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Advancing smartness of traditional settlements-case analysis of Indian and Arab old cities

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Abstract

The study aims to investigate the concept of Smart Sustainable Cities in traditionally planned and organically grown settlements. Smart Cities Mission is an ambitious project of Government of India targeting 100 cities for improving their urban quality of life. However, there is no universally accepted definition of smart cities because of its vast and vague scope. In such a situation, it becomes important to understand where our old cities stand in terms of smart sustainability and inclusiveness. The methodological approach adopts case analysis of old Indian cities and Arab cities in terms of their environmental, economic and social planning paradigms. These include land use mix, compact development, dwelling density, internal and external connectivity, open spaces, walkable neighbourhoods, access to social services, collective cohesiveness, local area governance, crime & safety, economic diversification and socio-cultural diversity.

The study enlists smart urban elements in our existing old cities, which are derived from extensive literature study of Middle East cities and primary surveys of around 160 samples in a medium sized old Indian city in Rajasthan. The study assesses the baseline situation of culturally rich and varied old cities and need to advance from their inherent smartness using innovative and interactive ICT and urban engineering solutions.

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Keywords: Smart sustainable cities; Inclusiveness; Middle east; Old Indian cities; Smart urban elements

1. Introduction

Cities are the face of the future acting as the engines of economic growth and centres of excellence (ICLEI and the

Cities Alliance, 2007). The United Nations' World Urbanisation Prospects report identifies the highest rate of urbanisation in Asia, which is currently increasing at 1.5 per cent per annum. Between 2014 and 2050, the urban areas in India are expected to grow by 404 million people (United Nations, 2014). It is a strong realisation by international and national community that a successful city should balance social, economic and environmental needs, should respond to all the domains of urban life, should offer security, quality level basic urban infrastructure and a healthy social environment to prosper its culture and community by recognising its natural assets, citizens' needs and

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environment on which it builds (Elmer & Leigland, 2013). Thus, with a focus on ecological and humanistic dimensions of urban environment, sustainability is an important concept, which is appropriate only when implemented in their current cultural contexts (Narayanan, 2015).

The sustainable urban development has emerged as an important urban planning priority in India. However, Narayanan (2015) has well pointed out in her book that uncritically imposed planning policies in developing countries like India, without considering its socio-cultural and historic variations of place and community, has a high risk of failing or even intensifying existing social and environmental injustices. In order to develop planning policies which integrate social, cultural, political and environmental needs of existing cities, a localised sense of place is identified as a vital element of sustainable cities (as cited in Narayanan, 2014).

In the middle east, the impact of modern planning practices is very profound on its historic centres. The introduction of modern technology and western school of planning has interrupted the evolutionary processes of middle eastern societies (Blake & Lawless, 2016). Even if some of its historic urban fabric is alive, the economic and social shifts are predominant in its historic centres. Simultaneously, the concept of Smart Cities is very promising in India and new urban initiatives are paving new ways towards urban development. However, the problem arises when the buildings are given more importance than its inhabitants (Narayanan, 2015). That's why the cities that were re-planned pre-independence in India generally left the old historic cities untouched and the focus was on new western style city extensions around them such as Lutyen's New Delhi. The clear message of Narayanan (2015) in her book is to consider the importance of religion and social beliefs of community than adopting western inspired urban planning principles.

The Middle Eastern cities have already seen a transformation phase from traditional urban fabric to modern skyscrapers and smart cities (Kiet, 2011) while India is just entering into this new phase of modern development. Also, a high similarity is observed between planning principles of traditional settlements in the Middle East and India; imparting high importance to social and religious belief system of its community. Many scholars have also opposed the insensitive and incongruent approach of modern planners for such old settlements with a complex society system and values. Hence, the interventions of Government of India for Smart Urban Development require an investigation of old cities in India to understand their traditional planning principles so that the inherent features of these old settlements can be advanced to perceived level of smartness.

The main research question which arises is how inclusive is the concept of smartness and how sustainable is the built-up environment of these old cities. The study aims to present case analysis of the traditional settlements in the Indian subcontinent and Arab World, evaluating their

sustainability based on set criteria. The key objectives of the study are to explore the concept of Smart Sustainable Cities and assess the sustainability of the selected case studies and give an overview of their traditional planning system.

The study concludes that the physicality, society, and economic aspects can't be seen in isolation. It is almost impossible to delink the past from the future. If smart and sustainable are the buzz words for future cities, then the old and historic principles can't be ruled out and needs to integrate heritage and technology altogether. The future scope of research can be to advance inherent layers of sustainability of these settlements to smart urbanisation.

2. Literature review

2.1. Concept of smart sustainable cities

Smart, in general, is associated with quick mental alertness, resourcefulness, capability of independent and intelligent actions and ability to reason. It is nothing but a proactive operation especially when it is required the most. However, a smart city is a concept rather than a universally accepted definition (Kondepudi, accessed 2015). With the change in the approach of the modern world towards urbanisation, the concept of digital cities, smart cities, and wired cities have flourished over time. During the 1980s and 1990s, technological advancement and economic growth led to migration as a common phenomenon in major cities. This urbanisation had profound negative impacts on the resources of the city and led to the development of the idea of smart urban growth during the 1990s. Initial idea was to invoke effective community participation in solving urban issues, but later with Kyoto protocol, the emphasis shifts to environmental protection (Kondepudi, accessed 2015). International institutions such as the European Union and Organisation for Economic Co-operation and Development (OECD) realised a strong correlation between the concept of smart and sustainable along with green growth, quality of life, ICT infrastructure and citizens' involvement. There is no concrete definition of the smart city but rather it is treated as a concept and adjective which is ambiguous and takes shape with the needs and priorities of its users.

A smart city is explained as a broad concept with many sub-themes such as urban and regional planning, economic development, environment and sustainability, ICT and technology in a literature study conducted using the mathematical model by Von Brocke et al. (Cocchia, 2014). Several authors had highlighted the difficulty in defining smart cities because of its multifunctional and fuzzy label. However, all definitions almost share some common characteristics, features, and boundaries. These concepts are not contradictory and isolated but partially or fully overlap (Cocchia, 2014). The trend analysis show five phases of development of this concept:

1. Kyoto Protocol (1997): It influenced the way the world perceived modern and industrialised cities with major thrust on the environment.
2. Information technology boom (2000): The flow of information became smoother among citizens and life became much easier with IT. The term digital city as the wired city became widely accepted with internet diffusion into public and private life to create socio-economic value.
3. Enforcement of Kyoto Protocol (2005): The publications with the term smart city started to increase which were mostly centred on specific projects.
4. Smart Technology (2007): Apple Ltd launched its first smartphone, i-phone and from here onwards the use of smart devices became everyday routine for general public. These devices have smart features which combine telephony and computing together and enable high-speed data access and real-time digital services to improve the quality of life. This also led to the building of digital urban arena by merging meanings of smart and digital for innovative urban policies.
5. Europe 2020 strategy (2010): The journals with smart city label started rising phenomenally till 2012. Europe 2020 strategy widely used the term smart city in terms of urban sustainability with its focus on environment protection, social and economic sustainability.

