al., 2007](#)).

Besides, [Townsend \(2013\)](#) argued that a smart city is not just a seamless web of integrated and joined-up technologies – which it probably never will be, but it is rather where information technology is combined with infrastructure, architecture, everyday objects and humans to address social and economic problems as well as the environment to create more liveable, functional and equitable cities ([Batty, 2015](#); [Datta, 2015](#); [Townsend, 2013](#)). Scholars like [Kitchin \(2014\)](#) see it as a city that is increasingly composed of and monitored by pervasive and ubiquitous computing as well as its economy and governance being driven by innovation, creativity and entrepreneurship enacted by smart people ([Kitchin, 2014](#)). Thus, essentially, smart cities are composed of technologies (being referred to as ‘everyware’) which are ubiquitous computing and digitally instrumented devices built into the very fabric of urban environments, that monitor, manage and regulate

city flow and processes; engage with place, activities and people – often in real-time ([Greenfield, 2006](#); [Hollands, 2008](#); [Kitchin, 2014](#)) and enhance efficiency and sustainability ([Hancke, de Carvalho e Silva, & Hancke Jr., 2013](#); [Townsend, 2013](#)). Furthermore, it is argued that the rich seams of data extracted from these technologies can be used to depict, model and predict urban processes and simulate the possible outcomes of future urban development ([Batty et al., 2012](#); [Schaffers et al., 2011](#)). It also supports infrastructure for business activity and growth and it stimulates new forms of entrepreneurship, especially with respect to service- and knowledge economy ([Kourtit, Nijkamp, & Arribas, 2012](#)). The economy and governance are driven by innovation, creativity, entrepreneurship and smart people ([Kitchin, 2014](#)). In other words, it has a business-led urban development and a neoliberal approach to governance ([Batty, 2015](#); [Deakin, 2014](#); [Hollands, 2008](#)); a focus on the social and human dimensions of the city ([Florida, 2005](#); [Hollands, 2008](#)); an adoption of a smarter community's agenda with programmes aimed at social learning, education and social capital ([Hollands, 2008](#)); and a focus on social and environmental sustainability ([Deakin, 2014](#); [Hollands, 2008](#)). Thus, although not limited to a congenial environment, a smart city offers economic opportunities and entrepreneurial endeavors; uses information and communication technology (ICT) as well as innovation to improve quality of life; provides a safe, efficient and emission free mobility system; possesses an education system and facilities to support research and innovation; possesses an appropriate health care delivery system; and has a responsive governance system as evidenced from various cities in North America and Europe ([Cohen, 2013](#); [Mercer Study, 2014](#); [Picon, 2015](#)).

As it stands in the Indian context, it provides two different pathways for development of smart cities. On one hand, it is envisaged to build cities like Dholera, which can be understood as a socio-technical manifestation of an urban utopia or an extension of a postcolonial modernization project with an aim to build new competitive global cities (or knowledge cities, IT Hubs, eco-cities, etc.) from the ground up with smart technologies led by ICT and create economic enterprises and opportunities to leapfrog or at least compete with the more mature economies ([Datta, 2015](#); [Kitchin, 2014](#); [Kant, 2013](#)). However, on the other hand, there is an effort to refurbish or transform some of the existing cities (which include for example Ahmedabad, Bhubaneswar, Kochi, Pune, etc.) to smart cities with incorporation of new and digital technologies and provision of essential amenities and services and make them more efficient. Moreover, according to the Ministry of Urban Development of Government India, the key pillars of a smart city include a clean and pollution free environment, efficient urban mobility, ICT connectivity, and energy efficiency through which an entrepreneurial and investment friendly, environmentally and aesthetically attractive and socially participative atmosphere can be created ([PTI, 2015](#)). It is envisaged that a smart city model, particularly in India – while improving the essential services through supply of adequate clean water, upgrading sanitation and the solid waste management system, making available 24/7 power supply, and strengthening urban mobility – will make people more informed and competent and enable them for higher participation in decision-making and governance. Besides, it would reinforce economic performance, enhance energy efficiency and reduce environmental pollution ([Pruseth & Satapathy, 2015](#); [PTI, 2015](#)).

Nevertheless, there are criticisms against the smart city concept. It is argued that the concept is either too narrow or on the other side too open,

expansive, and somewhat ambiguous (Greenfield, 2015; Russell, 2015). It may have been an outcome of the aggressive marketing by technological companies (such as IBM, CISCO, SIEMENS, etc.) to create new customers such as governments because of the reduction in their corporate customer base – and the willingness of city governments to show that they are trying to tackle the challenges and chaos of the rapidly growing cities (Datta, 2015; Townsend, 2013). Moreover, as Townsend (2013) suggested, a complex system like cities is intervened with peril, because truly smart cities would evolve and adapt technologies consistent with the way they grow naturally – slowly, one at a time, sensitively and calmly (Townsend, 2013). There is also a need to re-think issues of poverty, urban informality and development, particularly in the Global South (McFarlane, 2011). Besides, there are the challenges of dealing with the issue of widening inequality and social polarization (Graham, 2002; Hollands, 2008). Similarly, it is argued that the new technology will break the almost primordial psychic relationship between people and the materials (Greenfield, 2015) and will lead to an inevitable tension within smart cities between serving global-, mobile capital and stationary ordinary citizens; between attracting and retaining an elite creative class and serving other classes; and between top-down, corporatized, centralized development and bottom-up, grassroots, decentralized and diffuse approaches (Kitchin, 2014).

However, despite the various criticisms arising from the work of Townsend (2013), Batty (2015) argued that the smart city is in many senses the contemporary city that changes from the bottom up and thus new and smart technologies are closely woven into this fabric, which is evolved based on smart growth principle (Calthorpe & Fulton, 2000; Kunstler, 2003; Turner, 2007). Apart from technology, people and the governance system will remain central to the development. In case it is not so, it can only serve the elites instead of all city dwellers, and thus presents governance challenges to smart city development (Hollands, 2008). Consequently, it is argued that development of a smart city is not a challenge of technology or data, but rather a challenge of what role technology or data can play in providing a set of core public goods and infrastructures and protecting the people (Bhan, 2015).

3. APPROACH OF THE INVESTIGATION

A qualitative research method that includes review of literature and qualitative discussions with stakeholders was followed. Relevant published and unpublished literature and documents were reviewed to understand the theoretical paradigms behind smart cities, the governance system, and socio-political-, cultural-, and morphological aspects of cities in India. For this purpose, data bases like Scopus, ProQuest, Science Direct, Google Scholar and other relevant websites were searched. After initial screening, overall 78 articles that include peer reviewed research papers (39), books and book charters (23), study reports (9) and news articles and blogs (7) were selected. Selection of the articles was based on their source of publication, authenticity of publications and their relevance to the study. For example, peer reviewed journal articles and conference proceedings were given first priority, followed by official reports and reports from companies, newspaper reports, blogs from reputed scholars and opinions of people engaged in the smart city development process. The articles and reports were hierarchically coded according to the three stands of discourse, with peer reviewed journal

articles and conference proceedings as the first priority, followed by reports, newspaper articles and blogs and opinions. Literature reviews and discourse analyses were conducted on three strands of discourse such as (1) theoretical perspectives of smart city (definitions, approaches, criticisms in general and smart city in an Indian context); (2) urban development processes; urban development challenges; city administration and challenges of smart city development in India; socio-political-, cultural-, and morphological aspects of cities; and (3) mapping the politico-cultural perspectives of smart city in India. The published research articles selected were critically reviewed to develop a theoretical background of smart cities and theoretical insights for plausible policy interventions. Similarly, published and unpublished reports and archival records relating to urban development processes, urban development challenges, city administration and challenges of smart city development in India were reviewed to comprehend the socio-political-, cultural-, and morphological aspects of cities in India. The opinions and blogs were used to supplement the discussions obtained from critical review of the articles and the developing storylines of the stakeholders.

In addition, discussions with relevant stakeholders were conducted by applying a random sampling process and using a semi-structured interviewing method. The stakeholders constitute academicians, experts in the field of urban development, urban development professionals, architects, engineers, urban development administrators, political scientist, political leaders and municipal councilors, students, business men, merchants and personnel from the industry. The selection of respondents was based on their awareness of- and engagement in the smart city development process after confirmation through an initial scrutiny. For this purpose, a search of profiles to identify prospective respondents was done by using online search engines such as Google; contacting relevant organizations and institutions; and examining various promotional materials and advertisements. An initial scrutiny of the searched profiles was done to observe the personal profiles and professional activities of prospective respondents and their engagements with regards to city development, and to avoid personal bias, prejudices and affiliation with the investigator. The selection of the respondents was confined to five of the twenty cities that have been selected in the first round for development as smart cities in India. The selected cities include Bhubaneswar, Pune, Vishakhapatnam, New Delhi and Ahmedabad, of which the locations are geographically well distributed so as to represent the country. Then, from the search and subsequent scrutiny, a list of 76 people (prospective respondents) was drawn by using a random sampling process. Once the list of prospective respondents was drawn, they were contacted via telephone, e-mail (if available) or personal contacts visiting them, to determine their suitability for the survey and to invite them to participate in the survey if found suitable. While selecting respondents, care was also taken not to discriminate against or exclude any person based on his/her race, gender, religion, social and economic status, occupation and similar attributes. Of the total contacts made, about 54 people (71.05%) responded positively and gave their consent to participate of which 7 people later withdrew. Eventually, discussions were made with 47 willing participants. In addition, repeated discussions were made with some of the stakeholders – which include experts, political scientists, professionals and academicians – in an iterative manner to frame social solidarities and understand the level of participation and responsiveness in the governance of the cities. Table 1 presents the various demographic and professional attributes of the

respondents. The gender, age and professions of respondents are also proportionately distributed, thus avoiding any bias.

The outcomes of the snowballing process of discussions over the period of June 2013 to December 2015 were compiled and qualitatively analyzed by using the narrative analysis method ([Riessman, 1993](#)).

Table 1. Profile of respondents

Category (Profession)	Share	Gender	Share	Age	Share
Academicians	5 (10.6)	Male	27 (57.4)	18-24	6 (12.8)
Political leaders and municipal councilors	8 (17.1)	Female	20 (43.6)	25-35	10 (21.2)
Urban planning professionals	10 (21.2)	Total	47 (100.0)	36-50	14 (29.8)
Architects and Engineers	8 (17.1)			51-60	12 (25.6)
Urban development administrators	6 (12.8)			>60	5 (10.6)
Businessmen, merchants and industry personnel	10 (21.2)			Total	47 (100.0)
Total	47 (100.0)				

Note: The numbers in brackets show values in percentage.

4. CHALLENGES OF DEVELOPMENT OF SMART CITIES IN INDIA

4.1 Challenges against the rationale behind the development of smart cities in India

An enthusiasm is clearly visible among the political leaders, business leaders and professionals alike regarding the development of smart cities in India. Perhaps, the idea of building smart cities in India has emanated from the current poor plight of Indian cities and the visual experiences some of the European-, American- and of late Asian cities provide. An argument has emerged that if countries across the world could be able to build such cities, why should India fall behind³. However, the planning process is often found to be circumvented by formality and legality ([Bhan, 2013](#); [Roy, 2009](#)) and the development of cities in India is observed to be more of a political decision than any other rationale⁴. Thus, professionals like urban planners do not have another choice than to comply with the political decisions⁵. However, experience has shown that many things have gone wrong in the past if the development has not been well conceived and not been well comprehended at the outset. For example, the case of ambitious programmes – like the Provision of Urban Infrastructure in Rural Areas (PURA) ([Indra, 2012](#); [Ramesh, 2012](#)) and various urban development and renewal schemes – which have met with failures or in some cases with mixed successes⁶, although decision makers, executive authorities and people advocating such programmes and schemes differ from this viewpoint. However, the results are clearly visible from the plight of the cities in India, which are facing

³ Political leaders, urban development professionals and people from industries

⁴ Expert opinion obtained from discussions with chief executives and councilors from municipalities of the selected cities, India

⁵ Urban development professionals from Bhubaneswar and Pune

⁶ Urban development professionals, urban planners, businessmen and expert opinion

severe spatial, infrastructural and environmental challenges⁷. So, there is a need to explore how success in development of smart cities can be achieved, which essentially requires a discourse eliciting the challenges of building smart cities in India, and evolving a politico-cultural perspective that can be considered while planning to build such cities in India.

Important questions that emanate from this discourse include the following: What is a smart city and what does it entail? What is it intended for in India? Besides, while deciding to build smart cities, further questions arise as to whether new cities which should be smart should be built or whether some of the existing cities should be transformed to smart cities. In addition, debates arise on who these cities should be built for and what implications they will have on the country as a whole or on individual entities like people, society, economy, built environment, and so on. The answers to these questions would perhaps be able to provide directions that are essential for developing smart cities in India.

So, in the Indian context, there is a need to examine what is exactly aimed at while trying to build smart cities. Is it to transform the existing cities or part of cities to smart cities or is it to build absolute new cities improving all or some characteristics? In both cases, whether transforming the existing cities to smart cities or building new smart cities, the challenges to be faced are plenty. In the case of existing cities, broadly the morphology of the cities, the huge population, the spatial extent, and the heterogeneity in urban functions are barriers in transforming the cities to smart cities.⁸ Rather, if one or two aspects are improved or made more functional – depending on the potential of the cities and the opportunities they offer – perhaps some success may be achieved. For example, cities which provide opportunities for entrepreneurial activities or educational or communicational activities (ICT industry development) – like Ahmadabad, Pune or Bhubaneswar – could be transformed to entrepreneurial or pioneer cities. Cities like Pilani, Kharagpur, Roorkee, etc., which have a very strong presence in education and knowledge-based activities can be transformed to cities with smart people and so on.

The other aspect is whether the idea is to build new smart cities. Although, like Dholera, cities are being built –as global cities to compete with cities of mature economies ([Datta, 2015](#)), certain questions still arise such as: Is motivation behind building such cities at a huge expense well placed when the existing cities need more attention? Furthermore, who are these cities being built for – who will be benefited? What kind of cities will they be? Who will invest and what will their implication be on the society, and so on. For example, if digital connectivity (ICT connectivity) is taken as the sole or major consideration to make the cities smart and economically competitive, then digital cities should be built, which is far away from the concept of smart cities. Besides, there is no distinct requirement to make a few cities digitally connected, as digital connectivity is not necessarily bound by spatial boundaries. Rather, there is a necessity to digitally connect the whole country. Secondly, creating a few advanced (more recently known as green-, eco-friendly-, energy-efficient- and similar) buildings along with digital connectivity and using them for specific purposes in a specific area, cannot be counted as development of smart cities. Besides, developing new cities in proximity to existing large cities – like satellite cities with all the modern infrastructures – and using them for specific purposes, may not serve

⁷ Urban development experts and political leaders

⁸ View of urban planning professionals and experts

the purpose. The reasons being that with the fast expansion of cities, which has been witnessed over last decades, these new developed areas will soon be engulfed by the existing cities and be assimilated with them. Furthermore, the unequal infrastructure development may create disparity among different areas of the existing cities⁹. Thus, building new cities or transforming a part of the city with digital connectivity and advanced buildings does not make a city smart. On the contrary, it may create spatial, infrastructural and environmental inequality, and add unwarranted pressure on the existing built environment, which may compromise the sustainability of both the new and existing cities. Besides, it requires investment, of which a lion's share is likely to come from the public exchequer and from common tax payers, whereas only limited people or entities such as enterprises and the corporate sector will be benefited at the expense of the common people¹⁰.

4.2 Challenges of the prevalent general characteristics of Indian cities

There is a need to examine the general prevalent characteristics of Indian cities and understand if they could suffice to the mentioned characteristics on which development of a smart city rests. Most of the Indian cities – regardless of their size and character – have some economic functions. However, barring a very few cities, most of the cities lack innovation, entrepreneurship, trademarks, productivity and flexibility of the labor market as well as integration in the national and international market¹¹. Although, many medium and large cities of late boast of a higher education system and the level of qualification or education of the people has been enhanced, they lack quality and employability ([Aspiring Minds, 2010](#); [Sarkar & Choudhury, 2014](#)). There is some social interaction and integration but it is quite sporadic and sectoral, which is evident from intolerance and unwarranted communal happenings in the city life over the years. The participation of people in public life and the receptive attitude and openness towards the outer world is very limited¹². These features of the cities indicate towards a lower level of smartness of the urban population in the country. The 73rd and 74th amendment of the Indian constitution enabled governance by people at local level. It entails facets of political participation, services for citizens and the functioning of the administration. However, it is observed that the local governance has been limited to political processes by political leaders and executives and the will and wishes of the majority of the citizens are grossly being neglected. The local governance has become a tool for personal benefits of unscrupulous politicians, greedy businessmen and entrepreneurs¹³. For example, the cityscape and development of industrial and commercial zones are dictated by real estate developers and industrial entrepreneurs. Thus, the opportunity for smart governance is minimal. In recent times there has been enhanced local and international accessibility in the form of sustainable physical transportation systems and information and communication technologies. Arguments have emerged that ICT offers distinct advantages to the cities, which may provide opportunities for smart

⁹ View of urban planning professionals and experts and personnel from industries

¹⁰ Expert opinion: Professionals and academicians involved in urban development

¹¹ Expert opinion: Professionals involved in urban development and members from Chamber of Commerce, India

¹² Political scientist and experts in local governance

¹³ Academicians and experts in urban and regional development, political scientist and expert in local governance

information transfer and aid in mobility. However, despite being digitally accomplished, the level of physical movement in cities is still enormous. The traffic scenario is deplorable ([Alam & Ahmed, 2013](#); [Kumar, 2013](#); [Rao & Rao, 2012](#)). Public transportation is not a popular choice nor efficient enough to encourage people to adopt it ([Alam & Ahmed, 2013](#)). The greed of the automobile industries, the business model around automobile and related service industry, such as the finance sector, insurance sector, energy sector, etc., and the false vanity of owning a private car make the situation worse¹⁴. On the other hand, although it is emphasized that the ICT sector in cities has developed by leaps and bounds, the service providers are more interested in business and profits than in efficient services. Consequently, lower performance is experienced¹⁵. With regard to environment, the question is whether the cities have attractive natural conditions such as climate, green open space, level of pollution, resource management and efforts towards environmental protection. It is observed that open drainage and poor sewerage systems are common. Solid waste management is almost non-existent in many cities in India and pollution levels are undesirably high ([Annepu, 2012](#); [Bundela et al., 2010](#)). Furthermore, paradoxes are found in socio-cultural aspects such as culture, health, safety, housing, tourism, etc. The country has a great culture but often lacks communal and social harmony¹⁶. Health care service has become an unsavory business model with the collusion of health care centers, pharmaceutical industries, diagnostic centers, medical insurances and other stakeholders. Maximization of profit is the major motive, often at the expense of services ([Das & Sonar, 2012](#)). The poor environment and unwarranted physical and mental stresses are leading to more people in the cities being unhealthy. Safety and security in the cities are on the wane. Terrorism and crime have become part of the city life. The housing scenario is no better. Slums, squatters and urban sprawl are an integral part of the cities¹⁷. Many of the cities have good tourism potential, which is the only silver lining ([Gyan Research and Analytics Pvt. Ltd., 2012](#); [KPMG, 2013](#)).

In the wake of such challenges, it is observed that most of the cities in India are not tuned towards transforming to smart cities. Because of the challenges of people, governance, living- and environmental factors, it is also difficult to comprehend if new smart cities can be developed.

4.3 The challenges of stakeholders' participation in development of cities in India

A coalition of relevant stakeholders is imperative and their collaborative and participative approach is vital to sustainable development of cities. However, most studies undertaken to assess the functioning of municipalities or urban local bodies in India point out that their performance has deteriorated over time ([Aijaz, 2007](#); [Fahim, 2009](#)). They are confronted with a number of challenges, such as inefficiency in the conduct of business, ineffective participation by the weaker sections of the population in local governance, weak financial condition, lack of transparency in the planning and implementation of projects, etc., which affect their performance adversely ([Aijaz, 2007](#); [Fahim, 2009](#)). Under this premise the 74th

¹⁴ Expert opinion and professionals from urban development field

¹⁵ Member from CCI and professionals from urban development field

¹⁶ Expert opinion: Political scientists

¹⁷ Expert opinion from local governance and political scientist

Amendment Act, 1992 of the Indian Constitution was enacted with the following aims: to provide a basis for the State Legislatures to guide the State Governments in the assignment of various responsibilities to municipalities/ urban local bodies and to strengthen their governance in a bid to achieve democratic decentralization and provide constitutional endorsement to local self-governance authorities with participation of people at the grassroots level, aided with devolution of greater functional responsibilities and financial powers to municipalities/ urban local bodies; adequate representation of weaker sections and women in municipalities; regular and fair conduct of municipal elections; and constitution of Wards Committees, District Planning Committees, Metropolitan Planning Committees and State Finance Commissions. The central objective of this amendment act is the decentralization of planning and decision making procedures at urban area level. It also has the implicit intention of removing centralized notions of control and monopoly over development of resources. In this respect, the local governments or councils are representative of the people and they have the right of governance of their cities and are empowered to take appropriate decisions on behalf of the people. Furthermore, people or stakeholders are also consulted at the planning stage of any city development/ redevelopment process and feedbacks are taken before finalizing the plan. Based on this supposition, the system seems to work fine. However, it is observed that while many provisions of the 74th amendment act are met at structural level, such as constitution of three types of Urban Local Bodies, reservation of seats in the municipal councils, and constitution of State Financial Commissions, yet same cannot be said about certain provisions such as the constitution of Wards Committees, District Planning Committees and Metropolitan Planning Committees because of the lack of commitment from the State Governments, which essentially hinders the stakeholders' participation ([Aijaz, 2007](#); [Fahim, 2009](#); [Govinda Rao & Singh, December 8-10, 1999](#); [Singh & Rao, 2006](#)). Besides, although the municipal councils or local governments are set up constitutionally, most of the decisions are taken based on the pull and push factors ([Das & Sonar, 2013](#); [Stone, Clarence Nathan & Sanders, 1987](#)). In some instances, the individuals representing the council sway the decisions although they may have conflict of interest and in Indian conditions conflict of interest is not strictly defined. Political hegemony takes precedence over scientific logic and rationality. The council is also at times not well advised of their decisions by the professionals – maybe due to various personal and professional reasons such as individual affiliation to the decision makers, fears of loss of job, personal benefits, lack of knowledge or skills, rejection of professional advice, or the likes¹⁸. Above all, the stakeholders or the people at large are essentially not a part of such decision making. Also, although the system of feedback from the people or stakeholders does exist and is sometimes practised, it is done at a very late stage where their wishes or arguments do not hold much significance and as such are not given enough priority¹⁹. Besides, in some cases there are peoples' committees at various levels – from neighborhood-, suburban- to city level, and also at various professional levels like chamber of commerce, industry, culture, etc., – whose advice is sought. However, these committees do not have much authority and are basically advisory in nature without much significance in

¹⁸ Expert opinion: Political scientists and local governance expert

¹⁹ Executive officers, urban development authorities

the decision making process²⁰. Moreover, these committees are also characterized by conflicts, factions and self-motives, thereby not contributing much to the democratic decision making process of the development of the cities as envisaged by the constitution²¹ ([Stone, Clarence Nathan & Sanders, 1987](#)).

This condition is mainly attributed to a lack of responsibility and accountability and lack of respect to the stakeholders. Although, the said constitutional amendment act was enacted in a spirit of governance at the grassroots level and it can be viewed as being successfully functional from a structural point of view, the role of various stakeholders such as common citizens of the city/ urban area, businessmen, civil society, etc., are largely ignored, thereby confining the city development process to the hands of a few technical and administrative people under the auspices of local political elected leaders²². Thus, the question arises: when there is a clear mandate from the constitution, which strengthens the local governance with a spirit for sustainable development of cities – per se urban areas – by preparing and implementing plans for economic development and social justice, why are most of the cities of India languishing with improper development and poor services and facilities? The argument here is that possibly the top down approach of governance – even within the urban local governance; the ignorance and non-assimilation of a critical mass of stakeholders; and the manipulation of pressure groups such as real estate and property developers with a sole aim of short term gain, are the major barriers in achieving sustainable development²³. Reflecting these concerns, it is argued here that in the city development process, procedural equity is of great importance to achieve desired smart growth and appropriate sustainable development²⁴. It involves much more than legalistic and bureaucratic procedures for establishing and enforcing obligations and rights. In addition, it needs to embrace wider processes of public engagement, where multiple democratic and participative forms and channels are brought into play to foster participation and engagement with processes of change. This concern suggests that people should have access into public decision-making processes at different points (in particular at the junction of public and private decision-making affecting common city people). This requires a balancing of democratic and participative methods of engagement with decision-making, rather than a displacement of necessary democratic responsibilities by urban local bodies.

It is thus construed that there are several challenges which bar the development of smart cities in India. The challenges range from the rationale behind the decision to build smart cities, prevalent spatial and social characteristics, to issues in urban governance and stakeholders' participation. However, even if the first two challenges (rationale and prevalent city characteristics) are left out, the major issue in the current scenario is the minimal participation of various social solidarities in the development of Indian cities. Therefore, while developing smart cities in the country, the local urban governance issue needs to be resolved. This essentially seeks a new politico-cultural perspective that can bring fruitful engagement among the stakeholders and lead to development of smart cities based on the

²⁰ Members of Chamber of commerce

²¹ Expert opinion: Political scientists and local governance expert

²² Expert opinion: Political scientists and local governance expert

²³ Urban development professionals including architects and engineers

²⁴ Expert opinion: Local governance and urban development

requirements of the various solidarities of the society rather than benefiting only one segment of the society.

5. POLITICO-CULTURAL PERSPECTIVES FOR DEVELOPMENT OF SMART CITIES

As evident from the previous sections, it is ironic that in a populous, diverse and democratic country like India, most of the urban planning and development are concentrated in the hands of a few authorized people (executives and decision makers) who more often succumb to demands of the political/local leaders and/or pressure groups. Although, the 74th amendment of the constitution – in an attempt to involve local leaders and people in the development of their cities – has leveraged the urban local bodies to take decisions, it is not necessarily true that the local political leaders, who are divided in ideology, race, religion, caste and so on, represent the requirements of common people²⁵. In other words, the opinions or the decisions of the political leaders or pressure groups at times hardly reflect the demands of the society. Despite the constitutional interventions, the planning process largely remains a top down approach. Therefore, at the current state, it would be wrong to assume that development of smart cities in India will follow a different approach²⁶.

However, sustainability of smart cities can be achieved if a smart growth principle for development is adopted. Examples across the world are plenty. The cities of Europe, particularly from Austria, Switzerland, Benelux and Scandinavian countries, are the leading flag bearers which have shown how cities should be developed through application of smart growth principles and effective governance. Another glaring example is the participative city governance (with effective participation from all strata of the society) of Vancouver in Canada. The smart growth principles advocate that growth of a city is accomplished by combining the various discourses of physical and spatial issues into a rational sustainable development that integrates economic, environmental and social equity issues. It also invokes the notions of urbanity, creating a sense of a coherent community ([Calthorpe & Fulton, 2000](#); [Kunstler, 2003](#); [Turner, 2007](#)). It is a strategy that targets the physical development of urban regions, having strong social, economic and political components with public participation. It is an inclusive multi-actor planning process ([Brunet-Jailly, 2008](#); [Scott, 2007](#)). However, it is evident from many cases in India that multi-actor planning and stakeholders' involvement in planning of the development is a hugely cumbersome and difficult process. The conventional approaches of stakeholders' participation may not assure successful planning and development. It needs a new paradigm to make the participatory planning more inclusive and effective. The challenge, however, particularly while developing smart cities, can be overcome by creating a platform by applying theories of social organization and governance, such as the cultural theory or refurbishing the theory of Dahl's pluralist democracy ([Douglas & Wildavsky, 1983](#); [Schwarz & Thompson, 1990](#); [Thompson, Ellis, & Wildavsky, 1990](#); [Thompson, Rayner, & Ney, 1998](#); [Thompson, 2008](#); [Verweij & Thompson, 2006](#)) .

The cultural theory maps a fourfold typology of social solidarity: the individualist, hierarchist, fatalist and egalitarian ([Douglas & Wildavsky,](#)

²⁵ Expert opinion: local governance

²⁶ Academicians and political scientists

[1983](#); [Thompson, Rayner, & Ney, 1998](#)). For the individualist, man is inherently self-seeking and atomistic. The nature is benign and forgiving, and can be able to recover from any exploitation. Trial and error in self-organizing, ego-focused networks (markets) is the way to go. Individualist actors trust others until they give them reason not to and then retaliate in kind ([Rapoport, 1985](#)). They institute equality of opportunity (symmetrical transactions) and promote competition, which is no accountability. They see it as only fair that those who put most in get most out. The world, in the hierarchist solidarity, is controllable. Man is malleable, deeply flawed but redeemable by firm, long-lasting and trustworthy institutions. Fair distribution is by rank and station or, in the modern context, by need, with the level of need being determined by an expert and dispassionate. Hierarchies set all sorts of limits on competition. Fatalist actors (the common men here) find neither rhyme nor reason in nature and know that man is fickle and untrustworthy. Fairness, in consequence, is not to be found in this life and there is no possibility of effecting change for the better. The egalitarian solidarity is almost the exact opposite. The nature – and society in this case – are fragile and intricately interconnected and man is essentially caring and sharing, until corrupted by the coercive and non-egalitarian institutions of markets and hierarchies. It is not enough that people start off equal, but they must end up equal. Trust and leveling go hand in hand, while institutions that distribute unequally are distrusted. Voluntary simplicity is the only solution to the societal problems. These solidarities suggest that each generates its own storyline which contradicts those that are generated by other solidarities ([Douglas & Wildavsky, 1983](#); [Thompson, Rayner, & Ney, 1998](#)) and that the complex dynamics of their interactions can lead to sometimes destructive and sometimes constructive directions ([Beck et al., 2011](#)). Each of the solidarities distils certain elements of experience and wisdom that are missed by the others, and as such each provides a clear expression of the way in which a significant portion of the populace feels they should live with one another and with the society. It is important that some sort of account be taken of all of them in the policy process and that each of the three active voices – individualism, egalitarianism and hierarchism – and the passive voice (fatalist) be heard and become responsive to the other in the state of affairs ([Verweij & Thompson, 2006](#)). This approach has been put into practice and has observed success. Case studies include the resolving of the water sanitation system in Kathmandu valley; the Chattahoochee issue in Atlanta; access to service delivery (particularly in sanitation and solid waste management) by people in Kamapala; and ameliorating the problem of hygiene and sanitation in Yaoundé ([Beck et al., 2011](#); [Parrot, Sotamenou, & Dia, 2009](#); [Tukahirwa, Mol, & Oosterveer, 2010](#)). Although, in all these cases the engagement of different solidarities brought some clumsy solutions, it provided some prospect of collectively accepted progress. For example, in the case of Kathmandu valley, this cultural theory inspired mechanism has led to the scenario that no conservationist group (egalitarian) can argue for ‘no growth’ in the face of the highly emotive condition of insufficient water for drinking. Similarly, the situation is recognized as beyond any promises the water agencies (hierarchist) might care to make in order to maintain control over their framing of the problem for their way of problem solving. Although, the private sector of water-tanker supply (individualist) struggles to sell its services, it found a few crumbs of comfort ([Beck et al., 2011](#)).