Hence it can be seen that smart city regards more attention to the environmental quality of cities, unlike digital cities which focus more on the use of Information and Communication Technologies (ICT) in urban areas. Also, the concept is more of political nature, driven by international resolutions to implement innovative solutions to tackle complex urban challenges. The four key attributes of Smart Sustainable Cities (SSCs) are found to be Sustainability, Quality of Life, Urban aspects and Intelligence with four core themes as Society, Economy, Environment, and Governance (Kondepudi, accessed 2015). Approximately 116 most cited definitions of smart sustainable cities were analysed on the basis of chosen attributes and themes of SSCs developed in a parallel International Telecommunications Union's Technical Report on the Overview of Smart Sustainable Cities. Also 30 common keywords were found to be overlapping among all these definitions which were further categorised into eight categories (The International Telecommunication Union (ITU) - Focus Group on Smart Sustainable Cities, 2014) (1) quality of life and lifestyle, (2) infrastructure and services, (3) ICT, communications, intelligence and information, (4) people, citizen and society, (5) environment and sustainability, (6) Governance, management and administration, (7) economy and Finance, and (8) mobility. The five most important keywords in terms of percentage of occurrence were Quality of life (6.1%), Technology (5.8%), People (5%), Systems (4.7%) and Economy (4.7%) (Kondepudi, accessed 2015). Based on this analysis, a smart sustainable city is characterised as the one with following goals to be

achieved in an adaptable, reliable, scalable, accessible and resilient manner:

1. Improve quality of life of its citizens.
2. Ensure economic growth with better employment opportunities.
3. Improve well-being of its citizens by ensuring access to social and community services.
4. Establish an environmentally responsible and sustainable approach to development.
5. Ensure efficient service delivery of basic services and infrastructure such as public transportation, water supply and drainage, telecommunication and other utilities.
6. Ability to address climate change and environmental issues.
7. Provide an effective regulatory and local governance mechanism ensuring equitable policies.

2.2. Urban fabric evolution

City making is a process whereby social, economic, political and physical urban components interact with each other. Urban forms are more or less a result of urban experiences, which are key to human settlements, culture, and society. These material organisations of urban space are crucial to producing and reproduce social and economic arrangements and divisions. Elements of urban form tend to mediate physically and spatially with its social, economic and environmental setting (Lynch and Rodwin, 1958). This implies that urban form can't be defined only in terms of its physical and tangible constructs but requires a deep understanding of its intricate mix of social, economic, legal and political modes of organisation and interaction. Hence, any city is a result of complex relationship among its socio-economic, Spatio-temporal and environmental processes and practices (Tonkiss, 2013).

In cities, there are a lot of urban processes and urban systems interacting within an urban space. This idea of urban interconnectedness overpowers the traditional definition of cities as discrete spatial or functional units. Lynch (1981) defined urban form from the perspective of narrow fixity as a spatial pattern of large, inert, permanent physical objects in the city. However, Tonkiss (2013) redefined it from broad non-fixity point of views as not limited to fixed elements of morphologies but it takes in more dynamic and provisional features of city environments such as the patterns of mobility, inward and outward flow of people and things, events and interactions, occupation and history which are highly formative for cities but may or may not be permanent in nature.

In old cities, there are no end users rather there are users over time i.e. transformation of space with time. All urban occupations are temporary i.e. urban context changes more quickly than urban form. Urban design is expressive but what is formative of an urban space is not its physical shape alone but several personal and impersonal processes

such as socio-economic, environmental, political and legal. These processes may appear abstract but are not less social to individualise (Lynch and Rodwin, 1958). Wherever there is a society or mix of people staying together, it has resulted in social and economic practices from which an interactive environment is woven (Lynch and Rodwin, 1958). Even an organic pattern depicts some kind of arrangement or organisation of urban space relevant to human settlements and an urban context (Tonkiss, 2013). Technically, they are socially and economically planned through a more complex process resulting in an intricate urban fabric.

Generally, the physical form of cities are measured in terms of distribution and densities of population, housing stock, public buildings and spaces, workplaces and consumption, balance between private and public land uses, environment, etc. The social life of urban form refers to how cities are structured as spatial environments around and through social relations, practices, and divisions. Hence, urban form is not only about buildings and spaces between them, skylines and city boundaries but also about densities and distribution of people and functions, the spatial relationship between social groups, spatial markings of legal boundaries and entitlements, urban environments and the submerged or social infrastructures that shape and segment them (Tonkiss, 2013). The scales at which urban form can be considered or measured include the individual building, street, urban block, neighbourhood, and city. These levels of spatial disaggregation influence how urban form is measured, analysed and ultimately understood in terms of aspects shown in Fig. 1 (Jenks and Jenks, 2009).

2.3. Sustainability assessment matrix

The evaluation of the case studies in the Middle East and India is based on a matrix which is developed based on extensive literature review of urban form elements which contribute to sustainability in the long run. This assessment is important to make us understand whether our traditional settlements have been smart in their approach to urban planning and hence assess our baseline situation to move to next level of introducing ICT and other urban engineering solutions. Jabareen (2006) identified urban elements composing complex urban pattern and urban form. These urban patterns can be grouped together conceptually to form concepts and the author conducted a thematic analysis to discover these urban patterns, themes, and concepts (Jabareen, 2006). In the present study, these seven concepts are further being used to assess the urban fabric of traditional settlements and are termed as smart urban elements leading to inclusive and sustainable communities. Each of these concepts has an overlapping influence on the aspects of sustainability from social, economic and environmental paradigms as shown in Fig. 2.

These identified seven smart urban elements are listed below in Table 1 with their significance.