Based on this premise, the whole Indian society can be placed in these four solidarities as shown in Figure 1. Adopting the premise of the works of [Beck et al. \(2011\)](#) and ([Kubanza, Das, & Simatele, 2017](#)), the four

solidarities were developed and stakeholders were grouped under each of the solidarities after repeated discussions with some of the stakeholders and surveyed experts. Accordingly, as seen in Figure 1, the common and individual people like professionals, academicians, merchants, students, laborers, etc., are the fatalists; the industry, corporate sector, entrepreneurs and market represent the individualists; the governance system, political parties, political leaders, bureaucracy, etc., represent the hierarchists; and the Non-Governmental Organizations (NGOs), community based organizations (CBOs) and the society as a whole are the egalitarian actors. In the case of urban development in India, it is evident that the fatalists are the sufferers and that they are not heard²⁷. It is only the hierarchists (the political authorities and bureaucracy), and the individualists (the market forces/industry) who dominate the process. The market forces decide the functioning of the system in an unwarranted way and there are significant gaps in the functioning of the hierarchy (the governance system) which should be overseeing and articulating the system for the proper function and results to a non-egalitarian society²⁸. The egalitarian voices represented by CBOs, and NGOs are handicapped by shortage of resources and patronage and are donor dependent, therefore they are not always effective and are often not heard²⁹.

<p>Fatalism Common people and individual people like professionals, academicians, merchants, students, laborers, etc.: Voices are not heard, apathy and unwillingness to participate in any development process. Lack of trust and confidence in the government, new policy programs, institutional landscape and individual benefit.</p>	<p>Hierarchism Political parties, political leaders, government, bureaucracy, urban authorities, municipalities: Believe in rules and regulations, control and top down approach.</p>
<p>Individualism Industries, private companies, entrepreneurs, corporate sector: Don't care about common urban dwellers and higher profit motive.</p>	<p>Egalitarianism CBOs and NGOs: Hampered by shortage of resources, patronage and donor dependencies.</p>

Figure 1. Perceptions of social solidarities in Indian cities (Adopting the premise of works of Beck et al. (2011) and Kubanza, Das, and Simatele (2017) and discussions with stakeholders)

However, the democratic process insight suggests that any planning and/ or policy process needs to ensure that all the actors be involved and their storylines be fully developed into scenarios that are then engaged with one another – it may be noisily and argumentatively – and then to bring out a solution.

²⁷ Political scientists, professionals, government officials, people form NGOs and CBOs and academicians

²⁸ Academicians, students and political scientists

²⁹ Political scientist, local governance expert, urban development professionals

Based on the classic theory of refurbished pluralist democracy ([Dahl, 1989](#)) and adopting the works of [Beck et al. \(2011\)](#) and [Kubanza, Das, and Simatele \(2017\)](#) and stakeholders' opinion (through repeated discussions with various stakeholders and experts to arrive at the most acceptable phenomena that are occurring or are expected to occur in the governance system) a mapping between participation of stakeholders and responsiveness of the governance system was done and presented in Figure 2. As seen from Figure 2, by putting participation and responsiveness – the two pillars of a democratic process – in a nine provinces (blocks) map, it is apparent that as participation and responsiveness increase, deliberative quality also increases. In the current scenario, although there is no closed hegemony in the Indian urban local governance (as shown in block 1) where one voice drowns all and fatalists are not heard because of the democratic governance system, it rests in scenarios with participation and responsiveness varying between low to medium as shown by squares 2, 4, 5. Essentially, such scenarios are not ideal because of either lack of adequate and effective participation and/or adequate responsiveness. It is also inappropriate to expect an ideal scenario (as represented by block 9), where each voice is heard and responded to. However, there is a possibility of increased participation and responsiveness if all four solidarities are participating and responding (as represented by Block 6 and 8), which may lead to the ideal scenario further on as the process gains maturity³⁰. Perhaps, the interaction of the four solidarities is not to result in an elegant solution as many expect and although the engagement and socio-economic trade-off among them could provide a clumsy solution, it could be responsive to each other and acceptable to all ([Beck et al., 2011](#); [Kubanza, Das, & Simatele, 2017](#); [Thompson, 2008](#); [Verweij & Thompson, 2006](#)). Therefore, while developing smart cities, it is highly imperative that all these solidarities – which represent common men (citizens including teachers, students, doctors, professors, merchants, laborers, rickshaw pullers and so on); the industry (entrepreneurs, the corporate sector); the governance (government, bureaucracy, professionals, political leaders); CBOs and NGOs and so on from across the whole society – must engage in a constructive, but maybe clumsy manner. They must be part of the development process and develop a kind of belonging so that the development and sustainability of smart cities in India could become a reality. Or else, if the development process is left in the hands of only the hierarchist and individualist actors, they could only produce short term solutions or may simply use it for their myopic benefits. Consequently, the development of smart cities in India will suffer and may perhaps not be realized the way it is envisaged³¹. The advantages of this paradigm lie in clustering the plethora of stakeholders into four social solidarities, which would reduce the plethora of stakeholders to manageable groups that would facilitate effective constructive engagement among them based on their storylines (demands) and arrive at compromises through concessions rather than consensus. In other words, every solidarity will get maximum of what they want and minimum of what they don't want ([Thompson, 2008](#)).

³⁰ Political scientists, urban development professionals, government officials, people from community organisations and common people

³¹ Urban development professionals, members from business and industry, students and political scientists

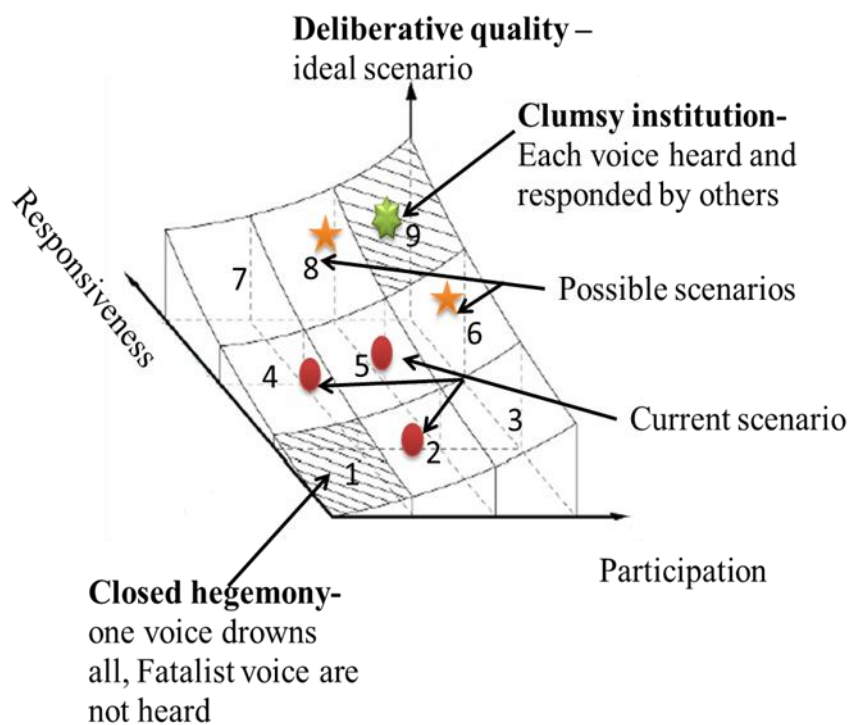


Figure 2. Adoption of the theory of plural democracy for urban governance (addition of politico-cultural dimensions) to aid development of smart cities in India (Adoption from [Beck et al. \(2011\)](#); [Dahl \(1989\)](#) and [Kubanza, Das, and Simatele \(2017\)](#) and stakeholder's perception).

6. CONCLUSIONS

This article was focused on examining the challenges of smart city development in India; and mapping a politico-cultural discourse for engagement and participation of different social solidities to realize the goals of smart city development in India. The first challenge is to clearly understand what is meant by the smart city concept and how it is relevant in the Indian context. Secondly, whether the challenges provided by the general and morphological characteristics of existing cities are attuned to transform them to smart cities. Besides, the article explored how the challenges and inadequacies of the current governance system may become a barrier in the development of smart cities in the country and how it can be overcome by a cultural theory premised planning process.

There are no equivocal definitions of a smart city and different approaches for developing smart cities are seen. In the Indian context, as argued by scholars, government authorities and practitioners, although there is a lack of clarity, two distinct approaches are experienced such as building cities like Dholera from scratch with an integration of ICT with urban planning to further economic goals and build competing cities at global level. On the other hand, there is the refurbishing of existing cities such as Ahmedabad, Bhubaneswar, Kochi, Pune, etc. with an integration of ICT and strengthening of the essential urban infrastructure. Apparently, India will have context specific smart cities of its own genre and thus needs a different planning perspective to build these cities. Therefore, this article argued for

a new politico-cultural perspective in the governance system for development of smart cities, based on the cultural theory. It advocated for constructive engagement among the various solidarities of the society, which represent the various stakeholders, such as common people (fatalists), industry and market forces (individualists), governance system (hierarchists) and community-based and non-governmental organizations (egalitarian). This politico-cultural perspective is envisaged to provide a platform for the fruitful engagement among the various stakeholders, listening to each other's storylines and arriving at compromises through concessions, although it may be in a very clumsy way as against the current approach of democratic consensus and without significant participation of the society and stakeholders. It could be able to develop a sense of belonging and make them part of the development process, which is highly essential for development of smart cities and their long term sustainability in India. Moreover, it has the advantage of grouping the often experienced insurmountable and unmanageable numbers and categories of stakeholders into manageable four solidarities and listening to their demands and developing their storylines more effectively that could enable acceptable and inclusive development of smart cities in India.

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Big data for intrametropolitan human movement studies

A case study of bus commuters based on smart card data

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Key words: Big data, human movement, intra-metropolitan, bus

Abstract: Unlike the data from traditional sources, there have not been standard ways to validate the quality and reliability of information derived from big data. This article argues that the theory of urban formation can be used to do the validation. In addition, the information derived from big data can be used to verify and even extend existing theories or hypotheses of urban formation. It proposes a general framework regarding how the theory of urban formation can be employed to validate information derived from smart card data and how the validated information can supplement other data to reveal spatial patterns of economic agglomeration or human settlements. Through a case study of Beijing, it demonstrates the usefulness of the framework. Additionally, it utilizes smart card data to delineate characteristics of subcenters defined by bus commuters of Beijing.

1. INTRODUCTION

Human movements and related activity centers at the intrametropolitan level have been a topic of lasting interest to geographers, planners, modelers and the like ([Cervero, 1998](#); [Hanson & Giuliano, 2004](#); [Salas-Olmedo & Nogués, 2012](#); [de Dios Ortúzar & Willumsen, 1990](#)). Data and information from traditional sources such as field trips, interviews, archives, surveys and censuses dominate related studies. Only in recent years have passive user-generated big data such as smart card data been introduced in those studies ([Tao et al., 2014](#); [Kim et al., 2014](#); [Briand et al., 2017](#); [Wang, M. et al., 2016](#)). Existing studies based on smart card data have demonstrated that smart card data can be used to reveal the spatial-temporal dynamics of bus trips, to identify subway trip between stations and to detect zones that share trip origins or destinations in proximity. It is argued that smart card data could support evidence-based transit planning ([Tao et al., 2014](#)) and could facilitate the simultaneous discovery of zones and subway passenger movements between these zones ([Kim et al., 2014](#)).

Little has been done, however, on how smart card data can be used to verify the theory of urban formation, for instance, the Zipf's law or the power law in general and how the theory of urban formation can be used to

validate the quality and reliability of information derived from smart card data when they are employed to reveal spatial patterns of economic agglomeration or human settlements at the intrametropolitan level, that is, where people prefer to work or reside in a metropolis. In this study, we argue that the theory of urban formation can be used to validate and calibrate the quality and reliability of information derived from smart card data. We propose a general framework regarding how the theory of urban formation can be employed to validate information derived from smart card data and how the validated information can supplement other data to reveal spatial patterns of economic agglomeration or human settlements. Through a case study of Beijing, we demonstrate the usefulness of the framework. Specifically, we elucidate how the framework can guide us to (a) derive and calibrate bus commuters' residence and workplace based on smart card data and other data from traditional sources; (b) use the derived information to verify Zipf's law; (c) combine processed smart card data and other data to reveal spatial patterns of subcenters of employment and residence.

The remainder of the article is organized as follows. The next section (Section 2) is a review of relevant literature. Section 3 describes our proposed framework. Section 4 is our case study, which is used to demonstrate the usefulness of the framework. Section 5 concludes.

2. RELATED LITERATURE

2.1 Smart card data and human movement studies

Smart cards are not new technologies in the transit field. Transit professionals and administrators have used the data produced by smart cards to do jobs at three levels: (a) strategic (long-term planning); (b) tactical (services adjustments and network development); (c) operational (ridership statistics and performance indicators) ([Pelletier, Trepanier, & Morency, 2011](#)). Transit researchers have employed smart card data as new input to do more than the above, showing that smart card data have great potential. [Bagchi and White \(2005\)](#), for instance, demonstrate that smart card data can help estimate turnover rates, trip rates per card on issues and linked trips. [Morency, Trepanier, and Agard \(2007\)](#) successfully measure spatiotemporal variability of transit trips in Gatineau, Canada based on smart card data in that city. In Seoul, [Park, Kim, and Lim \(2008\)](#) describe the characteristics of public transit users, such as the number of transfers, boarding time, hourly trip distribution of the number of trips for different transit modes, and travel time distribution for all transit modes and user types by using both local smart card and survey data. They argue that smart card data have the potential to supplement and even replace survey data in those regards. Similar to [Morency, Trepanier, and Agard \(2007\)](#), [Liu, L. et al. \(2009\)](#) use the smart card of Shenzhen to characterize spatial and temporal mobility patterns at the city and individual levels. They argue that their methodologies are replicable and can be useful for transportation planning and management. Taking advantage of the individual-level subway movement data provided by "Oyster" card in London, [Roth et al. \(2011\)](#) show the structure and organization of that city in terms of intraurban movement, hierarchy and activity centers.

Using the smart card and household travel survey data from Singapore, [Chakirov and Erath \(2012\)](#) identify the number of work activities and their

locations in that city-state. They conclude that smart card data from public transport offer significant potential for studies of travel behavior and activity identification. Their work, however, shows that despite the fact that processed smart card data from the local public transit system can reasonably detect work places but are subject to biases. In their case study of Singapore, they admit that the number of work places based on smart card data from the local public transit system can be underestimated. In other words, smart card data are often not full-population data but data of a bigger sample than the traditional survey data. There are cases that we need to take this into account and find ways to correct possible biases in research results based on smart card data. This should not be a surprise to researchers, as smart cards' main function is collecting the fare in the transit field ([Pelletier, Trepanier, & Morency, 2011](#)) and thus smart card data could have their limitations, for instance, they do not collect information of interest to researchers such as trip length ([Bagchi & White, 2005](#)), trip destination (e.g., [Li et al., 2011](#)) and socio-demographics of trip makers ([Long, Zhang, & Cui, 2012](#)). Methodologies thus have to be developed and supplementary data have to be used for researchers to obtain relevant information based on smart card data. [Li et al. \(2011\)](#) and [Munizaga and Palma \(2012\)](#) are two cases in point, which show how smart card data and other data could be used together to derive origin-destination matrices of transit trips, which are necessary input for any serious transportation system analysis. More recently, authors have used smart card data to help complete extra studies of transit trips and activity centers. [Zhong et al. \(2014\)](#), for instance, have used smart card data of Singapore for multiple years to profile the polycentrism in that city and how it evolved over time. [Tao et al. \(2014\)](#) utilize the smart card data from the bus rapid transit (BRT) and regular buses in Brisbane, Australia to geo-visualize the spatiotemporal patterns of BRT and regular bus trips. They argue that similar work can enhance the evidence-based BRT planning. [Kim et al. \(2014\)](#) propose a new approach to using smart card data as input to identify zones and movements between zones simultaneously.