3. Case studies

The selection of case studies is done on the basis of the socio-cultural and traditional belief system of Islamic and Indian societies. On one hand, Middle Eastern cities have

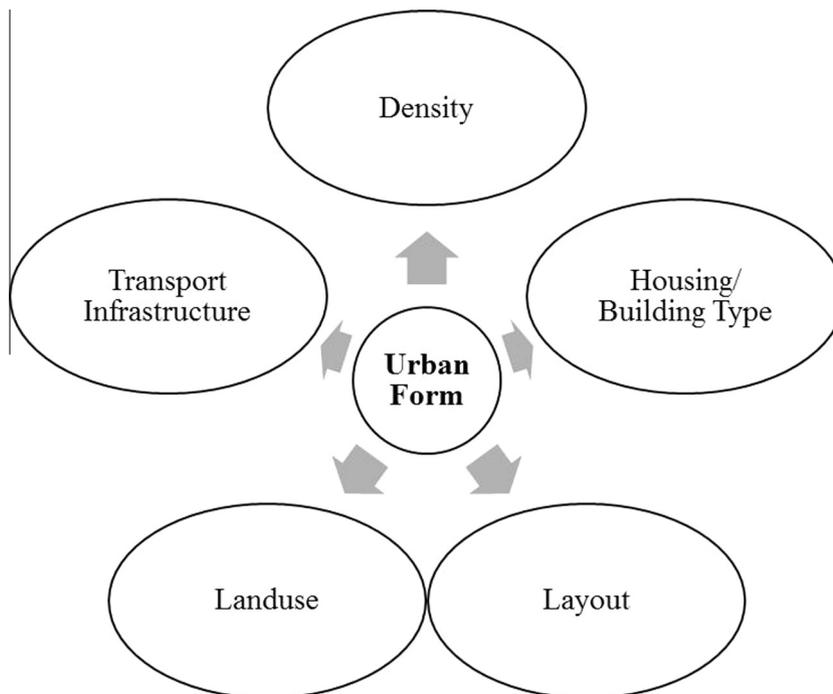


Figure 1. Aspects of a sustainable built environment (Jenks and Jenks, 2009).

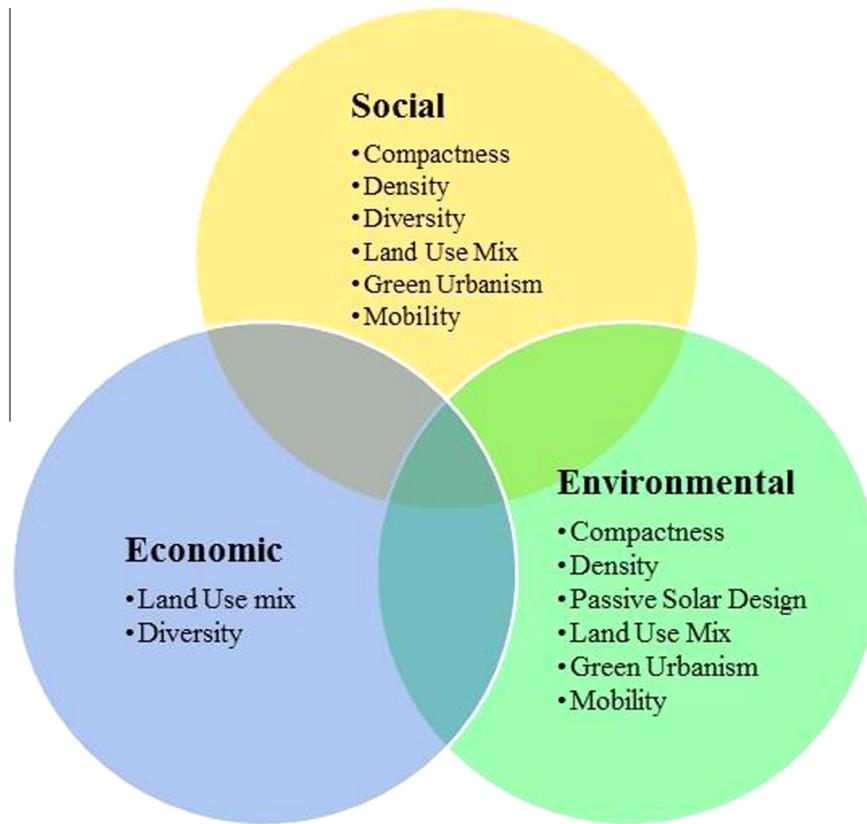


Figure 2. Smart urban elements to assess three sustainability conditions.

Table 1
List of smart urban elements.

S.No.	Smart urban elements	Significance
1	Compactness	Improves walkability; reduced energy usage; high quality of life in terms of social interaction; access to community services; mutual shading; reduced travel demand
2	Mobility	Reduced travel need; accessibility to services; environment and pedestrian friendly; anti-vehicular growth
3	Density	Viable interactions between urban functions and activities; encourages compact development; efficient use of scarce natural resources and urban land; reduces automobile ownership and travel demand
4	Land use mix	Ensures safety on streets; reduced number of trips; increases accessibility; attractive local streets; boosts local creative economy and handicrafts; high neighbourhood charm
5	Diversity	Rich social and cultural mix; promotes walking; closely grained; attractive urban landscapes
6	Passive solar design	Favours microclimatic conditions; reduces cooling and heating energy consumption; environmentally viable; promotes local craftsmen skills
7	Green urbanism	Favours microclimatic conditions; greens spaces for children to play; open spaces for social interaction; promotes participative decision making

Revised from (Jabareen, 2006)

almost completely transformed from traditional urban fabric to modern cities with tall skyscrapers and smart technologies while on the other hand, India is witnessing a new wave of urban development focussing on Smart City development by its government. India being a land of numerous historic cities, needs a holistic approach avoiding the application of western planning principles in its present form. Hence, the old cities in both the contexts are examined through set sustainability criteria to plan for their future without neglecting their rich past and inherent

smartness. The two cases that have been chosen for the purpose of this study are the city of Riyadh in the Middle East representing typical old Arab settlement and the old walled city of Alwar in India.

Saudi Arabia has experienced rapid growth in urban development during the last four decades with the city of Riyadh transforming from a mud-walled town of 25,000 inhabitants to an international metropolis of 2.5 million (Al-Hemaidi, 2001). The city belongs to the pre-Islamic era and has transformed over time with rapid urban

development. Since the 1940s the city has changed from an isolated and narrow town to a spacious modern city. It lies in the centre of Arabian Peninsula on a plateau with an area of around 1300 sq km. With post 1940s modern development and economic growth, the traditional urban settlements experienced a constant self-destruction by adopting imported town planning techniques from the western world (Al-Hemaidi, 2001). This urban development process has been widely criticised by scholars and now the city has started to experiment with something called improved traditional built environment.

The second case study of the walled city of Alwar is located in the northwestern state of Rajasthan in India at an elevation of 271 m and bordered by Aravalli Range to its west. It is the third most populous districts in the state out of 33 districts followed by Jaipur and Jodhpur (Town Planning Department, 2011). The origin of the region dates back to the era of Indus valley civilisation and epic age in India. The pre-historic evidences show its great association with Indo-Islamic heritage. During British rule in India, Alwar was one of the princely state capitals and the district is now a part of National Capital regional plan 2021 of Government of India with a total population of around 3.67 million in 2011 (Town Planning Department, 2011). Presently, a traditional way of living is still prevalent in the old city area with rich tangible and intangible heritage and it is an important magnetic centre of the region. This raises further concern how the new urban development will deal with the traditional settlements and can we analyse existing sustainable elements in the walled city to integrate them in new smart planning framework.

4. Methodology

Each of the case studies has been analysed and their qualitative characteristics are converted to scores based on the scale developed to assess the smart urban elements.

The indicators have been identified based on a comprehensive literature study (Yigitcanlar et al., 2015). The city of Riyadh is studied and analysed based on comprehensive literature review of secondary data and peer-review journals. The city is quite old and had rich urban planning principles. However, the literature reviews show that these planning principles have lost over the years due to inevitable forces of globalisation in the Middle East countries. This entire process has led to the deterioration of its traditional urban form and character. That’s also one of the reasons to adopt literature review for the city as the methodology to understand its traditional urban form and characteristics.

On the other hand, the walled city of Alwar is analysed based on the primary surveys for which GIS-assisted spatial analysis of its urban fabric is carried out (Dhingra et al., 2016). The walled city of Alwar still demonstrates Indo-Islamic town planning principles and gives an opportunity to the authors to understand the current baseline scenario of the traditional settlements. Alwar is similar to the city of Riyadh, which is still a medium sized town and is facing new forces of globalisation and technology. This brings to the question of how the new global market forces should respond in this context, keeping in mind the traditional layout of the city. This further brings closer to the need of understanding its presently existing scenario which is only possible through primary surveys as the secondary data at the micro level for cities in India is almost negligible and needs a micro level investigation. Both the case studies have further been analysed and compared in a matrix format for each of these urban concepts and results are presented. The methodological approach is shown in Fig. 3.

The scale which is developed for the assessment of the identified smart urban elements and their respective indicators are given in Table 2.

For the survey of the old settlements in the walled city of Alwar, a 3.80 sq.km soft boundary is delineated based on

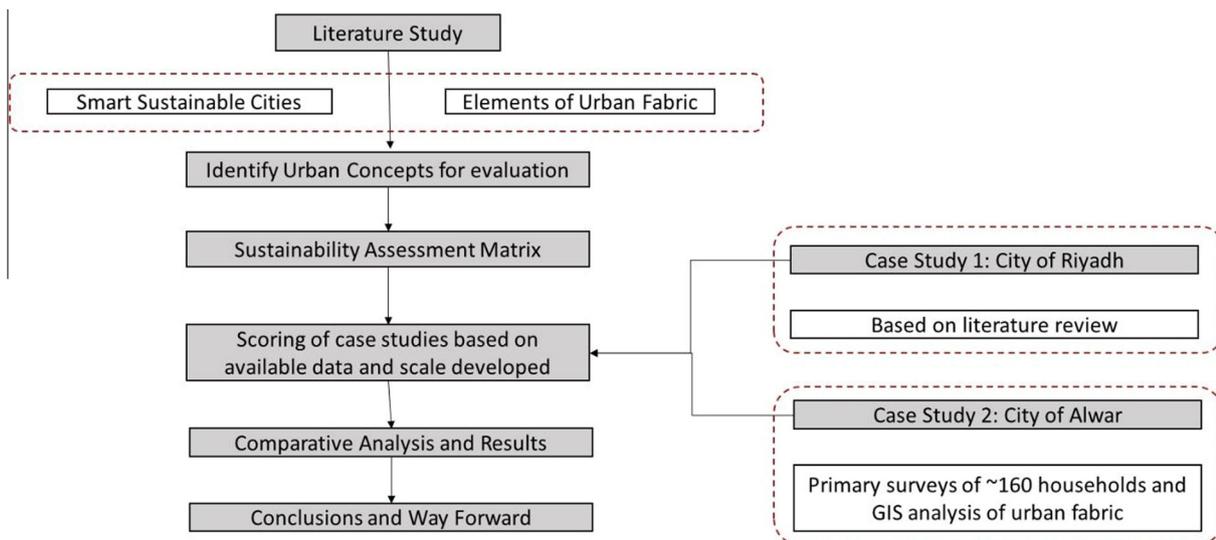


Figure 3. Methodological approach.

Table 2
Scale for evaluation of smart urban elements.

S.No.	Smart urban elements	Indicators	Evaluation criteria
1	Compactness	Dwelling units density	High = 3; Medium = 2; Low = 1.
2	Mobility	Home to work distance Internal connectivity External connectivity Street layout	Low = 3; Moderate = 2; High = 1 Good = 3; Medium = 2; Bad = 1 Good = 3; Medium = 2; Bad = 2 Well Connected = 3; Moderately connected = 2; Poorly connected = 1
3	Density	Persons per hectare Commuter mode choices	High = 3; Medium = 2; Low = 1 Walking/Cycling = 3; 2-Wheeler = 2; 4-wheeler = 1
4	Land use mix	Mixed residential land use Walkability to city centre Walkability to social services Mix of commercial and residential land uses	High = 3; Medium = 2; Low = 1 High = 3; Medium = 2; Low = 1 High = 3; Medium = 2; Low = 1 High = 3; Medium = 2; Low = 1
5	Diversity	Building typology Socio-cultural mix Local creative economy Income groups	Varied = 3; Moderate = 2; Not Varied = 1 Heterogeneous = 3; Moderate mix = 2; Homogenous = 1 Varied and Flourishing = 3; Stagnant = 2; Negligible = 1 Heterogeneous = 3; Moderate mix = 2; Homogenous = 1
6	Passive solar design	Orientation and Siting Building layout Façade and fenestration Building techniques and materials	Climatic considerations: High = 3; Moderate = 2; Low = 3 Climatic considerations: High = 3; Moderate = 2; Low = 3 Climatic considerations: High = 3; Moderate = 2; Low = 3 Climatic considerations: High = 3; Moderate = 2; Low = 3
7	Green urbanism	Accessible open spaces Impervious surfaces Common public spaces for informal discussion	High = 3; Medium = 2; Low = 1 Low = 3; Medium = 2; High = 1 High = 3; Medium = 2; Low = 1