More recently, [Wang, M. et al. \(2016\)](#) apply smart card data to identify frequent visiting locations of college students in Beijing. [Alsger et al. \(2016\)](#) validate different origin-destination estimation algorithms. [Briand et al. \(2017\)](#) categorize public transit riders based on the temporal features of the smart card usage. [Zhong et al. \(2016\)](#) compare mobility patterns of smart card users in London, Singapore, and Beijing. Further, [Ma et al. \(2017\)](#) develop a data mining method to understand spatiotemporal commuting patterns of smart card users.

2.2 The theory of urban formation and smart card data

Researchers have always attempted to explain the universal driving forces such as economic agglomeration, economies of location or urbanization and to identify laws such as the gravity law, rank-size rule or Zipf's law that govern the formation, evolution and interaction of cities, including intra- and inter-metropolitan movements of people and cargo (e.g., [Anas, Arnott, and Small \(1998\)](#), [Barthélemy \(2011\)](#), [Simini et al. \(2012\)](#), [Zipf \(1946\)](#)). If we regard related knowledge and insights from the above explorations as "the theory of urban formation", then there have been numerous studies of the theory of urban formation. Existing studies of the theory of urban formation, however, reply heavily on data from traditional sources such as censuses and ad-hoc surveys. [Giuliano and Small \(1991\)](#), for instance, use the 1980 Census journey-to-work data to study employment subcenters in the Los

Angeles region. [Anas, Arnott, and Small \(1998\)](#) employ census data of multiple years and of different countries in their studies of urban spatial structure. [Bento \(2003\)](#) examine the impact of urban spatial structure on travel demand in the US based on the 1990 National Personal Transportation Survey data. It is only recently that a few researchers have started exploring how smart card data from transit can facilitate studies of the theory of urban formation. [Roth et al. \(2011\)](#) and [Zhong et al. \(2014\)](#) are two examples. [Roth et al. \(2011\)](#) are interested in characterizing intraurban movement, hierarchy and activity centers based on smart card data from London's Metro. [Zhong et al. \(2014\)](#) apply recent methods in network science and their generalization to spatial analysis to identify city hubs, centers, and borders in Singapore with the 2010, 2011 and 2012 smart card data of that city's transit system.

Few existing studies, however, have applied the theory of urban formation to verify reliability of smart card data or information derived from them. [Roth et al. \(2011\)](#), [Eubank et al. \(2004\)](#) and [Gutiérrez and García-Palomares \(2007\)](#), for instance, have all found that the movement patterns in large cities exhibit a heterogeneous organization of flows. But according to our knowledge, nobody has used this finding to verify reliability of smart card data, regardless such data cover a large or small sample.

In this article, we argue that on the one hand, smart card data can facilitate more studies of the theory of urban formation; on the other hand, the known theory of urban formation, for instance, the above finding about heterogeneous organization of flows in large cities, can be employed to verify representativeness and reliability of smart card data or information derived from them. Later in this article, we will use a case study to show we use smart card data from the bus system in Beijing for us to identify employment subcenters in the city and how we verify those identified subcenters are representative and reliable based on Zipf's law.

3. PROPOSED FRAMEWORK

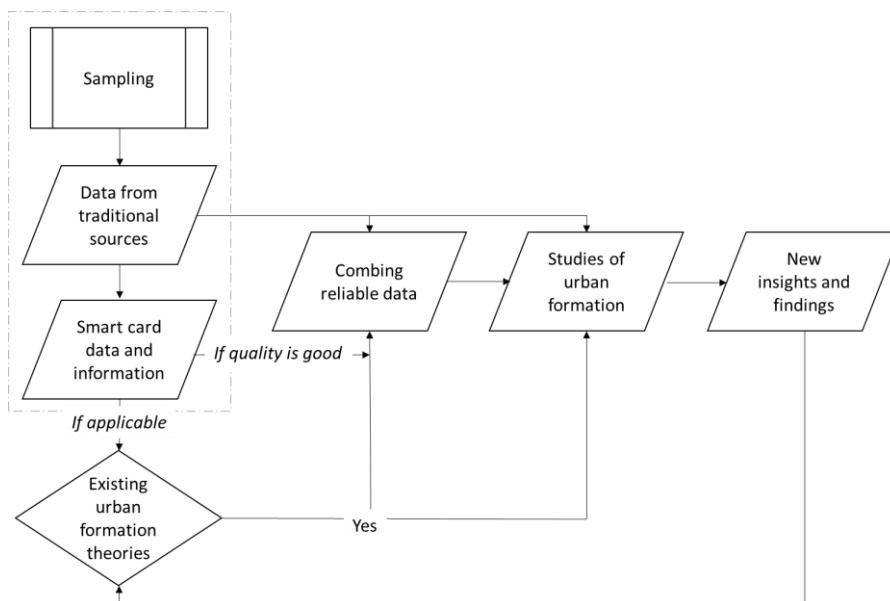


Figure 1. Proposed framework for better linking the theory of urban formation and smart card data

Considering the above literature review, we propose the following general framework regarding how we can have more meaningful linkages between the theory of urban formation and smart card data so that we could do a better job when we use smart card data to facilitate studies of the theory of urban formation and employ the theory of urban formation to verify the representativeness and reliability of smart card data and information derived from them.

In this framework, we argue that data from traditional sources (e.g., censuses, interviews and surveys), smart cards and the combination of traditional sources and smart cards can serve as input for studies of urban formation. There have been a notable number of publications on how we ensure the representativeness and reliability of data from traditional sources (e.g., [Box-Steffensmeier, Brady, and Collier \(2008\)](#); [Statistics Canada \(1975\)](#); [Groves \(2009\)](#)). However, unlike data from traditional sources, there have been few documented mature and systematic procedures and methodologies to ensure their representativeness and reliability of data and derived information from smart cards. We thus propose that we could use both existing theories of urban formation and data from traditional sources to help us verify and calibrate representativeness and reliability of data and derived information from smart cards, if applicable, before they are fed into our studies of urban formation. We also believe that the introduction of smart card data into studies of urban formation would produce new theories (or hypotheses) of urban formation, which would enable us to more effectively verify and calibrate representativeness and reliability of data and derived information from smart cards.

4. CASE STUDY

To show the usefulness of the above framework, this section presents a case study, which shows how we use smart card data from Beijing to study bus commuters' employment and residential subcenters.

4.1 The Site

Beijing Metropolitan Area (BMA) is our site for case study. It covers an area of 16,410 km² and has a population of more than 22 million as of 2015. The BMA lies in northern China, to the east of the Shanxi altiplano and south of the Inner Mongolian altiplano. The southeastern part of the BMA is a flatland, extending east for 150 km to the coast of the Bohai Sea. BMA is the anchor city of the Beijing-Tianjin-Hebei polycentric city-region, which is one of the three most renowned city-regions in China ([Liu, X., Derudder, & Wang, 2017](#)). Gaining momentum from China's recent economic success, Beijing, as the capital city, is becoming one of the world's most populous and fastest growing metropolises. The master city plan of Beijing has envisioned a polycentric urban form with one central city and ten subcenters. Detailed information about BMA can be found in Yang et al. (2013).

Beijing's public transit system consists of buses and subways. The combined share of subway and bus trips in BMA was 38.9%, making Beijing the largest public transit system in terms of daily ridership in China (Beijing Transportation Research Center [BTRC], 2011). Bus trips still accounts for 29% of all trips and thus studies of bus travelers or commuters are still quite relevant in the context of BMA (BTRC, 2011).

4.2 Data

For the case study, we were granted access to a full week's historical data from the administrator of the smart card data of the Beijing transit system. The data contain 77,976,010 bus trips of 8,549,072 anonymized cardholders between April 7 and April 13, 2008. Data on subway trips were excluded by the data administrator due to security concerns. Given the fact that 95 per cent of bus users in Beijing are smart card holders, the one week sample is representative of all bus users in the city (Long, Zhang, & Cui, 2012). Thus, if we simply utilize the above data to study the general behaviors of bus users' in Beijing between bus stops, that is, similar to what Liu, L. et al. (2009) and Roth et al. (2011) do, there should not be any problems. However, if we manipulate the data to derive locations of residences and employment of bus commuters and then identify subcenters of residences and employment for bus commuters, we encounter the issue of representativeness and reliability of the derived information. Technical details regarding how we derive locations of residences and employment of commuters from the smart card data are elucidated in Long, Zhang, and Cui (2012). By and large, what Long, Zhang, and Cui (2012) does is (a) using data from traditional sources to establish rules for smart card data queries; (b) singling out the most probable locations of residences and employment from smart card data based on those rules. Long, Zhang, and Cui (2012) embodies the procedures in the dash-line rectangle in Figure 1. It is not unique, for instance, Chakirov and Erath (2012) has processed and queried the smart card data of Singapore in a similar fashion. In our case study here, we thus no longer detail how to derive probable locations of commuters' residences and employment from smart card data; instead, we focus on how we address representativeness and reliability of the derived information based on smart card data.

4.3 Representativeness and reliability of derived locations

Roth et al. (2011), Eubank et al. (2004), Gutiérrez and García-Palomares (2007) among others, find that trips between any two activity centers (e.g., a subway station) exhibit heterogeneous organization. In the log-log plot of the histogram format, the number of trips between any two activity centers follows the power law (Equation 1). Therefore, if we believe that bus commuting trips in Beijing are not exceptions to the above, the derived number of bus commuting trips, that is, flows between corresponding residence and employment based on smart card data should also follow the power law. By analyzing the number of trips (OD flows) for bus commuters and the corresponding histogram, we find home and employment centers for bus commuters in Beijing followed the power law (Figure 2).

$$P = a \cdot N^b \quad (\text{Equation 1})$$

where

P denotes the frequency in the histogram distribution;

N is the number of trips between two traffic analysis zones (TAZs);

a and b are coefficients determined by the goodness of fit test.

In Figure 2, we find with $a = 0.139$ and $b = -0.473$, the goodness of fit test shows that $R\text{-square} = 0.926$, $RMSE = 0.012$. Figure 3 visualizes the

216,844 commuting trips between corresponding residence and employment locations for bus commuters. Again, the heterogeneous organization of the trips can be observed, which is in line with the pattern identified by [Roth et al. \(2011\)](#) for London’s subway trips. Based on the above, we can at this point be more confident that locations of residence and employment for bus commuters derived from the smart card data in the case of Beijing are likely to be representative and reliable.

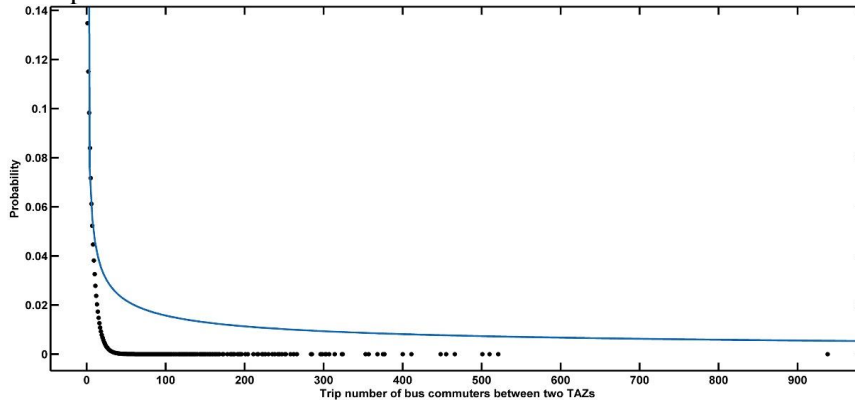


Figure 2. OD flow distribution. Plots of the histogram of the number of trips between two traffic analysis zones (TAZs). The black dots denote actual trip number; while the blue curve is a power law fit.

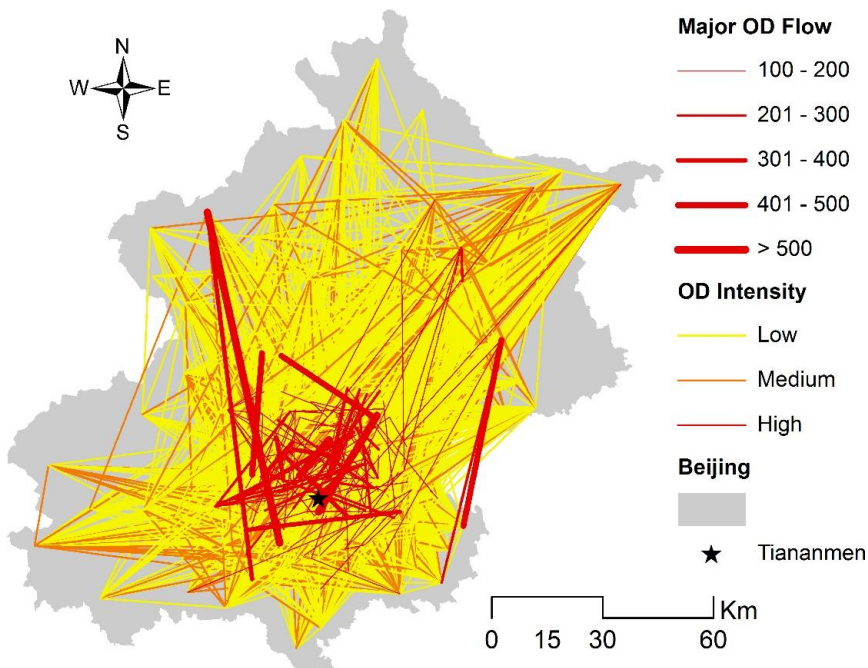


Figure 3. Visualization of OD flows for bus commuters between residence and employment locations. Major OD flows are categorized based on normalized trips.

4.4 Representativeness and reliability of derived subcenters

After verifying representativeness and reliability of the derived locations of bus commuters’ residences and employment, we utilize spatial autocorrelation statistics to identify subcenters of bus commuters’ residences and employment. We cannot replicate the approaches in existing studies such as [Giuliano and Small \(1991\)](#) or [Anderson and Bogart \(2001\)](#) to identifying those centers because those approaches deal with all workers.

Thus, their proposed thresholds for the total number of employment and density of employment would not be applicable to our case study.

Spatial autocorrelation analyzes the degree of dependency among observations in a geographic space. Positive spatial autocorrelation indicates the clustering of similar values across geographic space, while negative spatial autocorrelation indicates dissimilar values occur near one another. In other words, spatial autocorrelation can help us where there are concentrations of residences or employment of bus commuters in space.