several factors such as the master plan boundaries, historical evolution, high-density areas, arterial roads, the presence of traditional architectural elements and townscape value. This area contains several layers of historical evolution and comprises of approximately 66 identified old neighbourhoods called mohallas, 26 historical landmarks, important streets and 18 intangible heritage components (Dhingra et al., 2016). All the identified urban layers were mapped on Arc GIS desktop version 10.1 and figure-ground analysis was conducted. Around 160 households and 50 local shopkeepers were surveyed based on the structured questionnaire to identify the development trend and local behaviour pattern. Stratified random and clustered sampling survey technique were used for primary surveys of local residents and shopkeepers. For the purpose of sample size calculation assuming a normal distribution with the confidence interval of 90%, equation 1 is used (Dhingra et al., 2016).

$$n = \frac{z^2 \times p(1 - p)}{m^2} \quad (1)$$

where

n = required sample

z = value of confidence level C.L. (for 90% it is 1.645)

p = estimated prevalence of variable of interest (assumed to be 30%)

m = margin of error (assumed to be 20%)

Correction for finite population is done using Eq. (2) (Dhingra et al., 2016):

$$n = \frac{n}{1 + \frac{(n-1)}{\text{POPL}^n}} \quad (2)$$

where POPL^n = ward wise population as per 2011 census.

5. Results and discussion

5.1. Riyadh

The Arab world comprises of countries which are tied together by a common cultural and social ideologies. From an early point time, there is a specific and unique Islamic quality which is apparent in traditional settlements of the Arab world. It shows deep affinities based on a set of customs, daily living habits, functional patterns and structural principles. However, these settlements had the climate, socio-cultural values, vernacular building techniques and religious beliefs as the common denominator of development (Bianca, 2000). Traditional Arabic town is a unique phenomenon moulded around several factors which are not in sync with formal town planning principles but rather with the autonomous management of societies of a class (Kiet, 2011). Most of the traditional Middle Eastern cities followed an organic growth pattern (Fig. 4) marked by seeds of certain archetypes (Bianca, 2000). These could, in turn, develop a wide range of physical shapes responding to site constraints, community size, economic resources and building materials and techniques. The real source of unity in Arab traditional settlements lies in its pre-formal

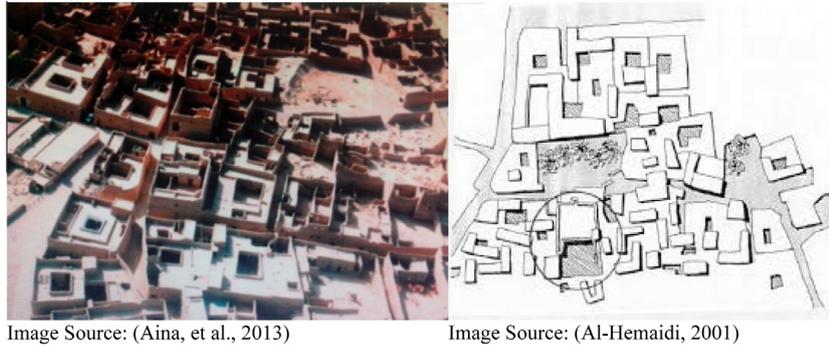


Image Source: (Aina, et al., 2013)

Image Source: (Al-Hemaidi, 2001)

Figure 4. Old urban fabric of Riyadh city.

archetypes and patterns rather than stylistic features (Ibrahim, 2015).

Urban morphology of traditional Arab settlements is characterised by the narrow and shallow street corridors leading to neighbourhoods resulting in closer public interactions and closed private spaces, which prevented friction from bustling public life (Kiet, 2011; Costa and Noble, 1996). The Arab culture mostly developed around the circular or spiral pattern with religion at its centre of gravity (Bianca, 2000). The centre of the city had multifunctional core system as main land use pattern surrounding central mosque by different layers of interconnected *souqs*. Inter-connected within are common public and commercial facilities (Ibrahim, 2015). The main spines from the grand mosque complex lead to the walls or gates from which the narrow streets lead to a cluster of neighbourhoods. There was a transition of urban space from public to semi-private to private residential units in these settlements giving a sense of zoning. The residential units were not merely a result of mechanical subdivision of space but rather a cellular aggregation process. The typical multifocal pattern was generated by countless centres of individual neighbourhoods and not on the basis of gridiron system. (Costa and Noble, 1996).

Also, the hot and arid climate along with the need for segregation of private spaces from semi-private and public spaces led to introvert urban plans. Most of the buildings were closer to the ground and grouped together to harness the potential of mutual shading to create a cooler microclimate. These dwelling units form clusters of neighbourhoods further leading to multiple clusters leading to continuous highly dense compact urban form. The old settlements possessed a high degree of ethnic and religious homogeneity where outside intruders were not allowed into private spaces of inhabitants. The openings opened inside the central courtyard rather than the main streets to ensure high-level privacy, especially for its women (Kiet, 2011). The internal narrow roads didn't have provisions for vehicular movement and hence preferable mode of movement was walking with complete segregation of private and public spaces leading to purely residential land use. Each neighbourhood cluster has its own set of tradition and culture which further integrated into a united urban form.

Traditional *souqs* were the ultimate marketplaces where items such as spices, dyes, jewels, silk and others passed from generations to generations. Well-off families were settled near the central complex and working class people were situated closer to the periphery with agriculture land beyond it.

The assessment of Riyadh as typical Arab settlements against all the smart urban elements with their characteristic features is presented in Table 3. The courtyard and high-level venting spaces ensured warm air to rise up and cool convection currents near the ground. The orientation of building and openings was away from the sun and towards north and west (Costa and Noble, 1996) The absence of dominant civic institution increased the need for local consensus and certain mechanism for human interaction. Courtyard type planning is prevalent which is introvert in nature to ensure a high level of privacy of family activities. The vernacular ventilating system of *mulgufs* or wind-towers was employed with inward facing fenestrations and raised at a certain height to ensure privacy and ventilation. Mud was the most common material used for walls which kept houses cooler and was also locally available. There was a strong system of open spaces, courtyards and circulation patterns at every scale. Impervious surfaces were least in number due to minimal metalled road surface and private street corridors were used mainly as spaces for social interaction among the people.