Spatial autocorrelation statistics include Moran's I ([Moran, 1950](#)), Geary's C ([Geary, 1954](#)), Getis's G ([Getis & Ord, 1992](#)) and so forth. Among these statistics, Moran's I has the longest history and has been the most widely used ([Lloyd, 2010](#); [Wang, S. & Armstrong, 2009](#); [Huang & Dennis Wei, 2014](#); [Luo, 2014](#)). For n observations on a variable x at location (i, j) , Moran's I is calculated as:

$$I = \frac{n}{S_0} \frac{\sum_i \sum_j w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2} \quad (\text{Equation 2})$$

where

\bar{x} is the mean of the x variable;

w_{ij} are the elements of the spatial weight matrix;

S_0 is the sum of the elements of the spatial weight matrix: $S_0 = \sum_i \sum_j w_{ij}$.

Spatial weights matrix reflects the intensity of the geographic relationship between observations in a neighborhood, such as the distances between neighbors. Moran's I allows us to testify whether there exist subcenters of bus commuters' residences and employment ($I > 0$). However, the fact that the spatial heterogeneity of OD flows for bus commuters between residence and employment locations (Figure 3) suggests that the estimated degree of autocorrelation varies significantly across Beijing. Therefore, local version of Moran's I, as one of those well-established local spatial autocorrelation statistics ([Anselin, 1995](#)), is applied to provide estimates disaggregated to the TAZ level. In this case study, GeoDa software by [Anselin, Syabri, and Kho \(2006\)](#) is applied to test global and local spatial autocorrelation.

First, global Moran's I is used to determine if there exists any subcenter. Results of Moran's I show subcenters of both bus commuters' residences and employment exist ($p < 0.001$ for both cases). Second, local Moran's I is calculated for each TAZ to determine the residential and employment subcenters. We define a residential subcenter of bus commuters as a TAZ that is surrounded by TAZs with high bus commuters' residences or a TAZ that is surrounded by TAZs with significantly lower bus commuters' residences (i.e. the High-High and High-Low clusters derived from local Moran's I). Similarly, an employment subcenter of bus commuters is defined as a TAZ that is surrounded by TAZs with high bus commuters' employment or a TAZ that is surrounded by TAZs with significantly lower bus commuters' employment (i.e. the High-High and High-Low clusters derived from local Moran's I). Local Moran's I ($p = 0.05$) reveals that there are 35 subcenters of bus commuters' residences and 40 those of bus commuters' employment. Among these subcenters, there are 8 TAZs serving as both residential and employment subcenters (Figure 4).

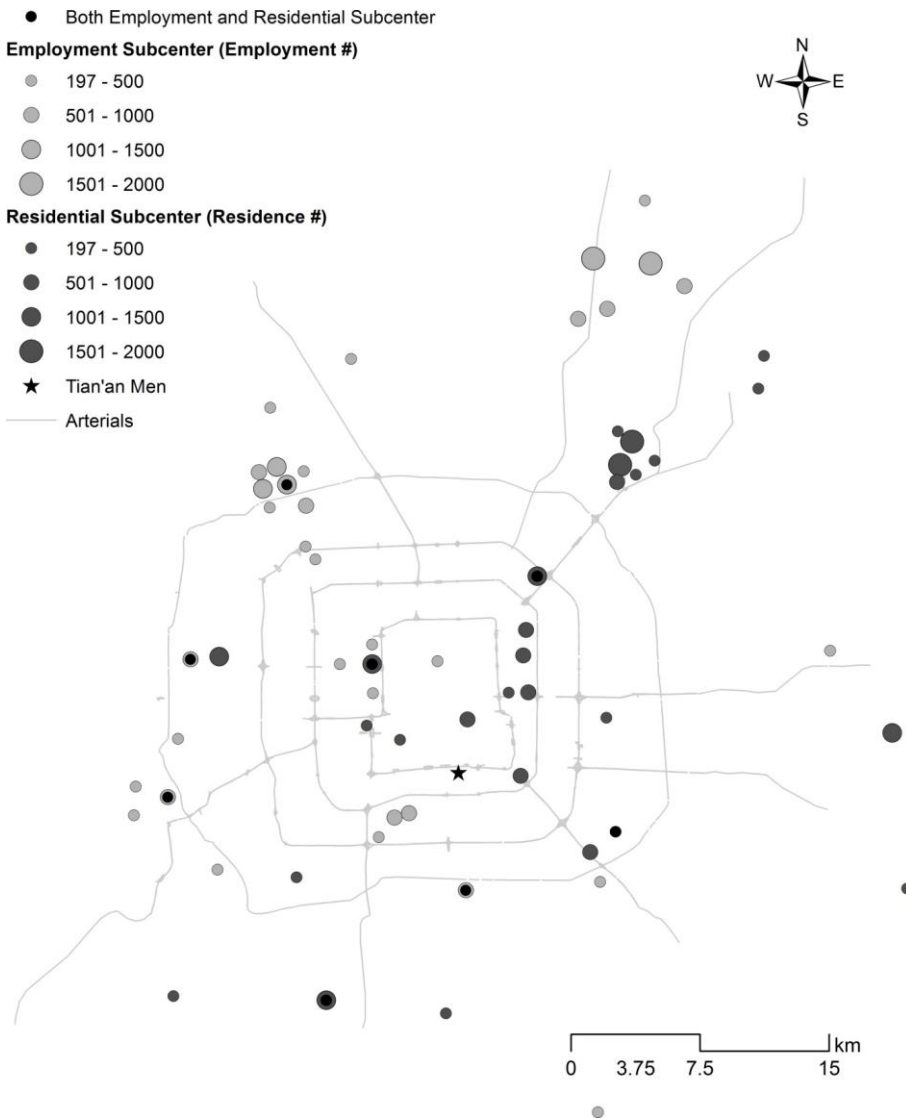


Figure 4. Subcenters of Bus Commuters in Beijing

Anas, Arnott, and Small (1998) contend that employment centers in a city are analogous to the system of cities in a larger regional or national economy and the former should therefore comply with Zipf’s law as well. Based on this, one simple and further check we can do with the derived locations of residences and employment is to test whether the derived subcenters follow Zipf’s law. In general, power-law distributions including Zipf’s law are plotted on doubly logarithmic axes via cumulative distribution (Equation 3 and 4).

$$P(x)=P_r(X>x) \tag{Equation 3}$$

$$P(x)=P_r(X>x) =C\int_x^\infty p(X)dX =\frac{\alpha-1}{x_{min}^{-\alpha+1}} \int_x^\infty x^{-\alpha} dX = \left(\frac{x}{x_{min}}\right)^{-\alpha+1} \tag{Equation 4}$$

In Equations 3 and 4, x is the number of employment by subcenter, α is a constant to be calibrated.

In this case study, Zipf’s law tests of derived subcenters of bus commuters are conducted (Figure 5), combining combination of maximum-likelihood fitting methods with goodness-of-fit test based on the Kolmogorov-Smirnov statistic and likelihood ratio based on (Clauset, Shalizi, & Newman, 2009). Results show both employment and residential subcenters of bus commuters follow Zip’s law.

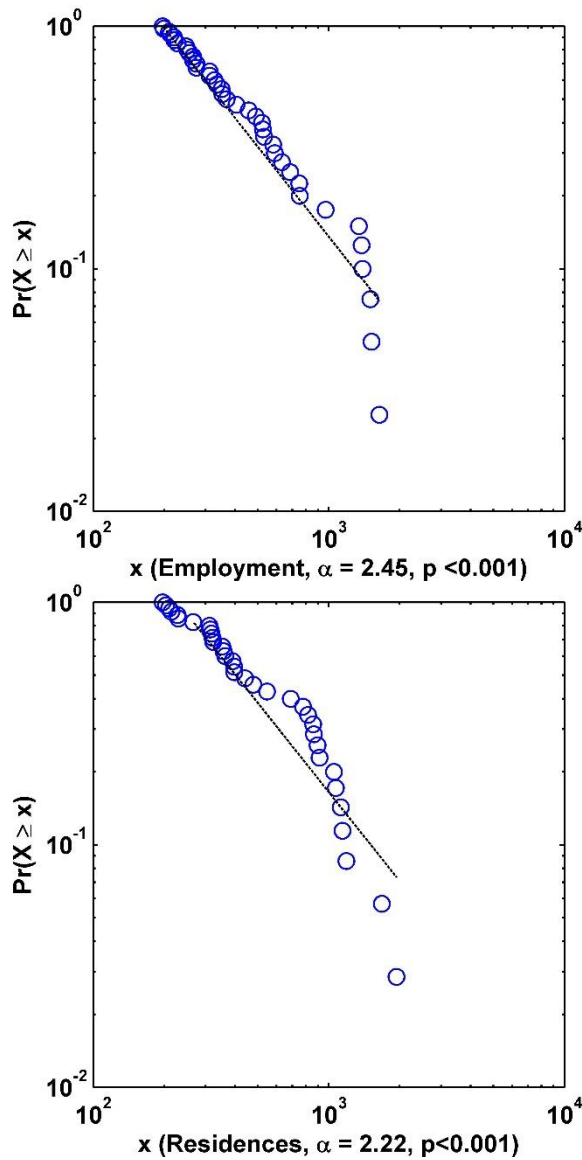


Figure 5. Power-distributions of subcenters

At this point, we have double-verified the representation and reliability of the derived locations of residences and employment based on the smart card data.

4.5 Characteristics of top subcenters

The smart card data alone do not tell us the land use and neighborhood characteristics of the identified subcenters. We thus have to rely on data from traditional sources such as land-use maps, satellite images, field trips and interviews if we want to find out those characteristics, which are of particular interest to geographers, planners and local policy analysts. They need to know those characteristics to better deal with issues such as economic agglomeration, traffic congestion and jobs-housing separation associated with subcenters. The characteristics, nevertheless, would also provide another opportunity for us to check the reasonableness of the identified subcenters. There have been a considerable number of existing studies of employment subcenters in metropolises (e.g., [Agarwal, Giuliano, and Redfean \(2012\)](#); [Cervero \(1998\)](#); [Giuliano and Small \(1993\)](#)). So, when we check characteristics of subcenters we also focus on employment

subcenters so that we have more references to make comparisons. Table 1 summarizes characteristics of the employment subcenters for bus commuters we identified in Beijing and those by other researchers elsewhere.

Table 1. Characteristics of the Employment Subcenters: Beijing vs. Other Places

References	Geographical Focus	Land-use Characteristics	Neighborhood Characteristics
This study	40 employment subcenters for bus commuters Beijing	Mixed land use; All located in suburbs (outside the 5 th ring road); University campuses; University employee apartment compounds; Gated communities; Suburb villages characterized by light industries and agriculture and related tourism	A large number of bus stops; Jobs \geq 1,300; Jobs/residences \geq 1.19 (Max. 4.94); All have easy access to arterial roads; Except jobs at the universities, all jobs are recently emerging; \leq 10% jobs are in the identified subcenters
Cervero (1998)	57 suburban employment centers (SECs) across American cities	Low density, single use and jobs-housing imbalance (He classified SECs into six groups: office parks, office centers and concentrations, large mixed-use developments, moderate-scale mixed use developments, subcities and large office corridors)	Free parking, low levels of transit services and lack of coordinated growth
Forstall and Greene (1997)	120 employment subcenters in Los Angeles	Most subcenters are recognized locally as separate activity centers and serve different functions	Jobs/workers \geq 1; At least one tract with jobs/workers \geq 1.25; Industrial profiles of the largest subcenters vary widely; Most subcenters had been in existence for more than 30 years
Giuliano and Small (1991)	35 employment subcenters in Los Angeles	Specialization in land use	Employment density \geq 10 jobs/acre; Total employment \geq 10k; Subcenters are associated with agglomeration and industry mix)
Anderson and Bogart (2001)	Employment subcenters in Cleveland, Indianapolis, Portland, St. Louis	Specialization in land use	Subcenters follow a rank size distribution; \leq 50% of metro employment is within the identified subcenters
Giuliano et al. (2007)	Employment subcenters in Los Angeles for three time points (1980, 1990 and 2000)	Subcenters remain stable over time; There are new subcenters emerging and growth at established subcenters at the same time; There is rapid growth of dispersed employment in outer suburbs.	The amount and density of employment have changed substantially. Employment and employment density has grown more rapidly in the suburban and exurban centers—but at an uneven rate among them.
Giuliano et al. (2012)	48 employment subcenters in Los Angeles	-	Subcenters have better road network and labor force accessibility; Subcenters follow a rank

References	Geographical Focus	Land-use Characteristics	Neighborhood Characteristics
Agarwal, Giuliano, and Redfearn (2012)	48 employment subcenters in Los Angeles	Specialization in land use (e.g., the LA downtown is a specialized manufacturing/wholesale/public administration center)	size distribution. With at least 10k jobs; Jobs/population ≥ 1.62 ; Subcenters follow a rank size distribution; Subcenters have better road network accessibility

One thing should be noted is that all the existing studies cited in Table 1 do not separately consider employment subcenters for bus commuters, rather, they consider employment subcenters for all commuters. Thus, we cannot directly compare those subcenters with the subcenters for bus commuters in Beijing. But there are still some similarities between the two groups of subcenters. Most notably, like in Los Angeles, university campuses are subcenters in Beijing too. In addition, there tend to more local jobs than residences in the two groups of subcenters, indicating some degree of jobs-housing imbalance. There are also several notable differences between the two groups of subcenters. First, there tend to be more diverse land uses in employment subcenters in Beijing. Second, there may be more bus stops in or around employment subcenters in Beijing, even in two suburb villages characterized by light industries and agriculture (Table 2). Third, the subcenters other than university campuses in Beijing are recently emerging and have characteristics that are not found elsewhere, for instance, large-scale all-rounded university employee apartment compounds, high-end gated communities and villages characterized by light industries and agriculture and related tourism.

Table 2. Selected Characteristics of Top 5 Employment Subcenters in Beijing

TAZ ID	All jobs*	All population*	Incoming bus employees	Bus commuters' residences	Bus stops**	Land Use Characteristics***
291	2,826	14,355	1,342	396	25	University campus, concentration
292	4,014	19,912	1,499	728	57	of star schools, university employee apartment compounds, a large number of bus stops
294	3,427	17,418	1,377	1,156	17	Suburb villages characterized by light industries and agriculture
787	2,221	5,035	1,640	747	66	
788	1,427	3140	1,518	307	1	

Note: * Derived figures based on the 2008 local economic census data.

** Based on Google maps and Baidu maps.

***Based on local land-use maps, satellite images, field trips and interviews.

5. CONCLUSIONS AND DISCUSSION

The literature reviewed and the case study conducted in this study show that big data such as smart card data from transit operators have great

potential for us to better understand human settlement and movement patterns in metropolis. But as argued by [Bagchi and White \(2005\)](#) and [Li et al. \(2011\)](#), big data are often not designed to facilitate our studies of human settlement and movement patterns. As shown in the case study, big data have to be processed so as to derive useful information of relevance to those studies. But one challenge facing us is validation of the derived information based on big data. Unlike the data from traditional sources, there have not been mature and established ways of doing the validation. This study therefore proposes a framework regarding how we can validate derived information based on big data. It shows via a concrete case study of Beijing that the theory of urban formation can be used to validate the derived information from the smart card data. Combining the validated derived information from the smart card data with data from traditional sources, it can identify and profile land use and neighborhood characteristics of the employment subcenters in Beijing. This demonstrates that big data should be integrated to traditional data to best inform local researchers and decision-makers. The study also has the following generalizable implications for other researchers or users of big data:

First, asking the right and appropriate research questions is an important premise of putting big data to better and more usage. [Pelletier, Trepanier, and Morency \(2011\)](#), for instance, show that when transit professional and administrators look at or use big data, they legitimately focus on issues related to planning and operations of transit. But as demonstrated in other studies such as [Zhong et al. \(2014\)](#) and [Roth et al. \(2011\)](#) big data from transit companies can be used to answer questions beyond transit planning and operations. Given the above, we argue that asking the right and appropriate research questions is an important premise of putting big data to better and more usage. In addition, even we cannot answer those questions right away, those questions could inspire us improve our work of big data, for instance, why shouldn't we redesign our data collection mechanism in advance to capture more relevant information, as recommended by [Pelletier, Trepanier, and Morency \(2011\)](#).