5.2. Alwar

The origin of Alwar walled city dates back to around 200 years ago over which numerous transformations have taken place in the city (Dhingra et al., 2016). The historical evidence shows a close association of the city with the pre-historic era and Indus valley civilisation. The foundation was however formally laid in 1049 AD by Kushwaha clan as Alapur city which was later renamed as Alwar. In 1775 AD a grand city wall with five main city gates was established as city limits with moat outside it. Several public buildings were constructed by rulers of the region which still exist and many of them have been added to the state protected list. Post-independence, Alwar city acceded into the Indian dominion as part of Matsya Union and later

Table 3

Assessment of typical Arab settlement: Riyadh traditional settlements.

S. No.	Smart Urban Elements	Indicators	Typical arab settlement- Riyadh	Characteristic features
1	Compactness	Dwelling units density	3	Dwelling Units form clusters of neighbourhoods further leading to multiple clusters leading to compact development
2	Mobility	Home to work distance	3	The main spines from the great mosque complex lead to entry gates or walls to each of the neighbourhoods within walkability
		Internal connectivity	3	Shallow and narrow alleyways connected various neighbourhood clusters
		External connectivity	3	These private street corridors link to main public spaces which are lined with shops leading to core complex
		Street layout	3	Irregular street network with organic growth pattern makes the settlements less exposed to dust and sun
3	Density	Persons per hectare	3	Dwelling units clustered together especially with closely staying kinship leading to highly dense settlements
		Commuter mode choices	3	The narrow roads don't have provisions for vehicular movement and hence preferable mode of movement is walking
4	Land Use Mix	Mixed residential land use	1	Private and public spaces segregated leading to purely residential land use
		Walkability to city centre	3	All the activities are in close vicinity of city core with grand mosque, commercial area and government buildings/royal palace
		Walkability to social services	3	Local neighbourhood clusters have all the common public services and facilities for its community leading to a self-contained neighbourhood
		Mixed land use	1	There is complete segregation of private, semi-private and public spaces leading to somehow a rigid zoning in terms of land use
5	Diversity	Building typology	2	Social classes dictated the growth pattern from the centre of the city almost in circular or spiral pattern
		Socio-cultural mix	2	Each neighbourhood cluster has its own set of tradition and culture to be followed further integrated into a united urban form
		Local creative economy	2	Souqs are the ultimate marketplaces where items such as spices, dyes, jewels, silk and others are passed in the form of tradition from generations to generations
		Income groups	3	Well of families were settled near the central complex and working class people closer to periphery with agriculture land beyond it
6	Passive solar design	Orientation and siting	3	Dwelling units are oriented and sited to minimise exposure to direct sunrays further shading the streets with their complex pattern
		Building layout	3	Courtyard type planning is prevalent which is introvert in nature to ensure high level of privacy of family activities. Vernacular ventilating system of mulgufs are employed
		Façade and fenestration	3	openings which are inward looking and raised at certain height to ensure privacy and ventilation
		Building techniques and materials	3	Mud construction is most common which keeps houses cool and is locally available
7	Green Urbanism	Accessible open spaces	3	There was a strong systems of open spaces, courtyards and circulation patterns at every scale
		Impervious surfaces	3	Least in number due to minimal metalled road surface
		Common public spaces for informal discussion	3	Private street corridors were used mainly as spaces for social interaction among the people
		Computed score	59	
		Total score	66	

in 1949 was reunited to form the district in the state of Rajasthan. Most of the royal structures including city palace were put to adaptive reuse mostly as government offices. In the late 1940s to accommodate refugee population from Pakistan, the town development schemes were implemented for which the city wall was broken down and the moat was filled. New contiguous old city areas started to develop with more or less similar pattern. However, with Alwar municipal council in 1958, new housing

schemes started to develop as an immediately adjacent area to traditional settlements.

Fig. 5 depicts city palace complex under the foothills of Aravalli with unique main streets layout with major landmarks located at the junctions (Fig. 6(a)). The streets leading to Jagannath temple complex are lined with the traditional shops on both the sides running for generations. The clusters of neighbourhoods (known as *mohallas*) are located behind the facades of the commercial streets

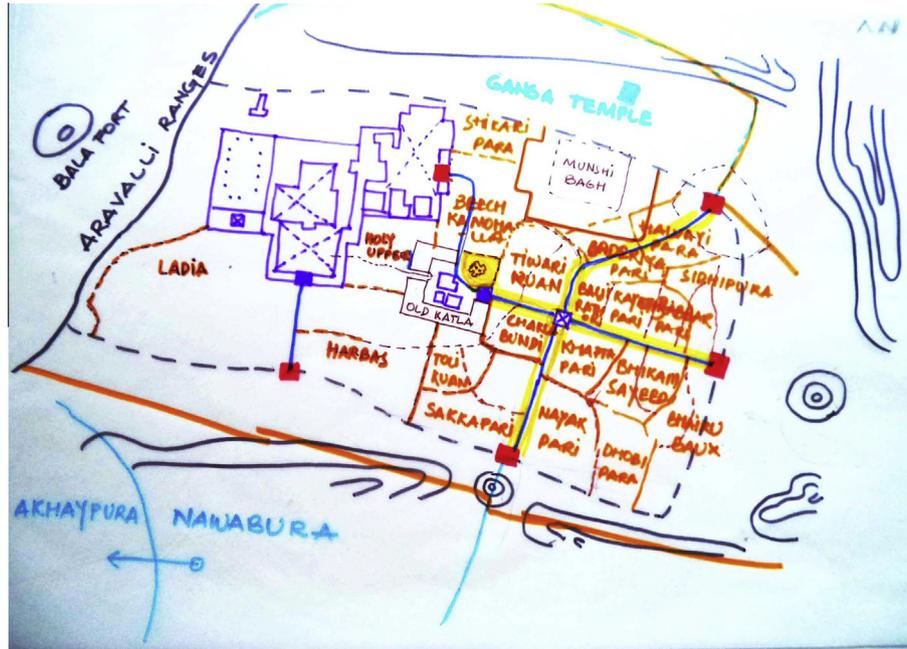


Figure 5. Historic urban fabric of walled City of Alwar.

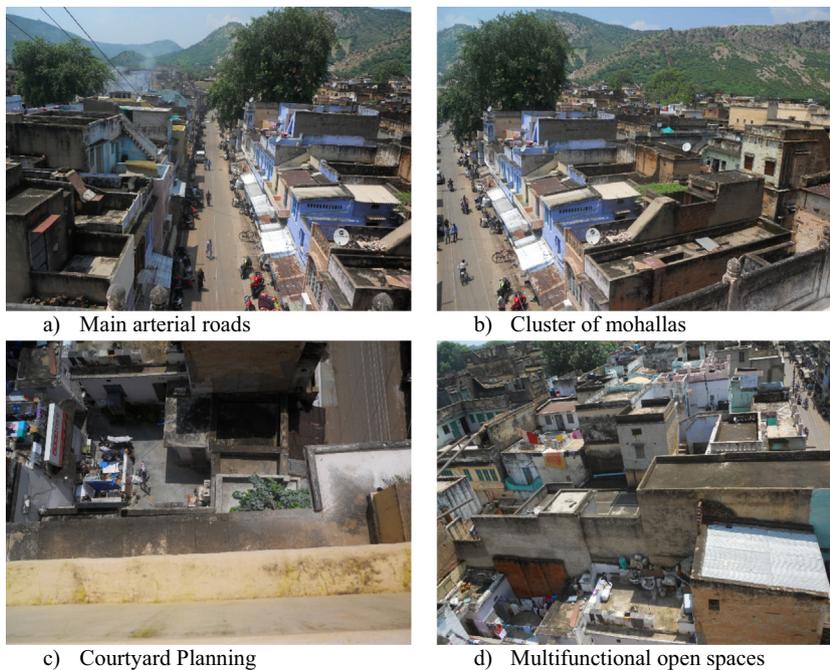


Figure 6. Clusters of old neighbourhoods in Alwar.

(known as *bazaars*) (Fig. 6(b)). The city still follows the traditional residential culture of Mohalla system which literally means neighbourhood term in Arabic. Most of them have courtyard type of planning which helps in keeping the rooms cool in summers (Fig. 6(c)). Also, these courtyard and roof spaces are used for sleeping in the night and other daily activities (Fig. 6(d)).

These mohallas have no rigid boundaries but rather are based on experiences of its local inhabitants. The figure-ground analysis in Fig. 7 reveals the urban morphology of historic city area of Alwar.

Usually, a mohalla in the Indian context is inhabited by a community of same social status forming a cluster altogether. In between these mohallas were open spaces with wells or religious places or a banyan tree under which some of the most important decisions of the community were used to be taken by the head of the social group. Also, these open spaces known as chowks were places for social

gatherings, rituals, celebrations and dialogues (Cieslewska, 2010; Dhingra et al., 2016). In terms of its social function, the mohallas act as a traditional self-governing small community which organises community's way of life. Their nomenclature is usually based either on a dominant professional group inhabiting the area in past and hence shows a strong historical and cultural association. The material for construction of houses is mostly stone and lime mortar with prominent use of Rajputana architectural elements such as *Jharokhas* (balconies) and *Jalis* (screens). Also, architectural elements such as brackets have been widely used in the building structure employing local craftsmen skills. The area has medium to high-density settlements with narrow, winding and dead alleyways.

There is an organic growth pattern observed in the city (Fig. 7(b)). Also, there is a sense of visual linkage to old monuments and Aravalli Hills from its network of roads. The overall morphology of the city is very interesting from



Figure 7. Figure ground analysis.

Table 4
Assessment of old settlements in Walled City of Alwar.

S. No.	Smart urban elements	Indicators	Walled city of Alwar, Rajasthan, India	Characteristic features
1	Compactness	Dwelling units density	3	Mohallas closely knitted together in the form of clusters leading to compact development pattern
2	Mobility	Home to work distance	3	Around 29% population was found to work in home based enterprises and 51% in core city area within walkable range (Fig. 8(e))
		Internal connectivity	3	Narrow zigzag streets connect to other mohallas forming closely connected network
		External connectivity	3	The main arterial roads provide access to important community areas, city palace and main temple complex of Lord Jagannath (Fig. 8(b))
		Street layout	3	Organic and irregular street network with excellent connectivity to innermost mohalla community
3	Density	Persons per hectare	3	In 2011, the residential density of the old city area was around 30,000 persons per square kilometre in comparison to net residential density of city of 20,500 persons per square kilometre
		Commuter mode choices	3	Except royal carts and other means of movement along main arterial streets, no provision for vehicular movement is provided within mohallas
4	Land Use Mix	Mixed residential land use	3	Increasing trend since 1940 s with around 26% surveyed houses having mixed residential land uses
		Walkability to city centre	3	The main city core is around 5 to 15 min walking distance from various mohallas
		Walkability to social services	2	Common facilities and services shared among 2 or more neighbourhoods thereby increasing accessibility of the local community
		Mixed land use	3	In most of the case, ground floor is used for commercial purposes and top floors are used for storage or godown and residential purposes (Fig. 8(d))
5	Diversity	Building typology	3	Most of the houses are still inhabited by owners. However, a rising trend of rental housing is observed. Housing transformation is also on rise
		Socio-cultural mix	3	Around 45% of the total sample is found to be of General Category, 27% belong to Scheduled Caste (SC) category and 21% belong to Other Backward Class (OBC) and rest is Scheduled Tribes (ST).
		Local creative economy	3	There are numerous intangible heritage and crafts for which Alwar is famous among tourists. Around 21% people were found to be engaged directly in traditional and cottage industries (Fig. 8(f))
		Income groups	2	There was a time when all classes of people used to stay together in old city area. However, now most of the affluent class has moved out leaving behind poor and socially backward people in the old city area
6	Passive Solar Design	Orientation and siting	3	Houses have been oriented and sited to avoid direct sunrays in habitable rooms and facilitating mutual shading on streets
		Building layout	3	Multifunctional courtyard type planning is quite common with rooms surrounding it. Family uses this space for several purposes such as sleeping, grinding spices, making pickles and making pottery or other craft based industries (Fig. 8(g))
		Façade and fenestration	3	Jalis (Screens) and Jharokhas (Balconies) are used as architectural elements to ensure cool breeze within the interiors and also to avoid heavy dust storms (Fig. 8(h))
		Building techniques and materials	3	Stone masonry and lime mortar is commonly used with intricate carvings and thick walls with more time lag is common
7	Green Urbanism	Accessible open spaces	3	Chowks or squares with wells or tanks or trees as sitting places in local mohallas (Fig. 8(a))
		Impervious surfaces	3	Less in number except forming arterial roads. There have been no major drainage issues in old settlements. Rain water used to get collected in wells and step wells for use in summers
		Common public spaces for informal discussion	3	Chowks were used as places for local gathering, celebrations, rituals and high level engagement and dialogues among its local public (Fig. 8(c))
		Computed score	64	
		Total score	66	

the perspective of ancient town planning practices. The assessment of smart urban elements is carried out in Table 4 with their characteristic features.