Second, deriving and validating information from big data demands new protocols, methods and procedures. In our case study of Beijing, yes, 95 percent of bus commuters use a smart card when making a bus trip. But this does not mean that we can automatically and conveniently get bus commuters' locations of residence and workplace, which are of interest to geographers, planners and policy analysts. In the case study, we devise and implement an ad-hoc way to derive and validate the locations. But we should not always devise and implement an ad-hoc way to take advantage of big data each time. For certain big data such as the smart card data in Beijing, we should be able develop some routinized protocols, methods and procedures to increase our efficacy.

Third, linking big data and data from traditional sources (or simply "traditional data") is important to generate more relevant knowledge and insights. In our case study of Beijing, the smart card data can at most tell us where those bus commuters reside and work at the TAZ level. Knowing such information is good but to better inform local decision-makers and researchers, extra information such as land use and neighborhood characteristics is needed. Based on our experience of the case study, it can be more efficient for us to get the extra information based on traditional data. Finally, traditional data provide another opportunity to validate the derived information from big data.

Despite the above features and merits, this study can still be improved and enhanced in several aspects in the future. First, it can validate the locations of bus commuters using extra traditional data, for instance, the bus commuting flow matrices by the local transportation planning agency. Given the planning data hoarding issue in China, this would mean extra work for us to get access to those data (c.f., (Zhou & Wang, 2014)). But it is definitely worthwhile. Second, it can standardize and streamline procedures and methodologies for the work of deriving and validating residential and workplace locations of bus commuters from smart card data. Third, it can deepen the current studies of bus commuters by collecting extra socio-demographic information of bus commuters, for instance, conducting on-board survey of bus commuters and giving incentives to bus commuters who are willing to complete on-line surveys about their residential and mode choices. If the smart card data can help us identify the settlement and movement patterns of bus commuters, as described above, extra socio-demographic information of bus commuters would enable us to get insights into why there are those patterns and whether and how the patterns can be changed.

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The Expansion of Densely Inhabited Districts in a Megacity - Case of Tokyo

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Key words: Megacity expansion, Densely Inhabited Districts, Tokyo, Spatial information, Transportation infrastructure, Public policy

Abstract: Understanding the patterns of human concentrations within megacities is of fundamental importance to our understanding of megacity dynamics, and for megacity management and policy making. This study presents an updated investigation of the historical expansion of densely inhabited districts (DIDs) in the world's largest megacity, Tokyo. Long-term DID data (1960-2010) at 5-year intervals were analyzed in a geographic information systems framework. Results show that Tokyo completed rapid growth phase and is now in a maturity phase with minimal growth. Extension was the main form of expansion, although fragmented growth in the form of patches was also noted. The rate of DID expansion was strongly related to economic trends. However the direction and shape of expansion was influenced much by geographic and policy related factors. West and southern directions had earlier and greater expansion, likely related to the historical Tōkaidō corridor. Over 95% of all DIDs are located within 4km distance from a railway line. The coastline and distance from the CBD had some modifying influence. During the course of expansion, there was substantial decrease of population density in the inner wards. Future trends in Tokyo's DIDs will be greatly influenced by aging demographic trends. This study therefore shows that megacity spatial expansion is a dynamic process influenced by various processes whose roles vary over time.

1. INTRODUCTION

Extensive global urbanization and land use intensification have led to uneven spatial development and the proliferation of megacities ([Brenner & Schmid, 2015](#); [Wenzel, Bendimerad, & Sinha, 2007](#)). There are presently more than twenty-five megacities housing over 10 million inhabitants each, and by 2030 the figure is expected to be over forty ([United Nations, 2014](#)). Large urban agglomerations are increasing not only in their numbers around the world, but also in their absolute sizes ([Jedwab & Vollrath, 2015](#); [Pacione, 2009](#)). Administrators of megacities face mega-challenges associated with high urban densities, traffic congestion, environmental and health hazards ([Bloom & Khanna, 2007](#)). As cities get larger, spatial information is becoming an indispensable resource for monitoring growth and delivery of services.

1.1 Issues in megacity spatial expansion studies

A large body of literature has emerged to investigate the spatial growth of megacities. This has been supported by advances in remote sensing and geographic information systems ([Dewan & Corner, 2014](#); [Doytsher et al., 2010](#); [Sharma et al., 2016](#)). By analyzing recurrent observations on a megacity-scale, it is possible to determine explicit patterns of land cover change ([Schneider & Woodcock, 2008](#)). An important land cover feature that is commonly used in megacity expansion studies is built-up area. Using this parameter it is possible to estimate the urban spatial extent ([Peng et al., 2015](#)), and over time determine rates and types of urban expansion. For instance it has been shown that Asian and African megacities are expanding spatially at unprecedented rates ([Muzzini & Aparicio, 2013](#); [United Nations, 2014](#)). Some key forms of urban expansion reported in literature are: edge expansion, leap-frog, and in-filling expansion ([Angel, Sheppard, & Civco, 2005](#)). While valuable knowledge about megacity growth has been obtained using built-up area observations, there is increasing awareness of the need to understand the dynamics of human concentrations within megacities.

[Zhong et al. \(2016\)](#) point out that to discover patterns in the changes of human concentrations within megacities is of fundamental importance to our understanding of megacity dynamics, and is essential to transport planning, urban management and policymaking ([Zhong et al., 2016](#)). However a challenge for any initiative to study the spatial dynamics of human concentrations across megacities is the lack of fine resolution data of populations. Census data for most megacities is usually available summed up for relatively large administrative areas/blocks that limit detailed spatial analysis of megacity-wide population dynamics. How can the spatial expansion of large populations be quantified for effective land-use administration? [Doytsher et al. \(2010\)](#) showed that many megacities lack strategic frameworks to guide and create their own spatial data infrastructures (SDI) and the authors suggest that new tools and policies are needed to baseline and monitor growth and change across megacities and to forecast areas of risk ([Doytsher et al., 2010](#)).

A further concern in megacity spatial expansion studies pertains to modelling long term trajectories. This is related to factors that influence the volume and forms of megacity expansion ([Angel, Sheppard, & Civco, 2005](#)). Some of the factors identified in literature include: physical geographic factors, demographic changes, socio-economic changes, transportation systems, consumer preferences for proximity, and governance ([Angel, Sheppard, & Civco, 2005](#); [Dewan & Corner, 2014](#); [Li, Sato, & Zhu, 2003](#)). The prediction of future land change in empirical models is often based on the interpretation and input of several of these factors to create a probability map which indicates the suitability of a location for a certain land use relative to the suitability of other locations ([Poelmans & Van Rompaey, 2010](#)). However megacities represent the accumulation of successive layers of collective activity and desires, and this involves macro-economic transformations and policy changes ([Portugali et al., 2012](#)). Moreover the underlying driving factors of long term growth are not constant over time and they cannot be fully captured by fixed mathematical relations. Dynamic models are therefore necessary for any attempt to represent the long term spatial growth of megacities ([Portugali et al., 2012](#)). Unfortunately creating such models is a complex task, particularly when considering cities in regions affected by numerous unpredictable events, such as dramatic economic crises, changes in planning policies, natural disasters, wars,

terrorism, and other issues that may profoundly modify the evolution of urban areas ([Barredo & Demicheli, 2003](#)).

The study of urbanization process and land use change is different from other disciplines because it does not allow experimentation on the ground ([Alsharif & Pradhan, 2014](#)). When developing long-term urban growth scenarios and policies, urban planners have to rely on either simulation models or historical case studies ([White et al., 2000](#)). Historical case studies provide descriptions and explanations about unique urban patterns or changes within real-life contexts, aimed at providing positive examples on successful urban policies with the hope that the experiences reveal some important learning points for future policies. Considering the limited studies on population dynamics in megacities, and the high uncertainty inherent in most models of long-term megacity trajectories, we suggest that it could be useful to make case-studies inquiries of the historical growth of megacities from various regions, thereby contributing to an evolutionary theory of megacities growth.

1.2 Rationale for a historical study of the expansion of Tokyo's DIDs

In this study we investigate the historical expansion of Tokyo. Tokyo has been the world's largest megacity since the 1970s, and is projected to remain as the world's largest city in 2030 with 37 million inhabitants ([United Nations, 2014](#)). Tokyo presents an interesting study area because despite its immense proportions and dynamism, many observers are surprised at how well the megacity functions efficiently, productively, and sustainably ([Hein, 2010](#); [Okata & Murayama, 2011](#)). Presently there is a notable rise in the number of poor mega-cities around the world ([Glaeser, 2014](#); [Jedwab & Vollrath, 2015](#)). Yet as [Jedwab and Vollrath \(2015\)](#) note, on the other end of the scale we have the currently rich mega-cities that were able to grow sustainably avoiding problems of congestion. How did these cities such as Tokyo become so large while avoiding the issues of poor mega-cities?

Tokyo is also interesting because it is one of the few megacities in the world with epochal historical experiences that include destruction by war, economic shocks, natural disasters, and major demographic transitions. The growth of cities is strongly influenced by economic, physical, and institutional constraints and is a result of human activities. These complex interactions have spatial features because they take place on the two dimensional surface of the earth. Therefore we seek to understand how the spatial patterns of human concentrations in Tokyo have evolved as the nation passed through various phases of growth.

Japan has a long tradition of high quality mapping, and there have been numerous spatial studies particularly in the Japanese language documenting the trajectories of the nation's urban areas. A landmark spatial study that is available both in Japanese and English languages was carried out by [Himiyama et al. \(1995\)](#), who read into machine readable form the land-use maps of Japan, and collated them into a 2-km grid that was published as an atlas ([Himiyama et al., 1995](#)). [Fuse and Shimizu \(2004\)](#) performed rubber-sheeting of important maps produced in the Edo (1603 and 1868) and Meiji (1868 and 1912) periods to conventional map coordinate systems ([Fuse & Shimizu, 2004](#)). They carried out various applications, e.g., quantitative analyses of land use, and bird's eye-view visualization of landscapes of the Edo period. [Zheng \(1991\)](#) presented a density function analysis of the Tokyo

metropolitan area, showing substantial suburbanization during the period 1975-85, and he also estimated the directional density functions of three railway-line regions ([Zheng, 1991](#)). Nakabayashi did an analysis of the nature of buildings in post-war Japan. [Siebert \(2000a\)](#) performed a detailed spatial and temporal analysis of the urbanization transition types and zones in Tokyo and Kanagawa prefectures, and revealed the sequential transformation of individual administrative units from village to town to city and to ward, from 1900 ([Siebert, 2000a](#)). The same author also visualized the historical spatio-temporal changes of shoreline, rivers, administrative boundaries, population and rail networks. More recently, [Bagan and Yamagata \(2012\)](#) investigated changes in land-use and land-cover across Tokyo metropolitan area during 1972–2011 ([Bagan & Yamagata, 2012](#)), and they demonstrated the usefulness of the grid-based method in linking disparate data-sets. The valuable knowledge from these past studies has thus contributed to showing the unique characteristics of Tokyo, with the aim of assisting in city wide planning and development, as well as demonstrating the application of some state-of-the-art techniques of geo-spatial analytics. Overall most spatial expansion literature of Tokyo focused on land-cover changes with particular focus on built up area. Though a few of these studies have referred to Tokyo's population concentrations ([Bagan & Yamagata, 2012](#); [Zheng, 1991](#)), we find limited updated literature in the English language, inquiring into Tokyo's long term growth with particular reference to human concentrations, at a megacity-wide scale.

1.3 The aims of this study

The purpose of this study is to investigate the long-term expansion patterns of densely inhabited districts of Tokyo. Specifically we 1) determine the spatial extent and rates DID expansion, 2) describe the forms of expansion, and 3) identify some economic, geographic and policy factors associated with Tokyo's growth. By using DIDs and population density as main indicators, this study thereby presents a longer and finer temporal resolution analysis of Tokyo's spatial expansion than studies that used mainly built-up area measurements. Moreover by taking a megacity-wide scale, we capture major trends that emerge from the cumulative patterns of small census units thereby providing new information that may not have been revealed in past prefectural level and small scale studies of parts of the megacity. We hope to provide a requisite of materials from which emerging megacities can learn from Tokyo's experiences.

2. METHODOLOGY

2.1 Study area

Tokyo began as a castle called 'Edo' which was constructed by the Shogun Tokugawa Ieyasu after 1600, and it grew to be one of the largest metropolises in the world by the early 1700s ([Ito, Nagashima, & Hons, 1980](#)). After the imperial restoration in 1860s, Edo was selected as the national capital city (renamed to Tokyo), and was remodeled into a modern city by the introduction of railway, tram and trunk road network, modern water supply and modern parks. In the twentieth century Tokyo has experienced a rapid growth with various issues associated with urban form

and urban environment (Nakai, 1988). The rapid urbanization of the nation's population since Meiji times, and particularly during the post-WW II period has been quite unprecedented (Ito, Nagashima, & Hons, 1980). In this study we focus only the Tokyo metropolitan region as defined to cover four prefectures; Tokyo-to, Kanagawa, Chiba, and Saitama. The total land area of the four prefectures is approximately 13149 km², though the densely inhabited districts cover only a fraction of this. Most of the study area has altitude less than 70m above sea level, except for the western mountain area and the south-eastern and north-eastern parts that also have high altitude.

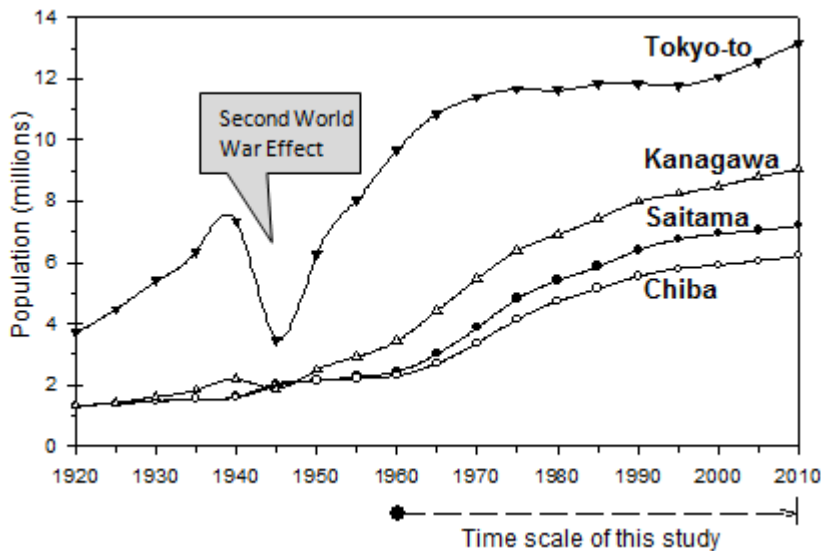


Figure 1. Long term population trends of four prefectures covering Tokyo Metropolitan area

2.2 Data Description

In this study we are concerned with the densely inhabited districts as they represent areas of concentrated human populations in the megacity. Japan is a highly dense society, and even as early as 1975, 57% of the population lived in Densely Inhabited Districts (DIDs) which covered only 2% of the land area of the country (Ito, Nagashima, & Hons, 1980). The DID is an innovative spatial information concept that was developed by the Japanese to identify the actual population situation in urban areas, thereby supporting the operation of land administration functions. The Japanese Statistics Bureau defines a DID as a district containing basic unit blocks with a population density of 4,000 or more per square kilometer, such districts being adjacent to each other in a municipality and forming an urban area with a total population greater than 5,000 (Japan Statistics Bureau, 2016). DIDs have been widely used for urban planning, transport planning, environmental measures, disaster prevention, and other administrative measures. We recognize that the concept of DIDs is Boolean in nature, hence we also examine actual population density data within the DIDs, and even the ages of the populations within the prefectures, in order to get a more holistic understanding of the long-term dynamics of Tokyo's population.