The mohallas are closely knitted together in the form of clusters leading to compact urban form. The primary surveys reveal that around 29% population work in home-based enterprises and 51% in core city area within walkable range to their houses (Fig. 8(e)). The narrow zigzag streets connect to other mohallas forming a closely connected network. The main arterial roads provide access to important community areas, city palace and main temple complex of Lord Jagannath (Fig. 8(b)). The organic and irregular street network has excellent internal connectivity to innermost mohallas. In 2011, the residential density of the old city area was estimated to be around 30,000 persons per square kilometre in comparison to the net residential den-

sity of city of 20,500 persons per square kilometre. An increasing trend since the 1940s is observed for mixed residential land use with 26% respondents having houses on top floors and commercial activities on the ground floor (Fig. 8(d)).

Except royal carts and other means of movement along main arterial streets, no provision for vehicular movement is provided within mohallas. The main city core is around 5–15 min walking distance from various mohallas with common facilities and services being shared among 2 or more neighbourhoods, thereby increasing accessibility of the local community. Most of the houses are still inhabited by owners. However, a rising trend of rental housing and housing transformation is observed. There are numerous intangible heritage and crafts for which Alwar is famous among tourists. Around 21% respondents are found to be



Figure 8. Characteristic features in old settlements of Alwar walled city.

engaged directly in traditional and cottage industries (fig. 8 (f)). Houses were oriented and sited to avoid direct sun rays in habitable rooms and facilitating mutual shading on streets. Multifunctional courtyard type planning is quite common with rooms surrounding it. The family uses this space for several purposes such as sleeping, grinding spices, making pickles and making pottery or other craft-based industries (Fig. 8(g)). Jalis (Screens) and Jharokhas (Balconies) are main vernacular architectural elements to ensure cool breeze within the interiors and also to avoid heavy dust storms (fig. 8(h)). Stone masonry and lime mortar are commonly used with intricate carvings and thick walls with more time lag are common. Squares (known as *chowks*) with wells or tanks or trees were used as common discussion places for the local community (Fig. 8 (a) and (c)). Impervious surfaces were less in number except forming arterial roads with no major drainage issues in old settlements. Rainwater used to get collected in wells and step wells for use in summers.

5.3. Key inferences

All these qualities of social and public space ensured an effective citizen participation and self-governance at the local level. People of the community used to participate and engage in the development activities of their neighbourhoods. Also, both the cases show a high degree of mobility, compactness, density, passive design and green urbanism. However, in terms of land use mix, the Arab settlements did not have much of mixed residential and commercial uses due to the constraints of segregating private spaces from public spaces. Each of these neighbourhoods had long walls and entry gates for selective accessibility whereas in Alwar mostly 29% of the surveyed population is involved in home-based enterprises or some form of cottage industries resulting in more of mixed land use pattern.

Both the cities had a heterogeneous mix of communities in terms of social as well as economic status. They had their own social hierarchy to be maintained to satisfy their respective cultural needs. These diverse communities, however, formed repetitive and continuous fabric which is homogenous and united. Also, their rich intangible heritage requires proper management of creative economy of the region. The planning principles of many old Indian settlements especially in northern part of the subcontinent are aligned with the Arabic philosophy which can be largely attributed to the cultural exchange and trade between the regions in the past. In terms of sustainability score, the design and functioning of Alwar are found to be 64 out of 66 and Riyadh is found to be 59 out of 66 i.e. almost 90%.

6. Conclusions

The case analysis was carried out for the typical Arab settlements and old walled city of Alwar in Indian subcontinent which are subjected to tremendous pressures of urban expansion. Both the cities- the traditional city of

Riyadh and the walled city of Alwar were based on smart urban planning principles. These principles evolved because of social, economic, geographical and religious paradigms of native communities over a span of time. The archetypes represent various urban elements which are smart and inclusive in nature and are at par with the modern and contemporary city planning approach. Both the cities had a characteristic compact development with a low rise and a highly dense cluster of neighbourhoods. These old neighbourhood or mohallas were flexible to accommodate the future needs of its community.

The basic circulation and transportation planning were sustainable with efficient walkability and accessibility of community to the local city centre and public services. The design and layout of buildings and dwelling units were based on vernacular design techniques well adapted to harsh hot and dry climate of the region. Also, in Islamic settlements, the houses were introvert in nature maintaining a high level of privacy and safety for its inhabitants. The crime rates were almost negligible because of the minimal intrusion of public into the private life of people. These old settlements also maintained an optimal mix of open spaces in the form of squares, courtyards as well as street corridors for children to play safely and adults to have important discussions and conversations.

The old and historic neighbourhoods of Alwar city exhibit a compact development and social cohesion among its local community. Importance was extensively given to pedestrians and local climatic conditions which enhance not only the walkability but also the energy efficiency in these old settlements. Chowks or Junctions were crucial meeting places for community discussion and participation. Old wells and tanks employ natural water management techniques. Also, a natural drainage pattern has been observed in the walled city as per the natural contours and the old neighbourhoods seldom face issues of water logging.

Overall, these traditional settlements show a holistic planning ideology in both cases which is intuitive and wholesome. Their spiritual values and social belief system guided them to a more sustainable and inclusive society. Environmentally, they used sound building techniques with sensitivity towards local climate and natural resources. Socially, these settlements maintained a diverse mix of people with least conflict among its communities. Public participation was of highest order where local decisions were based on the consensus of its people. Further, these communities have high potential to harness their local creative economy and intangible heritage. These settlements which are often termed as obsolete and backward are found to be more sensitive with creative features leading to cultural continuity.

As seen in most of the cases, modern planning stereotypes which have been imposed on these areas without considering their socio-economic and cultural context resulted in the destruction of a sustainable community rather than advancing their inherent local smartness. Their urban ele-

ments had an implicit smartness quality enhancing the inclusiveness and sustainability of the communities. Now the question is how to make way for their smart planning with new urban technology and ICT solutions. It is important that the urban practitioners and decision makers don't forget the roots of existing old cities to develop a plan which won't be even people friendly.

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