Vector data for DIDs were sourced from the Japan National Land Numerical Information download service. DIDs have been designated in each survey since the 1960 Population Census of Japan, and so we used the complete available set; 5-year DID data from 1960 to 2010, though we note that by 1960 Tokyo was already experiencing rapid population growth

(Figure 1). From the same source we also obtained vector data for rail and subway stations, highway sections, and airports showing the years when each of the services were established. Land-use mesh/grid data for the years 1975, 1995, and 2005, were also acquired from the Japan National Land Numerical Information download service. In order to reduce the number of classes, we reclassified the land use maps into the following categories; agriculture, forest, wasteland, buildings, transportation, other land, rivers and lakes. Economic data such as Gross National Income (US\$) were obtained from the World Bank data-bank ([The World Bank, 2016](#)).

2.3 Methods

As this is a case study, we have used mainly descriptive statistics in a geographic information systems framework. Firstly vector and grid data for the selected regions were converted to raster data and resampled based on a similar resolution. We used a resolution of 30 meters in order to maintain a high degree of precision for the geostatistical computations. All computations were performed using IDRISI software. Some maps for the final output were created in ArcGIS software. Graphs to summarize the statistical outputs were produced using Sigma-plot software.

3. RESULTS

3.1 Rates of expansion

The extracted area (km²) trends of Tokyo's densely inhabited districts (DIDs) are presented in Figure 2. The total area of new DIDs between 1960 and 2010 is approximately 2323.2 km², which reflects a 3.3 fold increase in size. Most of the DIDs are connected to form a single contiguous group. When comparing the main contiguous DID group and patches that are distributed across the metropolitan area, we find that the main contiguous DID expanded by 2002 km² which is approximately 3.7 fold, while the total area of patches expanded by 321 km² or approximately 2.2 times in fifty years. Expansion curves, particularly of the main contiguous DID group follow a sigmoid pattern that has an initial exponential phase, followed by slowing growth, and finally a maturity phase with minimal growth.

The rate of expansion of Tokyo's DIDs varied greatly during the course of the 50 years (Figure 3). Peak rates of expansion reached over 100 km² per annum between 1970 and 1975 for the main contiguous DID, and between 1965 and 1970 for patches. These peak growth rate levels have not been retested since then, although there was a short-lived spike in 1985-1990. Thereafter, near zero growth rates were seen. Based on these results we identify the years 1975 and 1995 as working estimates for key turning points in Tokyo's long-term growth. The growth rate plots of DIDs have a similar pattern to those for economic parameters. Both Gross Domestic Product (GDP) rate and Gross National Income (GNI) rate peaked in 1970-75, followed by a decline, and both experienced a short-lived spike in 1985-90. Hence there is a strong association between economic output and megacity expansion.

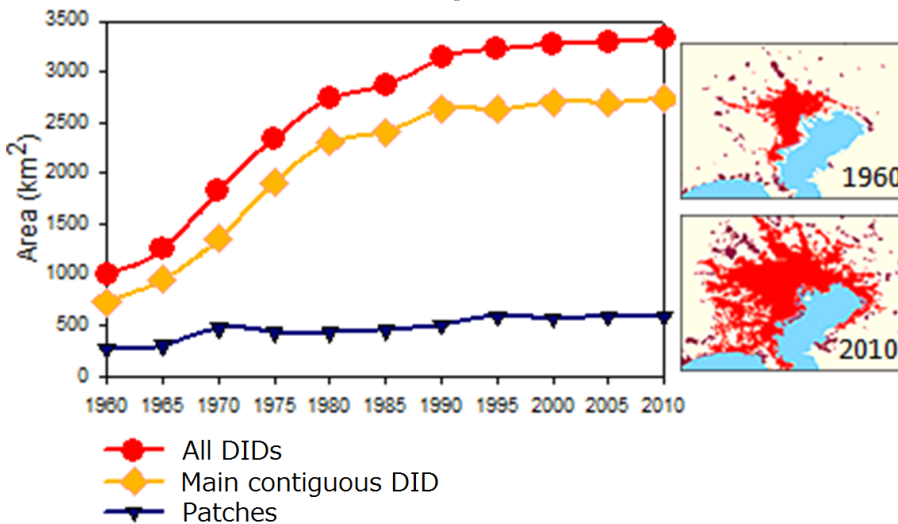


Figure 2. Growth curves of Tokyo's DID (left). Maps of Tokyo's DID in 1960 and 2010 (right).

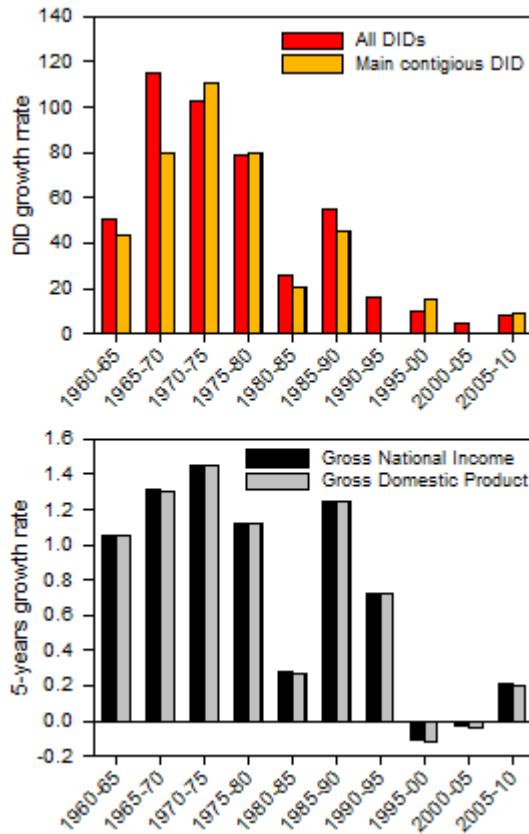


Figure 3. (a) Growth rates of Tokyo's DID computed at 5-year time steps. (b) Gross National Income and Gross Domestic Product growth rates of Tokyo's four prefectures.

3.2 Direction of expansion

The expansion of DID in the 50 year period was greatest towards the southern and western prefectures (Kanagawa and Tokyo-to), and least in the east direction that encompasses Chiba prefecture (Figure 4). Important variations in the direction of concentrated growth are seen upon examining the three time phases (Table 1). During the early phase (1960-75), Kanagawa prefecture dominated DID expansion. During the second phase (1975-95), Tokyo-to experienced reduced growth rate while Kanagawa and Chiba

expanded much. The eastern prefecture of Chiba had high DID growth rate in the second and third phases (1995-2010), though the actual magnitude of growth in square kilometres was comparatively low particularly in the maturity phase.

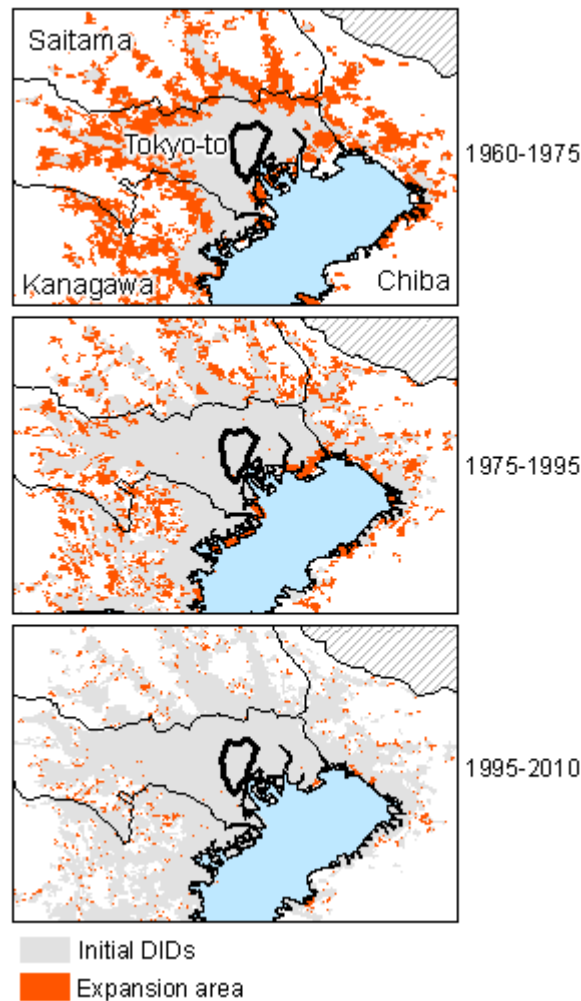


Figure 4. Maps showing DID expansion for the exponential phase (top), slowing growth phase (middle), and maturity phase (bottom).

Table 1. Proportion of new DID area in each prefecture

	Kanagawa	Tokyo-to	Saitama	Chiba
1960-1975	32%	26%	23%	19%
1975-1995	31%	14%	26%	29%
1995-2010	30%	14%	24%	32%

3.3 Types of expansion

3.3.1 Extension

The most abundant type of expansion was extension, which is the formation of new DIDs adjacent to prior existing DIDs. This type of expansion was most intensive during the exponential phase of growth. Visual inspection of the maps shows that the extension was spatially uneven. Selective extension favored the formation of elongated DID corridors stretching from the main contiguous DID. Extension also resulted in the absorption of some existing patches by the main contiguous DID.

3.3.2 Fragmented growth

Fragmented expansion was observed in the form of new patches of DIDs. The total number of DID patches in 1960 was 100. The figure increased to 157 by the year 1975, then it was 209 by 1995, and by 2010 it was 278. The number of patches increased despite the amalgamation of many patches into the main contiguous DID. While the total number of patches was highest in the latter phase of growth, the total area of patches was lowest in that phase. It seems therefore that fragmented growth was more rampant in the phase of slow growth compared to the rapid growth phase.

3.3.3 In-filling

Infilling was observed in the main contiguous DID. In-filling is a kind of extension that occurs in the confines of captured open spaces. The majority of the captured open spaces were observed in Kanagawa prefecture, though small captured open spaces are also seen in other prefectures (Figure 5). The total size of captured open spaces was approximately 96 km² in 1975, 154.4 km² in 1995, and 216.3 km² in 2010. The total area size of in-filling was 7.4km², 58.3km², and 42,3km², in 1960-1975, 1975-1995, 1995-2010 respectively. Infilling was greater in the phases of slow growth and maturity. However the rate of infilling was less than the rate at which open space was captured, and consequently the net size of captured open space increased.

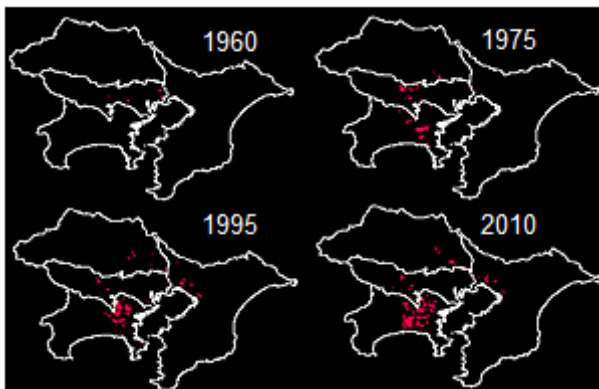


Figure 5 (a) Maps showing the captured non-DID areas. (b) Comparison of the total captured non-DID area and total in-filling

3.4 Association between DIDs and some physical and transportation factors

Figure 6 shows relationships between DIDs and some physical and transportation factors. It can be observed that there is a strong association between railway lines and DID location. Over 95% of all DIDs are located within 4km distance from a railway line. Most of these railway lines were established before 1975 so we can infer that railway lines influenced the location of establishment of DIDs. Moreover each of the outward corridors of DIDs follows a major railway line.

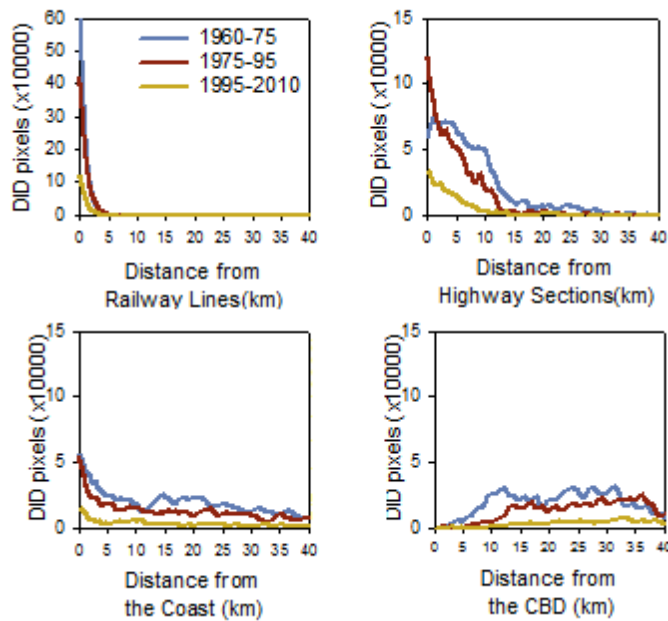
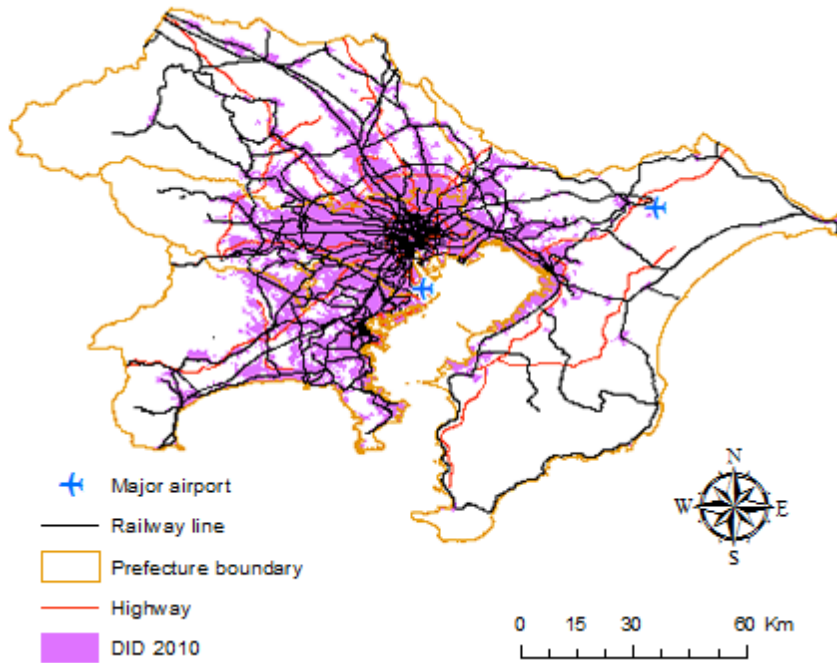


Figure 6. The location of new DIDs with respect to distance from railway lines, highway sections, the coastline, and the central business district (CBD)

There is some association between DID location and the distance from highways, though some DID pixels are also seen over 10 kilometers from highway sections. The association between highways and DID location may have been indirectly influenced by railway lines. The majority of highways are located almost parallel to key railway lines. Moreover most of the highways were completed after 1975, which is also the reason for the surge in the initial 1975-95 plot for distance from highways.

The bay of Tokyo is historically known to have been one of the key factors for the site selection of the original castle town. Hence a large proportion of the coast was already occupied by DIDs at the beginning of this time series. In our study period we find that distance from the coast had

a lesser influence on DID location compared to transportation related factors. Nevertheless it is noted that the first three kilometers from the coast were favored for DID location in all three growth phases of this study.

Distance from the CBD is another factor traditionally associated with urban population densities. As much of the areas near the CBD were already densely inhabited by 1960, most of the new DIDs after 1960 were established from 5 to over 40 kilometers from the CBD.

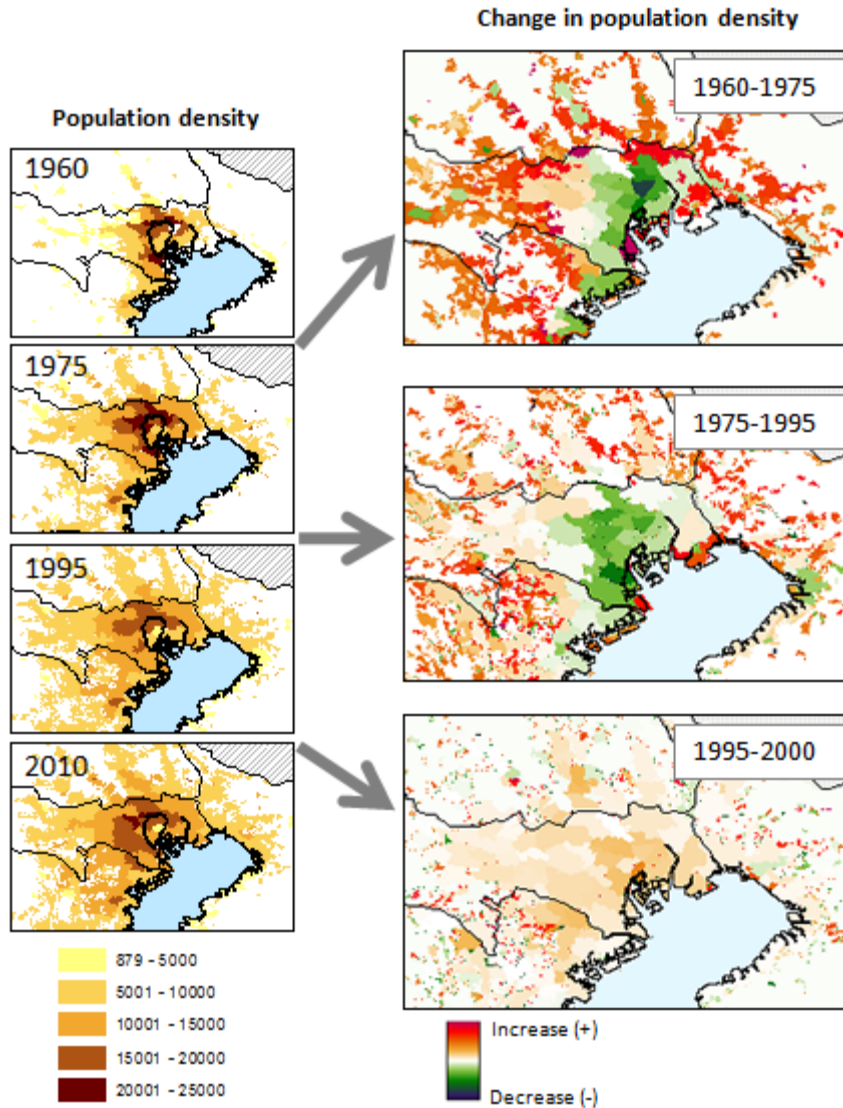


Figure 7. Changes in population density in DIDs.

3.5 Population densities

Having assessed DID expansion, it is also important to investigate trends in actual population densities within the DIDs. Figure 7 shows maps of Tokyo's population densities. The Yamanote loop line has been inserted for reference to the central business districts. The highest population densities have been located in the western parts of the Yamanote line since the early years. It is however important to note that the inner districts experienced a reduction in population densities from 1960 to 1995. At the same time the population in outer wards was rising.

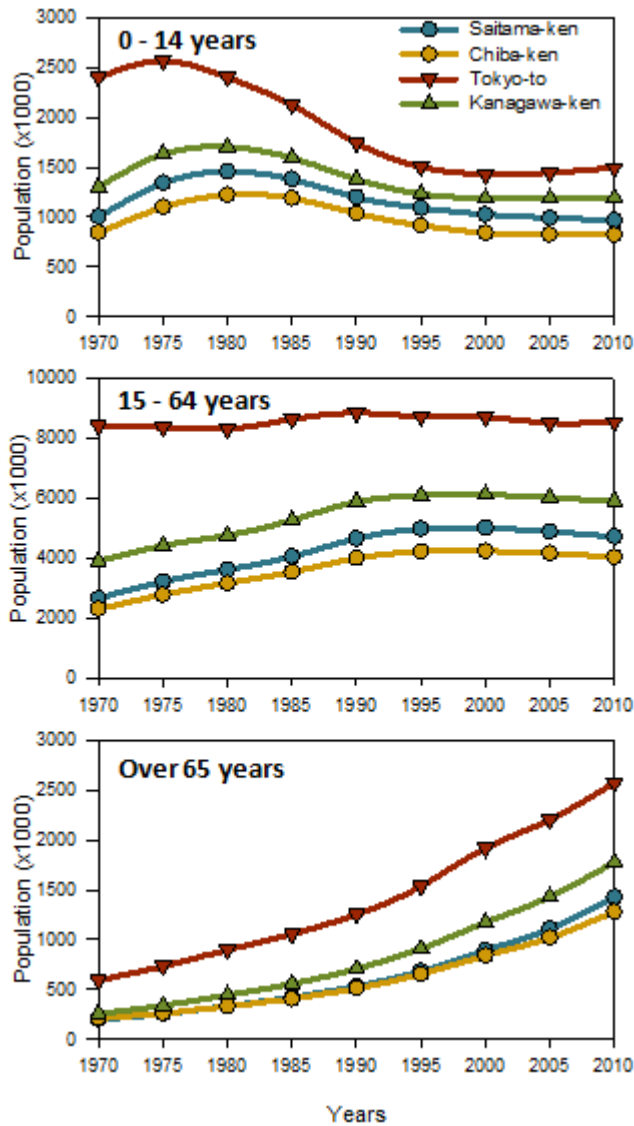


Figure 8. Age trends by prefecture.

3.6 Population ages

Figure 8 shows the trends in population by age for each prefecture. Since the mid-70s there was a decreasing trend in the age group of 0-14 year olds in all prefectures. This decreasing trend seems to have stabilized after 1995. While the population of 15-64 year olds was increasing gradually from 1970 to the mid-90s in Kanagawa, Saitama and Chiba prefectures, Tokyo-to did not change much. The age group of over 65 year olds has seen an increasing trend in all prefectures. These age trends will likely have a big influence on future DID trajectories.

4. DISCUSSION AND CONCLUDING REMARKS

This study has analyzed the expansion of Tokyo's densely inhabited districts (DIDs). Tokyo's historical growth was complex passing through various stages and forms of growth. By using 5-year intervals and a long time-frame (50 years), this study could reveal temporal details about key turning points in the historic growth. Tokyo passed through an initial

exponential phase, followed by slowing growth and is now in a maturity phase. Though our study starts in 1960, literature shows that rapid growth actually began soon after the Second World War. The final phase we describe as maturity phase is characterized by minimal growth, and does not seem to be decline yet. However it is apparent that without a major rejuvenation of growth, the megacity could encounter decline as some older megacities have done in the western world ([Turok & Mykhnenko, 2007](#)). It is to be seen if the 2020 Tokyo Olympics and the on-going Abenomics will provide the necessary rejuvenation for Tokyo's growth.

4.1 Rates of expansion

The rate of DID expansion shows strong association with economic trends, in particular rates of Gross National Income (GNI) and Gross Domestic Product (GDP). The initial phase of rapid DID expansion (1960-1975) corresponds with the post-war period when the country experienced rapid economic growth, rising to be the world's second largest economy. This concurs with Ito (1991) who notes that Japan's hyper-rapid economic growth began in 1944 and ended in 1973. The time series of this study starts from 1960, which coincides with Prime Minister Hayato Ikeda's taking office and announcing his goal of "doubling average personal income within ten years", but this was achieved within 7 years. In this decade of accelerated economic growth, the country attained large trade surpluses supported by the yen fixed at 360 yen per dollar under the Bretton-Woods system. Detailed information about the state of the economy in this period is available in literature.

From 1975 there was a declining trend of DID growth rates, with no return to the historical peaks. There were several critical economic changes in the 1970s. For example, in 1972 Prime Minister Tanaka's government increased money supply and lowered the interest rate and this created inflationary pressure. Then there was the First Oil Shock after OPEC countries announced the oil embargo in October 1973 which resulted in "Wild Inflation" (Kyo-ran Bukka) for Japan, reaching levels of up to 30% by 1974. The oil shock had profound and long lasting impacts on the fabric of the Japan's economy. It had the effect of forcing the country into economic recession ([Mihut & Daniel, 2012](#)), with negative consequences for corporate profit and the labor market. The effective rate of available jobs, which remained constant over the period 1967-1974, dropped nearly to half at the end of 1975, and the net profit rate reached the lowest level after the Second World War, dropping below 1% in the manufacturing sector (at 0.76%) in the first half of the fiscal year 1975 ([Mihut & Daniel, 2012](#); [Yoshitomi, 1976](#)). Concomitant to that were the decrease in investments and slowdown in technological progress ([Mihut & Daniel, 2012](#)).

Between 1985 and 1995 there was a temporary spike of DID growth rate and a corresponding temporary spike in Gross National Income. This likely reflects the economic bubble period (1986-1991) wherein real estate prices and stock market prices were substantially inflated. After the bubble burst however, there was low DID expansion of below 10 km²/annum. Economic literature refers to this period of economic stagnation as the "lost decade".

4.2 Direction and shape of expansion

The direction of Tokyo's expansion was greater towards the west and south, particularly in the early years. Prefectures in this direction are Tokyo-to and Kanagawa. That this direction was favored for DID expansion is greatly related to the Tōkaidō corridor which connects Tokyo to Japan's other megacities Nagoya and Osaka. The significance of the Tōkaidō in the history of Japan is outlined well in the literature. Historically the Tōkaidō was travelled by foot and wheeled carts, and the Tōkaidō railway line was established in 1889 ([Traganou, 1997, 2004](#)), so this encouraged settlements in that direction. Furthermore Kanagawa and Tokyo prefectures are attractive locations as they are both coastal prefectures, bounded by Tokyo Bay on the east and Sagami Bay in the south separated by Miura peninsula ([Siebert, 2000a](#)). These two prefectures were connected by rail as early as 1872, and this was Japan's first rail line ([Siebert, 2000b](#)). Siebert who examined the physical geography of Tokyo also notes that mountains in the west-end of Tokyo-to and Kanagawa limited further urban expansion in that direction ([Siebert, 2000a, 2001](#)), hence in later years expansion increased towards Saitama and Chiba direction.

The lagging of DID growth in Chiba prefecture is particularly interesting because it occurred despite policy effort and much financial investments to create Chiba New Town and the advantage of the establishment of Narita Airport. A major reason cited in literature for the failure of Chiba New Town to attract targeted population numbers is transportation limitations. The Hokusō line took long to construct, and the train fare is regarded as expensive. On the contrary, the successful Tama New Town in Tokyo-to and Kohoku New Town in Kanagawa already had railway infrastructure and were well connected to Tokyo.

4.3 Proximity factors associated with DID expansion

Among the proximity factors associated with DID expansion that were examined, transportation policy was the most dominant. With over 95% of all DIDs located within 4km distance from a railway line, it is clear that railway transportation is an integral feature supporting Tokyo's DIDs. Most of the lines were established before 1975 therefore it could be inferred that DIDs tended to grow near existing railway lines. These findings concur with literature emphasizing that Japanese railway companies intentionally foster DID growth near stations as part of their business strategy ([Calimente, 2012](#); [Zacharias, Zhang, & Nakajima, 2011](#)). Beginning in the 1920s, private railway companies purchased huge areas of land in the suburbs of Tokyo and developed housing estates and department stores next to stations as a business strategy ([Okata & Murayama, 2011](#)). This in turn created unprecedented demand for railway services ([Zacharias, Zhang, & Nakajima, 2011](#)). Transit-oriented development (TOD) in Japan is a fundamental characteristic of all central city urban development, and is almost exclusively rail-based ([Dittmar & Ohland, 2003](#); [Zacharias, Zhang, & Nakajima, 2011](#)). Urban sprawl was limited by Urbanization Promotion Areas (UPA) which were demarcated to create systematic urbanization around train stations. Urbanization Control Areas (UCA) were also created to limit urbanization beyond the UPA. Contrastingly, informal sprawl is rife in many emerging megacities, ([Benítez et al., 2012](#); [Hill et al., 2014](#); [Hove, Ngwerume, & Muchemwa, 2013](#)). Tokyo provides an example case showing that a possible

way of effectively controlling the extent of expansion is through long term investments into public transportation coupled with public policy support.

While discussing the association between Tokyo's railway network and DIDs, it is important to highlight that the trains of Japan are ranked among the most punctual in the world ([Brebba et al., 2014](#)). Hence the movement of human capital and goods through the megacity is voluminous yet efficient. Transportation infrastructure contributes significantly to a city's prosperity by facilitating workers' access to employers, consumers' access to shopping and leisure activities, and firms' access to capital, labor and potential customers ([Winston, 2014](#)). In contrast many emerging megacities are lagging in public transportation infrastructure, and without the construction of new public transportation infrastructure the majority of people will have very limited mobility making their participation to the formal economy almost impossible ([Vermeiren et al., 2012](#)). A policy recommendation for upcoming megacities is investments in transport infrastructure such as railways that can be used for long periods and can be upgraded when required to match with new technologies.

4.4 Population density trends in DIDs

The study has also shown important trends in the actual population densities of the DIDs. The inner districts had decreasing population densities from the 1960s through to the 90s. Concurrently outer districts increased in population densities. This suburbanization occurred as undeveloped land in the outer districts was being developed, and this was supported by public policy to reduce congestion in the city center. For example many "New Towns" were created in outer districts to provide affordable housing to the large working class. Examples of such "New Towns" include Tama New Town in Tokyo-to, Kohoku New Town in Kanagawa just to mention a few. These trends were supported by policies to curb urban sprawl, such as the Urbanization Control Areas (UPA) and Urbanization Promotion Areas (UCA). The UPA and UCA became effective in most municipalities by 1975. Therefore in addition to economic factors, public policy also had a very strong influence in directing and controlling the extent of expansion.

4.5 Age composition and future trends

Tokyo's demographic composition has changed substantially over the past 50 years. The elderly population has been progressively increasing while the young population decreased substantially. These are critical changes in population structure, and all prefectures are affected. In contrast many emerging mega-cities face challenges of high urban fertility. For Tokyo, unless there will be substantial absolute population growth, the mega-city's DID face future decline. We have not mapped the age trends by DID, but this could be an interesting subject for future research. However it is apparent that appropriate policy measures are needed to better prepare for the future decline in DIDs caused by these demographic trajectories.

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